DESIGN ANALYSIS OF THE GRADE 9 TECHNOLOGY CURRICULUM IN SOUTH AFRICA

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DEDICATION

This work is dedicated to my parents who have been a tower of strength in my life; to my three children Crystal, Candy, and Dewan for your understanding during the long hours of work; and to my dear wife Jackie for all your love and kindness during the latter part of the study. May this work inspire you all to pursue your personal goals in life and to know that anything is possible if you apply your mind to it.

G.A.CHAPMAN
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DECLARATION

I, GAVIN ASHLEY CHAPMAN, hereby declare that this dissertation represents my own work in conception and execution.

Signed:..............................

Date: 24th December 2002

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SUMMARY

During the years of apartheid (pre 1994) there were two main streams that one could follow while studying at school viz. academic or technical. The majority of South African learners followed the more traditional academic stream allowing some to enter careers as doctors, lawyers, policemen/woman, school teachers and the like, while the remainder ended up jobless. Those pupils who followed the technical stream were considered by some of the more academically inclined persons, to be the 'duller' type of pupil, who could learn a trade and end up as a blue-collar worker. As the cost of technical education has always been much higher than the purely academic courses, the number of schools offering technical subject courses in South Africa has always been in the minority.

The entire scene changed after the banning of apartheid (post 1994) and the introduction of the notion of globalisation. Rapid developments suddenly appeared world-wide especially with the introduction of new technologies, mainly in informatics. Suddenly the world seemed to be a much smaller place as one could e-mail, fax, or use a cell phone anywhere in the world at the touch of a button. In order for South Africa to become part of the new world order, and to think about global markets, certain essential changes had to be made firstly to the local environment. A depressed economy needed rejuvenation. There was a growing awareness that serious change was needed in the way children think and learn at school and to start aligning ideas with international trends. To do this, the Department of Education in Pretoria (DoE), decided to radically

transform the education sector by introducing a new system of education known as outcomes-based education (OBE). The new OBE system brought with it mixed reactions from the South African public and from the teachers within the system. Many teachers did not want to accept that education could be done in a different way than they had been used to, in the past twenty to forty years. Younger teachers on the other hand did embrace change but are still trying to get the right balance within the prescribed parameters laid down in national education policy documents. To try and achieve such balance, the minister of education called for an independent review committee to re-work the general education and training phase curricula in order for them to be made more 'user-friendly' as many complaints had been received about the policy documents being overly complicated and unmanageable in the normal classroom situation. This process was concluded in May 2001 and Technology education remained as one of the eight new learning areas within the general education and training phase (GET) of South African schooling.

The first draft of the Technology education curriculum was handed out for public comment in October 1997 and was used as the basis for a pilot study at selected schools in 1998. This information was used as the basis for analyzing the design of the Technology curriculum at grade 9 level. Grade 9 was selected as it is the final exit from general education and training (GET) into further education and training (FET), and because it was the starting point for the pilot project in 1998. Valuable data was available at the pilot project school sites to be used in this study. Not all the provinces were able to initiate a pilot project due to a number of reasons but those that did viz. Kwazulu/Natal, Gauteng, and the Western Cape were visited individually to collect data. This study therefore 'unpacks' the Technology curriculum into component parts using an analysis tool developed from a theoretical framework. This unpacking of the parts allows one the opportunity to critically check whether or not certain important aspects of the design were omitted either intentionally or unintentionally by the design team (NTT).

Chapter one orientates the reader and sets the scene from where I, as researcher, locate myself and what the prevailing conditions are like at South African schools. The study problem is highlighted as are the obstacles that have tended to have an impact on the final curriculum design.

Chapter two provides an overview of the related theory associated with the field of curriculum study. Technology education is discussed as broadly as possible within the framework of the new OBE education system for South African schools.

Chapter three discusses the methodologies applied to ensure reliability and validity of the findings. The design analysis tool is presented with an explanation of each of the eight components.

Chapter four relates an interesting story about the findings. A description of the educational sites is presented together with descriptions of the educators at the six pilot schools, as well as some background of the national technology design team (NTT). All recorded evidence was gathered during personal visits to the schools and individual meetings with the design team members.

Chapter five provides a discussion of the data to analyse the Technology curriculum. In this way the reader is directed to the problem areas that were identified and supported the purpose of this curriculum study.

Chapter six firstly answers the three critical questions posed in Chapter one. An alternative model for curriculum design and development is presented. This theoretical model is intended to reduce the weaknesses of the present curriculum design if applied to any similar initiative in the future. This will allow educators greater freedom to do what they do best – to teach from a curriculum policy that they clearly understand and are trained to deliver. In this way South African schools and all learners will be rewarded by being well prepared for a variety of challenging careers in the global world that we live in.

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CHAPTER 1

STATEMENT OF THE PROBLEM

1.0 Introduction

This first chapter introduces the learning area of Technology education, commencing with the rationale for including Technology into the education provided in South African schools. A brief description of the writer helps to set the scene, together with a description of the context and background information. Arguments are developed for the need for an analysis of the South African Technology education curriculum design process. Discussion of some of the curriculum design problems establishes the thrust of the study and its critical questions.

1.1 Rationale for Technology Education in South Africa

Human beings tend to generate needs as part of their daily lives. Maslow (1970) presented a motivational theory based on the hierarchy of human needs, arguing that needs drive people to action. Problem situations result as humans try to satisfy such needs. These are features of human culture that have existed throughout the ages. Some of the most basic problems have arisen from the need to have shelter, to have food and water and be able to communicate with others. Other needs such as transport, and protection against invaders are also important.

Quality of life is one of the key aspects of any communities' requirements to live a decent life, and is directly related to their ability to solve daily problem situations, largely through the application of Technology (Webster and Robins, 1991:78). A community member's ability to design, make, modify, re-make, and appreciate an appropriate technological solution is a key to success or failure (Daugherty, 2001:174-175). However, new technologies are not applied in isolation. In South Africa there is evidence to support direct correlation between successful technological innovation and the application of scientific principles together with economic, social, and environmental concerns. This is obviously so in large-scale technologies, such as the Koeberg nuclear power plant in the Western Cape. However, the converse can also be argued – namely that the application of modern technologies destroys the ozone layer, causes global warming and was directly responsible for the Russian Chernoble nuclear disaster. As Pitt (2000:99) describes "...the long and short of it is that those who fear reified technology really fear men. It is not the machine that is frightening but what some will do with the machine". Our dependency upon modern technology can thus be both advantageous and to our detriment. How will learners and our future generation know of such dangers unless they study the effects of inappropriate technological solutions to local and world problems? (Hill and Dewey, 2001:81).

Technological change in an age of fast-paced living, fast foods, and fast modes of production, transport, and information technology requires that educators do more than teach skills required to replicate or use existing technologies, but rather promote skills that are creative, flexible and portable (Noble, 1991:14; Jansen, 2000:6).

Educationists need to constantly ask what specific skills, problem-solving abilities, attitudes towards work, and values, children should learn at school to best prepare them for life in a rapidly changing society (Mackay, 1991:4; Wright, 2001:148). The ability of workers to work in teams is increasingly important for effective production in the modern and dare one say, the post-modern world. Accordingly abilities to learn individually and in groups have been included as a critical outcome in the new outcomes-based education (OBE) curriculum in South Africa according to the National Education Policy Act (No.27 of 1996) and the Department of Education, Senior Phase, Policy Document (October 1997:14,15). Communication skills and ability to work with machines and complex systems are also vital. Dr Ben Ngubane (former premier of Kwazulu/Natal) in a speech at Hilton College observed:

> Our unemployment problem is not only one of a lack of opportunity. The basic problem is that the economy of the new world order, which ours is rapidly becoming, no longer needs unskilled people. Modern factories and service industries need people who can calculate, read information printouts and understand complex instructions on more and more complex machines (*The Natal Mercury*, 25 October 1997).

The knowledge and many of the values and skills needed for work and everyday life can be taught through a Technology education curriculum. Technology education has the potential to develop and enhance a wide variety of skills and problem-solving abilities (Chapman, 1996:252; Lavonen, Meisalo and Lattu, 2001:10).

1.2 Setting the scene

The word Technology is derived from the Greek word "*teknologia*"; which has two roots; '*tekhne*' meaning an art or skill and '*logia*' meaning an area of knowledge or study (Chapman, 1996:3). Technology education is a derivative of this meaning and is applied to the formal school context throughout the study.

Prior to 1995, there was no Technology education in South African schools, although technical subjects such as motor mechanics and metalwork were available is some schools. Preliminary investigations into Technology education had begun, carried out by the Natal Education Department (this was the Department that served white education in the Province of Natal prior to liberation) in Pietermaritzburg (Sherwood, 1994:282).

For the democratically elected government of 1994, educational reform was a high priority. Reform was guided by principles of economic development, social transformation, equity and redress, and complete overhaul of the previous apartheid-based system (Reconstruction and Development (RDP), 1994:54). The apartheid system was discriminatory against all persons of colour (Indian, Coloured and African) in South Africa. The white community of learners in schools received greater financial allocations from the DoE than did their black counterparts (Steyn, 1992:93; Hartshorne, 1992:42). Inequalities existed in areas including standards, examination pass-rates, physical facilities, equipment and stationery, and teacher education. (Kahn and Rollnick, 1993:267; Asmal, 1999:11). Changes had to be made (Department of Education, Life long learning for the 21st century (4), n.d.: 20).

The resistance to apartheid policies within the education sector was triggered nationally by the 1976 Soweto riots resulting in the enactment of Law 76 of 1984 which provided general education legislation that included the movement towards equal opportunities for all South African citizens (Steyn, 1992:95). In 1991 schools were gradually opened to all race groups especially in the urban areas although often on a voluntary basis (Steyn, 1992:96). Since 1994, dramatic changes have occurred, including the introduction of outcomes-based education (OBE) as a single curriculum framework for all schools. Technology education was part of that reform.

1.2.1 Technology: A generalist perspective

Use a razor to shave, use a toothbrush every morning and evening, boil water in an electric kettle or drive to school in a motorcar and soon one realizes that technology is inextricably linked to our daily lives (Reeve, 2001:247; Ginner and Klasander, 2001:19). Technology as it is experienced in much of the world today reveals that it utilizes scientific and other related principles as possible means of solving everyday problems, needs and wants in order to improve human existence. However, the breadth and ubiquity of Technology make it difficult to define. Everyone views technology from a different perspective; resulting in different definitions (Williams, 2001:213; Mitchley, 2001:179). Technology in the broad sense includes all technological activities and outcomes in the world at large: nuclear submarines, rocket ships that are sent to the moon and back, computers linking all banking activities. Technology can mean extremely complex 'items' both by nature and definition, but can also relate back to the earlier years when a wedge, axle, wheel, and screw were considered to be wonderful innovations.

Technology can be applied to problem situations both in theory and practice in school classrooms. This is technology education. Technology education is one means by which educators can empower children from an early age to interact with, and become familiar with, existing technologies and principles. Technology education is the term used to describe the teaching and learning of technology and technological processes within a classroom or workshop. This study applies this term exclusively in a formal school context. Technology practiced by learners at school is intended to assist them to reason, solve problems, investigate, and research within different contexts in order to generate a suitable solution to a given or identified technological problem (Atkinson, 2000:255; Custer, Valesey, and Burke, 2001:1). Technology education in this context aims also at educating learners on the merits and demerits of technology. This study will use the term Technology education to refer to classroom practice.

Technology aims to help people by improving their quality of life and could be described as being fundamentally humanitarian in nature. However, as Petrina (2000:208) argues we teach design and problem solving to simplify the making of the built world but neglect the psychological, sociological, and ecological realities of the world in which we live. Although there are differences internationally about the approach to teaching and learning technology in schools, there is some general consent that technology includes working with materials, energy, and information (Harvey, n.d.:2; Lewis, 1999:10). Technology is closely linked to science, although Technology is more than science, drawing upon scientific principles and methods whenever necessary (Benson, 1998:10).

Technology practiced in first world countries is greatly different from the Technology of so-called third world countries. South Africa in this sense is both first world and third world. In rural areas and urban townships only basic technology is used by millions of people. Why is it that so many suffer from starvation, lack of running water, and die of disease due to a lack of adequate health services and suitable infrastructure to apply modern technologies that are readily available? The issue is complex, involving politics, economics, education and values. It is one that South Africa now seeks to resolve.

Indeed the relationships between first world technologies and third world technologies is also complex...The western world has attempted to develop 'indigenous' or 'appropriate' technologies for sustainable development through the use of local materials and techniques in partnership with indigenous people groups especially to assist the third world countries (Spencer, 1997:541; Fensham, 1999:212; Wicklein and Kachmar, 2001:10). Unfortunately, there is always the threat of domination by one group over another, for they who possess advanced technologies, it may be suggested, hold all the keys to the success or failure. One must also naturally be concerned about opportunities for exploitation that may arise from unequal partnerships (Petrina and O'Riley, 2001:42).

All of this leaves us with more questions than answers, however, the philosophy applied seems to be reliant upon the context of the Technological intervention required. In certain contexts the need is very basic (e.g. how to get water from the river) to very advanced (e.g. how to construct a nuclear reactor). Whatever technological intervention is required, a certain basic understanding of concepts is required together with a complementary means of solving a range of problems that may vary in intensity and as Ter-Morshuizen (2002:98) indicates "indigenous Technology is a vital new area in the curriculum". To achieve this end, a range of philosophies may be applied depending upon different attitudes towards reality (Brubacher, 1962:95) ethical judgements need to be made (Waks, 1994:35; Conway, 2000:252), value issues need to be addressed (Conway, 1994:109), and Technological interventions need to be sustainable (Petrina, 2000:224) when teaching and learning Technology. In the South African education context the philosophical approach (which was not articulated in the Technology curriculum policy document, Oct. 1997), could best be described as an attempt towards learners acquiring a broad or very general understanding of Technology.

1.2.2 Re-dress of the past and equity for all

In the run-up to the 1994 elections the political turmoil intensified in South Africa. The re-emerging African National Congress, who were challenging the National Party at the time, expressed their political slogans through promises of redress for 'disadvantaged' people in South Africa:

> ...a common South African citizenship in a sovereign and democratic constitutional state in which there is equality between men and women and people of all races so that all citizens shall be able to exercise their fundamental rights and freedoms (Draft White Paper on Education and Training, *Government Gazette* No.15974, 23 September 1994, p.22).

The education sector was one of the key areas in which there was intense debate and political activity about transformation and the role that education could, or should play, in bringing this about.

1.2.3 Re-entry into the global economy and global politics

South Africa was viewed as a developing country that could become a power-base and support for the region of Africa. There was a need to be part of the global information arena as Bounemra, Soltane and Adam (1999:331) state:

> The global information economy promises to have a revolutionary effect on the development of science and technology as well as on people, business, institutions, governments and even nations.

To become part of the global political arena, South Africa had firstly to 'learn' about International competitiveness and what it takes to become a global 'player'. Jansen (2001:2) cautioned that the first effect of globalisation in the third world is one of displacement rather than inclusion. South Africa had to improve the skills-base of the South Africa workforce, including the need to learn about new technologies (Carnoy, 2000:13; Vil-Nkomo, 2000:90). The realisation that there was a need for an improved skills base took root long before 1994 and has continued in the new millennium. This need is great. Iraj Abedian (in press) indicates that:

> ...We are in an ironic situation where companies are short of skilled labour while we have a 30% unemployment rate...even those with degrees are poorly skilled (*Sunday Times*, 9 July 2000).

This lack of human capability and capacity led to the introduction of the Skills Development Act (Act No.97 of 1998) being promulgated to ensure that change from past practices was possible from a Department of Labour (DoL) policy perspective.

1.2.4 The need to introduce value-added production and innovation

South Africa for many years simply exported raw product such as coal, gold, titanium and iron ore for other countries to transform into usable products. This was partly satisfactory while raw materials and cheap labor were readily available and commodity prices were high. It is not satisfactory now. But the nation was slow to realize that it needed to shift its base to value-added production and increased efficiency. It did not have the available technologies and skills to transform the raw product into viable resources for manufacture at competitive prices according to world market standards. It is now clear to government and industrialists that greater input needs to come from within the country. As Kemm (1991:8) states: "...increased industrialization leads to national wealth...". However, a dichotomy of purpose has resulted: the national economy is growing, but so is unemployment (47% of South Africa's youth are unemployed (*The Daily News*, 8 December 2001)). A greater scale of effort is required, and Technology education is seen as part of the solution.

1.3 Formulation of the problem – setting the context

1.3.1 Education pre-apartheid

The pre-apartheid education system has been characterized as 'an elitist-controlled stronghold' dominated by white male Afrikaans-speaking educators, essentially a top-down approach, authoritarian and bureaucratic (Draft White Paper on Education and Training, *Government Gazette* No. 15974, 23 September 1994, p.9). Education was discriminatory in terms of *per capita* expenditure for the different racial groups and tended towards rote learning (Hartshorne, 1992:244). During the apartheid era, all curricula and decision-making powers were vested in persons appointed to senior positions at the National Department of Education (DoE) offices in Pretoria. The province of Kwazulu/ Natal (where the author has been based for the past 14 years) was divided into five different Departments of Education that were differentiated along racial lines. Furthermore, many of the black learners were not succeeding, and either stagnated in the system or dropped out (Buthelezi Commission, 1981:72 - 73).

The author was assigned the task of conducting exploratory work in Technology education at grade 7 level for the ex-Kwazulu Department of Education towards the latter part of 1993 into 1994. The author was also part of the Technical Education Advisory Services located within the same ex-Department of Education whose duty it was to ensure that all schools who were offering, or who intended to offer technical courses, were supported in terms of materials, advice, and equipment. These technical education courses included motor mechanics, metalwork, woodwork, electronics, electrician's work, fitting and turning, panel beating and spray-painting and bricklaying.

One of the major problems encountered for the offering of technical education at school level, was the high cost of specialist workshop facilities, maintenance of equipment and purchasing of tools and materials for project work. Furthermore, these specialist facilities were only available to a relatively small number of learners (about 1%) compared to the vast majority attending more academically aligned schools, with the added problem of high failure rates in the final school leaving examination (Kwazulu Department of Education and Culture, *Annual Report*, 1993:62; Chapman, 1996:44). The appointment of trade-test qualified teachers was also problematic, as salary packages and the conditions of workshops at schools in certain areas were not attractive.

The technical education courses were vocationally oriented, aligned to learners becoming artisans after leaving school. Their purposes were therefore different from those proposed in Technology education. Technology education in South Africa is intended to be a generalist approach and include a wide variety of knowledge, skills, and experiences for learners regardless of whether or not the schools have specialist facilities (see Chapter 4).

Another complicating factor regarding technical education was that many learners did not want to follow technical courses because of a belief that such courses were an inferior type of education for learners who could not cope in academic schools (Van der Walt, 1991:171). The demand for and popularity of vocational courses has now changed, especially in Technical Colleges (now called Further Education and Training Institutions (FETI)) who mainly offer courses in the FET sector (see appendix G). However, little has changed so far in the school sector.

1.3.2 South Africa introduces an outcomes-based education (OBE) system.

South Africa's choice of an outcomes-based education system arose out of the government's wish to design a unified system of education not only within the schooling sector, but across general education, adult education, further education and higher education, institution-based learning, industry-based learning and community-based learning. Fundamental to this change were the values of the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996), which aimed at providing a basis for curriculum transformation and development (Department of Education, *Government Gazette* No. 22559, 2001:21). The government sought to integrate 'education' and 'training', and to provide for flexibility and portability of qualifications. Negotiations involved a number of government departments and stakeholders from education, industry, labour and the community. From the beginning, the choice of OBE as central to a National Qualifications Framework (NQF), and the model of OBE to be used were hotly contested (Jansen, 1998:321-331; Mason, 1999:137-143).

As part of the development, members of the DoE visited a number of overseas countries to investigate models of outcomes-based education and to gather ideas from international practice. For the schooling sector, one of the key proponents of OBE was Spady (1994) from the USA who visited South Africa and presented a number of workshops to educators and policy-makers in the period 1994-1998. In other countries, as in South Africa, there were many critics of OBE (eg., Glatthorn, 1993:354-363; McKernan, 1993:343-353; Schwarz and Cavener, 1994:326-338). Glatthorn had the following to say about OBE in the USA:

> ....I am suggesting that OBE is not the panacea that Spady believes it to be. Neither is it a pernicious movement to turn schools into factories, as its critics suggest (Glatthorn, 1993:354-363).

Also at issue was the actual model of OBE to be developed. For example, Spady's model is fundamentally different from that used in Australia (Malcolm, 1999:99). Malcolm comments:

> ...The decisions countries make about whether to develop or reject the basic ideas of OBE, and what OBE models to consider, illustrate the depth to which education depends upon politics, cultural norms, interest groups, history, and the committees and individuals who provide educational leadership (Malcolm, 1999:105).

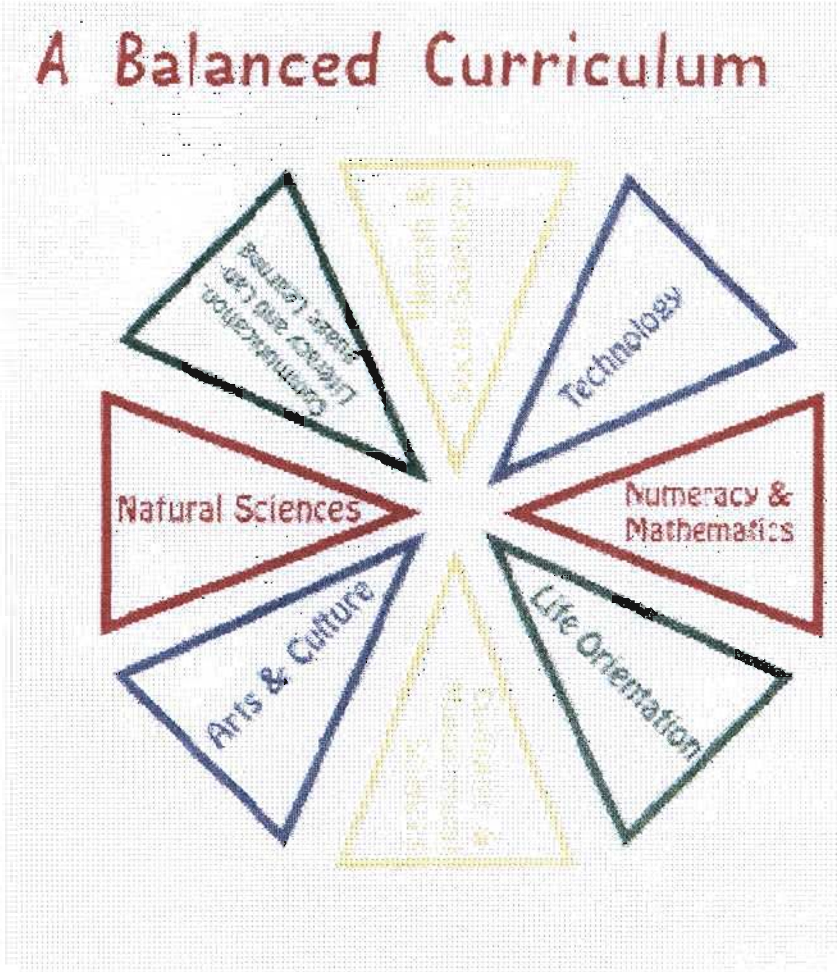
South Africa's version of OBE, for the general education and training band (Grades 1-9) was released in 1997, under the name of Curriculum 2005 (C2005). The name suggested that by the year 2005 the system would be fully implemented in all South African schools. Adoption of the OBE system has resulted in major changes to all curricula. It also introduced problems (*The Natal Mercury*, 20 June 2000; Minister's Report, Jan/Feb. 2001; *Pretoria News*, 31 January 2001).

1.3.3 South African schools have to adapt to an OBE system.

The outcomes-based education system was by and large an entirely new concept to all South Africans (managers, educators and learners). Terminology was suddenly changed, with new jargon such as learning areas, range statements, performance indicators, to suit the new structure. It was very confusing to educators (Chisholm, 2000:4,5,18,75; Edwards, 2001:39).

Eight learning areas were defined, with Technology one of them (Fig 1). In each learning area, the set outcomes were to provide the framework for the development of learning programmes by curriculum designers and teachers; programmes that were to be attuned to local resources, learners and their communities.

Figure 1.
The eight learning areas of outcomes-based education in South Africa (C2005, 1997:15).



1.3.4 Educators had to be trained in OBE principles

In the period 1995-1997 all of South Africa was concerned with curriculum change. There were few experts in the OBE system so educators had little choice but to embark on curriculum design and development with little support.

This proved to be costly and problematic. Large-scale capacity building had to be done over a very short space of time.

A 'cascade' training programme (C2005, 1997:18) was implemented in all nine provinces under the control of the respective provincial education departments. In the province of Kwazulu/Natal, as in other provinces, the cascade training model was not very successful (MBM Report, 1998:3; Chisholm, 2000:3). Educators found the policy documents and jargon complicated, resulting in widely varied interpretations; some educators who were trained were not able to share their information either due to selfish reasons or due to the principals not wanting to release their educators for meetings. Some educators were not willing to attend training sessions after normal teaching hours or on weekends. The provincial department of education also instructed principals to ensure that teaching and learning of the old curricula should continue while the new curriculum was being introduced. This dual system also contributed to confusion amongst educators.

1.3.5 A Technology education curriculum is designed

In the lead-up to Curriculum 2005, in late 1994, a team of educators was established to conduct a feasibility study for Technology education as a part of the general education and training band. This initiative was conducted under the auspices of the Committee of Heads of Education Departments (CHED). In 1995, the DoE built on this work by appointing a national Technology task team (NTT) as part of Curriculum 2005 strategy (C2005, 1997:15). An International reference panel with representatives from Africa, USA, Europe and the Middle East provided comment to the NTT (Kramer, 1996:7). The final Technology curriculum policy was launched in October 1997 (Department of Education, Senior Phase, Technology Curriculum Policy), as part of the eight new learning areas of Curriculum 2005.

1.3.6 Curriculum 2005 under review in 2000

In the light of widespread concern about Curriculum 2005, the national Minister of Education (Prof. Asmal) called for a review of the curriculum in late 1999. A South African curriculum review committee was established (chaired by Prof. Chisholm) and presented its report on 31 May 2000 to the Minister (Chisholm, 2000). One of its recommendations was that Technology be integrated with the Natural Sciences learning area, with a view to reducing the number of learning areas in the total curriculum (Chisholm, 2000:92). There was little objection to this recommendation for the foundation and intermediate phases (Grades 1-6), but it was widely opposed for the senior phase (Grades 7-9). For example, educators and learners from some provinces, who had implemented Technology at their schools, forwarded a petition to the Minister of Education (see Chapter 4 and appendix C). Ultimately, the government rejected the recommendation and

Technology remained a separate learning area at the senior phase level of schooling.

1.4 Concerns about the South African Technology curriculum

As part of understanding the context of the study, it is helpful to preview some of the design issues that the NTT faced:

- Technology education was introduced as part of Curriculum 2005. As indicated earlier, Curriculum 2005 was highly innovative and implemented rapidly. The confusions that were part of Curriculum 2005 were also part of Technology education.
- The curriculum design occurred during a period of wider social and economic transformation. Education was considered to be a pre-condition for development according to the previous Minister of Education Prof. Bhengu (*Engineering News*, 21 October 1994).
- The NTT did not have any local curriculum model to build on as there was no official Technology education course or programme in operation. There had been some exploratory work in 1992/93, but there was little historical information that could be of assistance. Furthermore, there were very few curriculum designers in South Africa experienced in Technology education.
- Detailed curriculum designs were available from other countries, such as the UK. How appropriate is it to borrow from first world countries? What

might a "South African" conception of Technology education be like? Would it incorporate indigenous technologies? How would it balance attention to high and low technologies?

- Although a broad framework for the curriculum design existed called 'the inescapable features of Technology' (T2005, Minutes of meeting, April 1995; T2005b, Draft National Framework for Curriculum Development, 1996:14), most educators were unaware of it, and saw the design process as largely unstructured.
- The designed curriculum would be presented only in English. Many educators and learners would have difficulty understanding the content of the curriculum.
- The NTT was required to define a balance between the new Technology learning area and the existing Technical subject courses still being offered in the Further Education and Training sector of schools (Grade 10 – 12). It was also necessary to balance the curriculum in terms of equity for rural and urban learners, male and female, rich and poor, and learners from different cultures.
- The DoE was insistent that democratic participation be applied to all curriculum design and development. The complex social conditions within communities, including high levels of social inequalities and diverse education politics, shaped consequent developments (Chisholm, 2000:2). Many educators were concerned about the large variety of people who

were involved in a very specific and rather specialized task of curriculum design and development.

1.5 Research Problem

As part of the government's programme of economic and social transformation since 1994, Technology was introduced as a learning area in the General Education and Training Band (Grades 1-9). The development began with a feasibility study in 1994, which became the basis for curriculum design as part of Curriculum 2005, published in 1997. Major programmes of implementation followed, including a pilot study of implementation of Technology in three provinces in 1998. Following the review of Curriculum 2005 in 2000, the Technology curriculum was revised, along with other learning areas, resulting in National Curriculum Statements (Draft Revised National Curriculum Statement – Technology, 2001). Thus the National Task Team worked in a complex political environment, developing a new learning area, to meet a wide variety of demands, according to extreme time constraints.

In this context, the research was conceived to explore and document the processes of design, the experiences of the National Task Team, the responses of teachers and learners in the pilot implementation and the features of the resulting Technology curriculum (as published in Curriculum 2005 in 1997). The study addresses particular stages in the process: the lead-up to curriculum design, the design process itself, the resulting curriculum, and responses to it.

1.5.1 Aim of the study

To analyse the design of the South African (senior phase) Technology curriculum and its suitability for South African learners, and to explain how and why the curriculum for Technology emerged in its current form.

1.6 Critical Questions

In order to answer the research problem, answers will have to be found, *inter alia* to the following critical questions:

1: Who designed the Technology curriculum?

2: Why was the curriculum designed in this way?

3: Is the curriculum likely to meet the expectations of designers and educators?

1.7 Overview of the Research

Due to the research focus on processes (of design and implementation) qualitative research methods were chosen (Ely *et.al.* 1991:213; McMillan and Schumacher, 1993:375; Glesne, 1999:1). A case study approach was selected to gain an insight into the experiences of educators at pilot schools for the

Technology project conducted by the NTT. Research data was collected through recorded interviews supported by a questionnaire, video camera, and photographs in the field. The methodology is discussed in detail in chapter 3. All interviews were guided by a framework developed for the purpose, which was also used for analysing the curriculum policy document. This framework is discussed in Chapters 2 and 3.

A research journal was logged throughout the period of study and two overseas visits to Scotland, UK, and USA, contributed to the overall understanding of the field. Application of this information is described in Chapter 3. The data recorded as findings is presented in a narrative format in Chapter 4, followed by a discussion of data aligned to the curriculum design analysis tool in Chapter 5 and the final summary and recommendations conclude the study in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

> The main thrust of the new economic paradigm is for well educated workers, broadly trained to deal with rapid technological change, able to solve problems, communicate and work in teams. In essence there is a growing need for 'smart' workers who are able to use knowledge to enhance innovative capacity, raise productivity levels, and inevitably, enhance our prospects of global competitiveness (Kraak, 1997:69).

Technology is a word that has many meanings and is applied within different contexts. The most common application is to problematic situations that are prescribed or arise naturally, that require the development or use of tools and systems. As described in Chapter 1, South Africa recently embarked on the introduction of Technology education for all school learners, as part of major curriculum reforms. In the absence of past experience of Technology education, the task was onerous, exacerbated by tight timeframes.

This chapter sets the design task into the broader field of curriculum, discussing issues to be considered when designing a new curriculum in a new learning area. This lays the basis for a theoretical framework for the study. An overview of equivalent international Technology curricula is also presented. Further detail is offered into the dilemmas that prompted reviews of the Technology curriculum and educational policies (2000/2001) as well as an overview of the Technology pilot project reports of 1998 and 1999.

2.1 Curriculum

2.1.1 Origin of Curriculum as a Field of Study: A Brief Overview

Concerns about curriculum are as old as teaching itself. Plato, Comenius, and Froebel (philosopher and educationists respectively), all wrote about curriculum and the problems associated with it (Zais, 1976:3). Curriculum as a field of study has its roots in the Herbartian movement of the late nineteenth century (Seguel, 1966:7). Herbart (1776-1841) was a German philosopher whose views were widely accepted Europe and in the United States. Herbart's theories about teaching and learning required systematic attention to the selection and organization of subject matter. This view inspired writers such as Dewey (1859 - 1952) who wrote about theories of learning and was engaged in curriculum experimentation and innovation at his famous laboratory school at the University of Chicago (Zais, 1976:4; Curzon, 1985:53), and Kliebard (1968:70) who reported that in those early years there was no 'readily identifiable field of curriculum specialization'. Bobbitt (1918) is credited with authoring the first book entitled "*The Curriculum*", seen as a milestone in recognising curriculum as a specialized field (Zais, 1976:5).

2.1.2 Concepts of curriculum and curriculum theory

Curriculum, like technology, is hard to define (Ornstein and Hunkins, 1993:190). One might say it is an attempt by a society to communicate its highest aspirations and deepest meanings to children. However, choices of 'highest aspirations' and 'deepest meanings' are contestable, as is the extent to which curriculum should include immediate and practical issues (Schubert, 1986:361). Gwynn and Chase (1969:581) suggest four basic, yet interrelated, determinants for curriculum theory: philosophy, psychology, sociology, and beliefs about the structure of knowledge. They define curriculum theory as:

> A set of beliefs that, when accepted and internalized by the individual, serve as a basis for decision-making in curriculum development and implementation (Gwynn and Chase, 1969:583).

Goodson (1994:26) cautions that curriculum theory has tended to become alienated from reality, as the theory becomes "prescriptions" of "idealised practice". Vallance (1982:10) counters this statement, arguing that curriculum theory "...is practical and based on real situations", suggesting that curricular experts should survey, analyse, synthesize and test the knowledge available about curriculum teaching and learning.

Cornbleth (1990:12) introduces the concept of curriculum as follows:

> How we conceive of curriculum and curriculum making is important because our conceptions and ways of reasoning about curriculum reflect and shape how we see, think and talk about, study and act on the education made available to students.

This statement highlights the needs for teachers and principals, as well as curriculum writers and policy makers, to have a well-developed base in curriculum theory.

2.1.3 A technocratic approach to curriculum

Cornbleth (1990:13) argues that mainstream conceptions of curriculum are usually technocratic which means that curriculum is viewed as a tangible product, usually as a document or plan for instruction in a particular subject. This technocratic concept of curriculum falls within the empirical-analytic paradigm and gives the appearance of being scientific, conveying images of efficiency, effectiveness and progress (Popkewitz, 1982:5-29). Posner (1995:16) differentiates between what he calls a technicist approach and a technical production framework that seems to be aligned with what Cornbleth is describing, although their terminologies differ. Posner (1995:13-15), building on the theoretical framework of Tyler (1949), advances curriculum as a 'step-by-step' process. These ideas resonate with conceptions of Technology: curriculum (and perhaps teaching) can be seen as technologies intended to promote students' learning. Thus curriculum development is a process of problem-solving through designing, making and appraising.

2.1.4 A critical approach to curriculum

Cornbleth (1990:24) also discusses a critical view of curriculum that emphasizes the continuing construction and reconstruction of curriculum in classroom practice, seeing curriculum as a contextualised, social process. The process is guided by principles of emancipation, questioning the power bases of authority, structure, and forms of discourse (Freire, 1972; Giroux, 1983; Apple 1986). These themes are important in curriculum in South Africa, as part of social transformation. They are also important as ways of thinking about technology and technological development: the choices of technologies and the uses of technologies are strongly bound to issues of power, social structures and liberation.

Basic differences are evident between a technocratic view and a critical view, in relation to context and purpose. Technocratic approaches tend to decontextualise curriculum conceptually and operationally, while critical approaches support contextualisation in the classroom, society and history (Cornbleth, 1990:13). Cornbleth (1990:202) advocates that technocrats and critical pedagogues work collaboratively in curriculum reform, bringing both perspectives to bear.

Samuel (2000:1-11) argues that the many attempts to renew, transform, or alter the school curriculum within post-apartheid South Africa have tended to regard schools as ahistorical entities in which teachers have to shoulder the responsibility of curriculum transformation without clear understanding of constraints and situatedness of their daily practice. From either a technocratic or critical view of curriculum, it is necessary to take account of the existing conditions and historical background of schooling. History frames not only what is desirable but what is possible. If the proposed curriculum is too far from current practice, implementation is at risk. Samuel argues that the gaze of curriculum transformation has been too firmly fixed on symbolic gestures of alignment with global educational trends. This accusation is relevant to the Technology curriculum in that it drew heavily from overseas developments.

2.1.5 Typologies of curricula

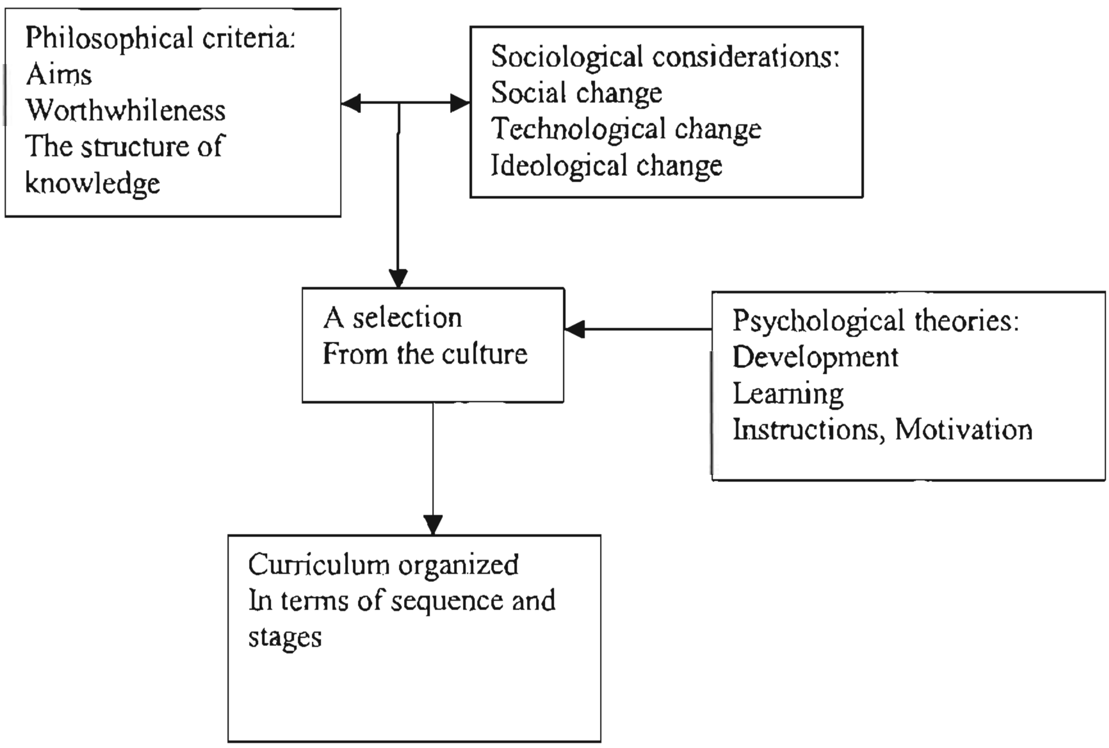
There are numerous ways of categorizing curricula. One of the most common is to be found in the work of Lawton (1990:3). He classifies curricula according to the essential base from which they draw their outcomes:

- subject-centred curricula draw from discipline-based knowledge.
- child-centred curricula draw from the needs and lives of children.
- knowledge-centred curricula draw from knowledge more broadly than disciplines or subjects;
- society-centred curricula draw from the needs and lives of society.

Lawton argues that each one is incomplete, but each can contribute to the curriculum as a whole. He proposes a situation-centred curriculum. In particular, secondary schools should be concerned with preparing the youth for the world of work after exiting the school system. This resonates with Spady's (1994) view that curriculum should be 'designed down' from exit outcomes, and exit outcomes should be derived from roles that students will have as adults in society. Such ideas were part of the rationale for the Technology curriculum in South Africa.

Lawton provided a theoretical model to be considered when planning a new curriculum (1990:5):

Figure 2
Lawton's explanation of curriculum planning (simplified)



In contrast to Lawton's model, Stenhouse (1975:125) favours a teacher-developer-researcher approach. The curriculum created in this manner brings together curriculum development and curriculum implementation in ways that allow for flexible response and continuous improvement. Curriculum is conceived as a probe through which to explore and test hypotheses and not as a recommendation to be adopted. This view is shared by Taba (1962) who believed "...that those who teach curriculum should participate in developing it..." (Ornstein and Hunkins, 1993:268). However, Lawton criticizes Stenhouse's proposal (1990:183) for not making clear enough criteria for answering the question "How can I judge whether something is suitable in these particular circumstances?"

Posner views any theoretical perspective as a metaphor for thinking and talking about the mind, teaching and the curriculum. He draws the conclusions in Table 1.

Table 1
Comparison of different curricula according to Posner (1992:68)

Traditional Curricula	Project the metaphor of the mind as a storehouse
Cognitive Curricula	Appear to view the mind as a garden
Behavioural Curricula	Conceive of teaching as shaping behaviour
Structure-of-the-disciplines Curricula	View teaching as the induction of novices into a community of scholars
Experiential Curricula	Consider teaching to be working behind the scenes to facilitate and guide student-directed projects

2.1.6 Curriculum and Instruction

Zais (1976:3) indicates that the term curriculum in the broadest sense is used in two ways; firstly, to indicate, roughly, a plan for the education of learners, and secondly, to identify and define a field of study (learning area). Citing the work of Beauchamp (1968:6), Zais states that there is a third meaning:

> ....legitimate use of the term curriculum is to refer to a curriculum system.....A curriculum system in schools is the system within which decisions are made about what the curriculum will be and how it will be implemented.

This third meaning takes the idea of curriculum into the school and classroom. Johnson (1967:130), distinguishes between curriculum (as a plan, defined especially by outcomes) and instruction (which happens in classrooms):

> there is ....no experience until an interaction between the individual and his environment actually occurs. Clearly, such interaction characterizes *instruction,* not curriculum.
>
> [Curriculum] prescribes (or at least anticipates) the results of instruction, and does not prescribe the means, i.e. the activities, materials, or even the instructional content to be used in achieving the results.

Thus Johnson maintains that the curriculum can only consist of "a structured series of intended outcomes".

2.1.7 Components of Curriculum

Zais (1976:16) argues that curriculum design most commonly refers to the arrangement of the component elements of a curriculum. This approach is consistent with writers such as Tyler (1949), Posner (1992), Jansen and Reddy (1994). These elements of a curriculum, according to Zais, are the aims, goals, and objectives, followed by subject matter or content, then learning activities, and finally evaluation. These elements are to be viewed as an analytical framework, as elements that all curricula should have, and not as steps in the design process. Lawton (1978c:273) similarly makes the point that the curriculum is 'designed' and developed in an often unsystematic, sometimes almost chaotic way, with aims, activities, content and evaluation considered together.

Longstreet and Shane (1993:358) propose different elements, especially for large-scale curriculum plans. Their suggestions include: scope, sequence, articulation, balance, and consistency. Each needs to be thought of as a set of 'tools' that can help form and 'tighten' the design. Longstreet and Shane emphasise that these elements can be applied regardless of the underlying philosophies of the curriculum. They further suggest (p.361) that when viewing a curriculum from different philosophical perspectives, social problems or characteristics of the learner might well be adopted as core design elements. This orientation to learners and social conditions, as part of South Africa's policies of transformation and redress, is important in South African curriculum design (Malcolm, 1998:9 -10; Asmal, 1999:1 -17).

A more extensive set of curriculum components, again intended as a framework for analysis, has been developed by Posner (1992). Posner's framework has been chosen and modified to suit the purposes of this study and is considered in detail in chapter 3. It originates from the work of Tyler (1949). Tyler posed four components: Selection of education purposes, determination of experiences, organization of experiences, provision for evaluation (Posner, 1992:14).

Posner's and Tyler's approaches can be considered as technical-scientific approaches, in the ways they seek objectivity, universality and logical structure. In this study, the notion of universality is applicable, in that the Technology curriculum is expected to suit all students in South Africa. Posner argues also that the aims of education should be the starting point in curriculum design, can be made known, stated precisely, and addressed in a linear fashion (Ornstein and Hunkins, 1993:273). This is consistent with OBE in South Africa. It is consistent also with the nature of Technology and the technological design process.

Posner (1992:21) also theorises about the processes and purposes of analysis of a curriculum design. He draws heavily on the work of Johnson (1967) as well as Tyler (1949). Curriculum analysis, according to Posner (1992:13), is an attempt to reduce or separate a curriculum into its component parts; to examine those parts and the way they fit together to make up the whole; to identify the beliefs and ideas to which the developers were committed (and which either explicitly or implicitly shaped the curriculum); and to examine the implications of these commitments and beliefs for the quality of the educational experience.

Curriculum analysis, according to Jansen and Reddy (1994:4-5) involves 'unpacking' the curriculum in order to understand the plan. They suggest that some of the reasons for a curriculum analysis might be to evaluate the curriculum in order to improve it; to identify potential and actual problems and recommend possible solutions; to make decisions about future support for continuation of the curriculum; to examine whether assumptions underlying the curriculum are valid and defensible; to identify blindspots, biases and perspectives; to determine whether goals have been met). For the purposes of this study, Jansen and Reddy's list of purposes of curriculum analysis have been regrouped as follows: to take a 'closer' look at the different component parts that make up the technology curriculum; to analyse why/whether they are each essential, and how they came to be included in the curriculum document; to make recommendations about further development and implementation.

Posner's and Jansen and Reddy's frameworks have been adopted to form a curriculum analysis 'tool' that is discussed in greater detail in Chapter 3, to analyse the South African Technology curriculum and to determine how the processes in drafting the curriculum influenced the final curriculum policy document (see critical questions in Chapter 1).

2.2 Dynamics of the curriculum design process

Lists of curriculum components such as those described earlier provide tools of analysis of a curriculum but make no statement about the processes of design. As such, they are essentially static. They can be applied to a particular curriculum at a point in time, but provide no insight into the dynamics that have brought the curriculum to that point, or the changes that will follow. (This study chose to 'stop' the curriculum at the documents published in 1997 as part of Curriculum 2005, and used in the pilot project of 1998.) However, for this study, the processes of curriculum design, and their ongoing nature, were also important. They required that the Posner framework be extended and supplemented.

The design process is, by nature, dynamic, involving creativity, analysis, discussion, compromise and iteration. A document (an artefact) has to be 'marked-out', through processes that reflect upon and decide the intended purposes, the perspectives of Technology, teaching and learning, the content (including values), and how the design will be evaluated (Longstreet and Shane, 1993:57). Some of the key factors in this dynamic are considered below: creativity, politics, personality, conflict and constraints.

2.2.1 Creativity

Ausubel *et al.* (1978:566) state that: "...creativity is the highest expression of problem solving". The development of a national curriculum framework, especially in the context of transformation in South Africa, required immense creativity. It was called for in the intellectual sense (to define the learning area and express it in a coherent and efficient set of outcomes and standards), in the management sense (to gather, heed and resolve competing interests) and in communication and writing. While it may build on complexes of existing knowledge, it requires imaginative inventions of structures, concepts and processes.

2.2.2 Politics

Curriculum design, especially at the national level, is a deeply political process (Chisholm, 2000:2), as it seeks to balance competing purposes and interests at the national level, within the larger management structure (Curriculum 2005), and within the working team itself (the NTT). Further, in post-apartheid South Africa, it was highly important that processes were democratic and transparent (Draft Revised National Curriculum Statement – Technology, 2001:4). The ways that political influences were played out were bound to be strong determinants of the final curriculum.

2.2.3 Personality, knowledge and aspirations

Individual attributes such as knowledge, creativity, values, team-skills, political skills and communication skills are important in individual and team achievement. They are part of the conceptualization of problems and solutions and part of the political processes of negotiation and decision-making. They are entwined with affiliations, past achievements and personal aspirations. The leader of a curriculum reform process may have great difficulty in trying to manage such dynamics with the result that a very sound initiative may be derailed due to personality clashes and conflicts within task team groupings.

2.2.4 Constraints

In any design process, there are physical, financial, policy, competence and other factors that constrain the final product. These might be construed positively as challenges in the design process, or they might be debilitating. It is important that constraints are not judged simply and negatively: they can also provide boundaries and guidance that stimulate creativity and achievement. For example, Posner (1992:31), argues that an 'ideal' curriculum provides: firstly, clues about the problems to which the curriculum was responding, a clear idea of what students are supposed to learn; explanations of why these learning objectives and content are important, guidance as to how to teach; an indication of how the students and curriculum should be evaluated (Posner 1992:31). Are requirements such as these be interpreted as constraints or guidelines? At the same time, there are constraints of resources (in the design process, and in schools) that have to be taken into account in the design process.

2.3 Technology and Technology Education

2.3.1 Historical significance of Technology

All nations throughout the world are in contact with technology in one form or another on a daily basis. Many fundamental technologies, such as the smelting and working of metals, the spinning and weaving of textiles, and the firing of clay have existed for many centuries. In about 3000BC, the first major civilizations in Egypt and Mesopotamia (and also in India and China), developed technologies such as irrigation systems, road networks, wheeled vehicles, a pictographic form of writing and also new building techniques to name but a few technologies. (Oxford Interactive Encyclopedia, 1997). Cockburn (1991:45) refers to the use of the 'mighty five' devices, the lever, wedge, screw, wheel and inclined plane, that made it possible to move mountains and build pyramids. Other civilizations also became important technological centers, such as Greece and Rome, the Arab empire of the 7th and 10th centuries and the Aztecs of meso-America. Around the mid-16th century, the focus of technological change shifted to Europe, with the beginning of what the scientific revolution. This was both an intellectual revolution and a practical one, during which time established dogma and ideas were questioned and re-interpreted through observation, theorising and experiment. Technology came to mean engineering. By the late 17th century many authors were inspired to write volumes in encyclopedia form (Oxford Interactive Encyclopedia, 1997).

During the 19th century, the partnership between science and technology helped to create new technologies such as the electric telegraph, the telephone, electricity supply and photography. This partnership accelerated in the 20th century to produce innovations such as radio and television, film and sound recordings, pharmaceutical products and computers. However, along with technological developments came pollution, depletion of energy resources, restructuring of work and other adverse effects. One response to these challenges was the development of alternative technologies and renewable energy sources such as solar power, wind power, and recycling of materials (Oxford Interactive Encyclopedia, 1997).

2.3.2 Technology in Technology Education

Cajas (2000:1) reports that 'current educational reform proposals recognize the importance of understanding Technology and have identified certain Technological abilities as goals for all students'. The South African Technology curriculum uses the following definition of Technology:

> Technology is the use of knowledge, skills and resources to meet human needs and wants, and to recognize and solve problems by investigating,

> designing, developing and evaluating products, processes and systems (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-2).

The primary aim of Technology education is to allow learners the opportunity to design and make objects or products (called artefacts) and to solve real (or imaginary) problems (Reddy, Ankiewicz, de Swardt and Gross, 2001:23; Williams, 2000:2). The artefact can be either large or small, it may be a single article that is required to solve a problem described for the learner, or it may be one part of a much larger project that involves a number of component parts and forms a culminating part of the project or need defined by the learner.

However, making an artefact is only one aspect of technology. Mackay (1991:11) states that:

> Technology thus encompasses physical artefacts, human activity, and human knowledge; it is a very broad phenomenon! .....technology literacy would involve learning to use the technology to achieve some end and understanding the capacity and limitations of the technology.

Whatever the artefact, knowledge, skills and values are used to ensure a balanced perspective with regard to environmental issues, safety, ethics, and morals. One of the dilemmas confronting this study is to decide whose values are to be taught and what the expected consequences are likely to be (McCormick and Banks, 1994:100).

There are two dimensions to the problem of values: a problem-solving dimension and a craft dimension (Woolnough, 1988:257). Traditional technical education focused on the craft. If one considers value-added production, the focus moves towards problem-solving and the design process (Thatcher, 2001:143) and this involves values (Barnett, 1994:58-60; Williams, 2001:218). The educator and learner must decide what values and whose values are important: for example, why solve this problem and not that one? Why do it this way rather than that way? Different solutions have different ramifications for the environment, resources, people and opportunities. So Technology is problematic as a social and human activity.

Whatever the context of the given problem, solution requires consideration of broader consequences and values. This means that Technology education integrates naturally with other learning areas. Science, mathematics, graphic and verbal communication, historical data, are sources of knowledge to combine (intertwine) with technology (Lewis, 1999:9). In Ontario (Canada) for example, students are to explore and understand what is technologically possible and whether it is socially, ethically and environmentally acceptable; Technology therefore cannot be learned in isolation (Toronto Board of Education, 1993:3).

Technology education is not simply analytical; it requires creative flair. The intention is to generate a unique design. Learners are given a chance to be practicing technologists just as artists are given the opportunity to be creative on canvas. Their creativity might not be in the invention of a new artefact, but rather the evaluation and improvement of an existing one (Williams, 2000:12). The linking of theory with the practical aspects of Technology education is expected within the South African context (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-4).

2.3.3 The Technological design process

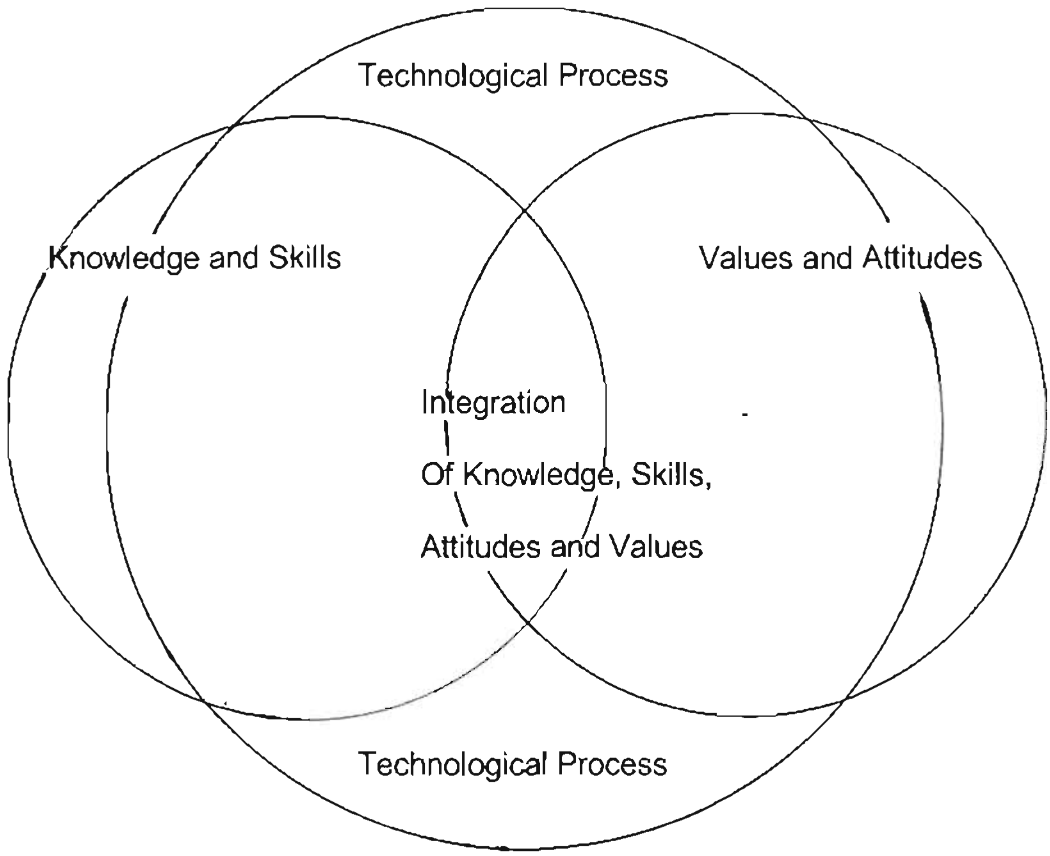
The Technological design process is often characterized as "design, make, appraise", and this position has been adopted in the South African curriculum (see Fig. 3 below). However, the implication that design is a linear process is a simplification (see Fig.4). Williams (2000:6) claims that in Western Australia "there has been a move away from the notion of a prescribed process such as Design-Make-Appraise, to the idea that there is a range of processes in which students are engaged when they do Technology". Lewis (1999:8-9) suggests similarly that

> .....to posit that there is 'the' method is mistaken.....the processes are more likely to be messy than clean...
> ...problem solving processes are dictated by the nature of the problems, and by the ingenuity of the inventors and other technologists who pose and tackle them. We would be trivializing the idea of technology if children at least are not taught that.

The South African designers of the Technology curriculum have emphasized a structured approach (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-4). This is shown in Figures 3 and 4 below.

Figure 3

The South African approach to the Technological process

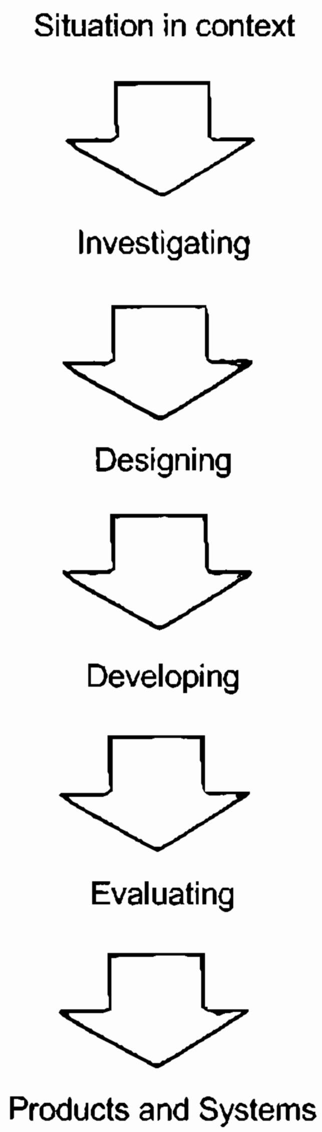


(Final report to HEDCOM, 1999:appendix 5.12)

The outer area represents the TECHNOLOGICAL PROCESS. This is a process within which all learning in Technology will take place. KNOWLEDGE and SKILLS are those to be acquired and applied in Technology. VALUES and ATTITUDES are those to be acquired and applied when engaged in Technological activities. Thus all knowledge, skills, values and attitudes have to occur within the Technological process.

Figure 4

A linear approach to the Technological process



(Final report to HEDCOM 1999, appendix 5.12, p.3).

This process is contained in specific outcome #1 (SO1) of the Technology curriculum. The Technological Process is described as a series of steps that allow the learners to engage in the process of problem solving in a logical manner: Investigating, Designing, Making, Evaluating. However, it is not considered to be only linear (according to the NTT) but may be approached in a cyclical manner as well (Final report to HEDCOM, 1999:appendix 5.12, p.2-3).

While South African educationists have accepted the Technology education policy (Oct.1997), the debate continues. To quote from papers presented at the International conference on Technology education held in Cape Town (October 2001), Sadek (2001:4) argued that "...understanding of the elements of design, as well as the knowledge underpinning design, is a foundation competency". , Walstra (2001:85) argued similarly that "...the curriculum will have the Technological Process...as its core and should be the vehicle for delivering the curriculum". More recently, Ankiewicz and de Swardt (2002:77) at the National Conference for Technology Teachers (October 2002) extended earlier thinking on the Technological process to a ten-point process indicating that "...learners need to use each of the processes a number of times". Whilst not disagreeing with Williams and Lewis, the South African educators have accepted a Design-Make-Evaluate approach to the Technological process. The structured approach allows educators and learners who have very little training and experience an opportunity to make a start to solving a problems and making artefacts. From this basis, reflective analyses and discussions of the actual processes used become possible.

2.4 Technology education: International perspectives

2.4.1 International trends

It is important to test South Africa's position in terms of international trends and benchmarks. They reflect the global changes in economies, production and trade and they provide input on the nature and purposes of Technology education. However the major developments have been in first world countries and may not suit the South African context. Nevertheless, the final Technology curriculum policy for South Africa borrowed heavily from curricula designed for Europe and Australia (see Chapter 4).

In the pre-apartheid era, South Africa was isolated from the rest of the world due to sanctions imposed against her and therefore only a limited number of educators were made aware of the changes taking place in curricula reform overseas. The United Kingdom had undergone major curriculum reform in the mid to late eighties, Australia, Canada and New Zealand in the late eighties and early nineties. It all of the countries, Technology was introduced into the general school curriculum (Shield, 1994:55; Francis, 1994: iii; Ferguson, 1994:8). The Toronto Board of Education in Canada (1993:16), for example, stated that

> Technical and Technological studies programmes have a value and integrity that rests in their balance of inherent practicality and creative problem-solving.

Similar developments occurred in the Netherlands (Hooghoff, 2002:20) and Germany (Sauer and Haupt, 2001:161). South Africa has followed suit.

The United Kingdom has been a leader in framing Technology education Interviews with technology educators around the world confirmed this (Discussions with Australian and New Zealand educators at the National Association for Research in Science Teaching (NARST) conference held at St. Louis, Missouri, USA (25-28 March 2001). The United Kingdom experience has significantly influenced developments in Australia and New Zealand, and to some extent the newly developing Technology curriculum in the USA (Savage and Bosworth, 1995:5; Reeve, 2001:247).

Curriculum design and development initiatives in the UK, Scotland, and Australia resulted in similar curricula being developed although different problems were encountered (Benson, 2001:155; Williams, 2001:213). Three initiatives are described below to indicate that although different issues had to be addressed in different countries, the resultant Technology curricula focus on similar areas of knowledge and understanding. These international influences helped shape the South Africa version of Technology education. One common thread throughout these curricula is that they were all designed as part of an OBE system.

2.4.1.1 United Kingdom

Early versions of the curriculum for England were developed by a committee which firstly ascertained what teachers did at school, then drafted a technology curriculum to suit their needs (in discussion with Sprake, 2000). Thus the early frameworks arose from existing Craft-Design and Industrial Arts programmes. After design and development the curriculum was sent out for public scrutiny and implementation. The Craft Design and Technology curriculum (as it was first called), immediately faced implementation problems (Chapman, 1996:113). A review process followed and the curriculum was subsequently 'streamlined' as part of the development of the National Curriculum (which was an outcomes-based programme). Four key stages were introduced from stage 1 (learners aged 5-7 years) up to key stage 4 (aged 14-16 years) (United Kingdom School and Assessment Authority, 1995:v). The revised Design and Technology curriculum was introduced for the first time in 1991 and was subsequently revised twice, in 1995 and 1999.

According to Sprake (2000), changes were made especially to the assessment process. Teachers received training on how to evaluate portfolios and projects, to try and ensure comparable standards throughout the country. A technology association was also established to provide on-line support for teachers. Prospective teachers can attend a one-year 'conversion' course if they have had some previous experience in industry.

The new Design and Technology curriculum (1999:6) states the following (for all learners up to age 16 years ie. key stage 4):

> The knowledge, skills and understanding in the programmes of study identify the aspects of design and technology in which pupils make progress:
> - Working with tools, equipment, materials and components to make quality products.
> - Evaluating processes and products.
> - Knowledge and understanding of materials and components.
> - Knowledge and understanding of structures.
> - Knowledge and understanding of systems and control.

Teaching should ensure that knowledge and understanding are applied when developing ideas, planning, making products and evaluating them. These aspects are developed through investigation and evaluation of products, product analysis, focused practical tasks, and design and make assignments in different context.

2.4.1.2 Scotland

The Scottish Technology education system is very similar to the English one. It too was derived from past programmes in technical education, so that facilities such as workshops for woodwork, metalwork and technical drawing rooms are included in the new Technology programme. This conversion of workrooms was viewed at the school I visited in Scotland (August 2000 – see appendix J (Scotland)). The Scottish S3-S4 levels (14-16 years of age) have three core focus areas; craft and design, technological studies, and graphic communication. The Scottish Craft and Design syllabus (later renamed Design and Technology) followed a review process in 1987 and was subsequently amended for implementation in 1989. The philosophy of the Craft and Design course was based upon the earlier definition of technical education in the Scottish Education Department Curriculum (Paper 10) entitled "Technical Education in Secondary Schools" (1972) as:

> ... a continuum of activities leading from design, sketching, and drawing to specifications, craftwork, and other production processes with consideration of relevant science, calculations, technology and sociology.

It was recognized that design embraces aesthetic aspects but little recognition had been given to the teaching of design as a problem-solving discipline. The Royal Society of Arts (1980) emphasized the need to include craftsmanship and the making of artefacts; the design, manufacture and marketing of goods and services; and the creative arts.

The new curriculum was to take account of the need to motivate the most able learners by providing situations in which intellectual and practical skills would be fully stretched. At the same time, the need to motivate the least able, by responding sensitively and supportively and by providing opportunities for success, was not overlooked. To ensure implementation, support groups were established to co-ordinate the production and distribution of a wide range of resource materials (Scotland Technology Curriculum, 1987:4).

The rationale for such a curriculum was primarily to develop the intellectual capacity and practical skills of learners through the process of making. Central to this intention was the encouragement of pupils to develop the skills to solve realistic problems and evaluate solutions objectively. Solving problems was seen to require an understanding of human needs and values, and provide opportunities for applications of other disciplines. Craft and Design was to provide opportunities for improving the balance between theoretical and practical aspects of the curriculum, to offer a fertile environment for independent learning, personal and social development. The course allows a blend of technological, vocational and aesthetic aspects in preparation for young people to enter tertiary education, work and leisure activities (Scotland Technology Curriculum, 1987:5).

2.4.1.3 Australia

The Australian Technology curriculum was initiated in 1989 and was developed into a policy document in 1994, just when South Africa was getting started on feasibility studies (Kramer, 1996:7). 1). Technology in the Australian policy is:

> ...the generic term for all the technologies people develop and use. It involves the purposeful application of knowledge, experience and resources to create products and processes that meet human needs (Australian Technology curriculum profile, 1994:2).

Particular technological applications are judged by their impact on communities and environments and their effects on personal well-being and ways of life.

Within the school system, Technology programmes encourage learners to use Technology productively to become enterprising people, generating ideas and actions as well as using and developing products. The design, make, appraise process is central through the exploration, application and development of information, materials and systems (Australian Technology curriculum profile, 1994:2). When learners design, make, and appraise they are expected to investigate issues and situations, devise proposals and alternatives, communicate ideas and actions, produce processes and products, and evaluate impacts and consequences. In addition to functional aspects, learners must consider the aesthetic, environmental and social appropriateness of designs and products (Australian Technology curriculum profile, 1994:4).

2.4.1.4 South Africa

The Technology education curriculum policy document was first issued to the general public in October 1997. Three levels of the curriculum were drafted simultaneously: one for the foundational phase (grades 1-3), one for the intermediate phase (grades 4-6), and one for the senior phase (grades 7-9). This study focuses upon the senior phase curriculum document.

The Technology curriculum document contains a definition, rationale, what the understanding of Technology should contribute to, and concludes by elaborating seven specific outcomes and eight areas of content knowledge: systems and control, communication, structures, processing, safety, information, materials, and energy.

The seven specific outcomes (SO's) are:

1. Understand and apply the Technological Process to solve problems and satisfy needs and wants.
2. Apply a range of Technological knowledge and skills ethically and responsibly.
3. Access, process and use data for Technological purposes.
4. Select and evaluate products and systems.
5. Demonstrate an understanding of how different societies create and adapt Technological solutions to particular problems.
6. Demonstrate an understanding of the impact of Technology.
7. Demonstrate an understanding of how Technology might reflect different biases, and create responsible and ethical strategies to address them. (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-3).

The Technology curriculum, as in all the learning areas, was structured in terms of outcomes, assessment criteria, range statements, and performance indicators. These new terminologies were linked to each of the seven specific outcomes and the eight areas of content knowledge.

The South African Technology curriculum is in fact very similar to curricula of the UK, Scotland, and Australia (see Chapter 4 and 5 for discussion). Table 2 illustrates the similarities between South Africa and the UK as an example:

Table 2

Comparison of the South African and UK. Technology curriculum content.

SOUTH AFRICA (GET level)	UK (Key Stage 3 = age 14yrs.)
Communication	Developing, planning and communicating ideas
Safety and materials	Working with tools, equipment, materials and components to produce quality products
Processing	Evaluating processes and products
Information and energy	Knowledge and understanding of materials and components
Systems and Control	Knowledge and understanding of systems and control
Structures	Knowledge and understanding of structures
(Oct 1997. policy document, p.Tech-7)	(Design and Technology policy document, 1999 p.21)

2.5 What other commentators said about the South African Technology learning area and C2005

Many groups commented on the changes made by the Department of Education (DoE) in the development of Curriculum 2005 and about Technology education as part of the C2005 initiative. Three reports were especially significant:

- The Foundation for Research and Development (FRD) which presented a report in December 1998 about the Technology pilot project;
- The NTT, which submitted its final report to HEDCOM in March 1999; and
- The Curriculum 2005 Review Committee, which presented its report in 2000 (Chisholm, 2000).

2.5.1 FRD Report of 1998 – Technology pilot project

The report focused upon the following issues, considered important for "...future policy decisions regarding Technology education in South African schools" (FRD Report, 1998:203). It noted the positive responses of learners and educators to Technology during the pilot project, and focused especially on implementation issues. Technology should not be forced into all schools, and schools should be given time to decide whether they are ready and willing to implement Technology. Technology classrooms must be built in under-resourced schools and teacher/learner ratios in Technology classes should be low due to the high levels of learner activity. Phased implementation should occur, with schools who are more successful in implementation sharing their expertise and experience. Implementation should be co-ordinated and supported through officers given full responsibility for implementing Technology in a given province/region. The report pointed also to needs for well-planned, long-term in-service education; improved learning materials and simpler language in the documents.

2.5.2 The NTT final report to HEDCOM – Technology project

The report was comprehensive and indicated possible solutions to problem areas noted during the trialing of the document. The NTT considered the seven Specific Outcomes to be logically structured. However, a coherent assessment framework could not yet be worked out because the assessment system was not finalized.

Curriculum frameworks, in all learning areas, needed to be simplified to make them easier to understand and more accessible. Terms had been interpreted differently in different learning areas. Some of the content under SO#2 (which states: Applying a range of Technological knowledge and skills ethically and responsibly) needed to be modified. The integration of Technology with other learning areas was considered a strong point, but required further development and trial. Technology was well suited to the expression of OBE principles. However, it was necessary to continue producing learning materials so that exemplars of student work could be generated. Coupled with this, the training of educators (who are often overworked in crowded conditions and loath to give up time after school) needed to be re-examined. The NTT provided a possible plan of cost implications for the nine provinces to implement Technology education on a large scale. They also provided a breakdown of the costs of the NTT's work within the nine provinces, which was in excess of R15million (NTT final report to HEDCOM – appendix 5.3).

2.5.3 The C2005 Review Committee Report – Chisholm Report 2000

The Review Committee Report was generated by a team of educationists who were commissioned by the Minister of Education (Prof. Asmal) to investigate and suggest possible changes to Curriculum 2005. The report attempted to address issues associated with 'indigenisation', policy formulation, implementation and the ways in which schools, learners and curriculum designers were experiencing

Curriculum 2005 (in the period between its release in 1997 and the time of the review, 2000).

The Review committee found that the curricula and policies were too complex, variously understood and insufficiently balanced. Implementation was further frustrated by lack of resources and capacity. Sharp time-frames undercut efforts to reach and provide support for all educators (Chisholm, 2000:109). The Committee recommended that the number of learning areas be reduced from eight to six by combining Technology with Natural Science, and Economic and Management Science with Life Orientation. National Curriculum Statements should be produced, with a simpler structure, and should clearly express what is to be learnt and the levels/standards to be assessed. The committee also recommended that the allocation of time to each learning area be refined to place increased emphasis on language and mathematics. It called for a co-ordinated national strategy for the preparation of educators, and learning materials that were closely aligned to the curriculum framework and educator development. The scope and pace of implementation needed to be reviewed (Chisholm, 2000: 90-108).

The development and implementation of Curriculum 2005 in the time frames laid out were extraordinarily ambitious, especially occurring as they did in the midst of other changes. These included the restructuring and staffing of national and provincial education departments, changes to finance and governance of education and schools, rationalisation and redeployment of educators, and new legislative frameworks and policies across a wide spectrum of education. All were considered to be as important as the new curriculum for effecting educational change (Chisholm, 2000:3 - 4).

2.6 Concluding remarks

This chapter has reviewed the literature related to definitions of technology, technology education, curriculum and curriculum analysis. Its primary purposes have been to provide background to the study and develop a theoretical framework for the study. The chapter directs attention to issues that the NTT faced, and idea that might have influenced their work (and hence the final design of the Technology curriculum).

The chapter argues for and outlines a framework for curriculum analysis that is structured and technical-scientific in nature. This is seen as an appropriate choice in relation to the purposes of the study, the nature of Technology education, and, perhaps, the theoretical orientations of members of the design team. The chapter has highlighted too the complex processes in which the NTT was involved, and the need to complement the analytical framework by more open explorations of the dynamics of curriculum design.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This study is based upon qualitative research methodology. Fraenkel and Wallen (1996:442) allude to qualitative research as "research studies that investigate the quality of relationships, activities, situations, or materials". Qualitative researchers tend to describe in detail all of what goes on in a particular activity or situation rather than comparing effects of a particular treatment as in experimental research (usually defined under quantitative research methods). Ely *et al.* (1991:31) suggest that qualitative researchers enter the field of study where the "questions shift, specify, and change from the beginning in a cyclical process as field logs grow, are thought about, analysed, and provide further direction...". An analogy of a jigsaw puzzle comes to mind as the researcher pieces together a picture that at first is unknown. In this instance it is an educational curriculum jigsaw puzzle; the picture being created is that of the senior phase Technology curriculum in South Africa.

South African education policy-makers included Technology education as one of the eight new learning areas in the outcomes-based curriculum (OBE) commonly known as Curriculum 2005. This research study investigates the development of the Technology curriculum, analyses the curriculum as described in the published policy document (Oct. 1997), and the ways in which the document was received and used in a pilot project.

Posner (1992:21) indicates that a curriculum analysis should not be limited to such matters as the reading difficulty of the curriculum document and the factual accuracy of the content, but include the extent to which curriculum and the assumptions underlying it are valid for particular classes, schools and districts. In the South African context, this includes all GET schools in the nine provinces and all educators associated with the teaching of the new Technology curriculum.

3.1 Methodology

3.1.1 Overview of Methods Applied

Structured interviews were chosen for what may be termed the primary source data (consistent with Fraenkel and Wallen's (1996:498) description of primary versus secondary sources): interviews with members of the NTT. The interview is an effective way to obtain information concerning facts, beliefs, feelings, and intentions (Ary *et al.*, 1972:168). The minutes of meetings held by the NTT from June 1994 though to January 1998 provided additional evidence (secondary source) regarding the development of the curriculum policy document. They were used in part to check aspects of the 'story' told by the NTT, to enhance the reliability of the data. Further, a personality orientation profile (Carl 1995:63) was administered to the three NTT members to ascertain their personal perspectives on education.

Traditional qualitative research, according to McMillan and Schumacher (1993:37), often employs case study, in which selected cases are studied in depth. A multi case study was part of the methodology to explore the ways in which schools, educators and students experienced Technology education in the pilot project. Video recordings as well as photographs were taken of all teaching sites visited, to gather primary data. In this manner the description of conditions at Technology pilot schools could be validated (see appendix J). A personal journal was logged to capture observations and ensure that the 'atmosphere / mood' at the time of interviews was recorded to support the transcribed data.

The study of the curriculum had two distinct yet complementary parts. Firstly, it looked at the *intended* curriculum compiled by the designers, to examine what the designers expected would be implemented. Analysis of the document involved 'unpacking' the curriculum in an organized manner to study the component parts and see how these parts contributed towards the whole (see Chapter 2). A theoretical framework and analysis tool were developed for this purpose (see Chapter 5 for application). Secondly, the *experienced* curriculum, as expressed in technology education pilot schools over a one-year period (1998), was examined. This was to check the feasibility of the curriculum at a school and difficulties the educators had while using the curriculum document in the teaching and learning situation. This *modus operandi* is consistent with what Layton comment:

> ...the differences between the intended, the enacted, and the achieved curriculum can be considerable; what students carry away from attempts at curriculum change can be very different from the outcomes that the original proponents had envisaged (1994:32).

Interviews were conducted with the three available members of the National Technology task team (NTT) and seven pilot school educators located in three different provinces. The interviews were carried out between July and December 2000. Six pilot schools were selected for case study, two in each of three provinces (Kwazulu/Natal, Gauteng and the Western Cape). These provinces were the only provinces out of the nine that implemented Technology as a pilot project in 1998. The choice of pilot schools was purposive. After gaining permission from the relevant provincial authorities, it was possible to liaise with the provincial Technology advisor in each province to find out which schools would constitute a satisfactory sample. Six schools were chosen in the light of these discussions with the provincial Technology advisors. The criteria used were the following:

- Schools must have participated in the 1998 pilot project.
- Educators should have been trained in Technology education.
- Learners should be from low/ middle/ and high income homes.
- Schools should be in low/ medium/ and high personal risk areas.
- Learners should be from single and mixed racial groups.
- At least one school should have learners with special needs.

The intention was to select a wide a range of schools, to see how educators managed the pilot project in different contexts. It was not an intention to generalize in a statistical sense from these six sample schools to the population, but rather to describe the experiences within the chosen schools.

The chosen schools were as follows:

- School 1 – an elite black school.
- School 2 – a mixed school for learners with special needs (LSEN).
- School 3 – a black school, mainly very low-income parents.
- School 4 – a mixed school (black, Indian, coloured), low-income parents.
- School 5 – a lower income coloured school in a gangster neighbourhood.
- School 6 – an elite white school.

From the six schools, seven educators were interviewed. School #4 had two educators assigned to their pilot group. Both educators were interviewed during a single session. The two responses were classified separately although they were integrated for the purpose of the response from that particular school.

3.1.2 The Structured Interview Method

One approach to interviews is to simply ask questions, following to a large extent the ideas offered by the respondents (Ary *et al.*, 1972:168). This was not considered suitable for this study, because the analysis was to take place through a particular theoretical framework. Wise *et al.* (1967:103) suggest that the interview can be considered as an extension of the questionnaire method and can also be used in combination with the questionnaire method. Here a combination of questionnaire and structured interview was used.

Although structured interviews and questionnaires can be similar in their intention, there are important differences. The interview enables rapport and interaction between the interviewer and interviewee not possible in a written questionnaire. The structured interview permits each respondent to speak freely and in confidence during the interview sessions, but keep 'to the point' in relation to the information required by the researcher. At the same time, it allows deviation as information is offered, according to the respondent's views about what is important, and questions that arise during the interview process. This can help clarify the contexts in which the respondents are working, and the dynamics of the processes in which they are engaged. The interview schedule also ensures that each respondent faces similar questions, hence building reliability and validity (see appendix A & B). The author was the interviewer for all interview sessions. Tape recordings were made, and transcribed for further analysis.

3.1.3 Personality Profile

A 'Personality Profile' was used (appendix D) to gather information on the individual designers' perspectives on education. This was completed by all three members of the NTT. The purpose was to examine the perspectives held consciously or unconsciously by the members of the design team. The profile was recorded in Carl's work at the University of Stellenbosch (1995:62-67), with permission from the developer Babin (1981). It has five categories, concerned with the respondent's beliefs about curriculum. Firstly, *development of cognitive processes* stresses belief in 'how' the learner learns rather than 'what' he/she learns. The development of thinking skills is strongly accentuated. Secondly, *curriculum as technology* reflects belief in a particular end goal that is set and detailed planning takes place to achieve that goal. An input must deliver an output in the form of certain achievement by the learner. Thirdly, *self-actualisation*, or *curriculum as consumatory experience* is a belief that the school should offer positive learning experiences for the learner. The curriculum must be relevant and topical so that self-actualisation can occur. Fourthly, *social reconstruction* requires a belief that learners should be orientated to social questions, such as unemployment and pollution. The needs of the community are strongly accentuated. Lastly, *academic rationalism* requires learners to master selected content as offered in traditional subjects. Stress is placed on the acquisition of knowledge through research. Learning and mastering facts is characteristic of this approach and the development and exchange of ideas (Carl, 1995:58).

3.1.4 Reflective Journal

Reflective field notes document what the researcher himself/herself is thinking about what s/he observes (Fraenkel and Wallen, 1996:461; Ely *et al.*, 1991:69) and may include reflections on analysis, method, ethical dilemmas, the observer's frame of mind; and points of clarification. The reflections help the researcher control for observer effects and promote on-going evaluation and judgement. Such a research journal was kept and updated after each interview/observation session. Writings from this document were used to corroborate findings and indicate the attitude of the respondents at the time. A certain 'feeling' is generated via interview sessions and observations and the reflective journal was useful to record what happened after each successive visit.

3.1.5 Minutes of meetings

The NTT made available the minutes of all official meetings, and documentation developed as part of the project. The minutes and documents provided an important account of the process and achievements. They were used in combination with the interviews, to support some of the findings and confirm others and to check factual evidence provided during interviews.

3.1.6 Interpretation of data

The data collection strategy was influenced in part by the availability of the interviewees and travel arrangements to other provinces. The selected pilot schools within the three provinces were visited and the responses to the educator questionnaire (appendix B) recorded both in writing (brief notes) and by audio cassette. A video recording of the conditions at the school as well as the learners attending the Technology classes was made and photographs were taken (appendix J). The next stage was to interview the three NTT members and administer the designers' questionnaire (appendix A). A similar procedure followed to capture their interview sessions.

During March and April of 2001, I received an award of a National Research Foundation (NRF) bursary to study in the USA at the University of Georgia (Athens). While there, I was able to transcribe all the audio recordings, *verbatim*. These verbatim responses were typed out on a computer and printed. The responses of the NTT members were individually cut-out and pasted on a large A3 size sheet against each question of the questionnaire, then likewise for the seven educators. Each interviewee was allocated a code to identify their responses. The sorted cuttings were then typed out against the questionnaire questions and placed in a matrix to enable comparisons and a search for patterns. This first draft captured all responses *verbatim*. A second draft allowed for the extraction of common 'themes' and 'issues'. Comments and opinions arising in response to the questionnaire and probing questions were also compiled, and incorporated into the data on themes and issues.

I wished to report the data in two ways, firstly the 'raw data' (largely uninterpreted, making strong use of the verbatim accounts) and then interpreted. Of course selections of the raw data had to be made, and they had to be assembled in a logical structure. Both of these actions inevitably modify (or impose) meaning. Three approaches were investigated: organizing the data according to the questionnaires, telling the separate stories of each of the individuals, and telling the story of the curriculum development and pilot as a whole. Because the research focus is the curriculum and its development, I chose the last option. This choice also allowed incorporation of data from documents and observations.

Ely *et al.* (1991:169) observe that ".....case studies are usually reported as narratives that read like chronologies of what led up to an event and what happened during and after it....". However, the data had not been collected as a simple chronology, and in any case the chronologies were different for different actors. Instead, I borrowed from stages in the design process, as defined in the South African Technology curriculum. This was appropriate insofar as the curriculum designers themselves were deeply aware of this process, and most of the comments they made were readily categorized according to steps in the process. The Technological process provided a logical structure for a complex situation. However, such organization of the data does not imply that the steps were consciously followed, nor that the process involved was essentially linear. The resulting presentation of the data is in Chapter 4.

Chapter 5 offers interpretation of the data, through the use the analysis tool: issues and comments, interpretations and supporting data were organized and discussed under eight headings. Finally, the data were searched for what seemed to be the most significant factors for understanding the design and implementation, and which might be of particular value to future curriculum designers and project managers. These are presented, along with recommendations, in Chapter 6. The structure of Chapter 6 firstly answers the critical questions posed in Chapter 1 and then presents six findings that might be considered for future curriculum designs. Finally a new curriculum design model is presented, based upon the experiences of the participants in this study.

3.2 A tool for curriculum analysis

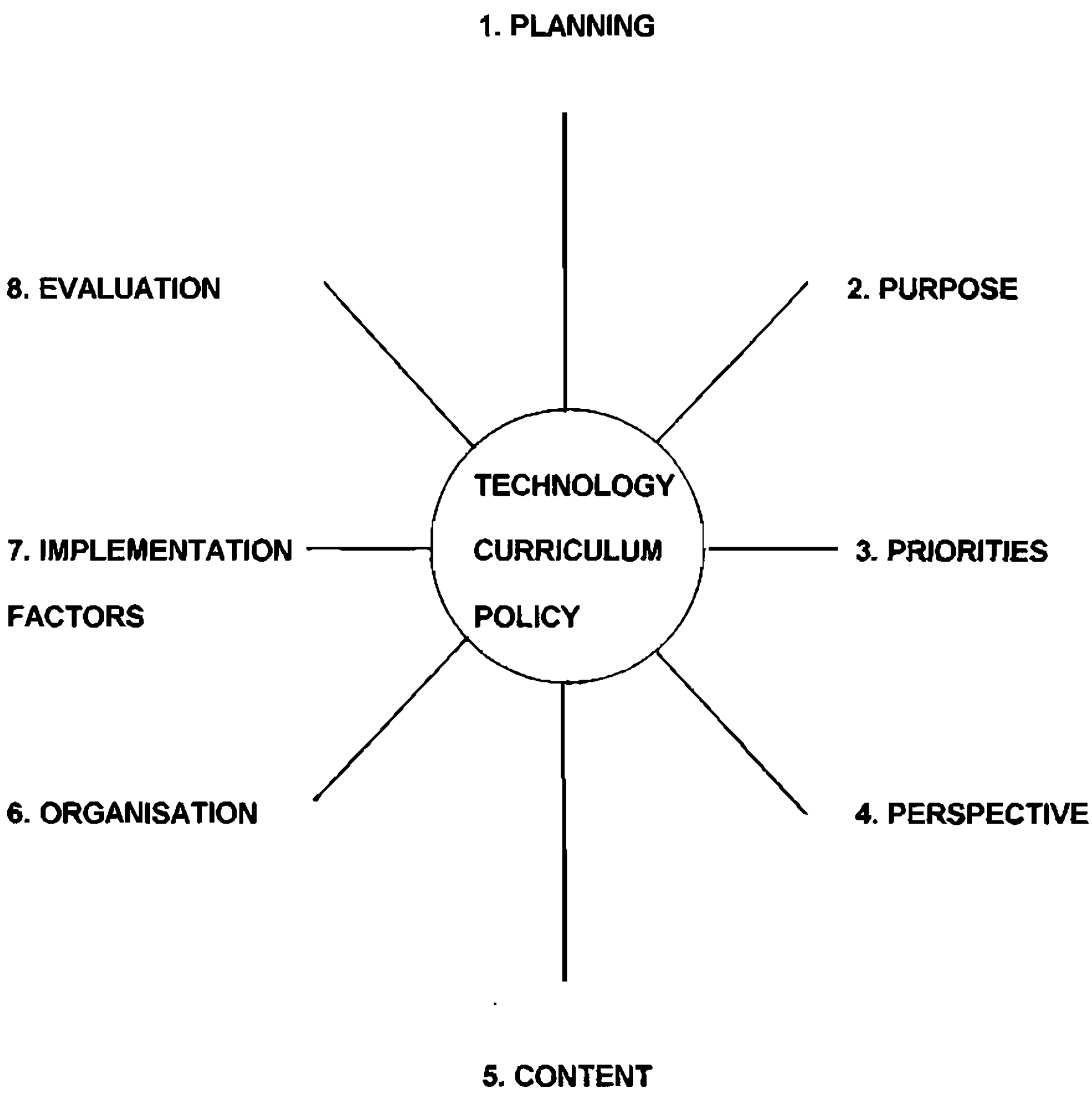
3.2.1 Introduction

The literature reviewed in Chapter 2 suggests numerous approaches to defining curriculum, and analyzing a curriculum document (the intended curriculum) or curriculum in action (the enacted or experienced curriculum). A case was made in Chapter 2 for adapting the frameworks of Posner (1992) and Jansen and

Reddy (1994) as appropriate for this study. Their frameworks show considerable similarity with others described in Chapter 2, including those by Tyler (1949), Johnson (1967), Zais (1976), Posner & Rudnitsky (1994), Longstreet & Shane (1993), and Carl (1995). Accordingly, Posner's model was adapted as in Fig. 5.

Figure 5

The curriculum analysis tool used to analyse the Technology curriculum design.



The framework or tool in Fig. 3 was used to structure the interviews and questionnaires for the NTT and educators, for analyzing the published curriculum documents, and for interpreting the research data. It identifies eight components of a curriculum: planning, purpose, priorities, perspective, content, organization, implementation factors, and evaluation. In practice, these different components are all complex, highly interactive and often overlapping. They may be explained as follows:

3.2.2 Planning

In curriculum design, planning is involved at two levels: planning the design process, and planning the curriculum itself. Planning is about relating means to ends. Whether the process is essentially linear (deciding the ends and then the means) or iterative (whereby means and ends continually reshape each other), planning is integral to curriculum design and project management. The curriculum plan can be inferred from the curriculum documents, the project management plan from accounts of the process.

3.2.3 Purpose

The term 'purpose' has a dictionary meaning of 'the object towards which one strives' (The American Heritage Dictionary, 1985:1006). Purposes can be defined at different levels. At the levels of curriculum and teaching, purposes are expressed in goals, outcomes and objectives. Curriculum 2005 was guided by (a) an overarching set of "critical outcomes" (also called critical cross-field outcomes) and developmental outcomes which were to apply to all learning areas and (b) a set of "*specific outcomes*" that were to be created in each *learning area*. The critical and developmental outcomes were non-negotiable (Department of Education, Senior Phase, Policy document, 1997:15), and were to be expressed in the invention of specific outcomes. The critical and developmental outcomes are:

Critical cross-field outcomes:

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 members of a team, group, organization, community;
3. Organise and manage oneself and one's activities responsibly and effectively;
4. Collect, analyse, organize 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 recognizing that problem-solving contexts do not exist in isolation.

Developmental outcomes:

1. Reflecting on and exploring a variety of strategies to learn more effectively;
2. Participating as a responsible citizen 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.

However, the purposes of curriculum (and the outcomes of the curriculum) are defined not only 'downwards' in relation to learning areas, but 'upwards' in relation to the purposes of schooling and the reason/s for designing and developing the curriculum at all. As indicated in Chapter 1 & 2, Curriculum 2005, including the Technology curriculum, was intended to serve national purposes of economic, social, cultural and personal development, with a view to transformation, equity and redress. The learning outcomes in the Technology curriculum, as in all learning areas, were to serve these purposes and achieve these outcomes. It is this larger sense of purpose that is central to this study, though details of specific outcomes (and their articulation with larger purposes) are also important.

3.2.4 Priorities

In order to indicate to educators that a greater emphasis may be placed on certain outcomes, designers have to prioritise and state their intentions. Priorities may be expressed in a hierarchical structure. One set of priorities might apply to the entire curriculum, or priorities may shift in different parts of the curriculum. Analysis of priorities as a component part of the Technology curriculum, seeks to ascertain any particular hierarchical order that exists, and if so, why.

3.2.5 Perspective

A perspective consists of a 'coherent set of assumptions' about education (Posner 1995:45), and refers to the broad views of education that are expressed (explicitly and implicitly) in the curriculum document. Many curriculum perspectives can be defined. For example, they might arise from educational philosophy (views of the purposes and nature of schooling in society), conceptions of the learning area or subject, conceptions of curriculum, and theories of learning and teaching. A 'coherent set of assumptions' emerges when the various perspectives are more or less compatible with each other – as happens, for example, when the purposes of schooling are concerned especially with democratic participation, Technology is considered as a human activity, curriculum is designed to be learner-centred, and learning is viewed as a process of construction in a social situation. While the principles of and rationale for Curriculum 2005 provided broad guidance on perspective (giving high priority to the position just described) curriculum design is also influenced by the beliefs, assumptions and theories about education of the designers (Carl 1995:62). These arise from the personal commitments of the designers, and from their understanding of the learning area.

Posner (1992:93) advocates curriculum design based in single perspective, to build coherence in the curriculum. However, Schwab (1970), quoted by Posner (1995:258), argues that following a single perspective leads to tunnel vision and that a curriculum developer should develop what he calls "...arts of the eclectic" by using various theories in combination (Schwab, 1970:12). These arts include the ability to trace a curriculum's features to underlying perspectives, the ability to identify the commonplaces that the curriculum addresses and those it ignores or subordinates, and the ability to identify facets of the commonplace the curriculum illuminates or obscures (Posner, 1995:258).

3.2.6 Content

Content within a curriculum framework refers to what is to be learned. It may be defined in detail, or by criteria for the selection of content (Steyn, 1982: 70-72). Within the structure of Curriculum 2005, the content in the Technology learning area was to be indicated through specific outcomes, range statements and performance indicators. This indication was to be quite general, to allow for local interpretation and local selection of examples, contexts and learning methods that would effectively achieve the outcomes. Posner & Rudnitsky (1997:8) distinguish between curriculum (what is to be learned) and instruction (the 'how' to facilitate learning). Given the nature of the published Technology curriculum as a framework to guide schools and materials developers, this study is not so much about instructional design but the macro curriculum policy. At the same time, it is concerned also with the ways in which the framework was interpreted in the pilot schools.

3.2.7 Organisation

The term organization means 'to put together in an orderly, functional, structured whole' (The American Heritage Dictionary, 1985:876). Posner (1995:156) refers to the work of Popper (1959) who suggested that knowledge should be organized in scientific disciplines, to provide 'the logical organization of concepts, with the most general basic concepts serving as a basis for understanding more specific concepts and facts'. However, in Technology education, other alternatives are attractive – especially organization around problems to be solved, or competences to be achieved (see Chapter 2). Organisation may also refer to the sequencing of learning within a curriculum and linkage to other learning areas.

Good organization should maximize opportunities for learners to acquire the desired knowledge, skills, attitudes and values intended by the designers. The curriculum, according to Tyler, should be organized so that the ordering of experiences is somewhat systematic, interweaving ideas, concepts, values, and skills (Ornstein & Hunkins, 1993:268). Zais (1976:441) gives attention not so much to learning pathways but to organizing centres related to both scope and sequence. The organizing centre, according to Goodlad (1963:25-50), defines the substance of the learning that is to occur at a given level of schooling and is linked to other centers, especially above and below. The organizing centre controls sequence by guiding the upward progression of learners and defines scope by specifying content, materials, and procedures at each level of the curriculum (Zais, 1976:441). For a curriculum such as the Technology framework in South Africa, organization has horizontal and vertical dimensions. Horizontal organization is 'the integration of content taught concurrently' and vertical organization is 'the sequencing of content' or progression (Posner 1995:124; Chisholm, 2000:2).

3.2.8 Implementation Factors

Ornstein and Hunkins (1993:297) indicate that:

> Implementation should not be viewed as a clear-cut yes or no – to use or not to use, a new program. The process is developmental and occurs at different levels. Successful implementation of a curriculum, regardless of its design, rests on delineating at the outset of the development process the stages necessary for implementation.....implementation also involves attempts to change individuals' knowledge, actions, and attitudes.....it is an interaction process between those who have created the program and those who deliver it.

Some of the factors that influence implementation include educator attitudes, beliefs, and competencies, physical resources, school management, and the clarity, plausibility and feasibility of the curriculum documents. An apparently well-designed curriculum may fail due to the neglect of implementation factors. By nature, these implementation factors may be extremely dynamic, contextually based, and unpredictable (Chisholm, 2000:8).

3.2.9 Evaluation

Posner (1995:221) indicates that 'the process by which some individual or group makes a judgement about the value of some object, person, or process is termed evaluation. Evaluation occurs as an integral part of the development process, through team discussions and inputs from various reference groups. It can also occur at the 'end' of a particular phase in the development, through trials and pilot studies. In the case of Technology, a pilot project was commissioned by the Foundation for Research and Development (FRD) for this purpose during 1998. The intention of the FRD evaluators was to test the curriculum document by observing its implementation (see Chapter 2) to ascertain, for example, whether implementation complied with the intentions of the implementers, whether the educators experienced difficulties, and whether learners enjoyed doing Technology (FRD, 1998).

3.3 Conclusion

Methodologies have been presented for data collection, and for the design of instruments and data analysis. The data collection involves interviews and questionnaires with members of the NTT, analysis of the minutes of NTT meetings, case studies in six schools involved in the pilot study, and analysis of the published curriculum document.

Building on definitions of technology, technology education and curriculum and models of curriculum analysis presented in Chapter 2, a theoretical tool has been developed to frame the interviews and analyze the data. The analysis tool is a blunt one. Its components can have levels ranging from micro-level to macro-level (eg, purposes, priorities and plans), and the components overlap and interact (eg, plans, purposes and perspectives). Nevertheless, the tool provides a comprehensive framework for analyzing the curriculum document, planning questions to NTT members and educators, and organizing what they saw as important. At the level of detail, the author's own frameworks, knowledge and beliefs are inevitable parts of the research, in the document analysis and in the interviews. In part to explore and supplement my personal frameworks, reviews of the literature, and published evaluations of C2005 and the Technology curriculum were conducted, and presented in Chapter 2 and here.

CHAPTER 4

FINDINGS

4.0 Introduction

The curriculum for Technology education in South African schools was designed and developed over a four year period, mainly by South African educators but also with comments from an international panel of experts and wide consultation with stakeholders. The process was unique in the sense that never before in the history of South African education had such mass curriculum development taken place on such a scale. Technology education was not an entirely new concept in South Africa. It built on ideas that were conceived around 1991 but only developed on a macro scale between 1994 and 1997. The period 1994 - 1997 was a time of excitement but also frustration for the design team (NTT). The design process was not smooth, simple, or problem-free, but was filled with problematic situations that required difficult choices. The team had to work with various stakeholders and their different claims, including many who were not educators or acquainted with curriculum.

This chapter presents a summary of primary data collected from the NTT members and educators at the pilot project schools in three provinces, supplemented by information from minutes of meetings. It begins with an overview of the persons involved in this case study, how they contributed towards the Technology curriculum, what it was like at the pilot project schools, and moves to what both groups (NTT & educators) had to say about the Technology curriculum in South Africa. The latter is presented using the framework of the Technological process in a South African context.

4.1 A Description of members who formed the National Technology Task Team (NTT)

A decision was taken during earlier meetings in 1994, that a few persons should be appointed full-time to co-ordinate the design and development of the Technology curriculum and to ensure that a policy document was compiled within stipulated time frames. The National Department of Education decided to employ four full-time persons to the design team: one project director and three supporting members. Advertisements were place in national newspapers for suitable candidates in 1995. Funding for the project was available from the DoE and all members of the NTT were appointed on a contract basis until March 1998. Three of the four-member team had their contracts renewed for a further year until March 1999. These members were leaders in the consultative process that led up to the Technology curriculum document being drafted and later appearing as policy (Oct. 1997). The NTT members were also actively involved in helping to source relevant information and to draft suitable learning support materials to assist educators implementing Technology at their schools. This information was available to the consultative group when they met at different sessions, usually in Pretoria, and was also to the provincial co-ordinators of Technology.

The NTT were also responsible for establishing what was called the Techno-Centre. This was a set of offices and a workshop, located at the former Natal College of Education in Pietermaritzburg. It was intended to be a training centre for the pilot project and for future Technology educators. The NTT used this centre as their headquarters while being assigned to the Technology project by HEDCOM (Heads of Education Departments Committee). The buildings were rented from the Natal College of Education at a nominal monthly rental fee, a secretary was employed to assist with the administration and relevant training equipment such as computers, circular saw, band-saw, wood-lathe, a variety of hand-tools, glue guns, koki-pens, card, and plastics was purchased to provide support for the pilot project and also for on-going training of provincial co-ordinators. Provincial co-ordinators were appointed on a voluntary basis and were designated as the official representatives for each of the nine provinces.

One of the four-member task team left the project after only about two months and was replaced by a foundation phase specialist. The second member of the team left in 1998 at the conclusion of the initial phase of the project. The remaining three members had their contracts extended until March 1999; these were the three members who were interviewed. Two were met at their homes and the third at a busy coffee shop in a large shopping mall.

1

[1] For ethical reasons, all names used are ficticious (1-11)

4.1.1 The NTT Director – (Joe[1]).

Joe had extensive high school experience as a teacher, as well as some curriculum design experience. Joe had previously held the portfolio of the official curriculum designer and developer for the Natal Education Department before accepting a voluntary retrenchment package and leaving the services of the Natal Education Department during 1995. This was necessary for him to be considered for appointment to the position of Director of the NTT. The contractual conditions of his appointment were defined by HEDCOM. Joe's professional qualifications included a B.A. degree, a teaching qualification, and an M.A. degree in Technology Education from the University of York (UK). Joe was also the initiator of the ex-Natal Education Department (NED) Technology Education pilot project during 1992/1993 where some basic technological concepts were tested at a few selected ex-NED schools.

As Director of the NTT, Joe was responsible for, amongst other things, arranging meetings, ensuring minutes of all meetings were kept, informing the DoE representative. He was responsible for progress in drafting documents for consultation, gathering relevant information, ensuring capacity was developed in each province, consulting with provincial committee members, and delivering the final document to HEDCOM. To assist Joe, another person, (Mike[11]), was elected to be the chairperson for the NTT meetings. Mike was appointed on a voluntary basis. Joe's position as project director for the Technology curriculum was dissolved on 30th March 1999.

4.1.2 The Foundation phase specialist – (Mary[2]).

Coming from a high school teaching background and also spending a number of years at a large teacher training college in Kwazulu/Natal, Mary was appointed to assist in the training and development of educators as well as the design and development of material for the foundation phase of the OBE system. Mary joined the NTT a few months after the other members, following the resignation of one of the foundation members. The member whom she replaced, Nigel, was a specialist in information technology.

Mary has a junior degree, a teacher qualification, a bachelor of education degree and a master's degree. She has many years of educational experience as a teacher and teacher educator and was also previously employed by the ex-Natal Education Department. Mary's role in materials development for learning programmes resulted in the development of practical classroom-based projects for educators to test with their learners. This was not a step followed in the other learning areas. She has also published Technology books for a local publishing company. Mary was interviewed at her home.

4.1.3 The Teacher Training Specialist – (Rick [3]).

Also coming from the ex-Natal Education Department Rick has a B.Sc. degree, a teaching qualification, a B.Ed. Degree from the University of Natal and an M.Ed. degree from the University of Virginia, USA. He was a high school teacher for many years and principal of a large technical high school before being appointed as head of the technical education advisory services of the ex-NED and co-ordinator of the technical subject advisor committee (after amalgamation of the five ex-Departments of Education in Kwazulu/Natal). The technical subject advisors were responsible for the support of all technical subjects still offered up to matric (grade 12 equivalent) at all schools equipped with specialist workshop facilities. These courses are vocationally oriented. (The researcher also served as a member of this committee for a number of years.) Rick was responsible for the co-ordination and provision of training for the educators in Kwazulu/Natal who participated in the 1998 pilot project. (These educators did not attend Ort-Step training, as happened in Gauteng and the Western Cape.) Rick was also responsible for the compilation of a national programme for Technology educator training.

4.2 The Educators and Schools of the Technology Education Pilot Project

It was necessary to gather data from the persons who implemented the pilot Technology curriculum during 1998. These educators represent the comments made about the 'experienced' curriculum. As only three provinces in South Africa (Kwazulu/Natal, Gauteng, Western Cape) participated in the 1998 pilot programme, it was decided to interview educators from all three of these provinces. The other six provinces did not activate their pilot projects due to a number of unforeseen administrative 'glitches' (NTT Final report to HEDCOM, 1999:7).

Six schools were selected (two per province) based upon their physical location, the racial differences within schools, the type of environment in which the school was located, and the communities served by the pilot schools (see Chapter 3). The information collected from these educators enabled a comparison between the 'experienced' curriculum and the 'intended' curriculum. Seven educators participated in the data collection. This was because schools were the unit of analysis, and at one of the schools two educators were active in the pilot project. Both of them were interviewed at one scheduled interview session.

4.2.1 Kwazulu/Natal Province Schools

4.2.1.1 Kwazulu/Natal Province - School Number One – Educator Zakhe[4]

The school is located within a very large black community area near to the Durban International Airport. This school was one of the special education projects initiated by the ex-Kwazulu Department of Education and Culture before all five ex-departments of education were amalgamated. The school is equipped with workshops and a boarding establishment. In the earlier days (pre-1994) this school was classified as an experimental school that was well-resourced and catered only for black learners; it still does today. No other race groups were evident during the visit to the school.

The school attracts day scholars as well as boarders. Some boarders live in the area but choose not to travel each day to school. Approximately 900 learners attend this school. This school has attracted support from local industry that has allowed for greater expansion in the learning area of Technology and computer courses. The school is also equipped with a variety of specialist technical education workshops and classrooms for subjects like woodwork, metalwork and welding, electronics, electrical, and technical drawing. It is classified for the purposes of this study as a well-resourced urban school.

The Technology educator (Zakhe) is a black male, who comes from a science teaching background and has also completed a Bachelor of Commerce degree. Zakhe holds a teaching qualification and has been a teacher of science for more than fifteen years. He also has to run training workshops for educators at schools offering Technology in the Durban South education region, as part of the greater C2005 initiative. Since joining the technology pilot project in 1998, he has been very active in setting up a workshop infrastructure at the school and has kept the Technology classes running at the school for the past three years. This has allowed for constant self-development. There were many learner projects available for the researcher to see as evidence of his continued efforts. An important addition to his classroom was a strong room for keeping tools and equipment safe. He also had the use of a computer room adjoining his Technology facility. A library is available. The school is located between a Technical College (now called a FET Institution) and a Technikon with a University opposite the Technikon site. Zakhe has been resourceful in making contact with local industries. The researcher was shown a large amount of material like cardboard and textiles that are used for the learner projects which Zakhe had sourced (free of charge) from nearby industries.

4.2.1.2 Kwazulu/Natal Province - School Number Two – Educator Marie[5]

This school is located in a predominantly white urban area but caters for learners of all race groups with special needs. This means that those learners who are physical challenged, requiring special care and facilities, are catered for. The general academic progress of these learners is not greatly affected by their personal physical disabilities. This school population is integrated with slightly more white learners than other race groups. The school seems to be well resourced although the Technology room is very small catering for a maximum of about ten learners at a time. This is because there is a tendency to have smaller class groups due to the physical problems that the learners may have. On visiting the school, the researcher was witness to learners in wheelchairs in a class as well as one young boy who had no hands trying to do some Technology work. He was considered to be an extreme case but nevertheless he seemed to enjoy the class. He was sanding a piece of clay with sandpaper and also showed me how he uses a bench-vice while in a wheel chair although he had no hands. The school has an enrolment, including those learners occupying the boarding facility, of about five hundred learners.

The educator involved in the 1998 Technology pilot project is a white female named Marie. She had been forced to relocate due to the rationalisation of educators within the province ie. she had been declared 'in excess' according to the staffing norms of the Kwazulu/Natal Provincial Department of Education. Marie has a teaching qualification and has taught hotel-keeping, catering and biology at schools for about twenty years. She is also busy improving her qualifications by studying towards a Bachelor of Education degree at a local University. She has assisted with the regional training of educators in the OBE programme with special emphasis on Technology. She therefore conducts in-service training courses for Technology educators from schools located within the North Durban education region. The school did not have much of the work left on display from the 1998 pilot project when I visited, which was disappointing. One or two of the cardboard school building projects that were designed and made as part of the final 1998 Independent Examinations Board (IEB) examination, were however, on display.

4.2.2 Gauteng Province Schools

4.2.2.1 Gauteng Province – School Number Three – Educator Thande[6]

This school is located on the southern side of Johannesburg in a low-income area of the city. The school principal indicated that the school caters for many of the children coming from the nearby informal settlement. The collection of school fees is problematic. This school has an enrolment of about 900 learners, which was surprising given that the school was not very big. The buildings were in a fairly good condition, despite the surrounding area, suggesting that there is a conscious effort to ensure education remains a priority for this community. There was a fence around the school but anyone could gain access through a number of broken places. The area around the school looked derelict and a large number of broken bottles were lying in the road.

The educator of the Technology learning area, Thande, had obtained permission from the principal to convert a storeroom into her Technology classroom to save her the time of trying to move equipment about to teach different class groupings in the slightly over-crowded classrooms. The room was about the size of a normal classroom although the width seemed slightly narrower than usual. There were not many desks and chairs, but the provision seemed to be adequate for the classes she taught. Pupils attending this school were predominantly black learners. The equipment supplied by the Gauteng Department of Education for the pilot project was stored in three or four large grey-coloured steel cabinets in this new Technology classroom. Some student work was displayed at the front of the room. The interview was conducted inside this Technology learning facility.

Thande has a B.A. degree and a Secondary Teacher's Diploma teaching qualification. She has taught science, geography, and health education for a number of years. She also completed a Diploma in Technology from the Ort-Step Institution and had received a certificate for attending a follow-up programme held at another school. She was fairly new to the teaching of Technology and had been selected because she had taught science before the commencement of the Technology pilot project.

4.2.2.2 Gauteng Province – School Number Four – Educators Logie[7] & Reggie[8]

This school was about ten kilometers from school number three, in the same suburb. The suburb is South of Johannesburg and about 30-40 km from the city-centre. This school is located in a residential area that appeared to be more up-market than school number three although the researcher was informed that many of the learners attending this school could not afford the school fees. The learners appeared to be more mixed than school number three consisting of mainly Indian, Coloured and Black learners. Crime in the area was reportedly problematic to the school and burglar bars and razor wire fences were apparent. This was the school where the two educators who had presented the pilot project were interviewed.

These educators had disappointingly locked all the equipment away in a central storeroom with boxes piled up to the ceiling. Computers, still in the delivery boxes, tools and equipment for the Technology pilot project were still wrapped in the delivery wrapping bearing the price tags. Nothing had been used. The educators indicated that this was because of the high crime rate in the area. They were attempting to have the remaining classroom windows and doors burglar-proofed with weld-mesh and steel gates although finance was a problem. They showed me how vandals had broken into their previous room (now used as a tuck-shop) by simply breaking the locks on the wooden door and the steel gate. This was a sad situation.

The first of the two educators, Logie, had a technical background and had been teaching metalwork and technical drawing at a large technical high school in Kwazulu/Natal before accepting a transfer to Gauteng. The second educator, Reggie, is a younger educator both in years and to the education profession, and has no technical background. He had been teaching Geography and History up to matric (grade 12) level before being requested to teach Technology. Both educators were Indian males. The two educators had attended the Ort-Step Institute for an eighteen-month period as they had replaced earlier candidates who withdrew from the course; they both completed the Ort-Step Technology course.

4.2.3 Western Cape Province Schools

4.2.3.1 Western Cape Province – School Number Five – Educator Harry[9]

The school was located on the Western side of Cape Town, about fifteen kilometers from the city centre. The suburb in which the school is located is reputed to be the home of many gangsters. Some of the learners had been physically abused and many lacked parental support. The school is a large high school with slightly more than one thousand learners, mainly from the coloured community. The school was in a reasonably good condition and was surrounded by residential properties alongside a very busy road. The classroom was large and included a storeroom. Desks and chairs were arranged to form small groups. High walls and barbed wire surrounded the facility to form a type of courtyard. The collection of fees was viewed as problematic although some were collected. A small yet adequate budget was allocated to the educator for the running of the Technology department.

The educator is a coloured male named Harry. He has taught mainly physical science and biology for about eleven years and is a qualified educator. He started the Ort-Step course in the Cape area but did not complete it for a number of personal reasons. The educator informed me that he only taught half of his class of forty-five students at a time as learners lacked the ability to concentrate on the task for extended periods. Considerable work had been done through making efficient use of the budget allocated to him. Harry was confident that much more could be done if greater finance was available and felt that large industry in the Cape area might be willing to provide some support with off-cut materials, etc.

4.2.3.2 Western Cape Province – School Number Six – Educator Piet [10]

Located in the heart of the winelands of the Cape, this school caters for day scholars as well as having a boarding establishment. The school is one of the very old traditional and prestigious schools of the Cape, catering for many of the children whose parents live on nearby farms. The school could be classified as an elite school. Facilities included magnificent sports grounds, a swimming pool, gymnasium and technical subject workshops. The Technology center was large enough to have computer workstations on one end and still have enough space to accommodate another group towards the other end. The educator was also making use of the home-economics room, metalwork and woodwork facilities to support his teaching programme.

The Technology educator, Piet, was white. He had come from a nearby teacher training college and had a formal degree and teaching qualification as well as a technology degree from Southampton University (UK). It was obvious to me that he was drawing upon his International experience to combine all the technical workshops into the Technology Education programme. The school had computers in the special Technology room that were very well used by all learners. There was not much work on display in the technology room, but upstairs in a storeroom alongside the woodwork room were found some fairly advanced projects in Hydraulics and a number of projects on Structures.

4.3 The Technology 2005 curriculum design and development process: A reporting framework

As discussed in Chapter 2, the data from the NTT and schools are presented here using the structure of the 'Technological process' (SO#1 of the South

African Technology curriculum policy): design, make, evaluate. The steps suggested in the curriculum policy are: identify the problem; research possible solutions; select the most suitable solution and develop it; make the artefact that is the "solution"; then evaluate and re-design if necessary. The process need not be as linear as suggested, nor even cyclical: in practice all steps probably interact with each other (see Chapter 2). However the steps provide a logic through which to recount the narrative of the curriculum development, are well understood by the NTT members and educators involved, and proved, in practice to be a satisfactory way of organizing and reporting the data. All events in the account are real and comments indicated in quotes were actual comments made by the respondents.

4.3.1 Identify the problem

Simply stated, there was no Technology curriculum for South African schools and a new one had to be designed and developed by South Africans to suit the local conditions and emerging policies as part of national transformation.

Towards the latter part of 1994, a volunteer group of concerned educators decided to put forward some ideas to discuss ways and means of introducing Technology education into South African schools. A chairperson was elected out of this group to ensure meeting protocol was adhered to. The meetings gained the attention of the Heads of Education Departments Committee (HEDCOM) in

October 1994. This led to the members of the voluntary committee being given the brief to establish a Technology education forum; to gain the support of the education authorities for the implementation of a subject called Technology; to develop a contextualised (i.e. SA relevant) understanding of Technology; to develop, trial and finalise contextually, curricula and accompanying educational materials (including teacher support materials) in pilot projects; to structure teacher training (pre- and in-service) in liaison with the relevant role players, and to develop a strategic plan for the implementation of the subject throughout the education system including the logistics involved (Final report to HEDCOM, 1999:6).

4.3.2 Research possible solutions to the problem

There were two broad solutions: write a South African curriculum (in spite of little previous experience in the Technology area), or import a Technology curriculum from the United Kingdom, Australia, New Zealand or the Netherlands. Any mix of these approaches was possible.

The solution that was possible also had to fit with broader curriculum planning and related frameworks. The DoE decided to initiate a Technology curriculum, designed for South Africans at schools throughout the country. Then the rules of curriculum design changed between 1994 and 1996, as outcomes-based education (including its principles and structures) was formulated. The

Technology National Steering Committee was reconstituted by HEDCOM as a National Project Committee with powers to establish its terms of reference and to recruit staff. Following the resignation of the first chairperson in 1995, a new chairperson was elected. The DoE changed the project's emphasis in the following ways: broad stakeholder participation was required, representation on the National Project Committee was extended, the National Technology Forum was established (that included national, provincial, and sectoral constituencies), and an international reference panel was created (T2005, Draft National Framework for Curriculum Development, 15 April 1996, p.9).

The project's purpose changed from one of feasibility (of Technology education) to emphasis on: developing national and provincial capacity to support the development, trialing and ultimate implementation of Technology materials; developing and trialing stakeholder-approved, outcomes-based material in line with emergent National Qualification Framework (NQF) principles; setting up broad project evaluation mechanisms which would inform the development of broader implementation strategies, and linking the project with other initiatives such as Adult Basic Education and Training (ABET).

4.3.3 Select the most suitable solution

During September 1995, the project was re-named Technology 2005 (T2005) and in April 1996 a full-time National Task Team (NTT) was appointed to co-ordinate and manage the development (Final report to HEDCOM, 1999, appendix 5.2, p.3). The NTT, as noted earlier, consisted of Joe, Rick, Mary, and Natalie. These four members were responsible to ensure that the final policy document was ready by October 1997 (i.e.17 months from their appointment). Natalie left the project in 1998 leaving Joe, Mary and Rick to conclude matters until April 1999.

Using the initial framework documents for OBE, the NTT set about following their mandate to design a South African Technology curriculum. This seemed to be the most logical approach to solving the lack of Technological literacy at school level.

4.3.4 Develop the solution

The DoE required the NTT to proceed quickly (to completed the document by Oct.1997), matching the developments in other learning areas. The NTT did not have a trouble-free time. They reported frustrations. Delays in delivery of services and operationalising certain of the NTT plans caused uncertainty regarding funding. This delay in approval of funds had a ripple effect on provincial departments of education, delaying the appointment of provincial task team members which in turn forced the delay of the training the provincial task team staff, the development of interim teaching and learning materials for pilot schools, training of pilot school teachers, implementation of Technology in pilot schools, and the FRD research initiative (Final report to HEDCOM, 1999:7).

The NTT as leaders of the T2005 project were supposed to be empowered to overcome some of these problems, but often the persons who were supposed to empower them were the 'very same persons who caused the problems', usually members of the DoE. Some of the problems were directed at NTT members personally, while others were encountered through circumstances often beyond their control. The NTT was further restricted by the DoE's expectation of a final policy document in 1997 and a national Technology pilot project to be launched in 1998.

The data indicate many times when the NTT and educators provided similar comments and other times when very different comments were made. This is to be expected. The following issues were noted, only some of which were able to be resolved. They illustrate vividly the complexity of operational and contextual factors that must be accommodated in the technical development of the curriculum.

4.3.4.1 Funding Issues

The project suffered from the 'siphon-effect' of provincial departments of education that absorbed 'ear-marked' funding for the Technology pilot project implementation into their general education accounts and then utilized this money for things other than Technology education. The NTT final report to HEDCOM (1999:appendix 5.3) indicated the following: Total funding granted to nine provinces was R 15 339 000. From this must be subtracted the estimated amounts absorbed by some provinces who did not implement the Technology pilot project, some R 4 000 000, leaving a total amount used by the three provinces who did implement the Technology pilot project as R 11 339 000.

Only three of the nine provinces (Kwazulu Natal, Gauteng, and Western Cape) implemented the pilot project. The loss of funds to some of the provinces is a real indicator of the education provision in 1998. It seemed inconceivable that special funding could simply disappear due to what amounts to poor management. Mary stated, "...the original money was okay, but what happened in the provinces was a disaster. No one was held accountable..."

The FRD carried out an assessment of the pilot project programme and delivered a report of their findings (17 December 1998). They noted:

> ...shortages of resources and funding, as well as more general inhibiting factors such as staff cuts, large class sizes and appropriate teaching and storage space, are most often mentioned (FRD report, 1998:111).

4.3.4.2 Resourcing issues

A common aspect of South African schools is their lack of resources. The township schools and rural schools are particularly under-resourced. Minister

Asmal acknowledges this problem (1999:2). The 2001 statistics indicate that a Kwazulu/Natal *per capita* allocation per pupil was the lowest in the country at R2 943, with the national average being R3 511 and a learner in Gauteng receiving the highest allocation of R4 355 (*The Natal Mercury*, 14 February 2001).

The provincial departments of education spend most of their monies on the payment of educators. In KwaZulu/Natal, personnel costs in Education and Health account for nearly 90% of personnel expenditure in the province of Kwazulu/Natal (*The Natal Mercury*, 28 February 2001). This is just to keep the system functional. Often the blame was laid on the previous government, which enforced separate development and differential resourcing of groups through apartheid legislation. By 2000, the problem was larger than that. The spending on personnel versus resources is alarming and requires redress. Technology education, in particular, is affected as it is dependent on resources. Joe intimated that, as part of the design process, "it was always a consideration in terms of resourcing a school". The ideas of alternative resources and indigenous technologies came into the equation according to Mary, but essentially, the DoE is ultimately responsible for the provision of adequate resources for all learners, regardless of where schools are situated.

The Technology 2005 project provided detailed estimates to the DoE regarding general costing of resourcing schools, including a list of tools, equipment, and consumables for all schools (NTT Final report to HEDCOM, 1999:appendix 5.7).

The NTT recommended that even with simple materials, schools could teach the principles of Technology effectively; "...In fact, problem solving with minimalist levels of resources can often lead to a better understanding of the processes involved" (NTT Final report to HEDCOM, 1999:11). The NTT recommended that where more sophisticated equipment is available (including computers) it should be used to access information, manipulate information and present ideas in advanced communicative media.

However, for the use of alternative materials to be considered suitable by the educator, the educator must be well trained and resourceful. At the school level, resourcing available for anything 'new' or out of the ordinary, like Technology education, has to compete with resourcing in established areas. Schools located in townships and in rural areas are particularly under-resourced due to the non-payment of school fees, and low levels of support from provincial departments of education. Even though tool lists were developed by the NTT, the question remained as to who would pay. The other exasperating problem was theft and vandalism within certain areas. Joe commented on the state of general education as "...a lack of provision of the whole thing".

There were inefficiencies within the provincial DoE structure that negatively impacted upon how the Technology curriculum was experienced in the classroom (NTT Final report to HEDCOM, 1999:11). This was evident in one of the provinces visited where brand new equipment and materials were stacked up inside the storeroom in case of theft. This equipment was delivered very late in the year to the pilot schools. Logie and Reggie from this school echoed "...they equipped us with resources after we finished the course...we had to go and fight for it."

4.3.4.3 A Curriculum framework was designed

A draft curriculum framework for Technology was developed by a sub-committee of the National Project Committee (NPC) during 1995, prior to the appointment of the NTT. This curriculum framework document was presented at the first National Technology Forum in June 1996. The DoE then launched the first series of discussion documents in July 1996 introducing the new OBE system, later called Curriculum 2005. The NTT, NPC and members of the provincial task teams (PTT) played very significant roles in the subsequent work (NTT Final report to HEDCOM, 1999:14).

At all stages, development stemmed from earlier draft documents, especially one called 'the inescapable features of Technology', and a rationale for inclusion of Technology in South African schools. Other core documents included "A discussion document on an approach to developing a flexible core curriculum for science and technology compulsory general education" (STEC Curriculum Discussion Document, May 1994) and "T2005, Draft framework for developing a National Curriculum in Technology Education" (March 1996).

While all the new initiatives were being pursued, the focus of the teaching and learning materials had to be aligned with the principles described in OBE policy documents. These principles had to be included as an integral part of the learning support materials. Principles of learner-centred education, integration across learning areas (especially in the foundation and intermediate phases, Grades 1-6) and local design of learning programmes tend towards an educator being able to facilitate learning and not using 'prescribed' learning materials. However, the NTT felt otherwise. The materials developed for piloting in 1998 were not completely aligned to curriculum 2005 (Final report to HEDCOM, 1999:14) and integration across learning areas in the foundation and intermediate phases was to be addressed at a later stage. Initial emphasis was therefore placed upon the development of grade 9 materials.

4.3.4.4 Learning assumptions

The educators were vociferous about the assumptions the NTT seemed to make about how learning did and might take place in classrooms. Zakhe indicated that: "They (the NTT) assumed, wrongly, that all the racial groups will find it easy to integrate the curriculum materials." His experience was in previously black education departments, which he felt did not do enough to empower educators and learners to engage with new learning materials and courses. Reggie, from another province, stated: "They assumed that every kid can learn at the same level and have the ability to cope at that level". He was speaking from a background of Indian education and anticipated greater support for the mixed group of learners he was now confronted with. Many of Reggie and Logie's learners had great difficulty in reading and writing in English and this was problematic as the Technology materials were only presented in English. English was also the only language he was able to communicate in. Harry was more philosophical and was in support of the 'intent' of the Technology curriculum. He said, "…for learning to take place the assumption was that you cannot do content in isolation…process and knowledge and understanding, they're inextricably linked, but they are linked with attitudes and values." Piet, meanwhile, problematised the NTT's vision by saying, "I get the feeling that the people who do the curriculum have lost touch with the real world of teaching...you must keep track of what is going on in our schools and not just think of what is going on in first world schools". He came from a previously white department of education and now experienced some of the problems of mixed class groups as well as seeing what some of the neighbouring school educators had to work with as they tried to achieve comparative learning results.

The NTT were more optimistic and indicated that the majority of learners would be able to comprehend Technology content if taught by a competent educator. This overlapped with the notion of adequate training for everyone involved in Technology education, which was also problematic. Joe, as the director, said:

> …There's a sense in which the child needs to be doing and engaged in things that provoke wonder and amazement, and asking questions…and leading to more profound realizations later on. Now in the past I believe we have moved away from that delight as in de-light, I'm not talking fun,

> education is not really fun because it involves hard work and you really have to think, but you're drawn by a deep sense of desire.

The belief was that Technology education has the potential to unlock such desirable qualities within learners. It was also evident that disparities existed between urban elite and rural poor, school learners. The debate about what to do about inequities raged. It is well established that learners from high socio-economic groups and whose first language is the language of instruction advance academically at a much faster rate (Holman (in press), 2001).

4.3.4.5 School premises

The schools that engaged in the Technology pilot project of 1998 were selected from a variety of different areas. The sample of pilot schools selected for this study was also based upon a similar idea in order to analyse the possible options and conditions. The 'ideal' Technology classroom was only to be found in a few schools. It was only possible where parents of learners were able to make contributions to the facility, or if an industry adopted the school as a community support project as in the case of school number one of this study.

The NTT members were aware that the facilities at the majority of schools, at best, could be described as being poor to fair (Joe, Mary and Rick). They addressed this issue in two ways, firstly to design a Technology curriculum that they could claim was specific to South African conditions, by allowing for a variety of projects to be completed by applying common principles (Joe and Mary's comments) and secondly, to identify alternative resources as a means of making projects in crowded classrooms and poor resources. Mary was very supportive of the need "...to value low tech as well as high-tech and indigenous and appropriate technologies" but even this does not solve the problem of poor conditions.

The 1998 pilot project helped to identify some unique ways of coping with some of these problems. Harry, for example, handled the overcrowding issue by deciding that he could only teach one half of the class at a time, so he would send one half either outside or move them further back while he focused on the other half of the group, then change around half-way through a lesson Other educators like Piet, divided the class into teams and these teams worked on different projects at different times so as to free the equipment for everyone on a rotational basis.

4.3.4.6 Time period allocation

The NTT director was aware, because of his 1992/1993 initial experimental programme in Technology, that to teach Technology effectively requires more time than a general academic subject like geography or history. Once learners become involved in projects, time slips by and causes many to return during their lunch breaks or even after school to complete their work. Zakhe, who taught at a school having a boarding establishment, was very keen to promote Technology after normal hours to those learners who could remain behind because they did not have to go home to their township dwellings. When Joe was asked about time allocation, he said,

> ...Yes, I was aware of it. It's not easy in curriculum development to address, you can keep this in mind, but some can only be addressed later on for example, particularly if you look at the Technology curriculum.

The design of the curriculum did not take much account of the time factor: the NTT assumed that principals and heads of departments would make allowance for the needs of Technology. This did not happen in practice during the pilot project (1998) and there were numerous complaints by educators (most of the interviewed educators) that the time allocated was too short. Most schools allocated two single lessons (30-40 minutes each) per week, and this was inadequate. At least two double periods are required per week.

Mary answered the questionnaire question about time from a different perspective: the time in which schools were expected to implement the new curriculum. She said "...time is totally unrealistic, there's no way...to try and expect the whole country to implement. Those time frames were unrealistic if you want any kind of quality....". Rick was in agreement with her statement.

Thande observed that educators at her school "...did not take Technology very seriously". This disturbed her as she had developed a passion for Technology during her training and subsequent pilot project at her school. She was annoyed when her head of department remarked, "...anyone can teach Technology". Thande respected the amount of time and effort she had put into Technology teaching and learning and was adamant that an educator needs to be adequately trained for the task, that not just 'anyone' can be employed to teach Technology effectively, neither can random times be allocated by management for Technology teaching.

4.3.4.7 School Management

Mary observed that, "If you haven't sold it to your school management you can forget about it...the principal is the key person to me...". The NTT did not specifically consider the school management in their design phase as the assumption was that everyone will have to do Technology as a matter of DoE policy. Principals would be supportive of the initiative, or so they thought. However, that is not what happened at the different school sites during the pilot project. Zakhe felt that the NTT did not consider this factor while Marie said that "...some principals didn't know what Technology is about...it's problematic". Rick on the other hand was concerned that "...there's poor management as you know, but they're trying to rectify that...". He was referring to provincial DoE initiatives to try and provide training for school managers as well as the Technology project task team's efforts to provide workshops to inform educators and managers about Technology. The FRD report (1998:109) indicated: "...principals need more exposure to the field of Technology 2005".

Logie and Reggie had a completely different view of their principal. They said, in their school, "...The principal was very enthusiastic to a point...his primary thing was to get resources for our school...which he did nothing about...it was left on our shoulders". They felt the principal had not done enough to obtain materials from the provincial department, nor in providing secure and convenient storage arrangements when the materials finally arrived.

4.3.4.8 Economic constraints in South Africa

As noted in Chapter 1, the economic state of South Africa was part of the rationale for Technology education. Members of the NTT tended to see its relationships to curriculum design more in the provision of resources for the curriculum than in the goals of the curriculum. Joe said that he "didn't think it was the biggest problem" but Mary was of the opinion that as far as the Technology project was concerned "the original money was okay, but what happened in the provinces was a disaster".

4.3.4.9 Educator training in Technology education

The NTT were very aware of the need to provide suitable training for the future educators of Technology in South African schools and provided the DoE with approximate costs for training, tools and consumables in each province (NTT Final report to HEDCOM, 1999:43-73). To achieve this objective, courses had to be developed or adapted from other sources. A draft Teacher Training Course was developed under the guidance of Rick, whose portfolio it was, to complete during the NTT project time. Recommendations were prepared by the NTT but were not implemented.

During the 1998 pilot project period, a few teacher-training ideas for Technology education were tested. The Ort-Step programme was used in Gauteng and the Western Cape. The NTT conducted training programmes in Kwazulu Natal. The Kwazulu/Natal training seemed to be preferred, as it was aligned to the intended outcomes of the pilot project. The materials that were being developed by the NTT were explained, refined in the light of feedback during the training sessions and then further refined after testing in a few schools. The pilot project educators indicated that they would not have been able to teach Technology without their prior training. Harry, who was part of the provincial team of educators representing the Western Cape, said, "I think it was done with the understanding that there should be proper training, which up to this day I don't think the DoE has provided". Piet added that he thought the NTT "...had lost touch with the real world of teaching...you must keep track of what is going on in our schools and not just think of what is going on in first world schools...". Piet was from a well-resourced school and was also assisting with in-service training of educators at the nearby College of Education. The training of educators was known by the NTT to be a weakness but they could do nothing to ensure some sustainability in the long term. The large-scale training of educators cannot happen without a serious financial investment in human resource development and time.

4.3.4.10 Values were included in the Technology curriculum

One of the DoE's initiatives was to ensure a broad framework for values to become an important aspect of the new curriculum (C2005, 1997:10). These values were more broadly inclusive than the Christian National education principles of the previous government. Mary indicated that specific outcomes five, six, and seven of the Technology curriculum were specifically focusing on values and attitudes. She said:

> Now it could be racist, the whites wanted one specific outcome to cover that, but the people like Natalie (the fourth member of the NTT, who was not interviewed and who was a coloured woman), and other people, drove the idea that you have a disproportionate loading of it to try and address the imbalances of the past. So there was a separate one for looking at biases, and a separate one for looking at how different societies responded over time...

In the pilot schools, the educators were not aware of the detail connected to the value outcomes described in the specific outcomes. The training given to the pilot project educators enabled them to differentiate between the specific outcomes but they were not aware of much specific detail and what the reasons were for introducing overt value statements in the curriculum. The educators simply knew that values and attitudes had been included in the curriculum as part of Technology education curriculum policy.

4.3.4.11 The guiding principles of the Technology curriculum.

When Joe was questioned about the guiding principles that influenced the curriculum he stated,

> I think the people that were engaged in that original design were keen to see Technology reflected in schools in the same way that it's reflected in the broader society. In other words not simply as information technology (computers in classrooms), not simply as craft and not simply as science or applied science, but rather to see it as, in terms of the way by which industry and scientific design and engineering operate within the bigger world. I think that's where these content areas like processing, structures, and systems began to provide a foundation for Technology.

Mary stated that the NTT did not have a model for the design of the curriculum but rather followed "...loose, flexible parameters that were handed to us on overhead projector film". This was a weakness on both the NTT side as well as the DoE, probably due to the fact that Technology was entirely new to the majority of the learning population in South Africa. No clear curriculum theory or perspective was applied.

Authors such as Posner (1992), make reference to comprehensive sets of questions that must be answered depending upon the perspective and plan for any new curriculum. Such guidelines were not followed by the NTT, at least not in any formal way.

4.3.5 Making a solution

The discussion that follows reflects the experiences of both the NTT and educators during the curriculum development phase, the period after the design had been presented, and later during the pilot project that was conducted in three provinces. Designing a curriculum is never easy, as one will understand from the following stories:

4.3.5.1 Working with the stakeholder group

The NTT members were selected by the DoE because they had previously worked with Technology education (in a small way) prior to the amalgamation of all separate departments of education. This amalgamation took place both nationally and provincially. It was of national importance that everyone's needs be included in the new curricula. Accordingly the DoE insisted on democratic participation, and processes of representation and consultation were established. The total number of persons who were actively involved with the curriculum project was around forty although there was a smaller group (about fifteen) who were more active than the rest (T2005, Minutes of steering committee meetings, 20 Feb.1996; 19 March 1996; 24 April 1996). Consultation was far and wide, reaching into all the provincial co-ordinators, labour unions, industry representatives, and others who intended using the curriculum (T2005, Draft National Framework for Curriculum Development, 1996a:2). The different stakeholders offered many different perspectives, each urging that their perspective was correct and should be included.

Mary commented that: "...the stakeholders were from a variety of unions...and we had people who had not a clue about education...and we had to try and balance it...".The NTT had to facilitate a rather large and often unwieldy group of educators and non-educators simultaneously at some meetings. Joe stated: "...it had to be representative of government, labour and workers...the (curriculum) design had to be in line with other countries overseas and have credibility". Rick indicated: "...well it was new to South Africa and we were very conscious of the advantaged and disadvantaged community groups. At the time the economics of the country was very bad and so there were very strong social-political and economic factors driving the process". The NTT expressed concern that the diverse views became difficult to manage at times and hindered their progress. The educators were aware that "...it (curriculum design) was a group effort..." and that a team was responsible for putting the final policy document together."

4.3.5.2 Political influences

Joe was very outspoken about the political influences upon the curriculum design although Mary was more cautious. Joe indicated that:

> ...ignorance among policy makers is still a massive problem...people were completely ignorant, they didn't know what Technology was, or that some of them even had malicious intentions...we even had Chief Directors at DoE talking of FET (Further Education and Training (grades 10-12)) but

> answering a question on Technology and describing Technology as the worst thing since Bantu education...that's without any attempt to understand what this R20 million project of HEDCOM achieved or found, simply because some policy makers' perspectives are negative, so it does influence it.

It was also reported that Technology was another "white thing" being developed to subvert the black people, because the NTT mainly consisted of white members. Rick recalled the national department personnel who advised: "Ja, we don't want to hear that reactionary stuff, because our people will be able to do it....don't come and tell us what you're worried about.....get on and do it".

From the schools' perspective, the predominant values clashes were different. Harry alluded to "there being hidden agendas in terms of people....attached to their comfort zones". Some educators had indicated their unwillingness to accept the new changes being demanded of them. Rationalisation and re-deployment of educators in 1997/1998 did further damage. Piet said that as far as he was concerned the political influence was not really a problem.

4.3.5.3 Cultural values and differences

The incredible change from apartheid to democracy brought with it the situation of mixed race as well as mixed ability learners in the same classroom. The NTT had to design a curriculum that could be taught to a class of learners who were trying to adjust (together with their educators) from being largely mono- or uni-cultural, to being in multicultural classroom setting.

Joe stated that "...whites still sit in the situation where they think Technology is second class". This comment followed after Joe's description of the past where whites looked down upon those learners who followed trade courses such as motor-mechanics, plumbing, carpentry and bricklaying. The perception was that such learners were 'not so bright' and therefore they should become blue-collar workers. Such a choice of career was for 'lower' class citizens who were not academically inclined. Technology education, according to Joe, has tended to change that perception especially amongst the white population. Mary said that cultural values and differences were "...not a major problem as long as one can guard against being third-rate...", meaning that the perception of South Africa as a third-rate state should not be carried into the future. Technology education was intended in part to assist learners in bridging the gap; to be able to participate equally with new and modern Technologies as part of global trends. However, equity in curriculum design is difficult to define and harder still to achieve. For example, the NTT was expected to provide 'one education for all' but at the same time promote local variations according to cultural background, resources, etc. The result seems to be a blurring of difference rather than an achievement of equity. In spite of flexibility the documents provided for schools, the curriculum is more suited to already advantaged learners while those disadvantaged learners remain without adequate support and infrastructure.

4.3.5.4 Curriculum development as a feasibility-type project

The earlier thinking in the formation of the NTT was that the curriculum process should be an exploratory study, exploring features that educators considered important to the learning area of Technology. Part of this was the relationship between science and technology. Documents such as "*A discussion document on an approach to developing a flexible core curriculum for science and technology – compulsory general education*" were drafted by a group of science educators on 29 May 1994 (STEC Curriculum Discussion Document). Educators of science were concerned that Technology would take over the science learning area and vice versa. The debate about whether or not Technology should be part of science was conducted over a number of months before finality was reached.

Appropriate demands on teachers and the needs for trained teachers were also recognized early, with draft documents such as *"Teacher Training for Technology Education"* in November 1995, that later became *"A Curriculum Model for A Preset Teacher Education Course in Technology"* developed by Rick, together with colleagues from higher education institutions and other educational bodies. Another was the document developed via the T2005 project for JISTEC (Jerusalem International Science and Technology Education Conference) in 1996 entitled *"Broad Framework and "Disciplinarity and/or Interdisciplinarity in Technology and Science education"* presented by a South African University professor who was part of the consultative steering committee. Further documents consisted of a 4th draft *"Broad Parameters for Teacher Education"* in September 1996 to assist different teams working on different aspects of the Technology 2005 project to focus their attention in diverse, yet specific Technological study directions, using more accurate and relevant information.

In July 1995, all of the feasibility ideas were finally discarded as the actual curriculum design and development process was re-defined by National policy in the run-up to the launch of C2005 in July 1996 NTT Final report to HEDCOM, 1999:6). On 15 April 1996, the NTT produced a discussion document entitled *"T2005(b), Draft National Framework for Curriculum Development"* specifically presented to Technology provincial task team members (PTT's) and inclusive of draft interim standards for Technology education. Rick was one of the NTT who indicated his annoyance at the sudden change as the feasibility idea (1994) would have given time to identify strengths and weaknesses for a potentially new Technology curriculum without the unnecessary haste.

4.3.5.5 Curriculum design issues

When Joe, Mary, and Rick decided to accept a contract package offered by the DoE for their services as members of the NTT working group, they had no specific curriculum design in mind. Joe, more than the others, had a vision of what he thought the new Technology curriculum design should be. Each of the members brought their own strengths and weaknesses to the project. Mary's strengths were in the foundation phase and materials development, while Rick was more concerned with teacher education. Joe was the only one of the team who had some extensive curriculum design and development experience. He was also well accepted by his fellow colleagues as the leader or project director because of his experience in the preparation of a Technology programme and general curriculum development while employed with his previous ex-department of education.

The design brief presented to the team by the DoE was to draft a curriculum that was consistent with the principles of OBE that would be suitable for all learners in South African schools. The emphasis was towards social upliftment and community development due to the high level of poverty in many areas of South Africa (a sociological bias). Capital benefits would be gained economically by knowing about Technology and how to use Technology. Joe also stated that:

> ...a lot of attention was given to contextualisation.....there was a serious attempt to not simply adapt an international model but to take the best that we saw internationally, to make this 'thing' implementable within South Africa and to make it meaningful for children....perhaps the unstated driver, the awareness that in the past Technology had been neglected.

Mary was less concerned about the technical details of curriculum design. As she said,

> ...I'm not actually certain what encompasses curriculum design...there was too much verbosity...well you know they shopped around at too many places and they kept too much of too many places in terms of specific outcomes, assessment criteria, etc...we weren't too happy with it... but we went along with it.

Mary was distressed by the OBE jargon and structure that had infiltrated the design process. The DoE had insisted that all the new terminology be included in all the eight new learning areas. This was a problem for the designers as well as the educators. Zakhe, indicated that: "...from a teacher's point of view [the Technology curriculum policy document]....it is not user-friendly....I think it should be simplified in terms of terminology". This response indicates that the educator was not able to engage the new terminology adequately, even though he had received about seven weeks of training during the year in which the pilot project was implemented.

Marie was even more emphatic about the language and terminology in the curriculum document. As she said, "...the language, they put in such difficult terms that a lot of people can't understand it....it's not user-friendly at all to read. I mean if English-speaking people feel that way, what about the poor Zulu-speaking kids?" The question is thus, to what degree does a curriculum designer go to draft a policy document that is suitable for the use of educators regardless of their language proficiency in South Africa? The diversity within the South African population both culturally and politically is immense.

Harry, who had been involved in drafting the final curriculum policy document had a different view: "For me, I can use it because of my close connection to it...soon as you deal with this document the first thing that happens to teachers is total bewilderment, now that is not user-friendly...so a simplified version is definitely what is needed...". Piet also felt empowered to use the curriculum due to his Technological background and his degree at a University in the UK. However, Piet admitted that the "...terminology to start with...its confusing, its new terms...". The NTT therefore complied with the requirements of the DoE but missed on drafting a curriculum that was understandable by educators at schools.

Slightly different responses were forthcoming when educators were questioned about the suitability of the Technology curriculum for all learners in South Africa. Zakhe said, "...it came right in time when there was nothing that could be used at the time...", and Reggie commented, "I think the content is fine...". Harry was ecstatic and said, "...it's so empowering, it's different to any other learning area...it's a life skill that those learners are learning, and they can translate that natural process of investigate, design, make, evaluate, and identify a problem, needs and all those things....where a problem needs to be solved".

The fresh approach in the presentation and pilot project materials attracted the educators to the learning area of Technology. The support materials and written programmes provided by the NTT were tantamount to 'spoon-feeding', but allowed the educators the liberty to start feeling empowered to engage in the Technology learning area even though they never quite understood most of the policy requirements for Technology teaching.

Zakhe described his learners as being "positive" and Thande said they were "...very excited". Reggie indicated that, "...our kids come from a background of industrial arts for boys and home economics for girls. Now you have to put them in a class where they have to do the same things...." Harry gave the opinion that "...they were very interested...", while Piet said "...in general they were very positive...". For learners, Technology was enjoyable and new, allowing them some space to be different, to have their final products evaluated and confirm them as individuals.

4.3.6 Evaluation of the curriculum and pilot project

In Chapter 2 the results of some of the formal evaluations of Curriculum 2005 and the Technology curriculum were described. In this chapter focus is on the views of the NTT members and teachers.

4.3.6.1 The Technology curriculum could advantage learners in the future

Joe was of the opinion that,

> ...Technology, properly taught, does have the potential to open gates for learners in the field for developing natural science concepts and mathematical concepts. I think it creates a bridge between abstract conceptualization and the everyday application of these concepts in real meaningful design situations.....you see it has the potential.

Joe's opinion was based largely upon his experiences with his first project in 1991/92, prior to the NTT.

Mary commented that the "...entrepreneurship that we built in also makes them see a relevance that if they can't get a job in the formal sector they can do something, so I think it gives them hope". The notion of learning to be entrepreneurial at school has added a new dimension to the way learners view their schooling. Zakhe also stated that learners "...will be enabled to use the relevant terminology used by industry...". His experience in this regard indicated that learners had very little idea of how the real world of industry functioned outside of the school environment. Technology education allowed them the opportunity to explore the unknown in a structured manner. Thande stated: "...after learning all those skills they can be self employed". Piet added a new dimension when he said,

> ...learners will benefit from learning Technology hand in hand with the environment". In previous curricula, caring for the environment had not been emphasized. Technology through the values aspect of the curriculum, allowed learners the opportunity to realise that they need to care for their environment and that not all Technology is necessarily "good".

4.3.6.2 Assessing the Technology curriculum design

The final policy document for the learning area of Technology is often similar to that of the UK. The NTT were aware that, in the UK, the Design and Technology curriculum at the time was considered too detailed and that teachers could not understand what was actually required by the curriculum policy document.

Similarly, with the South African policy document, Joe admitted that: "The curriculum is too detailed...I think it needs to be easier for teachers to manage but at the same time it must not lose rigour...I think you can balance those two out".

In South Africa the final policy document was clear to the NTT but strange to the educators who implemented it at pilot project schools in 1998. Zakhe, Marie, Thande, Logie, and Reggie indicated that they did not understand the curriculum and also never referred to it much during the pilot project. This is a significant finding which needs to be explored further. Was it that the provision of support materials 'spoon-fed' the educators too much? The NTT provided each pilot educator with a detailed programme on topics such as transport, shelter and structures. These programmes were linked to the curriculum but the educators never knew or clearly understood the link between the programme and the policy (except for Harry and Piet due to their involvement with the curriculum design) This aspect of the curriculum therefore became problematic and will continue to be problematic without proper training.

Mary of the NTT said that, "...the design was relevant because first of all it had the support and enthusiasm from teachers and parents and children...and the fact that it was not too unattainable for people...they felt that the curriculum design was something that they could make sense of...". Mary was referring specifically to the learning programmes (projects) that she had helped to develop and which had been put on trial in the 1998 pilot project. The attainability aspect was also dependent on the tools, materials and equipment that were given to each pilot school and the enthusiasm and creativity of the educators concerned.

4.3.6.3 IT was intentionally omitted by the NTT

Joe observed: "One of the unresolved issues and I think that is still unresolved today, is what to do with IT" (information technology – computers in classrooms). Joe suspected that 70-80% of schools had no computers in South African schools and those available were probably used more in the senior grades. This would mean that in the formative years, (GET) learners would not have the opportunity of learning computing skills simply because of a lack of resources. Mary's reason for the intentional omission was "...because we didn't want people to say 'well my school can't do Technology' or 'it will never work in South Africa because of all the schools who don't have electricity, let alone a computer'. Mary likened the problem to waves; the first wave was to leave out the IT aspect because of the known resource problem; the second wave was to try and include it. Logie and Reggie were emphatic that the DoE had neglected their requirements with respect to IT. However, I did photograph the brand new computers that had been supplied to their school (albeit late) and these same educators had stored these new computers in their storeroom due to a lack of what Reggie and Logie termed "adequate security" (see appendix J).

4.3.6.4 SO#1 was emphasized: The technological process

In the Technology curriculum policy document, specific outcome #1 states:

> Learners will be able to: Understand and apply the Technological process to solve problems and satisfy needs and wants.

The Technology curriculum policy document gives the following description of the Technological process:

> 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 (1997:Tech – 4).

The Technological process consists of the following steps; firstly, problems, needs and wants are identified and explained; secondly, a range of possible and relevant solutions are considered; thirdly, an informed choice is made and a design is developed; fourthly, solutions are realized according to design, and fifthly, realised solution is evaluated and the process is recorded and communicated (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech 4 - 6).

Mary stated that SO#1 was "...imperative because if you don't have that then the rest just becomes like the old or whatever, so we felt it was warranted for staying on its own...". Rick confirmed this statement and added that the creativity aspect of individual learners was also considered important. Many discussions were held around the idea of learners being able to solve a problem on their own as well as to provide a solution to a problem with an answer that was different to their classmates. This difference was seen as being something new and unique to the Technology learning area: for the first time in South African education, difference was accepted and encouraged. The 'difference of opinion aspect' was also valued. It appealed to many learners and changed the climate of the classroom activities. Mary had noted that this was particularly prevalent among the black learners.

The UK, Australian, Scottish, and other countries similarly emphasized the design process in their curricula. The commonly used terminology is design, make, appraise or evaluate. There have been various comments made (see Chapter 2) about learners' abilities to design and why design is important to learn at school level. However not all educators agree on the process of initiating a design and solving a problem. The South African method is quite clear in the Technology curriculum policy.

4.3.6.5 The prevalent philosophy of the Technology curriculum.

Different philosophies concerning technology, education and curriculum had to be managed within the development. In South Africa, there was a shift from technical education to technology education. Joe stated that: "...I don't even think a lot of people involved in this had any conscious, explicit idea of what their own particular origins were...". Joe went on: "I feel the time has come for Technology to form part of liberal education and this is where I was strongly influenced by

A.N. Whitehead...Technology should be making people think, it should be making people more articulate...". Rick seemed quite irritated that: "...95% of the people on the committee were non-technological people, therefore had no technological background to inform their decisions". The curriculum policy document did not express a specific philosophy, although the closest I could find, attached to the T2005 Minutes of the fifth meeting of the steering committee (23 March 1995), was the ICHED (Interim Committee of Heads of Education Departments) Steering Committee Research in Technology Education Workshop (Ort-Step Institute, 24/25 Feb.1995) that made reference to 'a rationale needing to be aligned to the underlying/ideology of technical education'. This committee was required to agree on key elements of this philosophy.

The educators were generally not aware of any particular philosophy that had been applied, beyond their acceptance of constructivism as a learning theory. The members of the NTT had views that were broadly consistent with this definition. They did not extend these discussions into, for example, critical pedagogy, globalisation and theories about the purposes and structures of schooling.

Similarly, while members of the NTT were well aware of the hopes for economic development and social transformation, they did not explore in any detail social or political philosophies as part of the development. Harry, who had been committed to the project from the early days indicated that: "...a socialist philosophy was part of the union strategy". He went on to explain: "...socialism in the context of working together, the concept of collective responsibility, which is not only to yourself but to your group as well....". No particular philosophy was applied to the South African policy document for Technology that was either captured within the policy framework or discussed in the minutes of meetings convened by the NTT.

4.3.6.6 International influence

An arguable point to some South Africans is why curriculum ideas and content have been borrowed so heavily from countries such as the UK and Australia. The answer lies partly in that South Africa did not have much past experience to rely on for Technology education (see Chapter 1). On the other hand, Technology had been tested in the UK and Australia over a few years, and was seen as important there in economic development. It was natural and appropriate that the NTT learn from these developments. It was also the case that 'curriculum experts' from other countries were available and ready to help South Africa.

Joe responded when asked about whether certain content was borrowed from the UK and Australian Technology curricula that: "...some of them appear in those documents, I think structures do, but I think groups in South Africa did give emphasis to things like processing because of mining, fisheries and agriculture". The NTT intended to link South African industries (that differ from province to province) with the major content areas described in the Technology curriculum policy document (Oct. 1997). So in the Western Cape (for example), they intended to give greater emphasis to processing in fish and fruit, in Gauteng to the mining industry, and in Kwazulu/Natal to tourism and agriculture. This thinking was not apparent in the policy document to the educators, although it was assumed by the NTT.

A further issue was the wish to align the South African curriculum with international 'standards'. This is a complex issue. On the one hand, especially in technology, globalisation, competition and international discourse seem likely to be better served by having similar curricula across nations. On the other hand, it is not appropriate to simply adopt international curricula, partly because the conditions are different, and partly because it denies local determination. The NTT were aware of some of these dangers.

4.3.6.7 A purpose statement was not articulated in the policy document

Joe stated that: "...initially in the 1995 period when the Technology 2005 began to put the framework document together, a lot of debate went around it.....it was an important feature...it was revised again and you'll find whenever you bring new stakeholders into the process, that comes up again; definition and purpose". This debate seemed to be ongoing. Many changes were evident during the consultative stages of the project (1994-1997), and newcomers also tried to revert back to the work that had been completed during earlier sessions. However, in spite of the discussions and concerns, the final Technology curriculum policy document did not have a clear purpose statement. Instead, a rationale statement was provided that is assumed to include the statement of purpose (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-2).

4.3.6.8 The NTT aimed to introduce Technology into South African schools

The NTT focused on the lack of opportunity for GET learners to engage in learning that was considered to be suitable for the 21st century and beyond. Mary said "...the main one was to redress the imbalances of the past and I think another thing was that we wanted to value low-tech as well as high-tech and indigenous and appropriate Technologies". These dilemmas concerning the differential resources and conditions in schools, the variations in teachers' competences, diversity of cultures and problems of implementation were discussed earlier, and were critical parts of evaluating the curriculum.

4.3.6.9 Technology education curriculum rationale

The rationale for Technology education is presented in the curriculum policy document (Oct. 1997). However, Joe provided a detailed response to the question regarding the rationale.

Joe said:

> ...the rationale bases itself on a number of different arguments...one of them had to do with poor scientific understanding, another had to do with the whole business of children needing to be ready for employment, another had to do with just poor levels of Technology understanding, another had to do with gender issues and the need for Technology...in the 90's there was quite a shift to ensure that there was solid, broad, well-defined Technology education. So I think the place of Technology was seen as vital, partly because of the huge advances in Technological developments beginning to identify with the 21st century.

Joe had a clearer view than other members of the NTT of the Technology rationale. Mary and Rick had little to add. Rick commented: "...I guess that it has to do with high unemployment, the new Technological age, the upliftment of disadvantaged learners and the empowerment of our learners in schools".

The rationale presented in the Technology curriculum policy document is to develop 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 interrelationship between technology, society, the economy and the environment. Once having acquired the developed skills, the Technology policy document (Oct. 1997) indicates that this knowledge should lead to an understanding of nine other desirable attributes, similar to the seven specific outcomes.

At school level, the educators had not considered this rationale deeply. They said they did not use the curriculum policy document much during the pilot project. Some of the comments were as follows. Marie stated that: "...some was very vague...that was very difficult at first, I didn't know what was going on". Logie indicated that: "...there are no guidelines for the syllabus..." and Reggie said, "...the whole thing wasn't really set-up clearly for us to work out a defined programme". Other than Harry and Piet, who had had extensive training in Technology education, the educators did not understand the policy document in any deep sense. They implemented the pilot project largely because the NTT had supplied them with worked-out materials, which they could adapt and apply on the basis of their own knowledge as educators. In this way it was not essential that the policy document be closely consulted. While OBE is supposed to encourage local curriculum design, the educators were not adequately trained in curriculum to take advantage of this freedom.

4.3.6.10 The curriculum was considered suitable for South African learners

It is difficult to gauge the actual effectiveness of a curriculum in just one year, but, as noted earlier, the pilot project yielded positive findings. Zakhe stated, "...It came right in time when there was nothing that could be used..." and Marie said, "I think it will benefit the majority of the children". Reggie also added that, "I think the content is fine", while Logie seemed to be less optimistic about the curriculum as he disagreed with the other comments and stated, "...It should be dropped, it should be rewritten". Harry and Piet were upbeat about the advantages of the Technology curriculum for South African schools.

The NTT members were, perhaps expectedly, very positive about the suitability of the curriculum and Joe said, "...It forms the foundation for all the nice things you talk about, creative thinking, innovation etc. You can't have these without a deep reservoir of knowledge to draw on...". Mary focused attention on the fact that learners start to see: "...the relevance and start applying it to their everyday problems...like how to make a living and survive".

4.3.6.11 Assumptions regarding learner's expected levels of performance

Given the diversity of South Africa, the idea of a single framework and a single set of standards for all learners, is at the same time, a means of equitable access to educational achievement, and a mechanism that privileges some learners and groups over others. This raises hard questions about standards, learning styles and curriculum designs.

Joe questioned the "Piagetian divide", as he called it, "...between concrete operations and the more abstract, operational stages. I don't think those things are divided...children are capable at this level...of abstract thinking and logical thought..." Joe was of the opinion that learners needed to integrate the knowledge acquisition with the fun of making an artefact to solve a particular problem and he indicated that Technology was an excellent basis for this. This could be achieved by all learners, at all grade levels, through the use of appropriate projects. Mary and Rick were not so clear about assumptions that were made. They were fearful about standards, partly in the light of their experiences of the conditions at township and rural schools. They suspected that learning within rural schools can (and should) be very different from city schools.

The educators took a different approach to the question. Marie thought that questions of standards and learning were, "A very political story, anti-racism....equality of education". Thande voiced her opinion in terms of "...teaching children vocational skills." Reggie indicated that, "The designers took for granted that it would be accepted universally by every educator and by every pupil...not taking into account the individual circumstances....". Piet argued that the NTT "...should not just think of what is going on in first world schools".

4.3.6.12 The Technology curriculum was not biased towards any learner group

This question had been asked to verify the requirements of Technology that all learners will be able to participate in learning Technology. This was not the case in the past: technical education was generally a male domain, with white schools much better resourced than black schools, and no real opportunities for learners with disabilities. Technology, as a new learning area in the GET phase, was to be designed without any bias to a particular group of learners.

Zakhe said, "...The girls feel free to work", while Marie said, "...It's not biased, the old curriculum was biased". Harry and Piet took similar positions. However, Thande was of the opinion that the curriculum was biased, favoring schools and learners who were already privileged: *"...How am I going to teach Information* Technology without a computer here?" Reggie supported Thande's judgement.

It was interesting experience when I visited Marie's school as there were physically challenged learners in attendance. The way that Marie addressed this was to allow learners to work in pairs or groups so that a 'more-able learner' was paired with a 'less-able learner' in whatever disability prevailed. In this way the two (or more) learners were able to assist one another. While bias within curriculum and schooling remain deep and important problems, the Technology curriculum has made significant steps forward in this regard.

4.3.6.13 Learners enjoyed the Technology programmes

As noted earlier, learners' response to Technology had generally been positive. Joe put this tentatively: "There was no indication in the FRD report where learners particularly said, we don't like this...*it* was favourably received by learners and by teachers and even management within schools, once they see the impact on attitude". The FRD report (December 1998) reported comments such as, "They love Technology and it is their favourite subject...the children are very competitive...the children like it very much...they can try things out and are not necessarily wrong" (FRD report 1998:76). Such comments were important to the NTT.

Mary linked the success to the opportunities for learners to do different things in different ways. She said, "...It was relevant and exciting and different and something that they [the learners] could be proud of". Mary was referring to the projects that were completed. All learners could make their own designs and each project was different in some or other way. This was a significant deviation from the past where technical subjects required all answers to be the same according to a marking memorandum.

However, the pleasure that learners have and their sense of achievement are only part of an evaluation. Drawing on other criteria, the Chisholm report (2000:92) advocated that Technology be integrated with Science in the GET curriculum. Although the recommendation was eventually rejected, it had a negative impact on many educators at the pilot schools. When the pilot schools were visited, some of the educators had put Technology on hold at their schools pending decisions concerning the Chisholm Committee's recommendations being enacted as policy. Within the NTT, Mary reported that members were astonished by the report after they (the NTT) had spent so many hours drafting the curriculum and running a pilot project at great cost and effort.

According to Mary, one of the reasons for the government's rejection of the recommendation was that learners at some of the pilot schools wrote directly to the Minister of Education (Prof. Asmal) to say, "...Technology was the only reason they go to school...".

On the other hand, learners, like their educators, experienced problems. Rick told me that: "...His general impression was that it was positive...however, there were some negative responses mainly regarding the implementation side. The practical work had to be done and there were problems". Rick was specifically referring to the resourcing difficulties detailed earlier. Although the NTT had endeavoured to plan the curriculum in a way that would suit everyone, the support structures in many areas remained problematic.

4.3.7 Re-designing - as necessary

4.3.7.1 The NTT's and educator's thoughts about the Technology curriculum design

Joe indicated that, "...I think we came very close..." and Mary said, "...I think it was successful..." while Rick was less optimistic and said, "...No, other events overtook it....". Educators expressed their opinions as follows: Zakhe said, "...Some changes are required...". Marie said, "...Modification in the sense of terminology...make it more user-friendly". Thande stated, "...The resource tasks will be easier if learners had prepared worksheets". Logie and Reggie had no comment to add, but Harry recommended that "...In the intermediate phase, to separate natural science and technology as it is in the senior phase", while Piet concluded that: "It is correct....but must be decoded for teachers to interpret".

It is important to see the different levels at which the two groups responded. One group, the NTT looked at the macro picture while the second group, the educators, focused more specifically on the learning programmes. Ideally the macro and micro aspects need to be in some sort of balance, reinforcing one another. Applying hindsight, the OBE terminology issue tended to overshadow the curriculum process. In general the design of the Technology curriculum seemed to be suitable for most learners in GET level schools and the content seemed to be aligned to best practice internationally.

The review committee recommendations (Chisholm, 2000) led to the Minister of Education calling for new national statements to be drafted. These appeared in July 2001 in a document called Draft Revised National Curriculum Statement for Grades R-9 (schools) - Technology. The Technology framework was modified by collapsing the seven specific outcomes into only three learning outcomes, namely: Technology and Society; Technology capability, knowledge and understanding; and Information and communication technology (Draft Revised National Curriculum Statement for grades R-9 {schools} - Technology, July 2001, p.15). This draft National Curriculum Statement for Technology also reduced the content areas to four areas: processing, structures, systems and control and information and communication technology (*Ibid.*, p.17). This has been an attempt to try and satisfy the requests made by the educators (as detailed above). The intention was to reduce the many facets that seemed to confuse educators in the pilot project, to only three learning outcomes. However, most of the earlier requirements still apply. The National Curriculum Statement is not a dramatic change from the Department of Education, Senior Phase, Technology Curriculum Policy (Oct. 1997) document: consistent with the review committee's (Chisholm, 2000) recommendation it has been 'streamlined'.

4.3.7.2 Technology as a learning area on its own

There was an overwhelming response from both the NTT and educators that Technology has a place in the new curriculum on its own. Many saw the Science and Technology learning areas as complementary yet different. Thande for instance said, "Yes, Science has rigid rules but Technology is more flexible". The nature of Technology is such that it draws heavily on other learning areas as part of the projects being undertaken. As an example one may cite structures. There are scientific principles that apply, mathematical calculations are required, geographical aspects need to be considered and so one could continue to make associations with other learning areas. However, Technology is a learning area with distinctive characteristics and opportunities, and therefore is justifiable as a separate learning area. At the same time Technology links naturally and well with other learning areas making it highly suited to integrated approaches – which is consistent with the nature and spirit of Technology in the world.

4.3.8 Conclusion

The chapter has introduced the members of the NTT and educators who were interviewed. Their comments facilitated the exploration of different angles of the design and development phase of the Technology curriculum. A description of the schools at which the educators work indicates the range of conditions for curriculum implementation. In order to align the findings with the Technology curriculum, the technological process has been used to frame the comments of both groups into understandable categories. This framework represents a reporting mechanism only and should not be construed as the process followed by the design team and schools. The personal comments of interviewees depict South African educators at work. The factors listed are not exhaustive but direct attention to some of the important events that were experienced during the intense period of change and the complexity of curriculum design at the national level. These comments have to be analyzed further and this is done using the curriculum analysis tool in Chapter 5.

CHAPTER 5

DISCUSSION OF FINDINGS

5.0 Introduction

In Chapter 4, the data from interviews, case studies and document analyses were presented in narrative form. The data show that the NTT worked with complex issues in a complex environment. Questions emerged also from critiques of the curriculum document published in 1997. The intention in this chapter is to seek insights into the 'story behind the curriculum'. An interpreted view of the data is offered, based on curriculum analysis using a tool adapted from Posner's (1992) work (see Chapters 2 and 3). The tool defines eight components of a curriculum that should be part of a curriculum design: planning, purpose, perspective, priorities, content, organization, implementation factors, evaluation. The analysis addresses these eight components, and uses data from the interviews, case studies and document analyses to illuminate the design and the design process.

5.1 Applying the Posner (1992) model for curriculum design analysis

Posner (1992) posited that curriculum design and curriculum development could be carried out as a continuous action and not be construed as two separated actions. He developed a framework for curriculum analysis that is fundamental insofar as it can be applied to any curriculum (independent of the policy base of the curriculum), and yet its elements are 'non-negotiable'. It is partly for this reason that the Posner model was chosen for this study. A dilemma facing curriculum designers in South Africa (post 1994) was to decide where to start the design process and what framework to use in the absence of any established tradition in curriculum design in Technology education and outcomes-based education.

Curriculum design is more than just making sure that the parts of a curriculum are neatly organized in a document. In the hands of teachers and schools, the curriculum has to succeed in getting learners to learn those concepts, attitudes, and skills considered to be worthwhile and essential (Ornstein & Hunkins, 1993:261). A curriculum analysis attempts to separate a curriculum into its component parts; to examine those parts and the ways they fit together; to identify the beliefs and ideas of the developers (that either explicitly or implicitly shaped the curriculum); and to examine the implications of these commitments and beliefs for the quality of the educational experience (Posner, 1992:12).

5.2 The Eight Components of the Analysis tool

5.2.1 COMPONENT: PLANNING

Posner (1992:43) considers the primary 'planning elements' to be:

- objectives (What knowledge, skills, and attitudes should students acquire?)
- a rationale or educational philosophy (Why should students learn this?)
- the content (What should be taught?); the target audience (Who is this curriculum for?)
- the activities (What should learners do?)
- teaching and learning materials (What resources are needed or available?)
- sequencing and scheduling (When do students do what?)
- teachers' capacity and support (What can teachers do?)
- school management, administration and facilities (Curriculum support).
- the relationship of the curriculum to other subjects and programmes (Integration)
- evaluation and assessment (What were the outcomes?).

These aspects of planning *within a curriculum* have to be set into the context of planning *for the project*; the characteristics of the curriculum plan depend on the staffing and management of the entire project, including resources and decision-making. The discussion below focuses on aspects of planning that were raised by the NTT and educators, and seemed to have significant impact on the design.

5.2.1.1 The design team were appointed (1996-1999)

The HEDCOM appointed a team, on contract basis, to manage and lead the curriculum design process. The team consisted of individuals with expertise and interest in Technology education. In the course of the project, they were supported by reference groups, processes of consultation, and guiding policies. The guiding framework was provided especially by the policies of Curriculum 2005. (*Government Gazette* No.15974, 23 September 1994, p 14 - 15).

One may not assume that the process of design and development, and hence the process of planning, is linear, stretching from purposes to outcomes to content to activities to assessment, even though any curriculum is bound to have these components. A similar argument is made by Williams (2000:6) and Lewis (1999:9) regarding the Technology process. The elements are more likely developed interactively, through re-iterations and revisions. They have also to be developed simultaneously in different dimensions. For example, Zais (1976:395) observes that planning has to have a horizontal dimension (scope and integration) and a vertical dimension (sequence and continuity), and these must fit with each other.

The NTT could not have taken a linear approach to planning and development even if they had wished to: policy changes, revisions of the project brief and processes of consultation occurred throughout, in what some members of the team saw as 'political interference'. Perhaps for these reasons, even within the team, the process was 'messy' and more or less a 'hit-and-miss' type of strategy was applied. Davies (1976:10) refers to the work of Karl Popper who called this 'piecemeal planning'. Davies recommends it as methodologically sound, avoiding some of the dangers of 'rational planning', such as paying too little attention to contextual factors and the aspects of decision-making that are not rational. Wilds and Lottich (1966:240) indicate that rationalism can be destructive in hampering freedom of thought. Rather than defining the ends or the means first, in a clear-cut manner, a cyclical or piecemeal approach is adopted whereby means and ends are defined and redefined in a continuing process. This is shown diagrammatically in Fig 6.

Figure 6

Diagram of a means-end perspective of planning (Davies, 1976:5)

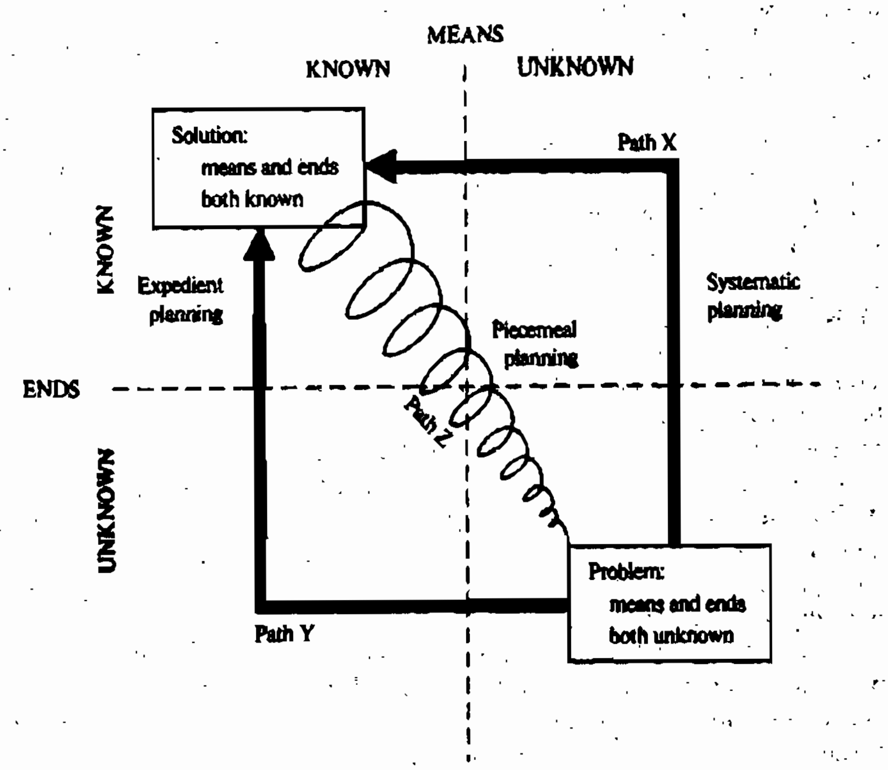


Fig. 1.1. A means-ends perspective of planning (Adapted from ideas from John Dewey, Karl Popper and Brian Lewis)

The NTT probably had no option but to adopt this kind of planning as there were very few 'experts' to draft a South African Technology curriculum. Secondly, a new system of education (OBE) had just been introduced in 1994 so there were few OBE experts. Thirdly, the Technology 2005 project was initiated as a feasibility study by a group of concerned educators to look into the possibilities of Technology education in South Africa. The events in policy development overtook this action so that in 1996, the Technology 2005 project was changed to rather focus on a curriculum design for Technology as part of Curriculum 2005 and to develop a curriculum document within tight time limits. Furthermore, the design team had to consult extensively in moving from one draft document to the next – a frustratingly slow and complex process for the NTT.

5.2.1.2 Stakeholder groupings were formed

Stakeholder groupings consisted largely of persons representing interested parties, or those who had vested interests in the outcomes of the design. They included representatives from industry, organized labour, educator unions and, provincial departments of education. The NTT found this consultative process rewarding on the one hand but also very time-consuming. It demanded patience and skill. As members of the team observed, some representatives had no clue about what goes on currently inside classrooms in South Africa, drawing instead from their own experiences of schooling, years ago. The consultative process created expectations that were unachievable within the time frames prescribed. Notwithstanding these difficulties, the process was extraordinary in South Africa, as it was the first time that such a wide audience had been called upon to offer their ideas and needs in curriculum development.

5.2.1.3 International curricula were consulted

Consulting international documents and policies was an important part of the planning, especially given South Africa's lack of experience in the curriculum field (especially in Technology education) and its relative isolation from the international community. The issue facing the designers was not so much whether to consult international documents and developments, but how to use that information along with knowledge of local needs and conditions. Malcolm (1999:105) comments that different models for education may be chosen, with decisions based upon the politics, cultural norms, interest groups, history, the committees and individuals who provide educational leadership in the local context.

The NTT indicated in their final report to HEDCOM (March 1999) that indications from countries such UK, Scotland, Australia, and New Zealand (whose curricula were consulted throughout the design process), were that reviews were required after the first round of policy documentation as the early drafts "...tend to be over-defined, complex, and difficult to implement" (p.19). Ironically, the Chisholm Report (Chisholm, 2000) identified such problems with the final Technology policy document. The NTT, even anticipating the problems, were unable to avoid them. The NTT described the problem as 'over-kill' of content, because different groups insisted that particular portions were important and therefore must appear in the policy document, expansion of content was easier to accommodate than negotiating what to leave out.

All nations have to make choices about the kinds of technology (and hence Technology education) that are in their best interests. Wright (2001:135) commenting on appropriate Technology, advocates that it is important to consider global factors when making Technological choices and therefore one should be more aware of the international dimensions (ranging from industrial needs through social and environmental issues) that influence the entire world. The design team accordingly gave attention to extracting best practice and identifying issues for the South African context. In the words of the NTT director, "...It was always a problem to know what to leave out'.

5.2.1.4 There were some racial and political issues

The constitution (Act 108 of 1996) of the newly formed democracy in South Africa includes an extensive section on human rights, including anti-discrimination in terms of race, gender, religion, etc. During the development phase of the curriculum it was evident that there remained a degree of intolerance between black and white members. Numerous such issues emerged during the process that went beyond the curriculum design exercise. Malcolm (1999:78) indicates that: "...the politics of OBE are especially messy...the politics of education and change are played out at many levels and in many places".

Perhaps this was to be expected, especially in a fledgling democracy with many voices trying to be heard at the same time and racial tensions that had not been forgotten. There was deep-down hurt and dissatisfaction among many in South Africa at the time. Quite apart from the processes of development and the setting of priorities, the curriculum had to be aligned to choices about the ways in which Western and African technologies, beliefs and lifestyles would be handled, as technology is an important aspect of any culture. The NTT had to plan ways through these issues. The specific outcome (SO#7) possibly best reflects the intentions of the NTT to address the problem :

> "Learners should be able to demonstrate an understanding of how technology might reflect different biases, and create responsible and ethical strategies to address them" (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-3).

5.2.1.5 The educator training model dilemma

Curriculum planning cannot be successful without a view of the ways the curriculum will be used. As part of the reform agenda, policies determined that educators and schools should take on new roles and work in new ways, as part of learner-centred, outcomes-based education. The conflicts between 'what is' and 'what is desirable' created real tensions for the curriculum development. Part of the solution was to conduct in-service training during and after the preparation of the documents.

There are many methods of providing in-service training, each at a certain price (budget requirements, as well as capacity constraints). In South Africa in 1998/1999, the DoE decided to provide mass training of educators through the use of a cascade model. This cascade model hinged on the training of a core of educators from different provinces who then went back to train others in their provinces within demarcated areas near their schools. Kwazulu/Natal had eight regions. North Durban is one of these, with six districts. Each district has between fifty and one hundred schools. A large number of schools and teachers required training by a small number of trainers who had had limited training themselves (see Table 3). In Kwazulu/Natal the Grade 1-9 schools numbered 3925 and those with only grades 8 and 9 numbered 1493 (NTT Final report to HEDCOM, 1999:32). Across South Africa, over 200 000 school-based educators required training in Technology. (This figure is conservative, as it does not include combined schools, secondary schools (Grades 8 & 9) and special schools (NTT Final report to HEDCOM, 1999: 23-24).

The Curriculum 2005 document, provided to all teachers, explained the benefits of OBE as a system of education for the 21st century thus:

> Teaching will become a far more creative and innovative career. No longer will teachers and trainers just implement curricula designed by an education department. They will instead be able to implement many of their own programmes as long as they produce the necessary outcomes (1997:29).

This has not been achieved, for a number of reasons, identified by the Chisholm Report (2000) and other evaluations (see Chapter 2).

Table 3

School register of needs survey 1996 (Extracts).
Educator numbers according to type of school and province.

PROVINCE	PRIMARY SCHOOLS (Grades 1-3)	INTERMEDIATE SCHOOLS (Grades 4-6)	TOTAL
	Educators	Educators	Educators
Eastern Cape	33 878	2 077	35 955
Free State	13 829	495	14 324
Gauteng	26 413	516	26 929
Kwazulu/Natal	46 146	383	46 530
Mphumalanga	14 833	352	15 185
North West	17 732	4 952	22 684
Northern Cape	4 245	27	4 272
Northern Prov.	33 631	150	33 781
Western Cape	19 522	139	19 661
TOTAL			219 321

(NTT Final report to HEDCOM 1999:23)

5.2.1.6 The Technology curriculum is interactive with other learning areas.

The NTT as well as the educators interviewed were adamant that Technology forms a natural link with other learning areas. The reason for this is partly related to the design process and secondly due to the nature of portfolios that students are to produce for assessment, as part of project work. The openness of the Technology curriculum, through its emphasis on design and projects, facilitated links with specific demands in other learning areas. All the new learning areas (eight in total) had similar design patterns as the designers applied a common set of principles for OBE, and part of this was to facilitate integration across learning areas. As C2005 Review Committee (Chisholm, 2000:2) reported, "....The C2005 design structure is strong on integration and weak on conceptual coherence."

5.2.1.7 The Technological process – a method of problem solving

In planning the curriculum, the designers felt that the Technological process should be the most important aspect of the way Technology is taught at schools. Whatever theme or project an educator decides to initiate, it had to include the Technological process, commonly known as: "design, make, appraise/ evaluate". This emphasis can be justified on a number of grounds, including the nature of technological design, constructivist learning, and problem-based learning.

NTT members felt that constructivism was an important underlying part of the new Technology curriculum (together with strains of behaviourism inherent in outcomes-based education). The Technological process and learning through projects support constructivist approaches. It may also be argued that the Technological process is not quite problem-based learning, but rather an attempt to develop problem-solving abilities in a Technological context. Problems are presented not so much as a mode of (general) learning but because the objective is to find a technological solution to a problem. A further issue, discussed in Chapter 2, was whether the Technological process should be spelt out as a step by step, prescriptive method or whether the curriculum should emphasise the open, eclectic character of design. The NTT, as part of their planning, had to be clear about how the curriculum would help with learners improving their ability to solve problems, think creatively, develop critical thinking skills, and work in teams. This they did by emphasizing the Technological process as an integral part of all Technology education activities and generally starting in a linear format although NTT members did state that educators could start at any point they liked.

The NTT and educators were in general agreement about the planning of the Technological process being emphasized more than the other Specific Outcomes (overlap with components priorities and organization). Part of this was to ensure that the new curriculum was not simply a craft programme that just involved 'making' for the sake of learning craft skills or developing interesting learning programmes. The emphasis rather was on problem-solving and design. However, it must also be noted that in the apparent wish to intellectualise the design process and creativity, the curriculum runs a risk of downplaying the craft aspects of technology. Craft aspects are important in all technologies, and central to African technologies, where the emphasis is often more on 'how' to produce something than 'why' it works. As the NTT director stated, the designers sought plan a balance between the process and making skills, so that neither were over-emphasized.

To be able to solve a problem individually and in groups, to develop critical and creative thinking skills, to develop craft skills linked to the problem solution, to be able to design a possible solution, are all important aspects of the published Technology curriculum. This call for a balanced approach was also endorsed during an earlier study (Chapman, 1996:232). The Technological process was a way of expressing this balance. It was intended to have a central place in the curriculum, and the curriculum policy document captured this aspect.

5.2.1.8 The curriculum had to be attainable and capable of being implemented for all learners in South Africa.

A Technology curriculum that would only serve the interests of a minority of the learner population was a prospect the NTT wished to guard against. The idea that everyone in South African GET education phase should be able to engage in Technology wherever they were located was foremost in the minds of the NTT members. A critical aspect of this is the disparity of resources in different schools (see Chapter 1). Technology education requires resources. The NTT sought to design a curriculum that was attainable and capable of being implemented in all schools, but this was not entirely achieved. Educators in the township schools reported that lack of resources limited what they and their learners could do (see chapter 4). They also complained that their learners found the Technology final exam for the pilot project difficult whereas educators in the well-resourced schools indicated that it was too easy. The NTT was not able to find a satisfactory solution to resource issues other than to make suggestions for using low-tech equipment. The provision of resources is a continuing provincial and national education problem.

5.2.1.9 Information Technology was intentionally omitted

The NTT reported that they had intentionally left out information technology because they knew, in the short-term, that most schools would not have computers. It was not that the NTT thought that computer-based technologies were unimportant, but that they wished to make the first phase of the curriculum implementable for all educators and schools. The Curriculum 2005 Review Committee's report (Chisholm, 2000) has since resulted in the draft National Curriculum Statements (*Government Gazette* No.22559, 2001:84) in which information technology is given a higher priority, regardless of whether or not schools have the necessary equipment. The gazetted draft National Curriculum Statement for Technology says:

> One of the features of a rapidly changing world is the accumulation of vast amounts of information and data. This has an impact on all aspects of modern life. Through this learning area (Technology), learners will be equipped with knowledge and skills to be competent and confident in accessing and working with various forms of information and data.

Accordingly, one of the learning outcomes of Technology in the same 2001 draft National Curriculum Statements is: "The learner is able to access, process and use information in a variety of contexts" (*Government Gazette* No.22559, 2001:85).

In the UK, the uses of computer-based technologies extend beyond the processing of words and numbers to computer-aided design (CAD), computer-aided manufacture (CAM), control systems, publishing, music production, etc. (UK, Design and Technology, 1999:23). At this stage in South Africa, only a few schools are in a position to use computer-based technologies in these ways. What happens to the rest of the learners? Williams (2001:216) also indicated that in part of Australia "matters of access and equity with regard to computers was also an issue". As noted earlier, for the NTT, part of the dilemma was whether they were writing for schools and teachers in their current settings, or defining some vision to which schools might move over time. In the interests of continuous improvement, the document had to promote transformation, but it also had to be realistic and pay heed to issues of equity.

The provision of infrastructure, including electricity, telephones and security, as well as equipment, to poor schools was identified as an urgent need. Hawes (1982:147) indicates that when purchasing educational materials the starting point should be the securing of a realistic allocation of funds. Chapman (1996:42) reports that during the historical development of black education in South Africa, those Departments serving black students were deliberately under-funded, which impacted negatively on the running of courses. This is the reality of the apartheid legacy that the government is trying to overcome: trying to provide adequate resources for modern learning requirements. If learners have the opportunity through a learning area such as Technology to learn how to use computers but many schools do not have a computers or even electricity, the curriculum fails. Does this mean it is a poorly conceived curriculum? Samoff (1999:1) writes: ".....education in Africa, like African education, is of course a simplification fraught with risk. For most purposes, neither exist".

Priorities in budgeting and the effective management of limited resources become important. This is captured in a press article entitled "Curriculum 2005 costs counted" (*The Natal Mercury*, 2 June 2000) where it is reported:

> ...Learning support materials, including textbooks, for the soon to be scrapped Curriculum 2005 will have to be thrown away or reworked after the government has already spent R 1,4 billion this year on them.

The NTT as part of its planning, resolved to tread gently on the use of computer-based technologies, but this position was eventually reversed in the development of the National Curriculum Statement and could be linked to Mary's comment about a 'second wave of implementation' (see Chapter 4). Either way, it remains a difficult 'hurdle' for the future.

5.2.1.10 Curriculum had to be suitable for South African classrooms

Having visited many classrooms as an education advisor for technical subjects, as a technology education pilot project leader and now as a researcher, the author has had many opportunities to view Technology classrooms. While some teachers and learners achieve extraordinary things when teaching under difficult circumstances, the general pattern is that better Technology programmes are better resourced, with smaller class sizes.

Also at issue in questions of similarity and difference across schools is the relative emphasis to be given to local technologies versus the kinds of high technologies that are important in global industries. (This debate readily extends into the values that underpin different technologies and the relationships between technology and culture.) If it is accepted that Western technologies should be part of the curriculum for all learners, should that be the case similarly for indigenous technologies? Who would benefit ultimately? The NTT grappled with these issues as part of planning but included these ideas in specific outcome number five as part of the performance indicators (ie. what learners are expected to do) (Department of Education, Senior Phase, Technology Curriculum Policy, 1997: Tech-18 -19). The curriculum does not cover the indigenous Technologies idea very well although such Technologies may exist or even abound in the rural areas of South Africa.

5.2.1.11 The Technology Curriculum had to prepare learners for Technical Education in FET

One of the purposes of the Technology curriculum in the GET band is to prepare learners for Further Education and Training and careers in Technology (see Chapter 1). Chapman (1996:252), suggests a Technology curriculum in GET will allow learners to be better informed of opportunities for careers in the technical world. A compounding issue is that, in spite of calls from government and industry for technical and vocationally oriented education, vocational education is often seen by the general public as 'inferior' or, more particularly, intended for students who are not bright enough for academic studies. The NTT responded to these aspects of careers education and preparation by planning to incorporate academic and vocational dimensions of Technology into the general curriculum. Development of a new curriculum for Technology education to be part of the new FET certificate (see appendix G) is currently being considered for South African schools and could have a positive impact upon the engineering industry in future as evidenced in the USA (Dyrenfurth, 2001:212).

5.2.1.12 Values had to be in the curriculum

As discussed in Chapter 2, attention to the values of human rights, democracy and social transformation was required in all curricula, as part of government policy. Accordingly, the NTT gave serious attention to the ways in which values might be incorporated into the curriculum. For example, the NTT interviews pointed to pressures from some members and the reference group to have as many as three specific outcomes dealing with values. Questions of value arise directly and naturally in Technology (Williams, 2001:218), as part of the process of design, and in the uses of technologies. The NTT covered this issue adequately in the Technology curriculum.

5.2.2 COMPONENT: PURPOSE

5.2.2.1 Purpose was not clearly stated in any formal document

Curriculum purposes can be conceptualized at many levels, ranging from broad social purposes to content purposes. As discussed in Chapter 2, Tyler (1949) and Posner (1992) recommend that a curriculum design should include a statement of purpose for all users of that curriculum. In exploring these issues, a simple question was put to the interviewees with respect to the Technology curriculum. They were asked to explain what they thought the purpose of the Technology curriculum was.

The NTT members were not able to answer this question (see Chapter 4) and referred to the rationale statement (see appendix E) that was given in the curriculum policy document (Oct.1997). There is an important difference between the two. Purpose means "...the object which one has in view" while rationale means "...a reasoned exposition of principles; a statement of reasons" according to the Oxford dictionary. It seemed strange that only a rationale was given in the final policy document without the mention of a purpose. The problem deepens for if one analyses the rationale in the Technology policy (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech–2) then it seems as though purpose and rationale are integrated and presented as a rationale. The NTT could have used the correct terminology to indicate the purpose, to reduce confusion, and to focus their intentions in a more appropriate manner. This may be regarded as a weakness of the curriculum design process. The draft Revised National Curriculum Statement - Technology (2001:14) has rectified this by including a purpose statement.

5.2.2.2 To redress the past imbalances in education

At the level of social purposes of the curriculum, a central purpose of Curriculum 2005 (and hence Technology) was to assist in the redress of the past anomalies in education within the South African education system during the apartheid era. The differences in education provision were vast. Statistics given by Luthuli (1981:59) show that the expenditure on education per child belonging to the white population group in 1979 was R644.00 while the black child was only allocated R54.08. (This has changed dramatically in 2001 to approximately R3 500 per child. See *The Natal Mercury*, May 2001.) This inequity of funding was partly the reason for the riots that exploded in 1976 and continued into the 1980's; equity was required as a matter of urgency as part of new OBE policy.

The NTT were aware of the disparities and therefore tried to ensure that everyone could participate in Technology learning, that there were no biases included in the content and structure, and that the content was suitable for the needs of all learners in the South African GET school system, regardless of their location. The general feeling expressed by educators and design team was that the Technology curriculum, issues of resources notwithstanding, does not discriminate against any particular learner group and therefore the NTT partly achieved this aspect of their purpose.

5.2.2.3 Introduction of low-tech Technology education

Within South African classrooms as well as those overseas, differences in the level of Technology practiced are evident (Eggleston, 1994:217; Eliahu, 1994:159). Whether students are working with high technologies or low technologies, they can develop their skills in the Technological process. The NTT intended for the educators to be resourceful so that where there was a lack of adequate resources, the educator finds simple and cheap ways of explaining the Technological process through the making of a product or artefact using 'found' materials.

Such products and/or artefacts are usually made of paper, cardboard and wood sticks, plastic bottles, yoghurt containers, etc. However, while the use of low technology materials can facilitate development of skills in the Technological process, students need opportunities also to work with high technology. At what stage does the DoE decide to supply adequate resources to the schools? If having started using simple materials, at what stage does the educator convert to a 'higher level' application of principles through more detailed projects?

The NTT advocated the use of simple materials because they were aware of the acute lack of resources at most schools in South Africa. The NTT tried to overcome the resource problem in the pilot project by supplying all participating schools with tools and resources for projects (learning programmes were developed for the educators) that were to be evaluated by the educators. This was of great assistance to most of the pilot school educators. However, there were two schools in one of the provinces where the educators complained that their provincial DoE had not supplied their tools and equipment timeously. Teachers at one of these schools felt that the principal was only interested in starting Technology at his school so that it could be supplied with additional resources from the provincial DoE. Yet, upon visiting this school, brand-new tools, computers, and materials were found locked up in a storeroom, never used by any of their learners (see appendix J school #4). The reasons given were late delivery by the provincial DoE and the high crime-rate in the area. The other school had made use of the tools supplied by the provincial DoE and the educator had been enterprising enough to convert an unused storeroom into a small Technology classroom (see appendix J school #3).

Although it is appropriate to start with 'low-tech' approaches in the Technology curriculum, this should not be the only way and was never intended to be by the NTT. Sadly, poverty still abounds at many South African schools and therefore this factor will not be remedied easily.

As with any major curriculum change, financing is a cause of concern (see acknowledgement in Chapter 6). Although the education department is allocated a sizeable sum of money from the National budget, it is not enough to adequately resource some of the new policy decisions, given the historical backlogs that have accumulated over decades. The state budget for 2000/01 indicated that the personnel expenditure for all nine provinces totaled R38 billion (making up 88,9%) of expenditure, while the non-personnel expenditure totaled R 4,7 billion (11,1%) of the total expenditure (Minister of Education Report, Jan/Feb. 2001). This factor negatively impacts upon the introduction of any new curricula, however good or great their potential may be. Ornstein & Hunkins (1993:307) state that: "...school districts...fail to allocate funds for the creation of the curriculum plan, its delivery within the classroom, or necessary in-service training". Policy fails when the state cannot fund the policies it has created. This factor has a negative impact upon the curriculum design and directly affects the curriculum purpose.

5.2.2.4 Appropriate Technology

'Appropriate Technology' refers to technological solutions that are sensitive to the social, economic and environmental impacts of the technology in the context in which it is used (Wicklein, 2001:5). Learners in a rural context might use logs to build a bridge over a narrow stream and urban learners welded metal sections. These choices are made according to local resources, to suit the local context. In both cases, the same principles of load, materials, usage, geographical/climatic factors, etc. apply, and in this way there could be similar learning outcomes, although the learners work with different materials and tools.

However, notions of appropriate technology go beyond the technical demands of the problem, to include environmental, social and economic effects in the long-term and short-term. Given that both steel and timber are available to build a bridge, why should one be chosen rather than the other? Who makes the choices, and on what grounds? McLaughlin (2000:72) indicates that:

> ...the infusion of appropriate technology into technology education makes good curricular and pedagogical sense. Appropriate technology provides students with opportunities to engage in solving problems with a real human dimension.

Similarly, Wright (2000:138) advocates that through appropriate technologies

> ...global concerns and the valuing of technology can play larger roles in the curriculum... and to develop an understanding of why appropriate technology content and themes should be part of every technology education classroom (*Ibid.*, p.133).

A related demand is for critical consideration of global technologies and the global effects of technologies. For example, Young (1991:242 - 243) argues for the importance of critical exploration of Technology in society:

> ...what is needed is technology as a social phenomenon intimately bound up not only with changes in production but also with every area of social life.....technology is important both on account of the enormous ideological power associated with technological expertise, and on account of the way technologies pervade more and more parts of our lives.....to become part of a more participative and democratic society we have to find ways of making explicit how different purposes are involved in its design, its implementation and its use, and how at each stage there are potential choices and decisions to be made.

The rationale statement in the Technology document (Department of Education, Senior phase, Technology Curriculum Policy, 1997:Tech-2) seems to imply such purposes, but they are not explicitly stated. However, attention is made explicit in specific outcomes 5 and 6:

> Demonstrate an understanding of how different societies create and adapt technological solutions to particular problems (SO#5).
>
> Demonstrate an understanding of the impact of technology (SO#6).

(Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-18 – 20)

These promote comparative discussions in the classroom of Western and indigenous technologies, rural and urban technologies, high and low technologies.

5.2.2.5 The Technological 'Age'.

One only has to read the daily newspaper to be aware of rapid advances in medical Technology in developing artificial hearts and life-support systems, in motor vehicle manufacturing using robot-operated motor assembly plants, sensors fitted to motor vehicles for city navigation, incredible advances in computerization: speed, storage capacity of data, and global communication.
Learners need to be aware of these advances and be able to use and critique different Technologies as consumers, innovators, entrepreneurs and citizens. This was one of the ideas behind the Technology curriculum design, appearing as part of the 'understanding of Technology that should contribute to.....' in the curriculum policy document. (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-2 - 3). It was not articulated in the rationale (purpose) statement.

5.2.2.6 Technology design process as a problem solving technique

As noted in Chapter 2, understanding and being skilled in the Technological process is a central purpose in Technology education in South Africa and in other parts of the world. In the UK technology curriculum, McCormick *et al.* (1994:5) indicate that the design process, as part of the National Curriculum in Technology, is seen as the manifestation of this problem-solving process and it follows a similar sequence. In South Africa the Technological process is considered by the NTT to be one method of teaching all learners problem-solving skills, creative and critical thinking skills, making skills, etc. It must be considered during every Technology project.

Shield (1994:58), however, draws attention to the process versus knowledge debate:

> ....the current trend in technology education has been towards emphasizing the pre-eminence of the 'process' of technology over the acquisition of facts and skills other than those of a problem-solving nature. These general problem-solving skills are said to be transferable across boundaries and once acquired may be used in many different situations. This philosophy has resulted in a system which has elevated strategies which lead to a perceived ability in problem-solving to a higher plane than technological understanding and which has also led to a dearth of those cognitive concepts more commonly associated with the subject content of 'technology'.

Technological concepts and knowledge are important in two ways. First, problem-solving and design require relevant knowledge. Second, there are concepts and theories (for example of the properties of materials, the manipulation of energy, and the nature of systems) that apply across many situations. Shield also points out that the transferability of process skills (such as problem solving) and concepts (such as systems) across contexts is not well established by research (Shield, 1994:59). This concern surely impacts on the purposes of the curriculum.

A related issue that the NTT grappled with was that of breadth and depth: the breadth of the curriculum was important, that it should cover as wide a range of Technological content as possible, yet they were also conscious of the fact that it should also have depth. However, the NTT did not tease out these issues. For example, 'breadth' could mean breadth of application of an idea, thereby deepening understanding and use of that idea, or it could mean superficial treatment of many ideas. Purpose was rather hazy in its treatment of these issues.

5.2.2.7 The rest of the world was starting to introduce Technology education so why not in South Africa?

The expectation that the Technology curriculum would bring South Africa on to a par with other international countries (Eisenberg, 1994:251) seemed to be clearly understood by the NTT. Two curriculum purposes arise from thinking globally: the demands for competitive performance in the global economy, and the demands for critical consideration of global technologies and the global effects of technologies. A third dimension of comparability expressed by members of the NTT and some of the educators, was to ensure South African schools were comparable to schools in the UK (for instance). Very little of this thinking could be extracted from the rationale statement made in the curriculum policy document. A purpose statement could have made the design purpose more explicit. However, from comparative analysis of the content of the South African, UK, Scottish and Australian curricula, the writers clearly gave attention to comparability with other countries.

5.2.3 COMPONENT: PRIORITIES

5.2.3.1 The curriculum had to be capable of being implemented

The number one priority expressed by the NTT was that the Technology curriculum be suitable for implementation within the South African GET classrooms. All three NTT members expressed this intention, but it did not happen. Gordon (1978a:126) indicates that Technological and economic factors are responsible for curriculum change but there is always a chance that these 'driving' factors are not enough to ensure that what is intended is actually what happens inside the classroom. As far as the Technology curriculum is concerned there were clear indications that in some areas a mismatch of intentions occurred. This is due to the policy versus practice tension that exists within education systems. This priority of implementability appears to have been missed (see Chapter 6).

5.2.3.2 OBE principles had to be followed

The Technology curriculum had to express the principles of OBE. The most authoritative documents regarding Curriculum 2005 were the Curriculum Framework for General and Further Education and Training (Draft); Curriculum 2005: Specific Outcomes, Assessment Criteria, and Range Statements Grades 1-9 (discussion document) and Curriculum 2005: Lifelong Learning for the 21st

Century. Malcolm (1998:37-56) provides a detailed discussion on many aspects of the general education curriculum by applying the OBE lens. Three main concepts had to be applied. These were learner-centred education, critical outcomes that drive the entire curriculum and specific outcomes, assessment criteria, range statements, and performance indicators within learning areas.

The design of specific outcomes according to the framework provided by the critical outcomes and principles of learner-centred education is by no means a simple task, given the range of curriculum purposes referred to earlier, and the participative processes that were used during the development. As a matter of priority, the NTT did adhere to 'priorities' as part of curriculum design, but the task was difficult.

5.2.3.3 Learners were challenged to respect differences of opinion

In South Africa there are many cultural differences amongst learners, not only in the technologies and environments in which they live, but in their beliefs, learning styles and social expectations (Chapman, 1996:49, 56). The NTT saw it as important that difference be encouraged and respected in the curriculum, as a matter of inclusivity, and as a way of encouraging creativity. Instead of every child having to produce the same answer or artefact, the NTT wanted to allow for differences of opinion amongst learners who may be attempting a similar project. Projects had to be defined that allowed for these differences, and assessment criteria had to be able to be generalised across particular instances. Learners would see first hand the differences of opinion and solutions among themselves. In this way respected values could be inculcated into the learners via the Technology curriculum. This priority was attained within the classrooms with differing degrees of success.

5.2.3.4 Curriculum balance was intended by the NTT

The survey of curriculum purposes presented earlier, points out the enormous complexity of 'balance' within the curriculum: design/craft; high/low; efficient/appropriate; Western/indigenous; global/local; knowledge/skills/values; etc. The NTT indicated that having a balance was important and was a priority. They gave high priority to achieving a balance between the design aspects of technology and the craft aspects, and to the technical and values aspects of design. Zais (1976:441) argues that balance is required also in the weights given to each aspect of the design "...so that distortions due to under-emphasis or over-emphasis do not occur". He concludes that most designs are weak in this respect. Many traditional curricula either emphasise the subject content or processes. The weaknesses of such 'either-or' approaches, as discussed earlier, may be resolved using 'problem-centred' approaches. The Technology process and learning through projects are strongly emphasized as a means of bringing together knowledge, skills, values and attitudes in authentic learning situations.

5.2.3.5 Technology promotes an understanding of the made-world

Technical education programmes of the past had focused on craft skills, with little concern for the nature and roles of technology in society. The NTT indicated that the made-world, or the world constructed through technologies, should be a priority within the new policy document. The made-world is a major part of the world in which we live. Dugger (1997:127), from his experience in the 'Technology for All Americans' project, notes that:

> ...people undertake to create, invent, design, transform, produce, make, control, maintain and use systems. The process includes the human activities of designing and developing technological systems; and assessing the impacts and consequences of technological systems.

The NTT attempted to include the made-world as a priority, although the educators were not too aware of this, especially its dimensions of appreciation and critical consideration. This is in spite of the related specific outcomes in the policy document: the educators did not read the policy document well.

5.2.4 COMPONENT: PERSPECTIVE

5.2.4.1 No perspective was articulated.

As there were a large number of stakeholders, representing diverse interests, there were bound to be many perspectives on the curriculum, vying for influence in the final document. This diversity was difficult to manage according to the NTT.

As discussed in Chapter 3, the idea of perspectives is complex. Perspectives may be defined by educational philosophy (purposes of schooling in society), conceptions of the learning area or subject, conceptions of curriculum, and theories of learning and teaching. The earlier discussion of purposes, priorities and balance makes clear the complex of ideas the NTT had to consider. While the principles of OBE provided broad guidance on the purposes of schooling and theories of learning, many perspectives remained available, especially in the conception of Technology and the ways students learn in Technology. The designers might have chosen a particular perspective (as they did in their focus on learning through projects), or mixed perspectives in some planned way (for example by emphasizing different aspects of Technology in different modules or grade levels). Posner (1995:255) argues that a 'single coherent set of principles' should be drawn together, across domains of philosophy, the nature of the learning area, the nature of learning, etc., to provide a single perspective for the curriculum design. Posner does concede limitations associated with a single perspective and acknowledges that typically, curriculum features can be traced to several perspectives (1995:258). The NTT did not seek to articulate perspectives in any systematic way.

Even so, the curriculum documents and the discussions with the NTT and educators indicate that perspectives were discussed and the design took clear positions on technology (centred on the Technological process), learning in Technology (constructivism; learning through projects), and the importance of equitable access to learning. This is illustrated by one of the NTT's early agenda papers, "Laying the Foundations", shown in Fig. 7 from the 24 – 25 February 1995 workshop (Reported in sixth meeting of the T2005 steering committee minutes, 19 – 21 April 1995).

Fig 7.

NTT Agenda Paper, Workshop of 24 - 25 February 1995

Laying the foundations:

- Review the rules of the game
- Reach consensus on consensus
- Review the nature of education and the educated person
- Eisner's five curriculum orientations
- Identify the elements of the concept curriculum
- Identify the defining attributes of Technology
- List the imperatives of Technology education
- Review the principles of democratic change

To try and ascertain the NTT members' beliefs about curriculum, a questionnaire was applied (Carl, 1995:62; see appendix D). Carl called this a curriculum orientation profile. It represents a set of 'value signposts' which may suggest a particular orientation towards the content, goals and organization of the curriculum (see Chapter 3). The result was that the NTT members had different profiles. Joe was strong on cognitive processes and academic rationalism, an orientation that stresses 'how' learners learn and the mastering of selected content. Mary was also strong on cognitive development and then evened out on the other four categories. Rick was strong on self-actualization – meaning that the learner should experience positive learning experiences at school – and has an academic rationalism high score that is similar to Joe's. The mix of personal profiles is broadly consistent with the Technology curriculum overall: Analysis of the Technology curriculum gives evidence especially of the experiential, behavioural, and cognitive perspectives.

The leader of the NTT, as reported in Chapter 4, offered a great deal of comment on learning theories and the ways they had been important in the design of the curriculum. All members of the NTT supported constructivist views of learning (though, as noted earlier, there are numerous interpretations of constructivism). The importance of understanding learning theories and child development in curriculum design cannot be ignored. As Chapman (1996:49) writes:

> Technology projects should be rooted in developmental theories. A closer look at the cognitive and affective development of children provides us with background information which may then be related to technology education.

Some of the well published writers in the field of psychology of learning or in the field of development theories are Bloom, Piaget, Dewey, Gagné, Ausubel and Eisner. Eisner (1985) was an important source for the NTT (see above Fig.7). His approach to educational objectives (outcomes) is fundamentally humanistic with a strong emphasis on personal growth. He advocates curriculum that is often divergent, providing opportunities for learners to explore and become self-directed (Ornstein & Hunkins, 1993:228). Zais (1976:245) writes:

> ...conflicting theories of learning have emerged which serve to complicate the curriculum worker's task. Of course, a single, well integrated learning theory may one day be developed, but for the time being, we are faced with the necessity of identifying, understanding, and assessing the various theories of learning generated by research and psychologists, and selecting from these the components that best suit our curricular purposes.

There is evidence of various forms of constructivism (all seeking to start from learner's existing knowledge and interests, to challenge that knowledge, and provide opportunities for development) and behaviourism (in the use of outcomes and the development of specific skills), context-based learning, and problem-based learning within the Technology curriculum policy document. These elements are expected to be brought together in project approaches in the classroom. Such perspectives existed in the minds of the NTT and educators but were not made explicit. They can be inferred from the specific outcomes and performance indicators.

5.2.5 COMPONENT: CONTENT

5.2.5.1 The South African curriculum is internationally comparable

Analysis of the curriculum documents from South Africa, UK, Scotland, and Australia shows that the approaches and general content are similar (see Chapter 2). The NTT consulted quite widely on the content of the curriculum, and so there were bound to be elements of international curricula in the South African Technology curriculum. The educators too were aware of the large influence that the UK and Australian curricula had on the South African model. The NTT confirmed this and also indicated assistance from New Zealand, some consultation with the USA, Germany and the Netherlands (Minutes of combined T2005 and Learning Area Executive Committees, 20 May 1997). The South African curriculum content was therefore heavily influenced by the international Technology arena.

5.2.5.2 Curriculum content is relevant

The educators were of the opinion that the curriculum content was 'good', and relevant to the needs of the South African learners, as indicated by the formal outcomes, and in the light of learners' experiences. They felt that the NTT had done well in selecting the content and linking it to aims, goals, and objectives. This is interesting, given that educators also complained that the curriculum was overly influenced by international curricula. The NTT members had commented that there was too much content, in spite of their efforts to contain it (see Chapter 4).

5.2.5.3 Educator teaching background played a role in the teaching of certain content

Educators from the pilot schools talked about the ways in which their particular expertise, prior to engaging the Technology pilot project, assisted and/or hampered their performance as educators of Technology. Marie was from a home economics and hotel-keeping background. She battled with the projects involving systems and control where different mechanisms had to be taught. Harry, coming from a science teaching background really enjoyed explaining systems and control but battled with textiles, sewing and woodworking. Even though the teachers were committed to and, to some extent, experienced in project approaches to learning and the Technological process, their detailed experience and content knowledge were important in their teaching. To become more proficient in the wide variety of knowledge and skills required, educators need time and training.

The NTT were aware that the chosen content would place greater knowledge demands upon educators. The educators, though they reported difficulty with certain sections, felt that once having taught those sections themselves and practiced a few times they could teach the content from a comfortable position. An individual educator's knowledge is as influential in the outcomes of the curriculum as the design team's thinking and the published documents!

5.2.5.4 Content is bias-free

It was important to design a curriculum in which the content did not discriminate against any particular race, gender, or disability in any way. This wish was articulated in specific outcome #7. Freedom from bias was achieved, according to the NTT and educators of the pilot schools. For example, the educators were quite amused when the boys battled with sewing and textiles while the girls battled with soldering and electricity. Whether boys or girls, when the learners had mastered the 'new skills' they performed well and thoroughly enjoyed the projects. There were no adverse reports about the content having any particular bias although some of the projects seemed to appeal to some learners more than others.

5.2.6 COMPONENT: ORGANISATION

5.2.6.1 The Design Team made certain assumptions in the design phase

The NTT, as in any design process, had to make assumptions – especially about the abilities and willingness of educators to work with the documents as curriculum writers, and engage in training programmes, and the capacity of the DoE to provide support. Such assumptions were risky. As one of the educators said: "...things were not going to add up...". There were assumptions being made that would not be fulfilled – for example, the assumption that educator training would ensure that the curriculum could be implemented, and that the lack of resources at many schools would be taken care of. Another was that the educators from previously disadvantaged schools, with their poorer resources and training, were going to be able to cope with the curriculum and its organization, with the help of training. One of the educators indicated that the NTT assumed that: "...all learners would be at the same level of ability and be able to cope at that level", although the NTT did not feel that they had assumed this. Organisation, as a component of curriculum design has to be considered from all angles. It is apparent that this did not happen.

5.2.6.2 Organising structures and principles

The organization of the Technology curriculum was largely directed by the design features for Curriculum 2005 (prescribed by the national DoE). Specific outcomes defined the scope and nature of the learning area, and were to be the learning outcomes for the students (Department of Education, Senior Phase, Technology Curriculum Policy, 1997:Tech-3). The specific outcomes were articulated within a set of critical and developmental outcomes that applied to all learning areas. Standards and progression in the outcomes were given by range statements, assessment criteria and performance indicators for each phase of schooling (Grades 1-3, 4-6, 7-9). Thus the outcomes and standards together provided the basic structure (Department of Education, Senior Phase, Technology Curriculum Policy, October 1997).

As noted in Chapter 2, the central ideas in the Technology Curriculum were the Technological process, and knowledge, skills and values drawn from communication, safety and materials, processing, information and energy, systems and control and structures. The educators reported great difficulty in interpreting the content of the curriculum policy document (Oct. 1997). This was in part because of terminology and unfamiliarity, and partly because the curriculum was not a learning programme, but a framework which educators were to use in designing their own learning programmes. The educators considered the terminology too complicated and not specific enough about what they should teach. Some of them simply set the document aside and focused their efforts on learning programmes and classroom materials that had been developed by the NTT as part of the pilot project.

Educator criticisms of the curriculum cannot be disentangled from confusion and complexity in the terminology and structure of Curriculum 2005 (see Chapter 1). Generally, the organization of the curriculum seemed to be suitable for the well-trained educators but too complicated for others. This weakness continues to be addressed. Although the curriculum was clearly organized, according to the structures laid down for Curriculum 2005, it turned out that educators and others had difficulty using the document.

5.2.7 COMPONENT: IMPLEMENTATION FACTORS

5.2.7.1 Omissions from the design that had not been foreseen

5.2.7.1.1 Training period of the educators was too short

In Gauteng, two educators from each of the twenty pilot schools were selected (by their principals) for training at the Ort-Step Institute of Technology (at a cost of R5 000 per educator), who then returned to their districts to train other educators. The programme was organized over two years, and led to a formal diploma in technology education. Training of the Kwazulu/Natal educators consisted of six intensive, week-long courses arranged and conducted through the year by the NTT with support from a Provincial Task Team (PTT). Most schools that participated sent only one educator and these small groups allowed for maximum support and guidance. The PTT in Kwazulu/Natal also made a budget available of R2 500 per month to enable a locum educator to be employed to act as a substitute while the Technology educator attended training sessions. This arrangement was well received by principals. The PTT also visited the educators at least once per term during the year to ensure the training was put into practice. This method of training seemed to be very effective in Kwazulu/Natal pilot project schools. In the Western Cape, educators attended a one-week training course before the start of the school year and pilot schools were requested to send two educators per school. These educators were to be responsible for co-ordinating Technology in their schools. Several follow-up workshops were planned but were delayed until mid-October (1998) due to administrative problems within the provincial department of education (FRD report, 1998:7 & 52). An alternative plan was put into action via the Boland College at a reduced cost, but this only started in October 1998. Training efforts were rather weak in the Western Cape.

The educators, especially in KwaZuluNatal, felt that their training programmes hade been useful and enjoyable. All of them partricipated in training programmes in their districts, helping other educators. However, the effectiveness was limited. Those who had been trained were often too busy with other work to give time to training, or their colleagues were too busy with other activities. The provincial departments of education would not allow educators time off during school hours to be trained, so Saturday programmes were offered, but attendance was reported to have been sporadic and largely ineffective (FRD report, 1998:53 - 56).

On a larger scale, the national DoE was using the cascade model to train all educators across the nation (see Chapter 2). This programme had limited success (Chisholm, 2000). This was a weakness that was identified by both the NTT and the educators. The NTT made applications to the DoE in a memorandum on 17 April 1997 (before the release of Curriculum 2005), indicating the following:

> ...the main function of Technology 2005 at national and provincial level is to plan and co-ordinate the development of the necessary teaching, learning and human resource capacity to support and evaluate the short, medium, and longer term implementation of Technology as part of the departments new national curriculum initiative (p.3).

The budget requested for developing all nine provinces totalled R21 million (April 1997-March 1999) (p.8) and the total cost of implementing grades 1 and 7 as part of curriculum 2005 in 1999 was R 1,7 billion (p.10). The number of trainers required to complete this task was calculated at 336 to train 229 766 primary educators and 11 586 secondary educators in 17 814 primary schools and 5 793 secondary schools in all nine provinces. The plan was not implemented, as the process was overtaken by Curriculum 2005, discussed earlier.

5.2.7.1.2 Level of difficulty of the exam was too high

Assessment programmes were conducted in the pilot schools. From these assessments, teacher reports, and the projects that students completed (FRD report 1998, NTT Final report to HEDCOM 1999), judgments can be made about the level of difficulty that was expected and achieved. Two schools in the Gauteng region reported that the level of difficulty of the final examination was too high for their learners. However, one school in the Western Cape claimed it was too easy. The problem seems to be two-fold. The educators in Gauteng seemed to practice one thing at the Ort-Step course where resources were plentiful and became 'paralysed' by the lack of adequate resources in their own schools. Secondly, the examination was in English and for many learners, their command of the English was poor. Unfortunately none of the pilot schools were able to produce any details of learners' achievements on the examination. This was disappointing.

5.2.7.1.3 Financial constraints

The NTT prepared plans for the provincial departments of education to supply tools and equipment to all schools. Tools and equipment was supplied to the pilot schools in three provinces. Educators used and extended these resources in different ways (FRD report, 1998:42). Some principals purchased materials from their school funds, some solicited donations from businesses, industry, tertiary institutions, and other schools. The main source was the parents' contribution for specific projects. Given the financial constraints there was great concern expressed by the educators and the NTT for the future of Technology. Schools who were not in the pilot project have not been given additional budgets or resources for Technology. The responsibility lies with both the national and provincial administrators. The requirements of the Technology curriculum should have been taken more seriously by the policy makers but highlights another weakness of the curriculum design process.

5.2.7.1.4 Time for implementation too fast

There were two main problems expressed in terms of the time. Firstly, the allocated teaching time in the school timetable was too short according to some of the interviewed educators. Some principals agreed to allocate double lesson periods for the Technology pilot project that seemed to work fairly well. Some schools allocated two 70-minute lessons per week. Some principals refused to make allowance for the Technology learning programme and merely allocated single 35 minute lessons (usually about three per week). This was frustrating for educators and learners.

The second problem was the speed at which the new OBE education system was introduced. Many of the educators and stakeholders did not have enough time to clearly understand the OBE principles and come to terms with the new terminology. The time was too limited according to educators and the NTT. Educators at some of the schools were confused and annoyed because they did not know how to handle situations that arose. This impacted upon the curriculum design implementation.

5.2.7.1.5 Curriculum requires refinement

Some educators indicated that the curriculum was too difficult to understand and needed to be refined. The NTT agreed that the document had too much detail and could be streamlined. A task team was commissioned by the Minister of Education (Prof. Asmal) to try and reword and refine the Technology curriculum into more user-friendly terms. (Chisholm, 2000:viii and Draft Revised National Curriculum Statement - Overview, 2001:16). This review committee recommended the following:

> Critical to a strengthened implementation process are: a revised and streamlined outcome-based curriculum framework which promotes integration and conceptual coherence within a human rights approach which pays special attention to anti-discriminatory, anti-racist, anti-sexist, and special needs issues.

The national Minister of Education then commissioned another task team to refine the Technology curriculum into a more understandable document and so the Draft Revised National Curriculum Statements were generated in 2001. The seven specific outcomes of Technology were reduced to three learning outcomes by combining certain of the original specific outcomes but having four supporting outcomes. The content basically remained the same but is presented in an 'easier' format (Draft Revised National Curriculum Statement – Overview, 2001:75). The document provides examples to allow for a greater understanding of the required Technological capability, knowledge, and understanding (Draft Revised National Curriculum Statement - Technology, 2001:16).

5.2.7.1.6 Classroom size for large class groups

The NTT were critically aware of overcrowding in many schools and classrooms. This affects educator : learner ratios, and the space available for project work. At present the national average is 1:35 in a secondary school, but the numbers are much higher in certain areas. Schools experiencing these problems are usually in the poorer urban areas or in the remote rural areas. This poses a major problem for both curriculum designers and educators alike, as they are helpless to intervene. The DoE have the responsibility of addressing this problem.

5.2.7.2 Omissions from the design that were foreseen

There were no intentional omissions reported by the educators. However, the NTT reported that they had intentionally omitted the need for computers when teaching communication and information processing (SO#3). Although members of the NTT acknowledged that access to computers was highly desirable, it was omitted because they were aware of the lack of such resources in the majority of South African schools. The educators, especially those in the poorer school areas, were annoyed by this omission. They had not been made aware that it was not a requirement to have access to computers in the school, even though there was a specific outcome oriented to information processing. However, the NTT acknowledged that in the next phase of development it would be a good idea to introduce the use of computers. The recently released *Government Gazette* No.22559 (2001) has taken this position.

5.2.8 COMPONENT: EVALUATION

5.2.8.1 The intentions of the project were achieved

In a memorandum to the DoE (17 April 1997:1), the NTT described the following aim:

(a) Since the adoption of the national curriculum in June 1996, Technology has been recognized as a compulsory part of the future curriculum for all learners in grades 1-9. In July 1996 the Department of Education (National) established a Learning Area Committee: Technology to: Develop a rationale, learning area outcomes, and specific outcomes, for Technology as a learning area in the new national curriculum.

(b) Since then a Ministerial Task Team and a Reference Committee have refined and extended the work of the Learning Area Committee by reviewing the Learning Area's specific outcomes and developing associated Assessment Criteria and Range Statements for Technology. These materials will, by May 1997, be developed into Learning Programmes by representative committees which will include Provincial Departments.

(c) These Learning Programmes will form the basis for the training of provincial trainers, teacher in-service preparation and the subsequent implementation of Technology in grades 1 and 7 at the beginning of 1998". *All of the above were achieved* (NTT Final report to HEDCOM, 1999:6-10).

Evaluation of student performances in the pilot study was undertaken by the Independent Examinations Board (IEB). They developed an examination that was written at the end of the pilot project year (1998) by the grade 9 group of learners. The NTT indicated that they were happy with the students' results although any reports in this regard were available.

Other evaluations were conducted by the FRD (1998). Their evaluations were quite varied as they attempted to obtain an overview of the pilot study. The FRD report indicated that increased awareness of Technological capabilities had taken place in the three provinces that implemented the pilot project (Kwazulu/Natal, Gauteng, Western Cape). There was also a heightened awareness within the educators to improve their own capacity to teach Technology and to find additional resources to improve their project selection choices. Such an evaluation must be included as part of the initial design concept of a curriculum to ensure objectives, purposes, planning, etc. are met or in need of revision.

5.2.8.2 The IEB examination was unique to South African schooling

This examination was compiled by the Independent Examinations Board (IEB) members together with members of the NTT. The intention was to draft a uniquely different examination for Technology education that would allow the learners maximum opportunity to think about a problem situation, to do some research prior to the examination, and then to answer a set of questions on the actual day of the examination. A product had to be made in order to demonstrate the learner's skill in making an artefact to specifications in response to a prescribed problem or need. In generally, the NTT were pleased with the results of the final examination but acknowledged that it could be improved in many ways. As noted earlier, some educators found the level of difficulty of the exam too high, others too low.

5.3 Conclusion

Chapter 5 has attempted to discuss the findings reported in Chapter 4 through the application of the curriculum design tool as described in Chapter 3. The intention has been to look at what happened in the lead-up to designing the new Technology curriculum, to see what happened during the design process, to identify whether or not attention was paid to the eight theoretical components of a curriculum, and to find out what happened after the curriculum was designed.

The eight components (planning, purpose, priorities, perspective, content, organization, implementation factors, and evaluation) are important in any comprehensive approach to curriculum design. In the development of the Technology curriculum, the analysis reveals the complexity of the design process in the context of South Africa in 1994-1997. It shows that most of the components were addressed, though often not systematically and with too many assumptions about implementation. Issues have been identified for each of the components. Chapter 6 selects six issues that emerge as the most critical for curriculum design in the future.

CHAPTER 6

SUMMARY, RECOMMENDATIONS and CONCLUSION

6.0 Introduction

Chapter 6 provides a conclusion to the many issues that arose out of the South African Technology curriculum design for senior phase learners. The chapter summarises the problem, overviews methods and analysis of the curriculum and presents some general findings. Answers to the critical questions that were posed prior to investigating the curriculum field in South Africa are provided. This is achieved by checking who was involved, what other forces came into effect, and how the processes influenced the final curriculum 'product'. Recommendations as well as a new model for future curriculum designs conclude this chapter.

6.1 Summary of the study

6.1.1 Statement of the problem

In chapter 1 the problem was described as "to analyse the design of the South African (senior phase) Technology curriculum and its suitability for South African learners, and to explain how and why the curriculum for Technology ended up the way it did". A new Technology curriculum was being designed in South Africa, by South Africans, as part of large scale curriculum reform intended to radically transform the teaching and learning at schools. A newly formed democratic society was emerging post – 1994 elections and was embarking on major transformation of society, based in part, on policy ideas that had been prepared earlier. The intention of this study has been to look at what happened in the lead-up to designing the new Technology curriculum, to see what happened during the design process, to identify whether or not the curriculum design was comprehensive, and to find out what happened after the curriculum was designed.

6.1.2 The research design – methods and analysis

The development of the Technology Curriculum began as an initiative independent of Curriculum 2005, in 1994. The process was later incorporated into Curriculum 2005. The focus of this study was the work begun in 1994, through to the publication of the Technology curriculum as part of Curriculum 2005, in 1997. Part of the development included a pilot study of the new curriculum that was conducted in selected schools, in 1998. This pilot provided information on the suitability of the curriculum for South African learners, and served as an appropriate source of data about the curriculum.

Data were assembled from interviews with members of the design team (who were with the project throughout), analyses of minutes of meetings and curriculum documents, and case studies of a sample of pilot schools. A tool for analyzing the curriculum documents was developed from the work of Posner (1992) and Jansen and Reddy (1994). The tool was based on components that should be part of a complete curriculum: planning, purpose, priorities, perspective, content, organization, implementation factors, and evaluation. This tool was also used as a framework for designing structured questionnaires for members of the design team and educators in the pilot schools. Analysis of minutes and related documentation was used to enrich the information from the NTT and educators, and as a way of checking ideas and accounts. The case studies addressed particularly the suitability of the curriculum for learners and educators in the pilot schools, as well as issues of implementation. A sample of six pilot project schools was selected to represent the range of schooling situations in South Africa.

6.1.3 General findings

The analysis in Chapter 5 shows that the designed curriculum attended to all components in the analysis tool, though not always well, and often not systematically. In particular, the design made too many assumptions about implementation. The accounts reveal the complexity of the design process in the context of South Africa in 1994 -1997. Members of the NTT and educators in the pilot schools raised a number of issues, for each of the components. An overview of these findings are elaborated below to answer the critical questions posed in Chapter 1.

6.1.4 Answers to the critical questions

6.1.4.1 Critical question one – Who designed the curriculum?

The curriculum for Technology was designed by a core group of interested educators with the guidance of a large stakeholder group consisting of NGO's, teacher unions, organized labour, industry, universities, and representatives from provincial project teams. To these can be added the inputs from overarching committees and policy documents, overseas documents and consultants. A national task team (NTT) was appointed to ensure that the process was carried out in an orderly manner via the HEDCOM management structure. The four members of the NTT strongly influenced the way in which the curriculum was designed and developed over a seventeen-month period.

There were a number of important influences on the work of the NTT.

- Events overtook the early part of the process. The project began as a feasibility study to test out whether or not Technology education was a viable learning programme for South African schools. This brief was changed by the DoE, as the development of Curriculum 2005 got underway.
- The new Technology curriculum had to be aligned to the principles and structures of Curriculum 2005, which were a dominant force in shaping the Technology curriculum. Curriculum 2005 was itself under development, creating a changing context during the design and development phases.

- Tight timeframes were set for the entire transformation. This tended to unsettle the process, as working groups were obliged to put ideas together to meet deadlines, often before they had adequately shaped guiding frameworks.
- The NTT did not write an explicit purpose statement (although a rationale and supporting statements were given), did not develop and express a curriculum perspective, or take careful account of implementation factors that could negatively impact upon the success or failure of the project.
- Technology education was a new concept in South African education, so no theoretical framework or model existed from which to draw. Neither had South Africa any history of democratic involvement in curriculum design.
- The DoE was informed about Technology education and the reasons for it in countries such as the United Kingdom, Australia, New Zealand, and the Netherlands. These experiences influenced the South African decision to embark on Technology education.
- South Africa's re-entry into global competition and the global market economy made Technology education and value-added production imperative.
- The new Technology curriculum could create an awareness of Technology in daily lives, enabling more effective problem-solving and more critical use of technology.

6.1.4.2 Critical question two – Why was the curriculum designed in this way?

South African education underwent massive transformation after the 1994 elections, to rid the education sector of all the 'old' apartheid policies, structures and legislation. Democracy, transparency and redress were central themes, alongside economic renewal. The education system was to reflect these themes. Outcomes-based education was selected as the system to manage this process and therefore the Technology education curriculum had to be designed and developed within this system.

The parallel development of the OBE system proved to be a compounding factor. For example, innovation in curriculum design and the introduction of Technology as a new learning area were compounded by new jargon (new terminology peculiar to OBE) and curriculum structures that few educators understood. Evidence of this was forthcoming during interview sessions with the educators and general conversation with principals at pilot project schools.

The NTT were aware that the curriculum had to be able to be implemented into all schools, regardless of location. This clearly did not happen; the curriculum design was flawed in this regard. Major resourcing problems were and still are a huge issue in South Africa and in Africa as a whole.

A rational means-end approach to curriculum design (which was one possible alternative that could have been worked on) could not be employed, in part because neither the end nor the means could be accurately identified. The result was a somewhat *ad hoc*, 'hit-and-miss' approach to design. No clear design plan or model was followed, beyond proceeding through successive drafts of the document. With so few Technology 'experts' to carry the task forward, no one knew, with any clarity, what was eventually to be presented to learners in the classroom. The design was indeed an innovation!

The initial design framework was completed in 1994, by a small group of educators who offered their assistance and made proposals that were eventually captured in the minutes of meetings and later became parts of NTT working documents. With the expansion of stakeholders as part of the Curriculum 2005 process, the NTT had to bring together a wide range of interests and concerns. This proved frustrating at times for the NTT: it slowed the process, and some of the members of the stakeholder group were not educators and had little idea of what was possible in South African classrooms. The stakeholder group was very influential in setting up the three specific outcomes that deal with values in the curriculum policy document. Such broadly representative participation would never have occurred in the pre-1994 apartheid education system where curriculum specialists attended to the curriculum alone or in syndicates and depended upon theoretical models as a guide.

6.1.4.3 Critical question three: Is the curriculum likely to meet the expectations of designers and educators?

The designers (NTT) were generally happy with the final design, although they acknowledged that the curriculum could be streamlined into a more 'user-friendly' document, by which they meant 'more clearly understood by educators'. The NTT, having hunted for options from international curricula, had been overwhelmed by the detail and available content. International consultants were also influential in the early stages, with ideas and critical comments. However, ideas from overseas were not necessarily suitable for South African schools. Choices about what to put in and what to leave out had to be made in consultation with the broad stakeholder group, who tended to add rather than subtract content. The result was that too much content and detail was retained. The final curriculum policy document (Oct. 1997) contained a Technology curriculum that was considered (according to members of the NTT) as 'over designed'. By this they mean it retained too much detail that was unsuitable for the majority of schools to implement.

The NTT were at the center of the design process, and probably the most *au fait* with the Technological terminology, international trends and conditions in schools. They were expected to provide leadership, and they did the writing. They were committed to Technology education, and saw great potential for it, if it could be taught well. The NTT battled with the tension between, on the one hand, producing a document that is visionary within a strategy of transformation and, on the other hand, able to be implemented in schools as they are, with teachers and learners as they are. The needs for resources, training of educators and upgrading schools were clear, but, as the interviews with teachers from the pilot schools suggested, the curriculum as presented was only easily interpreted by trained Technology people. In that sense, the curriculum design failed to meet the needs of learners and educators.

The achievements of the curriculum – in defining Technology education, and providing successful learning experiences for learners in the pilot schools – were documented by independent evaluations. Evaluations, from this study and others, have shown that learning programmes in the pilot project were highly effective. However, they were based on learning materials developed by the NTT, not by teachers working from the curriculum document, as is expected in schools generally. Thus successes of the curriculum have to be qualified, acknowledging the special conditions of the pilot project.

As far as the educators were concerned, those who were involved in the pilot study were optimistic about the Technology curriculum and its potential. They spoke favorably about the attention given to the design process (or the Technological process in SO #1), as an outcome and as a learning process. They reported that learners clearly understood and responded to the notion of individual and cultural differences, as when expressing opinions and creating different solutions to a particular problem. Learners could experience being different, and anticipate differences in the real world and career positions. The educators felt that no other learning area allowed for such competencies and attitudes to be developed in such a nurturing way.

However, not all the educators were happy with the curriculum document. Some were of the opinion that it was not user-friendly (a terminological issue), and therefore required supporting documentation. Two of the educators who had had extensive experience in Technology education, were very comfortable with the curriculum and saw it as an empowering document. The others in this study had difficulty. Many never used it during the pilot project, working instead from the learning programmes provided by the NTT.

6.2 Significant Issues

From the study, six issues have been identified as critical when designing curricula (Technology curricula in particular) in the future. These have been selected from the detailed accounts and analyses in Chapters 4 and 5. They were selected on a number of grounds. First, they are drawn from weaknesses in the design process and the resulting document that emerged from the analysis, which might have been avoided. Some were seen as critically important by the NTT and educators, but others were not: they arise from the theoretical perspective of the analysis. Second, they provide a basis for a more complete model of curriculum design, and more effective processes in future curriculum developments. These chosen issues are expressed below, as a set of hypotheses:

- A systematic approach to design is desirable in the absence of a curriculum model or previous history of the learning area;
- A coherent curriculum perspective, as a theoretical 'boundary', should be made explicit in curriculum design, as part of the development process;
- First world countries purport to be credible as curriculum designers and are assumed almost without question to offer more advanced curricula;
- Information technology is an integral part of achieving global parity and redress of disadvantage;
- Resources for Technology education must be planned in conjunction with the curriculum development if the experienced curriculum is to approximate the intended curriculum;
- A sound curriculum will fail if there are untrained educators to implement the design.

These issues are discussed below.

6.2.1 A non-linear approach was used to design the curriculum

For the curriculum analysis, a tool based upon the theoretical frameworks presented by Tyler (1949) and Posner (1992), was developed. The framework employs a technical-scientific approach to curriculum analysis – looking for components of the curriculum design that fit together logically, and relate to activities in the design process: formulating a plan, resolving issues of purpose, perspective and priorities, deciding the content, agreeing on the organization and structure, and preparing for implementation and evaluation. Tyler (1949) advocated these as sequential – for example, be clear about purposes, perspectives and priorities before deciding content and organization. Posner (1992), while favoring systematic approaches to the design process, was more flexible about what might be done when. He argued that, regardless of the process or the underlying philosophy of the curriculum, the final product should exhibit his components. Thus, in adapting Posner's (1992) framework for this study, care was taken to apply the resulting tool to the curriculum, not the process. At the same time, the tool was used as a way of structuring interviews about the process.

The information from the NTT, minutes of meetings and educators show clearly that the designers did not follow a linear approach in the design process, and neither were they especially systematic. A linear process from rationale to outcomes, content, etc. was simply not possible, even if they had wished it to be. Through the involvement of large numbers of people, interest groups, reference groups, experts and documents, developments occurred on many fronts at once, interacting with each other. The project was part of the larger Curriculum 2005 project, which was highly politicized and also taking shape at the time, so that the rules were often changing. The result was a somewhat *ad hoc* process of reiteration, in which it was difficult to hold on to any particular 'big picture'. This had the advantages of broad consultation but the disadvantages of being unsystematic and not building certain components in strong ways. For example, the final document does not contain a clear statement of purposes nor any discussion of perspectives; these have to be inferred from the details of content. Neither is there any evidence that the designers and reference groups used any agreed framework to evaluate successive drafts of the curriculum. The policy document for Technology, from a curriculum point of view, was strong democratically but weak theoretically. Educators found the policy document difficult to understand, over-designed from a content point of view, and not easy to manage without extensive training.

The nature of the design process – including the desirability and possibility of working through a sequence of steps – is a matter of contention in Technology education, as discussed in Chapter 2. The curriculum design process manifests the same issues. The Technology curriculum comes down on the side of a linear approach, though suggesting cautions. The DoE, in its advice to teachers as curriculum designers (writing learning programmes), has been outspoken in advocating a linear 'design down' strategy – from outcomes to activities and assessment. But linear and systematic processes were clearly not followed by the designers of the Technology curriculum. A solution that brings together a systematic 'components' approach to curriculum analysis and open processes of curriculum design is offered later in this chapter.

Recommendation: An appropriate, tested theory or a workable curriculum model should be used as a framework to guide the curriculum design process. This model should serve as a tool of analysis, a means of asking logical questions of the design, of interrogating and revising the design. Agreement on the details of that framework should be decided as part of the design process.

6.2.2 A coherent curriculum perspective was not articulated

Curriculum perspectives arise from a number of domains: the purposes of schooling, the nature of the education system, the nature of the learning area, the nature of learning, power relationships in the classroom, and so on. The perspectives chosen in the different domains might fit together coherently, or they might not. For example, traditional objectives models of curriculum formed a coherent perspective characterized by teacher-centred transmission of knowledge and skills, bureaucratic management, and assessment by written tests.

For the Technology curriculum, the general features of a coherent perspective were laid out by the Curriculum 2005 documents: outcomes-based (with outcomes defined as broad competences), learner-centred, and employing continuous formative assessment. This was further expressed in a set of critical and developmental outcomes that were to guide all learning areas, and promote problem-solving, critical thinking, working in teams, respect for cultural and individual diversity, and communicating in a variety of ways. The NTT had the task of interpreting this framework interactively with their own conceptions of the Technology learning area and a rationale for it.

There is no elaboration in the curriculum documents of any particular perspective or discussion of perspectives. The NTT was greatly concerned about issues of 'balance' between knowledge and skills, craft and design, high and low technology, indigenous and Western technologies, efficiency and socially-critical technologies, breadth and depth. They expressed these various positions in specific outcomes and suggested performance indicators, but did not develop them into a framework, offer suggested weightings or present a discussion of the issues. This had ramifications for the overall design. There is also the problem that teachers, who are to use the document to design their own learning programmes, are given little insight into the theoretical issues they need to address.

Recommendation: Curriculum designers should clarify and articulate the perspectives from which they engage in curriculum design, as these direct their own practice, make their decisions transparent, and guide educators in the interpretation and use of the curriculum.

6.2.3 The curriculum was aligned with first world countries

The South African Technology curriculum was heavily influenced by developments in countries such as the UK, Australia, and New Zealand. These countries had produced Technology curricula to suit their particular needs and histories. However, South African society and schools do not equate with first world countries. This is a complex issue. Whether to plan for some imagined future South Africa or the current one; whether first world countries offer an ideal to which South Africa should aspire; whether to be concerned for global standards, or define them locally. The issue is played out in assumptions about resources as well as content, and the NTT was greatly concerned about both aspects. Ultimately, the NTT was overly influenced by overseas curricula, resulting in a curriculum that is too crowded, and beyond the resources (in equipment and educator capacity) of most South African schools. Educators in the project schools were heavily reliant upon the learning programmes given to them and resources especially provided. While the pilot programmes were generally successful, the conditions of the pilot are met in few other schools. In most schools resources are scarce, training is limited, support is weak, and the concept and practice of Technology education are new.

Recommendation: International studies should be done, to gather and appraise overseas curricula, as inputs to the design of a uniquely South African curriculum – one that takes account of the cultures, resources and

aspirations of South Africa. The framework for appraising overseas curricula should be developed and discussed as part of the process.

Recommendation: Curriculum design should be reasonably consistent with the human, physical, and financial resources required for its implementation. Planning for resources should feature prominently in planning the curriculum.

6.2.4 Schools lack information technologies

The importance of information technologies, in all countries, is unquestionable. Not only are information technologies an increasing part of daily life and economic and technological activity, they provide access to information, communication and learning. However, in the Technology curriculum design, the NTT intentionally downplayed the use of information technology in schools, due to the fact that most schools do not have computers. This is problematic for the country as a whole and for Technology education in particular. Without access to computers, disadvantaged learners in South Africa will become more disadvantaged. The vision of participating in the global market economy is severely impeded if learners are without access to computers. The potential of Technology education cannot be realised unless action is forthcoming in the provision and use of computer-based equipment.

Recommendation: The introduction of computers into schools throughout South Africa must receive priority as a national imperative.

6.2.5 Schools need resources for Technology education

The resourcing of schools for Technology education is a critical part of curriculum implementation. The NTT, aware of the lack of resources in many schools, tried to compensate by recommending that educators start with 'low-tech' Technology. However, as the analyses in this study indicate, this is not satisfactory if the needs for development and equity are to be met. To only ever practice technology using recycled materials and simple tools is to be denied most of the knowledge and skills required for further education and employment in technological areas. Educators and learners should have access to at least a reasonable classroom to work in, basic tools, equipment and materials. This implies adequate financial resources to support curriculum design initiatives, as investments into the future of the nation. Improved economic and social benefits based on the potential of producing creative and problem-solving learners at school level, cannot be ignored.

Recommendation: The DoE should provide adequate resources to all schools (financial, physical and human) in order for the Technology curriculum to be implemented as per the C2005 vision.

6.2.6 Educator training

Educator training is an extremely important aspect of curriculum design and development. The study has shown that the educators, in general, were not adequately trained to interpret the Technology curriculum on their own. There was a further complicating factor in South Africa that additional training was required for a clear understanding of the new OBE system. The importance of educator training supports the notion of implementing a good curriculum design with a fair amount of success rather than failure to implement an otherwise excellent design because of poor teaching ability.

Recommendation: If the Technology curriculum is to be clearly understood by all educators in South Africa, training programmes must be arranged with follow-up and support systems to ensure sustainability.

It is acknowledged that the three latter recommendations are all calling for increased spending for Technology education in a system straining under competing demands. Apart from the obvious competition for funds between learning areas, there are also other tensions of infrastructure versus equipment versus personnel; class sizes and teacher provision; and of course the HIV AIDS pandemic that is causing havoc even amongst school communities. Effective funding calls for more creative solutions to be developed which will involve a combination of increased budgets, local partnerships, more efficient administration and greater dedication from the educator corps. Another possible idea may be to establish specialised Technology schools within regions and districts, which, although they cut across notions of equity, may be a short to medium term solution. Such thinking cannot be overlooked if Technology education is to grow in South Africa.

6.3 Planning the way forward

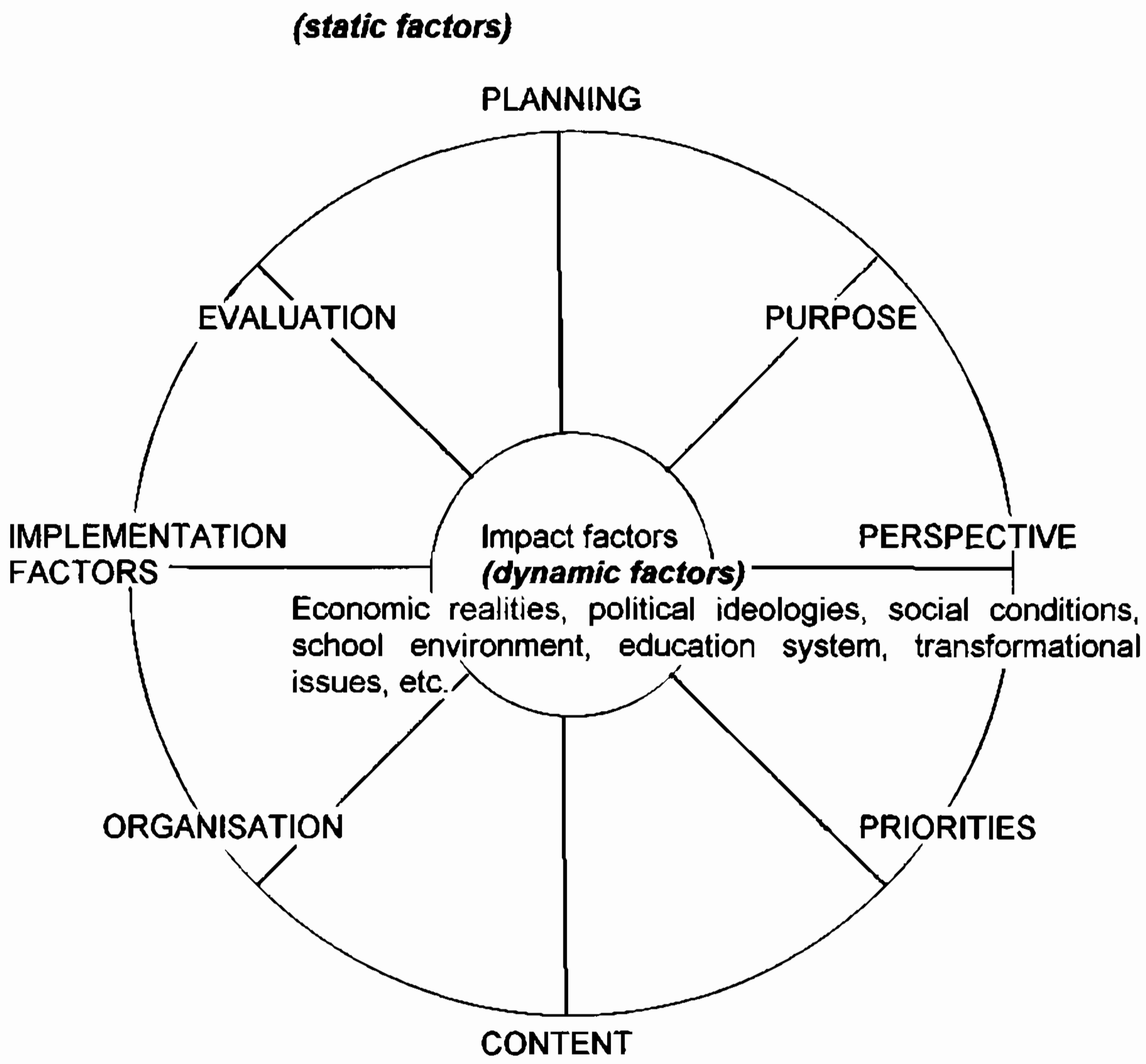
6.3.1 Designing curricula for South Africa in the future

The application of a design framework such as the one developed in this study can be of great benefit to curriculum designers. It allows for the conceptualization of the critical points to be considered for the design and offers an analysis framework to 'unpack' the components of the curriculum. Such analyses were not done in any formal way as part of the design of the Technology curriculum. Application of the adapted version of the Posner framework showed weaknesses in the final design of the South African Technology curriculum, and suggested weaknesses also in the 'hit-and-miss' approach that was applied in the development.

On the other hand, widely participative processes (through the NTT and its reference groups, and the larger development of Curriculum 2005) permit wider input and consultation, with the prospect of a curriculum more in tune with the needs and interests of the nation. A possible means of reducing the risk of a 'hit-and-miss' or 'ad-hoc' style of curriculum design is to adopt a 'hybrid' curriculum design model presented below.

Figure 8

A 'hybrid' curriculum design model:



It is proposed that one starts with the '**static**' components. These static components are appropriately defined by the analysis tool used in this study. The (eight) components form the fundamental or foundational structure of a complete curriculum design. The components are intended as a tool for analyzing the curriculum product at any stage, but not the process of development. In this sense, they have been called static.

The analysis tool as used in this study was in some ways a blunt instrument. There were different levels of meaning implicit in the eight components, an overlap of components existed (eg. some of the issues raised via the interview responses had to be discussed in more than one component), and some complex issues were contained within components (eg. perspective). Hence, in application, the framework needs to be refined by the development team as part of the conceptual phase. Articulation of the details of components in the context of the particular curriculum provides a basis for democratic principles of transparency, establishing common terms of reference, and working as a group. The process of refining the tool would be helpful in theoretical terms too, reducing the risk of *ad hoc* style designing. Ultimately design of curricula is a creative process, in which various themes and demands are addressed in an orderly manner that should be aligned to the vision and strategies of the education sector and the country as a whole. Analysis of the curriculum (as presented in this study) provides a checking system and is not prescriptive as a design system in itself.

Alongside analyses of work in development, consideration must be given to '**impact**' factors: dynamic factors that impact on the curriculum design. The dynamics of a situation (considered as a set of impacting factors) are bound to context and process and therefore vary in intensity depending upon the location of the curriculum intervention. Critical theorists such as Apple and Giroux are highly critical of static systems, and argue for transformation of social systems and structures, as part of achieving emancipation and democracy. In the same way, during this study tensions arose between the static framework used to structure the interviews and the dynamic processes in which the NTT had been involved. An analytical tool, even when applied to the product of the curriculum design process, needs to be attuned to the dynamics of the design process. The model proposed here seeks to incorporate these dynamic aspects as impact factors. The impact factors noted in the case of the Technology curriculum include OBE as a transformative system of education; under-resourcing in schools (physical, financial, human); the size of classrooms and class groups in South Africa; the training of educators in Technology education; cultural diversity; and social inequalities. To these must be added factors in the management of education and schools, and the management of the curriculum design process. Attention to these impact factors, alongside the static factors, in curriculum design has the potential to bring together theoretical, political and managerial dimensions of the process, improving its effectiveness and its efficiency.

Recommendation: As part of curriculum design, employ a model that combines theoretical analysis and evaluation of the curriculum at key stages with analysis of factors that impact on the design, including contextual, political and managerial factors.

6.4 Concluding remarks

Curriculum design is a very complex process that requires the utmost skill and professionalism. South African educators embarked on a project to design and develop a new Technology education curriculum in seventeen months that had neither means nor ends clearly defined. All efforts occurred at a time in South African history (post 1994) where there was great uncertainty within the newly formed democratic society. A new constitution entrenched new levels of equality, human rights, and dignity for all citizens and many found they now had a 'voice' and naturally they wanted to be heard. The NTT had to contend with such issues and many others like political intolerance, unwieldy stakeholder groupings, no curriculum model to follow, and no previous history of Technology education in South Africa, to name but a few. I must therefore pay tribute to the NTT who managed remarkably well (without really knowing it) and finally produced a policy document that could be tested against the design analysis tool of this study. The Technology policy document has generally performed well and therefore compliments need to be paid to everyone who contributed to this success. Weaknesses that were identified can still be remedied, but this will take some time. A new beginning in teaching and learning has dawned as Technology education has been finally been given a place in the South African curriculum 2005.

Technology education has the potential to revolutionise the way learners think and act in their everyday lives, to transform the intellectual stimulus of learners to be both productive and critical for the future demands of South Africa. If South Africa as a nation is to become competitive in the global market, to understand the implications of a global economy and the uses of technology, then, Technology education is a necessary pre-requisite. If the weaknesses are resolved in the near future, then large-scale implementation of Technology education into all South African schools could become a reality and support the vision of education policies as well as the politicians who were instrumental in the general education reform. The degree to which such implementation can be achieved, will inevitably be part of ongoing political, economic and social struggles. If it is achieved well, the whole nation will benefit.

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Appendix A

Questionnaire to the Design Team (NTT)

Interview schedule to: CURRICULUM DESIGNERS
Note: All questions are with reference to the Senior Phase Technology Curriculum Document (Oct. 1997) with special emphasis on the Grade 9 Pilot Project. [Intended Curriculum]

1. PLANNING
Note: [There are many elements one could consider during the planning stage eg. What knowledge, skills or attitudes, why learn this particular content, what content to include/exclude, who is the target audience, what activities to include,materials resources required, how to evaluate success, administration facilities, etc].

1a. Why were you selected as one of the design and developers of the Technology Curriculum?
A. - because of prior experience in Technology or a related field
B. - by chance
C. - Unsure
Comment:..
....
....

1b. How many people were involved with the curriculum design and development process?
A. - 10-20 people
B. - 5-10 people
C. - Unsure
Comment:..
....
....

1c. Were there any noteworthy social, political or educational requirements which influenced the design?
A. - Yes
B. - No
C. - Unsure
Comment:..
....
....

1d. Was your intended curriculum design realised?
A. - Yes
B. - No
C. - Unsure
Comment:..
....

....

1e. Are you aware of positive or negative reactions by learners (Gr.9) to the developed Technology curriculum?
A. - Yes
B. - No
C. - Unsure
Comment:...
....
....

1f.Do you think learners who follow the Technology curriculum will be educationally advantaged in any way?
A. - Yes
B. - No
C. - Unsure
Comment:...
....
....

1g. What did the 1998 Technology pilot project reveal about the Technology curriculum design?
A. - Significant findings
B. - Very little
C. - Unsure
Comment:...
....
....

1h. Were there any important curriculum aspects omitted (either intentionally or unintentionally) which you think should have been included?
A. - Yes
B. - No
Unsure - Unsure
Comment:...
....
....

1i. What planning elements dominated the curriculum development process?
A. - Identified a few
B. - None
C. - Unsure
Comment:...

....
....

1j. Did the design and development team attempt to address any educational problems via the Technology curriculum?
A. - Yes
B. - No
C. - Unsure
Comment:..
....
....

1k. What were the guiding principles which influenced the design?
Note: [There may have been prescribed curriculum design principles or a suggested model].
A. - Identified some principles
B - No principles
C. - Unsure
Comment:..
....
....

1l. Whose values were included in the design of the curriculum?
Note: [There may have been a prescribed value system or some value system may have been adopted from elsewhere]
A. - Identified a source
B. - None specified
C. - Unsure
Comment:..
....
....

2. PURPOSE
Note: [Purpose refers to the reason/s for designing and developing the Technology curriculum].

2a. Is the purpose of Technology clearly stated in the grade 9 policy document (Oct 1997)?
A. - Yes
B. - No
C. Unsure
Comment:..
....

....

2b. What special educational conditions, (if any), did the designers seek to address?
A. - Identified some
B. - None
C. - Unsure
Comment:...
....
....

2c. What is the Technology curriculum rationale?
Note:[Rationale usually begins by presenting the problem or situation that the curriculum is intended to address. Rationale also includes the fundamental reason/s for including Technology into the South African school system and a rationale guides curriculum development by providing overall direction].
A. - Identified
B. - None identified
C. - Unsure
Comment:...
....
....

2d. Why was Technology introduced into the new OBE curriculum?
A. - Provided a reason
B. - No reason
C. - Unsure
Comment:...
....
....

3. PRIORITIES

3a. What educational aims and/or goals are emphasised?
A. - Identified one or more
B. - None identified
C. - Unsure
Comment:...
....
....

3b. Did the designer/s prioritise any educational **aims and/or goals above others?**

A. - Prioritised one or more

B. - No priority specified

C. - Unsure

Comment:...

....

....

4. PERSPECTIVE

Note:[Educational problems can be responded to via curricula. The approach chosen depends upon the beliefs and assumptions (often termed philosophies or perspectives) of the people who developed the curricula. Curriculum perspective refers to the broad views, which you or the team have/had, of education which may have formed a particular view of the curriculum. Various educational philosophers have forwarded opinions about education eg. behaviourists, pragmatists, technocists, critical, experiential, etc].

4a. What or Whose perspective, is dominant in the Technology curriculum?

A. - Identified one

B. - None identified

C. - Unsure

Comment:...

....

....

5. CONTENT

Note: [Curriculum Content refers to the outcomes in applications of safety, information,**materials, energy in systems and control, communications, structures,** processing].

5a. Why was the content, which appears in the 1997 policy document, selected?

A. - Reason specified

B. - No particular reason

C. - Unsure

Comment:...

....

....

5b. How will learners benefit from learning this content **in Technology?**

A. - Reasons given
B. - No reason given
C. - Unsure

Comment:..
....
....

5c. Is the content comparable to that prescribed in similar Technology curricula internationally?

A. - Yes
B. - No
C. - Unsure

Comment:..
....
....

6. ORGANISATION

Note: [Organisation in the curriculum refers to showing how to sequence and group learning units (SO's) within Technology and **across the other learning areas.** This should allow for maximising the learner's opportunities to acquire the knowledge and skills intended by the designers].

6a. Why is the Technology curriculum organised in this way? (Reference to the Oct 97 policy document).

A. - Reason given
B. - No reason
C. - Unsure

Comment:..
....
....

6b. What psychological assumptions, if any, underlie the curriculum organisation?

Note: [Focus on psychology of learning at the senior phase level].

A. - Identified an assumption
B. - No assumptions made
C. - Unsure

Comment:..
....
....

6c. What other assumptions, if any, underlie the organisation of the **curriculum?**

A. - Identified one or more other assumptions

B. - No others

C. - Unsure

Comment:..

....

....

7. IMPLEMENTATION FACTORS

Note: [Designers should have been aware of the requirements for implementing the Technology curriculum into the new OBE C2005 school system].

7a. Does the curriculum design account for:

FACTORS	YES RESPONSE + COMMENT	NO RESPONSE + COMMENT
Time		
Physical resources (school,educators,equipment)		
School management		
Political influences, policies & regulations		
Economic requirements (finance)		
Educator attitudes Educator beliefs Educator competencies		
Cultural values & differences		

8. EVALUATION

8a. What were your expectations of the **grade 9 pilot project?**
A. - Identified an expectation
B. - No expectations
C. - Unsure
Comment:..
....
....

8b. Were the 1998 - IEB exam results at the pilot schools satisfactory? What conclusions could you draw from these results?
A. - Yes, results were satisfactory and identified some conclusions
B. - No, results were unsatisfactory - also identified some conclusions
C. - Unsure
Comment:..
....
....

Thank you for participating. All information collected will be treated confidentially and only used for research purposes.
Gavin Chapman
Student No. 9903255
Univ.of Durban-Westville

Appendix B

Questionnaire to the Educators

RESPONSE CODING

Interview schedule: Pilot Project Educators [Grade 9 pilot project - 1998 & IEB exam]

All curriculum references are to the 1997 Senior Phase Curriculum Policy Document published by the Department of Education

Six educators to be interviewed:

2x Kzn

2x W/Cape

2x Gauteng

RESPONSE CODING:

Tick the appropriate choice A, B, or C [Response Code for analysis purpose only: A=3, B=2, C=1]

INTERVIEWER:...

Date:...............................

NAME:..

PROVINCE:...

SCHOOL NAME:..

TECHNOLOGY - Grade 9 - [Senior Phase - Pilot Project]

INTRODUCTION

A. What is your teaching background - prior to being involved in the Technology pilot project?

....

....

....

B. Why were you selected to teach the Technology pilot programme at your school?

....

....

....

1. PLANNING

NOTE: [There are many elements which one could consider during the planning phase of a curriculum design eg what knowledge, skills, attitudes or values should be taught, why this particular content is necessary, why the content is organised in a certain way, what resources are required, etc.]

1.1 Who designed the curriculum?

A. - A team or committee

B. - I don't know

C. - Unsure

Comment:..
....
....

1.2 Is the curriculum document user-friendly?
A. - Yes
B. - No
C. - Unsure
Comment:..
....
....

1.3 Did you clearly understand the curriculum requirements stated in the curriculum document?
A. - Yes
B. - No
C. - Unsure

1.4 IF YES (to 1.3 above) THEN - Are the requirements achievable?..
....
....

1.5IF NO (to 1.3 above) THEN - What problems did you experience?..
....
....

1.6 Is the curriculum suitable for the needs of all learners in South Africa?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

1.7 How did your group of learners react to the new curriculum?
A. - Very interested
B. - Slightly interested or uninterested
C. - Unsure
Why do say this?..
....

1.8 Did you receive any prior training before commencing to teach the grade 9 pilot programme?
A. - Yes
B. - No
C. - Unsure
Comment:(If Yes state duration, type, etc.)..
Comment: (If No state why not)...

1.9 Would you have been able to teach this curriculum if you had not received prior training?
A - Yes
B. - No
C. - Unsure
Why do you say this?...

1.10 Do you think the curriculum developers may have assumed [anything] (related to learning) during the planning of the curriculum?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...

1.11 Do you think the curriculum was well planned?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...

2. PURPOSE

2.1 Are you aware of the purpose of the curriculum?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

2.2 Are you aware of any special purpose/s which the designers tried to address in their design?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

3. PRIORITIES
Note [Certain aspects of the curriculum may be considered more important than others. The designers may have prioritised certain content (specific outcomes) above others].

3.1 Are the educational outcomes (aims or specific outcomes) prioritised in the curriculum?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

4. PERSPECTIVE
Note: [Educational problems can be responded to, via curricula. The approach chosen depends upon the beliefs and assumptions (often termed philosophies) of the people who designed and developed the curriculum. Curriculum perspective refers to the broad views of education which may have been held by the designers and consequently resulted in a particular perspective being expressed through the curriculum].

4.1What perspective (or philosophy) is apparent in the curriculum? (Consider - behavioural, cognitive, critical, technical, etc.)

A. - Identified a perspective/s
B. - Do not know
C. - Unsure
Why do you say this?..
....
....

4.2 What perspective (or philosophy) emerged dominant in the design?
Note: [Various educational philosophers have forwarded opinions about education eg. Those emphasising behavioural aspects of learning, the pragmatists, technocists, critical, etc.]
A. - Identified one or more perspective/s
B. - Do not know
C. - Unsure
Why do you say this?..
....
....

5. CONTENT
Note: [Curriculum content refers to the outcomes in application of safety, information, materials, energy in systems and control, communications, structures, and processing].

5.1 Why was this content selected?
A. - Provide a reason/s
B. - Do not know
C. - Unsure
Why do you say this?..
....
....

5.2 What do think of the content?
A. - Think it is good
B - Don't think it is good
C. - Unsure
Why do you say this?..
....
....

5.3 What content did you attempt to teach?
A. - List some of the content

B. - Unable to identify content
C. - Unsure
Why do you say this?..
....
....

5.4 Which of the content you tried was easy/difficult to teach?
A. - Nothing was difficult
B. - Identified some content
C. - Unsure
Why do you say this?..
....
....

5.5 Which content did learners find difficult to comprehend?
A. - No problem with comprehension
B. - Identified some content which was difficult
C. - Unsure
Why do you say this?..
....
....

5.6 Is the content relevant to learners?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

5.7 How will learners benefit from this content?
A. - Named benefits
B. - No benefit
C. - Unsure
Why do you say this?..
....
....

5.8 Do you think the content is comparable with countries like Australia, New Zealand and UK.(1st world countries)?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

5.9 Will learners benefit from learning this content?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

5.10 Is the content biased (displays certain preferences or tendencies) towards any particular group of learners eg males?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

5.11 Does the content prohibit participation of any particular group of learners (eg. Racially, physically challenged, gender, culture, etc.)
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

6. ORGANISATION

Note:[Organisation of the curriculum refers to the sequence and grouping of learning outcomes (specific outcomes) within Technology and across the other learning areas. Good organisation should allow for maximising of learning opportunities in order for learners to acquire the desired knowledge, skills, attitudes and values intended by the designers].

6.1 Do you think the designers may have made certain assumptions (about learning) when the curriculum was organised?

A. - Identified assumption/s
B. - Don't know
C. - Unsure
Why do you say this?..
....
....

6.2 Do you agree with the way in which the curriculum is organised?
A. - Yes
B. - No
C. - Unsure
Why do you say this?..
....
....

7. IMPLEMENTATION FACTORS
Note: [Designers should have been aware of the requirements for implementing the Technology curriculum into the new OBE school system].

7.1 Does the curriculum design account for:

FACTORS	YES RESPONSE + COMMENT	NO RESPONSE + COMMENT
Time		
Physical Resources (classroom, school, projects)		
School Management (principal, hod)		
Political influences, policies & regulations		
Economic requirements (finance for resources)		
Educator attitude: Educator beliefs: Educator competencies:		
Cultural values & differences		

7.2 What implementation factor/s do you think was/were omitted (either intentionally or unintentionally) by the designers?

A. - Name some factor/s
B. - None
C. - Unsure

Why do you say this?..
....
....

8. EVALUATION

8.1 In your opinion, was the 1998 pilot project a success at your school?

A. - Yes
B. - No
C. - Unsure

Why do you say this?..
....
....

8.2 What did the results of your learner's 1998 IEB examination indicate about the curriculum?

A. - Positive comments
B. - Negative comments
C. - Unsure

Why do you say this?..
....
....

8.3 What lessons did you learn by trial and error which may indicate problems with the curriculum design?

A. - List a few
B. - None
C. - Unsure

Why do you say this?..
....
....

8.4 Do you think this curriculum will assist learners to develop useful competencies for the 'real world' after completing their grade 12 school career?

A. - Yes
B. - No
C. - Unsure

Why do you say this?..
....

8.5 Is there a need for technology in the OBE system?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

8.6 Is the curriculum design correct or does it require modification?
A. - Yes correct - no changes required
B. - No - requires changes
C. - Unsure
Why do you say this?...
....
....

8.7 Should Technology be a learning area on [its] own?
A. - Yes
B. - No
C. - Unsure
Why do you say this?...
....
....

THANK-YOU FOR PARTICIPATING IN THIS INTERVIEW.
YOUR RESPONSES WILL BE HANDLED IN THE STRICTEST CONFIDENCE AND DE-CODED ONLY FOR THE PURPOSES OF THIS STUDY.

REGARDS
GAVIN CHAPMAN [STUDENT NUMBER: 9903255]

Appendix C

Letter to the Minister of Education

AN OPEN LETTER OF APPEAL TO THE HON. MINISTER OF EDUCATION, PROF. KADER ASMAL

IN SUPPORT OF TECHNOLOGY EDUCATION IN SOUTH AFRICA

Professor K Asmal
Minister of Education
Magister Building,
Schoeman St.
Pretoria

Dear Minister Asmal

In your response to the report of the Review Committee, you mention that it has decided to keep Technology and Economics & Management Sciences (EMS) in the curriculum **'at this stage'**. In your statement you say that the actual form that these learning will take **'will be made known after an assessment of provincial capacities, within one month of today'**. This implies that both Technology and EMS may still be dropped from the curriculum if it is found that current capacity is inadequate to deliver them. Given that (a) both of these learning areas are new and have no precedent or tradition in South Africa and (b) that provinces have had almost no time to build capacity, provincial capacity must be anticipated to be under strength.

If this is indeed a possibility, we would appeal to your ministry to take a longer term view. Government's commitment to building the capacity to deliver technology must not be limited by the current constraints. We trust that this will not be an excuse to drop technology from the curriculum. Our appeal is based on the following points:

- The inclusion of Technology education is a growing international trend. It is a trend because governments have recognised the future non-negotiability of technological and economic literacy as basic requirements for success in society and the economy in the 21st century.

- Schools which are already doing technology have now been convinced of the benefit it brings to learners and to the improvement it causes to teaching and learning in particularly science and maths, but to all learning areas. Those schools are planning to continue and to expand their technology curricula. This will widen the gap between schools who are keeping abreast of modern standards and those which are lagging behind – exactly the opposite of what government is seeking.

- There is overwhelming evidence in schools already offering technology that teachers and learners understand OBE better because of technology and the way it is being delivered. By abandoning technology we may be losing one of the best on-site teacher training tools for OBE and public examples of OBE working successfully.

- Technology is the best option to creating a base for solid science, maths and economic literacy to be built on. It is particularly useful as an educational vehicle for the millions on South Africans who will not enter universities and technikons immediately upon leaving school.

We cannot, however, ignore the fact that the South African education system is not ready to deliver technology education in all schools at a consistently high level of quality. For that reason we suggest that the following actions be taken in the short term.

1. COMMITMENT TO TECHNOLOGY EDUCATION

Your ministry should declare government's commitment to

- Retaining technology as part of the national curriculum in the GET band and
- Working towards its full implementation within a period of 7 years.
- Inviting the private and public sector to partner with the Ministry of Education in helping to make this happen.

2. PROVINCIAL 7 YEAR PLANS TO IMPLEMENT TECHNOLOGY EDUCATION

Provinces should be asked to prepare a 7-year plan to implement GET level technology in all schools. The plan should be in phases and set targets for the number of teachers to be trained and schools to be equipped. As provinces already have trained technology trainers and teachers, this can be easily done.
There are universities, technikons and NGOs which have the capacity to offer world class training in technology. They have already trained sufficient teachers for four provinces to set up technology education associations. These resources must be part of the provincial plans.

Schools in the provinces should be listed as either

a already competent to deliver technology; or
b likely to be competent within 3 years to deliver technology at all level;
c likely to be competent within 5 years to deliver technology at all levels;
d likely to be competent within 7 years to deliver technology.

Education departments should then consider a policy of differentiated support to help schools plan, train teachers and seek resources.

3. RESOURCES FOR TECHNOLOGY EDUCATION

The CEM or HEDCOM should oversee the development of a strategy to resource technology in schools. The strategy should be compiled jointly by the Ministry of Education and the Ministry of Arts, Culture, Science and Technology. The two departments may jointly set up a working group to manage the implementation of the strategy.

The National Science and Technology Forum (NSTF) could play a useful role in harnessing resources for this purpose.

Approaches should be considered to the relevant ministries to seek support from funds raised through the Skills Levy and even the national lottery to support the resourcing of schools.

We, the undersigned organisations and individuals, appeal to you to seriously consider these suggestions in the belief that they are feasible and for the good of South Africa. We also offer our support to you in making them happen.

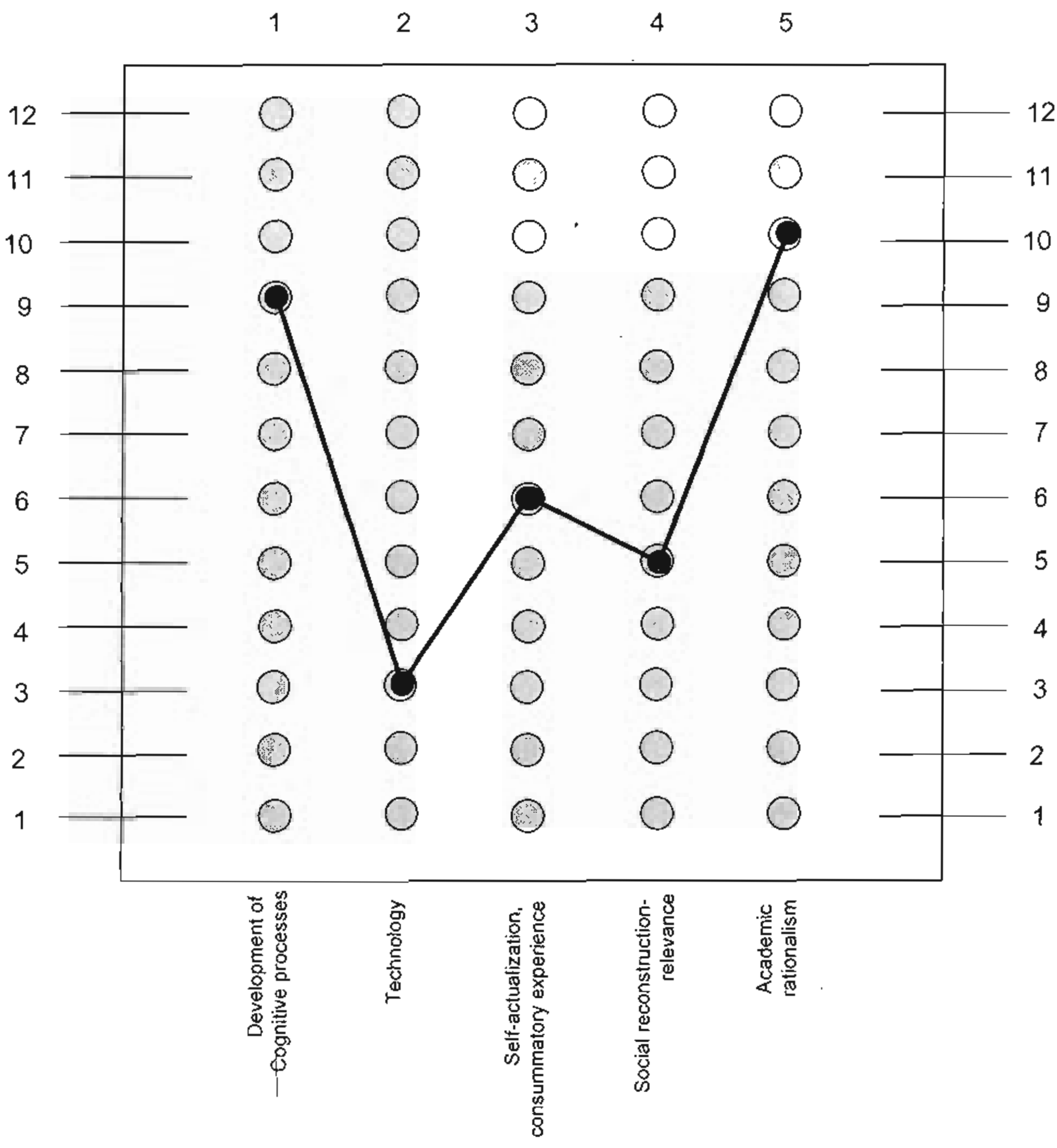
Yours sincerely,

For **PROTEC** CEO: David Kramer Tel: 011-3391451	
For **TECHNOLOGY FOR ALL** MD: Rod Sherwood Tel: 083 301 083 7	

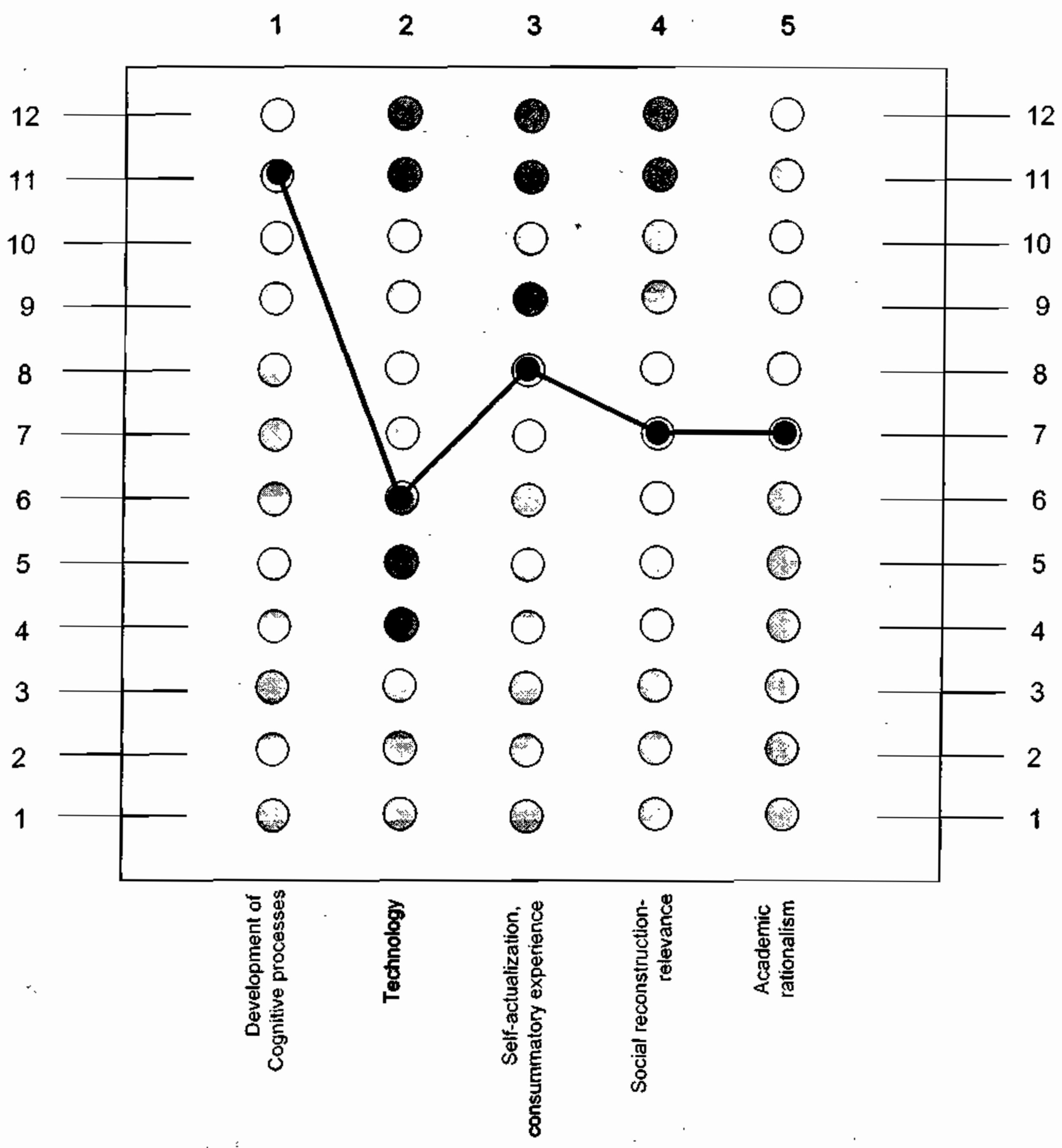
Appendix D

Curriculum Orientation Profile
Of
The Design Team (NTT)

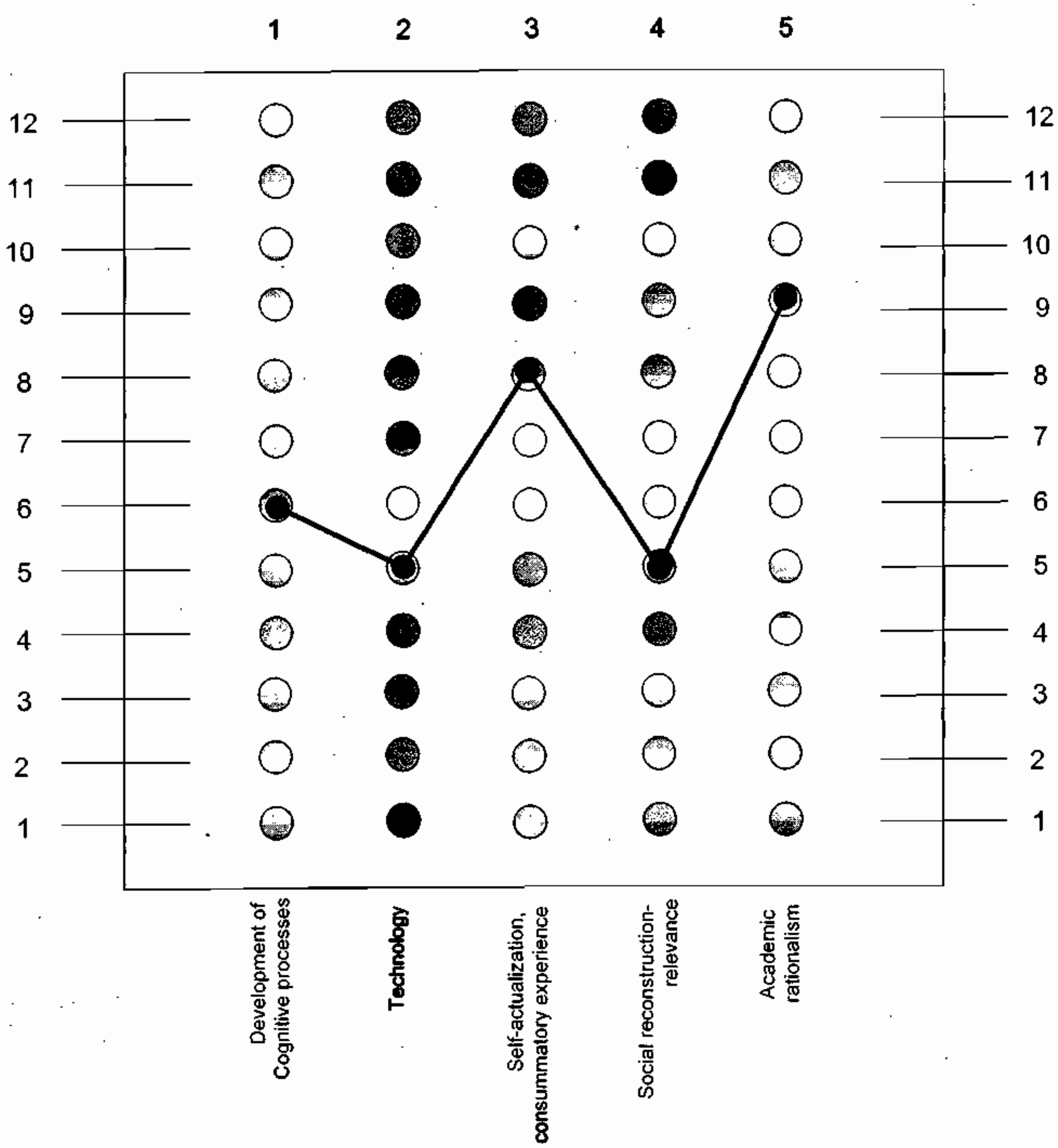
Curriculum Orientation Profile of Joe (NTT)



Curriculum Orientation Profile of Mary (NTT)



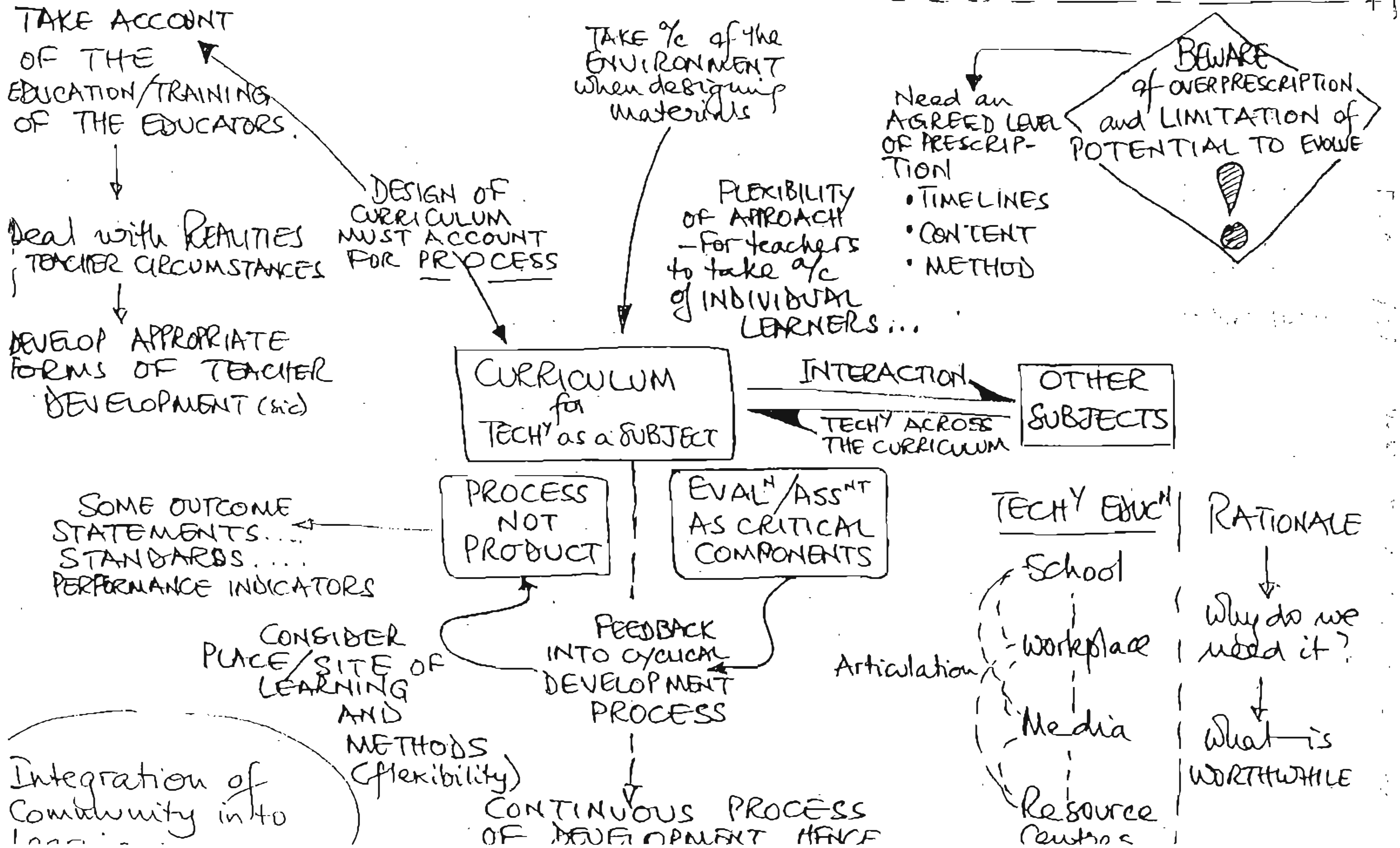
Curriculum Orientation Profile of Rick (NTT)



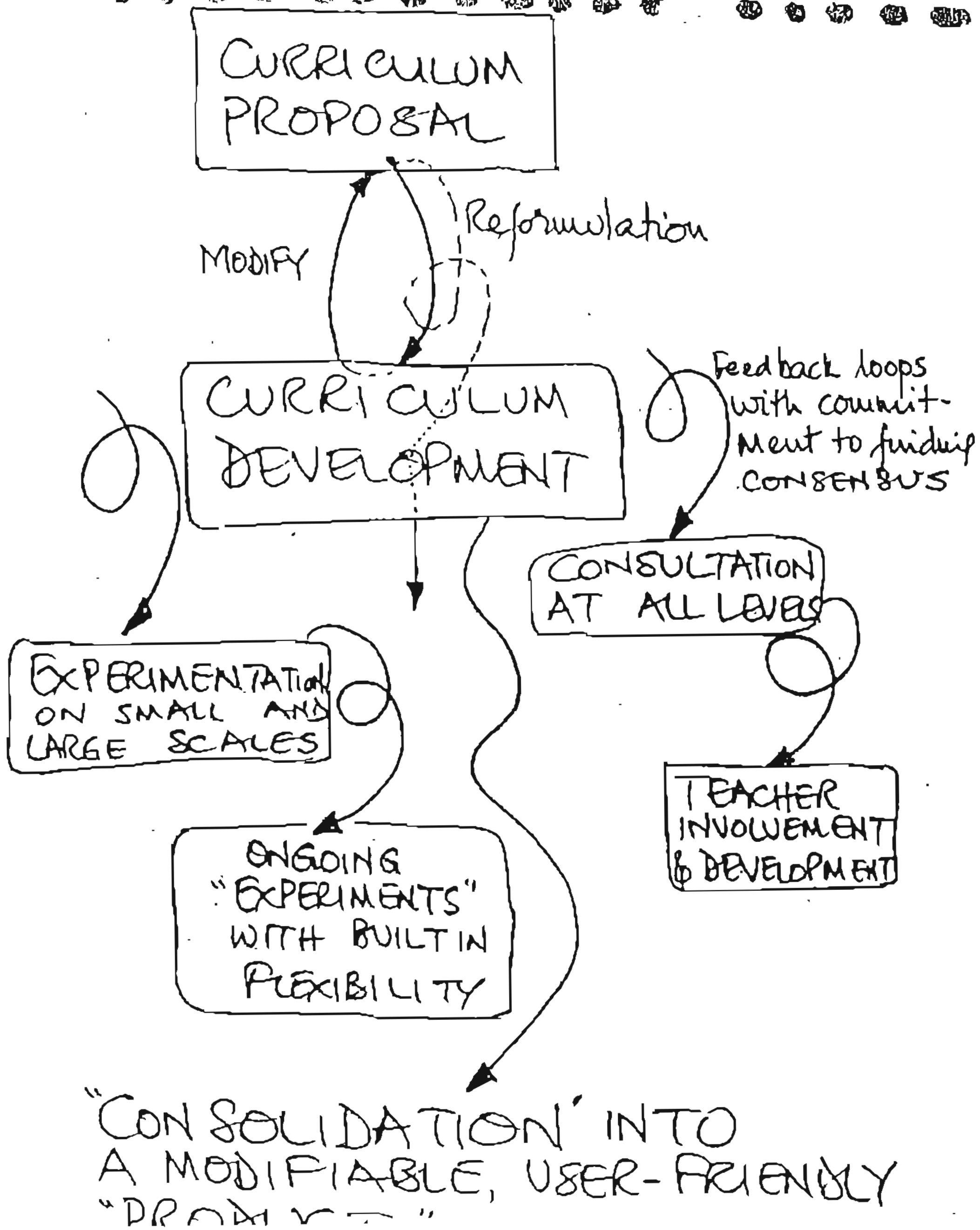
Appendix E

Curriculum Design Notes
1995
from the Design Team

INGREDIENTS AND DESIRABLE FEATURES OF CURRICULUM



CURRICULUM DEVELOPMENT IN TECHNOLOGY EDUCATION



IMPERATIVES

- Cannot be constrained by styles + norms of Curriculum Development used in the past ....
- Avoid "Tabula Rasa" view of knowledge
- Keep contact with the World of Work – keep an eye on meaningful citizenship.
- Emphasis on process (towards worthwhile products ....)
- Loops, feedback and a continuous process
-

Appendix F

Terminology used in the Study

TERMINOLOGY

- *Outcomes Based Education:* The new system of education in South African schools. Commonly called OBE; it is intended to be developmental as it encompasses both what learners learn and are able to do at the end of the learning process. It is learner-centred and emphasizes whatlearners can achieve. It is an activity-based approach to education designed to promote problem-solving and critical thinking.

- *Learner:* Previously called pupil the new OBE terminology refers to a learner. This is actually a child who attends school.

- *Learning area:* This is the new term for a subject curriculum. It demarcates the area of learning eg. Technology, mathematics, natural science, etc.

- *Learning programmes:* This is the content of what is to be learned in the classroom. Previously known as a subject syllabus.

- *Range statements:* Refers to the scope of what is to be learned. It sets the parameters of what is to be taught at a particular level; essentially restricts the amount of detail required for that level of learning.

- *Performance indicators:* This defines the outcomes. What has a learner accumulated during a certain period of learning and how is this performance to be measured.

- *Critical cross-field outcomes:* These are outcomes inspired by the constitution of South Africa. They best describe the kind of citizen the education system should try to produce. There are seven outcomes and they must be evident across all learning areas.

- *Developmental outcomes:* These outcomes support the critical-crossfield outcomes. They add value to the critical-crossfield outcomes. There are five outcomes and they must be evident across all learning areas.

- *Technology pilot project:* This project was started in 1998 and lasted for one year. There were a number of schools selected in three provinces to trial the new curriculum and learning programmes designed and developed by the National Task Team (NTT).

- *Curriculum:* In this study it refers to the body of knowledge that is to be taught to learners at grade 9 level. It describes broadly what learners are expected to learn and what educators are expected to teach in South Africa.

- *Curriculum Design:* This refers to the way in which a curriculum is put together from some type of framework or skeleton structure. In this study it specifically refers to the way in which the grade 9 Technology education curriculum was designed and describes the component parts in detail via the analysis. In this study it also includes the development of the curriculum.

- *Curriculum Development:* In some readings there are suggestions that design and development of a curriculum are carried out in separate work sessions. Development specifically refers to 'fleshing out' the skeleton framework with some content and organized in a certain way.This study includes the development of the curriculum with the design process as one continuous activity. In South Africa this process resulted in a curriculum policy document (October 1997).

- *Previously disadvantaged learners:* Learners who were pre-1994 not afforded equal opportunities with the other racial groups in South Africa. Many of the predominantly black communities throughout South Africa These learners are now afforded an equal opportunity in South Africa according to the constitution but for the purposes of my references I choose to use this name to refer to this specific group of learners.

- *Educators:* In the old education system (pre-1994) the term commonly used was teachers. OBE terminology uses the term educator to mean a teacher.

- *Constitution of South Africa:* Adopted on 8th May 1996 and amended on 11th October 1996 by the constitutional assembly this document contains the fundamental rights of an individual who is a citizen of South Africa.

- *Resources:* Refers to the tools, equipment, materials, buildings, money, etc. that is required for the purpose of teaching and learning Technology education in South Africa.

- *Methods of training of educators::* The training of educators for the specific purpose of making them more knowledgeable about a particular topic or course. In South Africa there are three recognized methods of providing training; a *formal* course refers to a course offered at an institution for higher education and training (HET), *short courses* offered either by an HE institution or by members of the department of Education (DoE) during the normal day (in-service) or after normal teaching hours (part-time), and *cascade* training that is based upon the assumption that the DoE or a special training provider can train a core of educators for a special purpose (eg. for OBE) and they will return to their schools and train their neighbouring school educators (in a cascade fashion).

- *Department of Education:* The Department of Education (DoE) as it is referred in the text means the national department of education based in

Pretoria. These members are responsible for providing the education needs of South Africa. They are also the main policy makers. They have nine provincial departments of education that ensure the policies they make are carried out in the nine provincial regions.The national department of education is headed by the minister of education (Prof Kader Asmal at present) who reports to the national assembly. This national structure is supported by nine provincial ministers of education who represent the respective provinces.

- *CHED:* The committee of heads of departments of education established in 1994 and amended in 1995 to become HEDCOM.

- *HEDCOM:* Heads of Education Departments Committee established in 1995 to oversee education in all provinces.

- *Technology education:* The main focus of this study. It is the knowledge, skills values and attitudes that learners acquire while following the learning programme (Technology) designed by South Africans and presented in a policy document in October 1997. Technology education in South Africa has a specific focus on developing problem-solving skills, creative thinking, working independently or in a group, and finding logical solutions, when planning, designing, making an artifact or project to suit a particular need or want according to the technological process (design process). This technological process appears as specific outcome #1 (SO#1) in the Technology curriculum policy document (Oct.1997). Great emphasis is placed on values in society and care for the environment as well.

Appendix G

Structure of the National Qualification Framework (NQF)

Structure of The NQF

<table>
<tr><th>NQF Level</th><th>Band</th><th colspan="2">Types of Qualifications and Certificates</th><th colspan="3">Location of Learning for units and Qualifications</th></tr>
<tr><td>8</td><td rowspan="4">Higher Education and Training</td><td colspan="2">Doctorates
Further Research Degree</td><td colspan="3">Tertiary / Research / Professional institutions</td></tr>
<tr><td>7</td><td colspan="2">Higher Degrees
Professional Qualifications</td><td colspan="3">Tertiary / Research / Professional institutions</td></tr>
<tr><td>6</td><td colspan="2">First Degrees
Higher Diplomas</td><td colspan="3">Universities / Technicons /Colleges / Private / Professional Institutions / Workplace</td></tr>
<tr><td>5</td><td colspan="2">Diplomas, Occupational Certificates</td><td colspan="3">Universities / Technicons /Colleges / Private / Professional Institutions / Workplace</td></tr>
<tr><td colspan="7">Further Education and Training Certificates</td></tr>
<tr><td>4</td><td rowspan="3">Further Education and Training</td><td colspan="2">School / College / Trade certificate</td><td rowspan="3">Formal High schools Private/
State Schools</td><td rowspan="3">Technical / State Schools Community Police /
Nursing</td><td rowspan="3">RDP and Labour Market Schemes
Industry training boards</td></tr>
<tr><td>3</td><td colspan="2">School / College / Trade certificate</td></tr>
<tr><td>2</td><td colspan="2">School / College / Trade certificate</td></tr>
<tr><td colspan="7">General Education and Training Certificate</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">General Education and Training</td><td>Senior Phase</td><td>Abet 4</td><td rowspan="4">Formal
Schools</td><td rowspan="4">Occupation
Workbased Training</td><td rowspan="4">Schools
Abet Programmes Work Place</td></tr>
<tr><td>Intermediate Phase</td><td>Abet 3</td></tr>
<tr><td>Foundation Phase</td><td>Abet 2</td></tr>
<tr><td>Preschool</td><td>Abet 1</td></tr>
</table>

Appendix H

Implementation and Development Time Frames Reported in the NTT Business Plan (18 November 1996)

APPENDIX A

TECHNOLOGY 2005: IMPLEMENTATION AND DEVELOPMENT TIME FRAMES

DATES	STAFFING, INFRASTRUCTURE AND RESOURCES	OUTCOMES AND LEARNING PROGRAMME DEVELOPMENT	TEACHER EDUCATION	PROJECT EVALUATION	ADVOCACY AND LINKS
April - June 96	Provincial Coordinators identified National Task Team appointed Provincial Project Committees in place	National Framework Document finalised National Technology Education Forum reviews NFD	Specialist Committee Teacher Education completes initial review of institutions intending to offer technology education	Define evaluation goals and strategy Develop trial instruments to assess levels of Technological Literacy in pilot and other schools	Establish links with Directors of the ECD and SYSTEM projects Links to museum services projects Links to Directorate ABET
July - Sept 96	1996/97 budgets transferred to provinces	Review NFD Submit NFD to review in terms of Learning Area Committee development	Follow-up questionnaire finalised and distributed	Obtain baseline data on provinces and project committees Refine and finalise instruments	Meet representatives from the National Training Board, DBSA and Professional Bodies
October - Dec 96	Equipment for Provincial Task Teams, Pilot schools, and teacher training institutions to tender Pilot schools and institutions identified Provincial Task Teams advertised	National Task Team prepares workshop materials for Provincial Task Teams. NTT - review of best practice in SA, Netherlands and Scotland NTT - additional experience in outcomes based curriculum development and assessment	Guidelines for institutions wishing to offer Technology programmes completed and distributed Follow-up questionnaire analysed	Trial assessment instruments Establish research networks with education research institutes in the provinces	Provincial Coordinators establish links with ECD Coordinators and explore possibilities of sharing pilot sites / other collaborative development strategies
January-March 97	Provincial Task Teams appointed Selected pilot institutions resourced	WORKSHOP 1: for Provincial Task Teams - setting goals and time frames - developing Provincial Learning Programmes	WORKSHOP 1: for Teacher Education institutions	Obtain baseline data on levels of Technological Literacy in pilot schools	ECD and SYSTEM share school and teacher education sites
April - June 97	TEACHER INSET 1: for teachers in first cohort of pilot schools Prepare budgets for 1998	WORKSHOP 2: fro Provincial Task Teams - developing sample teaching and assessment materials - trialing procedures in schools ..	Revise guidelines for the development of teacher education programmes	Coordinate provincial and national research initiatives	Begin to develop links/ partnerships between pilot schools and business/ industry
July - Sept 97	Teachers work with Prov Task Teams in developing and trialing materials in schools	Trialing materials with selected pilot schools.			
October - Dec 97	TEACHER INSET 2: for teachers from full complement of pilot schools Further pilot institutions resourced	WORKSHOP 3 to review and refine outcomes and materials developed in 1997 for full implementation in 1998 Complete FIRST COMPLETE DRAFT of materials and outcomes	WORKSHOP 2: for Teacher Education institutions whishing to begin courses in 1998	Run second set of Technological Literacy assessment instruments Submit FIRST DEVELOPMENT REPORT	
January-March 98		Implement FIRST COMPLETE DRAFT of materials and outcomes in full complement of pilot schools			
April - June 98	TEACHER INSET 3: refining skills of all teachers from full complement of pilot schools Prepare budgets for 1999	WORKSHOP 4. to review and refine outcomes and materials implemented in 1997			

DATES	STAFFING, INFRASTRUCTURE AND RESOURCES	OUTCOMES AND LEARNING PROGRAMME DEVELOPMENT	TEACHER EDUCATION	PROJECT EVALUATION	ADVOCACY AND LINKS
July - Sept 98				Submit SECOND DEVELOPMENT REPORT	
October - Dec 98	TEACHER INSET 4: preparing pilot school teachers for the systematic stepping out o the project in 1999				
January-March 99	Resourcing schools in the first stepping out phase TEACHER INSET 1A: for teachers from schools involved in the first stepping out phase	Finalise outcomes, sample assessment profiles, teacher support materials and a National Framework upon which broader implementation can be based		Submit FINAL DEVELOPMENT REPORT including recommendations on teacher ed., INSET and broader implementation strategies	

Appendix I

Summary of Provincial Data Reported in the NTT Business Plan (18 November 1996)

TECHNOLOGY 2005

SUMMARY OF PROVINCIAL DATA

1. PROVINCIAL PROFILES

1.1 Statistics

	No. of primary schools	No. of sec. schools	No. of tech colleges	No. of colleges of education	No of tertiary institutions	No. of teachers	No. of pupils
ECP	2 858	744	27	19	4	64 735	2 378 644
FRS	2 361	238	10	9	4	24 570	775 317
GTG							
KZN	3 750	1 274	23	19	6	74 440	2 661 245
MPU							
NRP							
NWP	1 627	668	7	7	2	31 000	950 000
NCP	332	62	6	2	0	7 576	208 769
WCP	1 164	436	18	8	3	32 249	863 553

1.2 Growth &Development Issues

	Remarks
ECP	
FRS	
GTG	
KZN	Large No. of unresourced schools (material & human); Lack of stable & permanent bureaucracy - creates uncertainty as to procedure; Extensive delays in appointments
MPU	
NRP	
NWP	
NCP	
WCP	

2. IMPLEMENTATION

	Project comm's	Funding D o E	Funding Other	Pilot schools	Resources	Links to other projects
ECP	YES	NO	YES	YES	Not yet ready	
FRS	NO	NO	YES	NO	Planning	No formal links
GTG	YES	YES		YES	Urgently required	Yes
KZN	YES	NO	YES	NO		
MPU						
NRP						
NWP	NO	YES			None	Yes: Protec
NCP	YES	YES		NO	Purchasing in process	Yes: Protec; Telmast
WCP	YES	YES	NO	YES	In process	

	Teacher Education	NGO Projects	Curriculum development
ECP	Not yet started	May '97: ORT-STEP workshop for pilot school teachers	In process
FRS	By Prov Task Team once appointed	ORT-STEP and Protec at various centres	No development yet
GTG	By ORT-STEP and negotiating with RAU	RADMASTE - Pilot schools and teacher training	Draft curriculum framework document finalized
KZN	PRESET: Primary school at Edgewood college	Protec: monthly 2 day workshops for high school students ORT-STEP: Students & teachers	Some initial work during '94 by ex NED
MPU			
NRP			
NWP	INSET - by Potch. College of Educ.	None	
NCP	None	None	In process of establishment
WCP	By departmental trainers	ORT-STEP workshops & teacher training	Receiving attention

H F le Roux, 18 November 1996

Appendix J

Photographs of Pilot Project Schools

&

Overseas Visits

Appendix J

Photographs of Pilot Project Schools

Visit to

Kwazulu/Natal Province
(School #1)

Appendix J

Photographs of Pilot Project Schools

Visit to

Kwazulu/Natal Province
(School #2)

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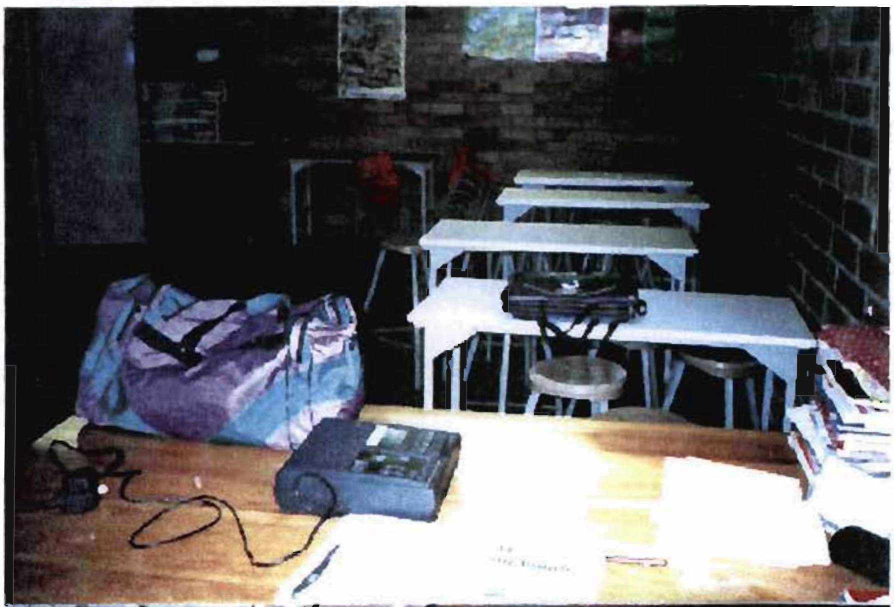
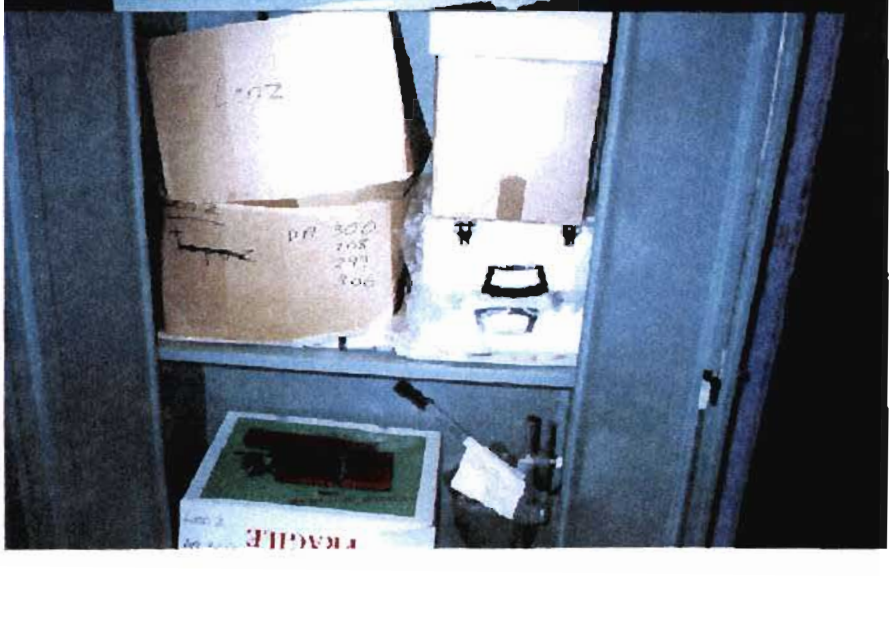
Appendix J

Photographs of Pilot Project Schools

Visit to

Gauteng Province
(School #3)





Appendix J

Photographs of Pilot Project Schools

Visit to

Gauteng Province
(School #4)


MECER
Mustek


SECONDARY SCHOOL
TOPAZ

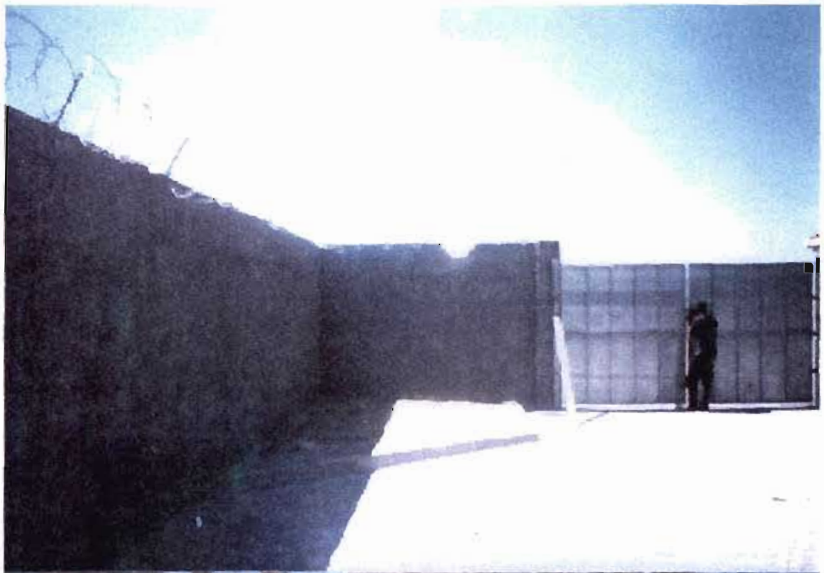
Appendix J

Photographs of Pilot Project Schools

Visit to

Western Cape Province
(School #5)



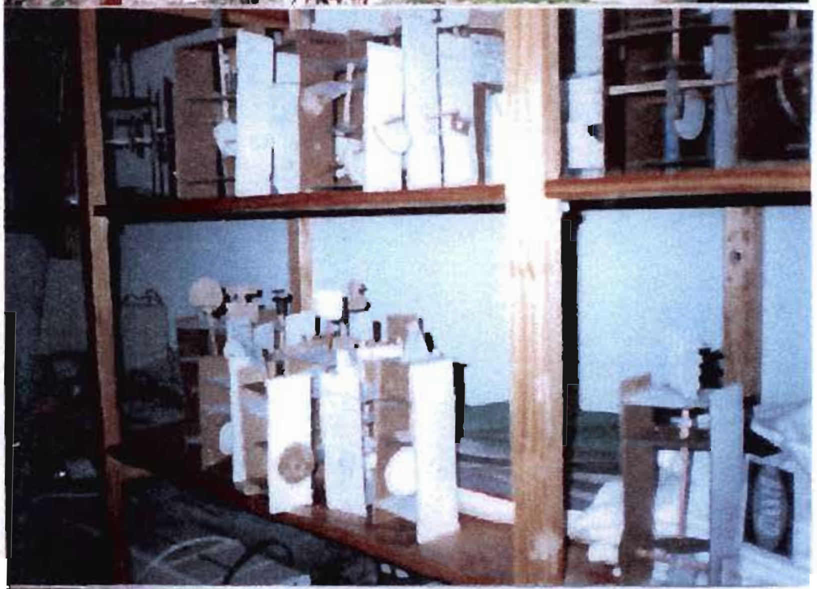
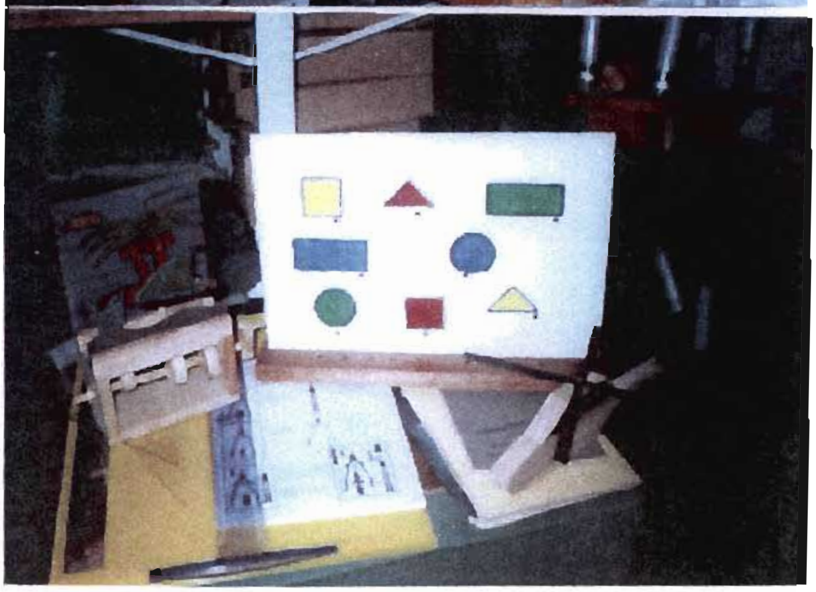


Appendix J

Photographs of Pilot Project Schools

Visit to

Western Cape Province
(School #6)

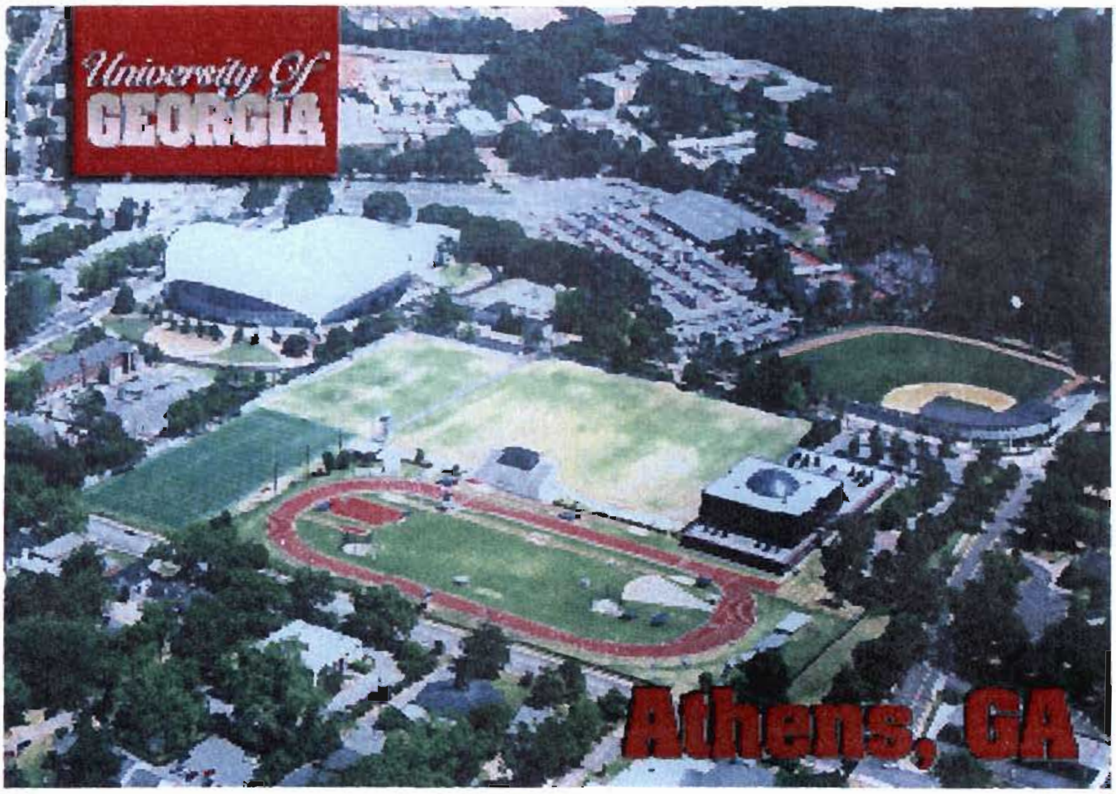
Appendix J

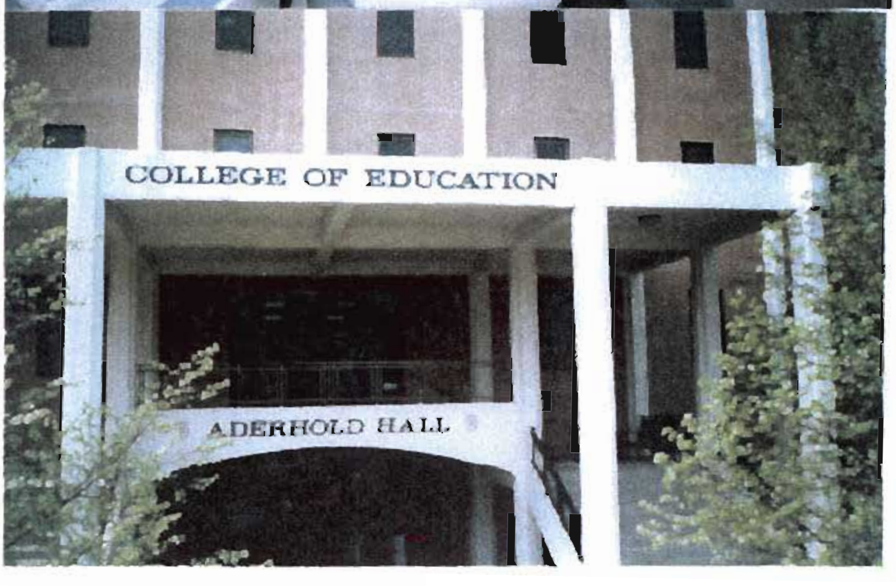
Photographs of Overseas Visit

To

USA

(University of Georgia – Athens)


University Of
GEORGIA
Athens, GA


COLLEGE OF EDUCATION
ADERHOLD HALL

Appendix J

Photographs of Overseas Visit

To

United Kingdom
(Goldsmiths College – University of London)


GOLDSMITHS COLLEGE

Appendix J

Photographs of Overseas Visit

To

Scotland

(Grange Academy – Technology Centre)