CHAPTER 1

ORIENTATION AND OVERVIEW

1.1 BACKGROUND AND RATIONALE OF THE STUDY

The national implementation of Technology is a relatively new learning area in Curriculum 2005 (C2005) and the Revised National Curriculum Statements (RNCS) in the General Education and Training (GET) Band. This band comprises Grades R to 9 and Adult Basic Education and Training (ABET) levels one to four. This implies that schools are faced with demands pertaining to financial costs, human and physical resources. These are perceived as challenges facing the reconstruction of education (Anckiewicz, 1995: 245; Hugh, 2003:1).

Technology is associated with many different fields. It has been linked with tools and machines, Applied Science and most recently has been equated with Information Technology (Mallet, 1997:1; Manitoba Publications, 2006:1). It is multi-faceted and no single definition of Technology would explain the concept. For the purpose of this study, Technology would be assumed to be the use of knowledge, skills and resources to meet human needs and wants across all cultures by solving practical problems.

The introduction of Technology as a learning area in schools has produced a challenging future for all those involved with every aspect of Technological education. This challenge is particularly relevant to the educators whose future responsibility will be to implement this exciting learning area as members of the school based Technology teams. Teaching Technology makes a unique contribution to the education of all learners. It prepares them to work in a rapidly changing technological world by introducing them to the design methods and skills needed to produce practical solutions to real problems (Black, 1998:2; Anonymous, 2002:2).

The successful implementation of the Technology curriculum is dependent on educators at all levels having a solidly established personal construct of Technology, equivalent to that of the curriculum. The views of educators about the nature of Technology are of great concern to curriculum support specialists at in-service level

(Nkotsoe, 2004:4). In an examination of the dimensions of Technology, Custer (1995:219) argues that there is a critical need for all individuals to develop at least minimum levels of the understanding of Technology as it has a profound influence on all parts of human life in the world. Technological literacy is becoming one of the backbones for development through education on a global scale.

Some form of Technology Education has been implemented in most countries of the world (Williams, 1996:266). However, as Technology is new in the South African curriculum, there are many questions that remain unanswered about its implementation. According to Mallet (1997:1) and Kumar (2003:2), this is mainly the case in developing countries or Newly Industrialized Countries (NICs). This study focused on the concerns about the quality of Technology education provided by schools. It explored the possibilities of developing an approach for promoting quality implementation of Technology as a learning area in the North West Province of South Africa.

The rationale of the study can be discussed as follows:

1.1.1 Redress of past inequities

The entire South Africa Education system is changing to address the problems inherited from the past. One of the most serious problems is the irrelevance of the curriculum and its inability to prepare learners for entry into the world of work because they leave schools without an adequate balance of skills, knowledge or attitude forming capacity (Chisholm, 2000:20).

The introduction of Technology Education in the school curriculum suggests the need to promote technological literacy and economic development of the country (Technology 2005 Project, 1996:29). From this exposition about the implementation of the new curriculum (C2005 & RNCS), this study will, it is hoped, contribute by coming up with an approach for the implementation of Technology Education in schools.

1.1.2 Technology education and workforce productivity

The modern workplace is becoming increasingly technological in nature. This implies that the level of technological literacy needed by the individual at work should be addressed if productivity is to increase. The entire Reconstruction and Development Programme (RDP) depend partly on education's capacity to address basic technological literacy. Eight of the ten priority areas earmarked for development in the RDP are directly dependent on Technology. These include:

- Electrification
- Housing
- Telecommunications
- Transport
- Water and Sanitation and
- Nutrition and Health

(Technology 2005 Project, 1996:13).

1.1.3 The role of Technology Education in Economic Development

The South African economy must improve its international competitiveness in order to:

- Allow South Africa to re-enter the global economy and to
- Avoid the debt trap that has plagued many developing countries and leading them to accept a high level of foreign aid.

In the last few years South Africa has ranked low in World Competitiveness in the Competitiveness Report category in respect of Human Resource Development. Over 50 countries, including all our major competitors, have included Technology Education as a major part of their pre-tertiary curriculum. South Africa's failure to keep pace with Technology Education does not support plans to sustain re-entry into the global economy (Eksteen, 1991:54; Anonymous, 1999:1).

1.1.4 Contribution of Technology Education to Science and Mathematics Education

The existing Science, Mathematics and other work related subject curricular are in a parlous state. International experience shows that Technology Education supports improvement in these subjects for learners who study Science and Mathematics. In England and Wales Technology is offered as a compulsory General Education subject (Potgieter, 1994:20; Clark, 1998:10).

1.1.5 Career Development

There is little in the way of useful career development in schools, especially in areas of Science and Technology. Both the state and the private sector have recorded their concern about the gap between the national curricula and the needs of the new democracy and the economy. The National Education Department has already committed itself to programmes aimed at improving national capacity for economic growth. These Programmes include Technology Education and Business Projects as priorities (Kramer, 1996:26; UNESCO, 1998 (a):4).

1.1.6 Relevance of the study with regard to Technology 2005 Project

In 1994 the Interim Committee of Heads of Education Departments (ICHED) set up a committee to investigate the feasibility of Technology Education in South Africa. Various stakeholders were involved, including those from industry and education in exploring a draft experimental curriculum. The committee adopted the title: Technology 2005 Project: The Heads of Education Departments Committee (HEDCOM) Technology Education Project. They declared the vision of the project which shows that by the year 2005 Technology Education should be part of every boy, girl, teacher and adult learner in order to bring the desired learner outcomes, which will enable them to become creative, critical, entrepreneurial and employable citizens who can contribute meaningfully and responsibly to the South African economy (Technology 2005 Project, 1996:29; Khumalo, 2004:1). In 1996 the National Project Committee (NPC) enlarged its territory by forming the National Task

Team (NTT) with the view to support the curriculum development process and oversee project implementation in the provinces.

The recommendations of the NTT were overtaken by the developments of Curriculum 2005. Without their submission, a National decision was taken to incorporate Technology into the Curriculum (Mouton, Tapp, Luthuli & Rogan, 1998:4). There are still many unanswered questions regarding its implementation. Some of those questions include whether Technology should be offered as a separate learning area or as an area linked with Science. Against this background, the question arises: Is Technology curriculum implemented to its defined standards?

1.1.7 Relevance of the study with regard to the North West Science Technology Education Project (STEP)

STEP is a provincial component of a wider national project called Technology 2005. This has been mandated by the Heads of Education Departments Committee (HEDCOM) to assist with the implementation of Technology Education in all the Provinces of the Republic of South Africa (Tholo, 1999:34). In the period January to May 1996, the Province made arrangements to establish a project committee and to help with the selection of high schools for implementation in the province in accordance with project agreed criteria.

In the period June 1996 onwards the project managed the selection of nominated Technology educators for each participating school. The project further provided the necessary orientation for the principals of selected schools, and helped with the distribution of materials and equipment to the schools. Ten schools were selected and training was provided to educators (Tholo, 1999:34).

1.2 STATEMENT OF THE PROBLEM

Technology Education needs approaches that build upon the best thinking in the field and also takes into account special needs of learner populations and the particular context in which Technology is offered. This research proposed to identify the elements of strong Technology Education planning, and building on those elements to offer an implementation approach useful to educators and curriculum developers. The introduction of Technology education in South African schools can best be described as uneven (Stevens, 2001:235). There are no clear local working approaches of Technology education in typical public schools, particularly those that were controlled by the defunct Department of Education and Training (DET).

There is no precedent work for a large scale Technology Education project. This study therefore draws heavily upon the National Curriculum Framework emerging from the Technology 2005 education project. Most South African Provinces have already implemented pilot projects in Technology education. These include Programme for Technological Careers (PROTEC) which managed Technology Education projects in Mpumalanga, the Northern Cape, Eastern Cape, Kwa-Zulu Natal, Free State, Western Cape, Limpopo and Gauteng Provinces. This was done in order to test the suitability of Technology as a school subject in South Africa. Teacher training courses have been initiated at the University of Natal, University of Western Cape and at the University of Johannesburg.

Pilot projects in schools as part of Technology 2005 for all provinces were planned in the second half of 1996 (Tholo: 1999:29). These were planned to be implemented at different educational levels, both primary and secondary. The National Education Department allocated funding but unfortunately these projects were successful in three provinces only, namely: Kwa-Zulu Natal, Gauteng and the Western Cape (Mouton, Tapp, Luthuli & Rogan, 1998:8). The work of the Provincial Task Teams (PTTs) in Provinces virtually collapsed and there was no Department which acted as a driving force foreseeing the introduction of Technology into schools. The researcher is in total agreement with Stevens; (2001:235), when he says:

> "*To this day it is difficult to assess the role that certain education departments are playing in supporting, co-ordinating or managing Technology in schools*".

Technology was introduced in South Africa as part of Curriculum 2005(C2005) in 1998 (Potgieter, 2004:208) and subsequently became part of the Revised National Curriculum Statements (RNCS) and the first learners to have studied Technology will graduate in 2008 (Howie, 2001: 47). Technology is a new learning area worldwide (Senesi, 1998: 27; Zuga, 2002: 16; Reitsma & Mentz, 2006:606), especially in developing countries of Africa, South America and Asia. According to Khumalo (2004: 4) and Pavlova (2005:199), Technology as a learning area can bring social transformation. Educators are desperate in implementing the curriculum changes (Chisholm, 2000:44). The rate of implementation was too rapid and was not properly resourced (Chisholm, 2000:10). This transformation in the Technology perspective suggests the need to promote technological literacy, attitudes and interest in technological careers in view of the economic development of the country.

The Department of Education (South Africa) has introduced a national strategy for Mathematics, Science and Technology education in General and Further Education and Training (DoE, 2001(a):5). The main aim of the strategy is to provide quality education to all learners as well as to improve human resource capacity in Mathematics, Science and Technology education. The Department of Education has committed itself to support those educators, involved in the teaching of Technology education to study at higher institutions (DoE, 2001(a):12).

The curriculum overload identified in the curriculum review report is a matter of concern, and the Council of Education Ministers (CEM) recognizes the fact that educators for the areas of Technology and Economic and Management Sciences are not available at present (DoE, 2000(b):4). However the importance of these learning areas in the 21st century means that CEM cannot support the proposal to drop them (CEM, 2000:7). The review committee also realizes that the vast majority of schools do not have training in Technology and there is a shortage of equipment and learning support material (DoE, 2000(b): vi-vii). They recommended that:

> " *In order to address overcrowding of the curriculum in the General Education and Training (GET) Band, it is proposed that learning areas in this band be reduced from eight to six and that more time be allocated to Mathematics. These rationalized learning areas should include Languages, Math, Science and Technology, Social Sciences (History and Geography), Arts and Culture and Life Orientation".*

The review committee attached a lower status to Technology and suggested that it should be offered as an integrated subject/learning area. These views can confuse the initiatives of sustainable development in a country where communities are exposed to first and third world life styles (Potgieter, 2004: 208). Technology education has the potential of addressing the problems of coping with these changes (Draghi, 1998:85).

Political independence in Africa was an important factor contributing to the development of Science and Technology. According to Yolowe (1998:2), the following recommendations were made at the 1960 Rehevoth (Israel) conference regarding Science and Technology:

> "*The governments of developing states should regard the furtherance of Science and Technology as a major objective of their national politics and make appropriate provision for funds and opportunities to achieve this end...until such time as their own scientific manpower is adequate, new and developing states would be well advised to seek the help of scientific advisors and experts from friendly countries and international agencies to help them develop a scientific practice and tradition*".

Furthermore, the 1961 Addis Ababa (Ethiopia) conference of African States on the development of Education in Africa, which was organized by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), recommended that:

> "*African educational authorities should revise and reform the content of education in the areas of curriculum, textbooks and methods, so as to take account of the African environment, child development, cultural heritage and the demands of technological progress and economic development, especially industrialization*" (Yolowe, 1998:2).

The educators' perceptions influence the approach they take to the teaching of Technology (McRobbie; Ginns & Stein, 2000: 81). Ogawa (2003:147) asserts that educators' belief, knowledge and practices influence how they implement curriculum policy. Zuga (2002:10) indicates that understanding the curriculum of Technology impacts on the teaching of this learning area.

There are currently a variety of pedagogical approaches to introduce Technology. In the foundation phase there are three learning programmes and Technology forms part of Life Skills. In the Intermediate phase there are five learning programmes and

Technology is integrated with the Natural Sciences. In the senior phase there are eight learning areas and Technology is a self-standing learning area (DoE, 1997:35). A summary of the implementation plan for C2005 is reflected in Figure 1.1.

FOUNDATION PHASE	IMPLEMENTATION GRADE 1	IMPLEMENTATION GRADE 2	IMPLEMENTATION GRADE 3
Life Skills	Year 1998	Year 1999	Year 2000

INTERMEDIATE PHASE	IMPLEMENTATION GRADE 4	IMPLEMENTATION GRADE 5	IMPLEMENTATION GRADE 6
Natural Sciences and Technology	Year 2001	Year 2002	Year 2003

SENIOR PHASE	IMPLEMENTATION GRADE 7	IMPLEMENTATION GRADE 8	IMPLEMENTATION GRADE 9
Technology	Year 2000	Year 2001	Year 2002

Figure 1.1: Implementation plan for Curriculum 2005

In 1998 Technology was introduced as part of Life Skills in Grade 1, followed by Grade 2 in 1999. In the year 2000 Technology was implemented in Grades three and seven while in 2001 it was implemented in grades fourth and eighth grades. In 2002 it was implemented in Grades five and nine and the last implementation was in 2003 for grade six. It goes without saying that the implementation was hurriedly done without sufficient support and reflection.

Given that there is a lengthy debate about the nature of Technology education and that current practices may be seen as transitional in nature, there are shortcomings in these practices that need to be addressed. A problem shared with other learning areas such as Natural Sciences is the lack of depth. There is a need to balance the offering of the integrated learning programme with critical thinking. It is recognized that knowledge of Natural Science would enrich and result in effective technological literacy especially the design process (Mooa, 2004:2). Given the time constraints faced by primary school educators, this possible enrichment tends to be neglected.

Science is normally associated with Technology. This linkage is so common that Science and Technology are often assumed to share a common methodology and a common community of practitioners (Frey, 1995:7; Williams, 2000:641). Despite these perceived commonalities, Science is generally perceived to be superior to Technology. As educators implement Technology education in schools, they may find that the integrated curriculum is equated with Natural Sciences. Now, even more, educators of Technology education need a clear understanding of similarities and differences between Science and Technology.

However, in the year 2000 C2005 was revised (DoE, 2005:1) and the implementation plan is shown in Figure 1.2. below. This curriculum is referred to as the Revised National Curriculum Statements (RNCS). The researcher feels that still the implementation was rushed. The curriculum was introduced in the Foundation Phase in 2004 without building sufficient capacity for educators to teach the learning programme. In 2005 it was implemented in the intermediate phase. The implementation plan of the RNCS, now confirmed as the National Curriculum Statements (NCS) for the GET is interesting. All learning areas including Technology are phased in grade by grade as from 2006 until 2008 (DoE, 2005:9). Will a year difference make any impact towards capacitating educators and resourcing schools for full-scale implementation? What approach and strategy will the Department of Education adapt in implementing the NCS in the GET especially Technology? These are some of the questions which need answers.

FOUNDATION PHASE	IMPLEMENTATION GRADE 1	IMPLEMENTATION GRADE 2	IMPLEMENTATION GRADE 3
Life Skills	Year 2004	Year 2004	Year 2004

INTERMEDIATE PHASE	IMPLEMENTATION GRADE 4	IMPLEMENTATION GRADE 5	IMPLEMENTATION GRADE 6
Technology	Year 2005	Year 2005	Year 2005

SENIOR PHASE	IMPLEMENTATION GRADE 7	IMPLEMENTATION GRADE 8	IMPLEMENTATION GRADE 9
Technology	Year 2006	Year 2007	Year 2008

Figure 1.2: Implementation Plan for the Revised National Curriculum

This study is designed to address the lack of information in the literature on how to address Technology education implementation in senior phase schools in order to create Technology-rich learning and teaching environment in the classrooms. The intention of creating this environment is to provide opportunities for both learners and educators to learn and teach Technology well in order to provide positive attitudes toward and greater understanding of technological concepts. Wright (1999:61) points out that:

> *"The technology education profession does not have a clear understanding about its unique contribution to children, about what it does better than anyone else in the school. There are many benefits of elementary school technology education (ESTE) to children, but no conclusive evidence to support the claims"*

Although the National Curriculum Statements for Technology education (DoE, 2002:5) has been disseminated, research is needed to indicate the type of educational activities that will enable educators in the classroom to meet the Technology curriculum statements. Educators need to know the type of activities and experiences that could be used to ensure learner development and understanding of technological concepts. The purpose of this study is to explore learners' understanding and concepts of Technology as well as educators' attitudes toward Technology and come up with a suitable approach for the North West Province.

The current study is modeled on research synthesised from studies of Mallet (1997:4) and Holland (2004:16). These studies reflect research efforts to identify suitable approaches for the implementation of Technology as well as assessment of instructional strategies in Technology education. According to Holland (2004:16) assessing learners' cognitive ability resulting from various instructional approaches is difficult. However, measuring learners' attitudes toward Technology may reveal the teaching approaches that relate to positive attitudes toward Technology.

There is no approach for implementing Technology in the North West Province. The main reason is that the curriculum designers do not have sufficient capacity, theoretical framework and knowledge of the different approaches to Technology Education internationally. Therefore the main research question reads as follows: What is the appropriate approach in local context for the implementation of Technology Education in schools in the North West Province? Hopefully, this study will add to the body of knowledge about developing technological concepts in the senior phase classrooms and will serve to enlighten Technology educators about their own teaching practice.

1.3 RESEARCH QUESTIONS

The following are the research questions that guided this study:

- What are the challenges experienced by educators, curriculum planners and subject advisors regarding the implementation of Technology in schools?
- Do educators have the necessary qualifications and resources to implement the Technology curriculum to its defined standards after it was declared a policy?
- What are the attitudes and perceptions related to Technology of senior phase learners in schools? Are there gender, location, grade and age differences in learners' attitudes and perceptions related to Technology?

1.4 AIM AND OBJECTIVES OF THE STUDY

The main aim of the study was to come up with an approach for the implementation of Technology Education in the North West Province. To achieve this aim, the study was guided by the following research objectives:

- To identify critical issues in the implementation of Technology Education in schools worldwide;
- To discuss the international models in the implementation of Technology Education in schools by conducting an extensive literature review;
- To document the profile of educators involved in Technology education as well as determining In-service Education and Training (INSET) needs and other forms of support they receive. This will be achieved by empirical investigation;
- To determine educator's attitude towards the implementation of Technology by conducting an empirical investigation;
- To determine Technology resources in schools by conducting an empirical investigation;
- To determine learners' attitudes and concepts of Technology empirically; and
- To record the Technology heads of department, learning area specialists and Technology experts' experiences and perceptions on factors affecting the implementation of Technology.

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1.5 CONCEPTUAL APPROACH

Figure 1.3 shows the conceptual approach for this study. This conceptual approach centres on Technology Education in the senior phase schools in the North West Province of South Africa. It is externally linked to philosophies and worldwide trends in Technology Education. In this context it takes into account the international developments in Technology Education and the study of the implementation of Technology Education in the North West Province. The conceptual approach reflects the constructivist approach in which points of views are considered. Finally, from the fieldwork and the literature review an appropriate approach was derived for the implementation of Technology Education in schools in the North West Province.

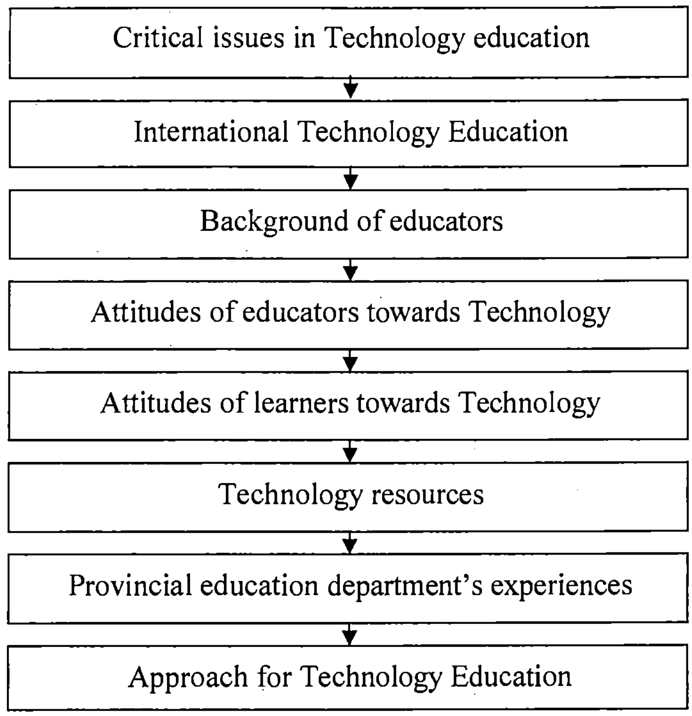

Figure 1.3: Conceptual approach for Technology Education in the North West Province

The purpose of the conceptual approach is to offer meaningful definition of senior phase Technology for educators and learners. What sets the study of Technology apart from other branches of knowledge are the core concepts that help to unify the field and give learners a way to understand the designed world. The areas of knowledge and skills of Technology defined in the Revised National Curriculum Statements are "systems and control, processing and structures" (DoE, 2002:8). The areas of knowledge and skills are the cornerstones for the study of Technology. They should be taught very well as an integrated component of the learning content.

- Systems and control: this content is divided into mechanical and electrical systems. The study of mechanical systems focuses on producing movement in some way, and examines how energy sources can be used to produce movement. The study of electrical systems focuses on the practical use of electrical energy in circuits to satisfy specific needs. The learner explores the systems and control content area through contexts like transport, lighting, household devices, simple machines and so on (DoE, 2002:8);

- Structures: this area focuses on practical solutions that involve supporting loads and ways of making products that are rigid, stable and strong when forces are applied to them. The learner can explore these issues within the contexts of housing, habitats, shelters, containers, towers, bridges, packaging, transport, storage and so on (DoE, 2002:8);
- Processing: this area focuses on practical ways in which materials may be processed or manufactured in order to improve their properties to make them more suitable for their intended use. Materials to be processed include paper, resin, cement, sand and plaster of Paris. The learner explores processing in various ways including moulding, drying, casting, extracting, preserving, heating, laminating and forming (DoE, 2002:8).

Many definitions have been assigned to Technology Education. The concept Technology Education refers to Technology and education of individuals in terms of acquiring knowledge and skills and the use of Technology. It also uses scientific knowledge that involves people and machines (Naughton, 1986:8). Technology is a branch of knowledge dealing with scientific and industrial methods and their practical use in industry (Longman Dictionary of Contemporary English, 1987:1087). Education is the process by which a person's mind and character are developed through teaching, especially through formal instruction at a school or college (Longman Dictionary of Contemporary English 1987:325). Technology has something to do with changing our culture and defining quality (Scheibach, 1988:20). It is derived from the Greek word *teknologia* (The Oxford Companion to the English, Language, 1992: 1025). The word *technic* means an art, skills or craft and *logia* is an area of knowledge or study (The Oxford Companion to the English Language, 1992:1025). Anckiewicz (1995:247; HEDCOM 1996:12) defines Technology in terms of the application of skills and knowledge to solve problems. Technology uses knowledge and skills and involves the appropriateness of technological actions in our society and environment (Norman & Roberts 2005:2). In the light of the above descriptions it goes without saying that in Technology we use skills, knowledge and the available resources to solve problems that are experienced in society.

Technology is a unique human endevour and people interact with it to extend human capabilities (Clarke, 2005: 1). Technology is as old as human beings and has existed throughout history. Today people still have needs and wants. The society of today is very complex and they need modern products that show sensitivity to culture and values (DoE, 2002:4). Technology is human innovation in action (Rasinen, 2003:9). Technology is changing so rapidly that it is difficult for schools to keep up to date technologies in the classrooms (Loveland, 2004: 2). Technology refers to the design, process and product of environmental modification, as well as socio-cultural interactions with these (Khunyakari, Mehrotra, Natarajan & Chunawala, 2005:1). Dillon and Hayes (1994:48) see Technology as having three aspects. These are:

- Technical aspect, which is concerned with the associated knowledge and skills;
- Cultural aspect, which focuses on the underlying values; and
- The organizational aspect, which relates to the economics and sociology of the conduct of Technology and employment of its outcomes.

It is in this context that the researcher is in total agreement with the following definition of Technology: "*The use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration*" (DoE, 2002: 4). Certain skills are required in dealing with the processes, approaches and artifacts (Custer, 1995: 220). Technology also strikes a balance between theory and practice (Middleton, 2000:2; DoE, 2002: 5). "*Technology is rather a way of thinking, a new "worldview", a new organization of meanings and assumptions about the world and human life*" (Williams, 1996:35).

Technology is productive work done by the learners of grades 7 and 8 in earlier socialist industrial or agricultural enterprises (Blandow & Mosna, 1994:94). Technology is a force that reshapes society, the dominant organizer, which fundamentally changes everything (Gradwell, 1999: 241). Technology is the process where knowledge, skills, and resources are applied to identify human needs and problems and to solve it through analysis, planning, manufacturing, implementation and evaluation (Sanders, 1999: 35). Technology can be defined as involving the purposeful application of knowledge, experience and resources to create products and processes that meet human needs (Makgato, 2006: 491).

In view of many definitions of Technology, it is therefore not easy to prescribe a single definition of Technology. The impact of Technology on society is still increasing (Mottier, 1999:5). Technology is a creative, purposeful activity aimed at meeting needs and opportunities through the development of products, systems or environments. Knowledge, skills and resources are combined to help solve practical problems. Technological practice takes place within, and is influenced by social contexts (Black, 1998:2). Technology is the area of human experience, skill and understanding that reflects man's concern with the material culture and with making and doing; that is with the appreciation and adaptation of his surroundings in the light of his material and spiritual needs (Roberts, 1994:172).

According to Gradwell (1999: 245), there are a variety of perceptions on how people view Technology. These views are illustrated in Table 1.1 below. The social dilemmas group is interested in how Technology affects the environment and the society. They perceive Technology as having negative consequences to the environment, culture and resources. The industrialists are concerned more about the economy than the environment. They view society as being global and consuming more products equals a better life. The luddites are concerned about conserving the environment and using renewable resources only. They are of the view that it is not necessary to follow industrial nations but to find better ways relating to culture and society. The greens create non-polluting alternatives to the environment. Whenever they use resources they ensure that they have a second use by recycling them and they prefer the use of indigenous knowledge systems as local alternative.

Social Dilemmas	Industrialists	Technologists	Luddites	Greens
Toxic substances Pollution Environmental effects	Pollution happens but the economy benefits	Technology will cure the problems	The sources of pollution should be eliminated	Invent non-polluting alternatives
Resource exploitation	Build in obsolesce and create new needs	New methods are more efficient and therefore worthwhile	Use renewable resources only	Ensure items have a second use (not discarded)
Matching culture to a society	It is a global society and everyone has to catch up	Advanced nations will solve problems for third world countries	Not necessary to follow industrial nations; find a better way	Use local alternatives Appropriate Technology
Effects on workers	More Technology is ineviTable	More Technology equals a better type of job	Say "no". Don't let Technology displace workers	Consider the workers first
Consumerism	More products equal a better standard of living	More products equal more leisure time	Focus on what is good in the present	Focus on a simpler life

Table 1.1: Visionaries in different settings Gradwell (1999:245)

In the light of the above presentation and the description of Technology, for the purpose of this study the following working definition has been compiled: Technology is the use of knowledge, skills and resources to meet human needs and wants across all cultures by solving practical problems in the natural and man-made environment.

Constructivism is an approach to cognitive development in which learners discover all knowledge about the world through their own activity (Berk, 2000:645). It is based on a combination of a subset of research within cognitive and social psychology. Dewey is considered to be the founder philosopher of this approach (Huitt, 2003:1). In constructivism knowledge is not a fixed object; it is constructed by an individual through his/her own experiences of that object (Hsiao, 2007:3; Doolittle and Camp, 2007:17).

According to Bently and Watts (1994:8) constructivism is

> "a *philosophy and psychology about the way people make sense of the world. The central point is that people are always intellectually active-they do not learn passively, but go out of their way to try to make some meaning in what is taking place in the environment. Our constructions of life are conditioned and constrained by our experiences and this means that-since we all have different experiences-we are all likely to have different perceptions about ideas, actions, behaviors, incidents, situations, tasks, feelings, and so on.*"

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Doolittle and Camp (2007:17) see constructivism in the following manner:

> *"A constructivist pedagogy acknowledges the learners' active role in the personal creation of knowledge, the importance of experience (both individual and social) in this knowledge creation process, and the realization that the knowledge created will vary in its degree of validity as an accurate representation of reality. These four fundamental tenets provide the foundation for basic principles of the teaching, learning, and knowing process as described by constructivism"*

Dewey stressed the importance of having the learners' experience grow from experience. Knowledge and ideas came only from a situation where learners had to draw them out of experiences that had meaning and importance to them (Epstein, 2002:5). These situations have to occur in a social environment, where learners could come together to analyse materials and to create a community of learners who held their knowledge together.

Piaget believed that the fundamental basis of learning was discovery (Epstein, 2002:6). The said researcher goes on to say

> *"To understand is to discover, to reconstruct by discovery, and such conditions must be complied with if in the future individuals are to be formed who are capable of production and not simply repetition"*

The focus of Piaget's theory is the various reconstructions that an individual is thinking goes through in the development of logical reasoning. Vygotsky believed that children learn concepts from their everyday notions and adult concepts. He felt that learners need to be guided by adults, but he also thought that it was very important for the learner to be influenced by their peers as well as discover things on their own (Epstein, 2002:6). He termed this the zone of proximal development. These supports that learners receive from peers and adults are gradually removed as learners develop autonomous learning strategies, thus promoting their own cognitive, affective and psychomotor learning skills and knowledge.

Bruner's major ideas was that learning was an active, social process in which learners construct new ideas or concepts based on their current knowledge. He also advocated that the instructors should try and encourage learners to discover principles by themselves (Chen, 2007:3). According to Huitt (2003:2) Bruner provides the following principles of constructivist learning:

- Instruction must be concerned with experiences and contexts that make the learner willing and able to learn (readiness);
- Instruction must be structured so that it can be easily grasped by the learner (spiral organization); and
- Instruction should be designed to facilitate extrapolation and fill in the gaps (going beyond information given).

Principles of constructivist learning (Epstein, 2002:3) and characteristics that underpin constructivist learning environments (Chen, 1995:1) are shown in Table 1.2.

Principles of learning	**Learning environment**
Learning is an active process in which the learner uses sensory input and constructs meaning out of it	Constructivist learning environments provide multiple representations of reality
Learning consists both of constructing meaning and constructing systems of meaning	Multiple representations avoid oversimplification and represent the complexity of the real world
Physical actions and hands-on experience may be necessary for learning, but is not sufficient; we need to provide activities that engage the mind as well as the hand (reflective activity)	Constructivist learning environments emphasise knowledge construction inserted of knowledge reproduction
Learning involves language: the language that we use influences learning	Constructivist learning environments emphasise authentic tasks in a meaningful context rather than abstract instruction out of context
Learning is a social activity: our learning is intimately associated with other human beings (teacher, adult, family, peers) as well as other causal acquaintances	Constructivist learning environments provide learning environments such as real-world settings or case-based learning instead of predetermined sequence of instruction
Learning is contextual: we learn in relationship to what else we know, what we believe, our prejudices and our fears	Constructivist learning environments encourage thoughtful reflection on experience
One needs knowledge to learn: it is not possible to absorb new knowledge without having some structure developed from previous knowledge to build on	Constructivist learning environments context and content dependent knowledge construction
Learning is not instantaneous: it takes time to learn	Constructivist learning environments support collaborative construction of knowledge through social negotiation, not competition among learners for recognition
The key component to learning is motivation	

Table 1.2: Principles and characteristics of constructivist learning (Chen, 1995:1; Epstein, 2002:3)

According to Chen (1995:2) constructivism embodies two major perspectives, namely cognitive constructivism and social constructivism. In cognitive constructivism the role of the educator is to provide a classroom full of interesting things that will encourage the child to construct their own knowledge to have the ability to explore (Epstein, 2002:4). Social constructivism emphasizes the importance of culture and context in understanding what occurs in society and construct knowledge based on this understanding (Kim, 2006:2).

Recent trends in educational reform have their basis in constructivism (Epstein, 2002:4). The said researcher goes on to suggest that since constructivist theory addresses higher cognitive skills, problem solving and collaborative work skills, it may provide a valid framework in which to organize and synthesise the knowledge and concepts within Technology education. Holland (2004:50) presented essential factors of a constructivist pedagogy that may lay a foundation for the teaching of strategies and approaches in an elementary school Technology education classroom. She proposed that real world environments be the setting for learning; content and skills addressed should have personal relevance for the student and taught with regard to the learners' prior knowledge; assessments should provide information for educators on which they can develop future learning experiences; learners should be encouraged and taught to have a role in assessment of their progress and learning; educators should serve as mentors, facilitators, and guides to learners rather than merely instructors; and educators should teach learners to view content from multiple viewpoints and perspectives.

Constructivism provided the theoretical framework for this study because learning by doing and simulations of occupations are the basis for much of the instruction in Technology education. Although constructivism is not a theory of teaching, it suggests taking a radically different approach to instruction from that used in most schools. The best way to learn is not from lectures, but by letting learners construct knowledge for themselves. Learners should have a constructivist educator along with a constructivist classroom to help them discover new things for themselves. Constructivism promotes increased social interaction and discussion in the classroom, both between educators and learners and between learners.

The question as to how these research objectives could be realized remains of primary importance. Which research strategy and methods will be employed? These questions are discussed in the next paragraph.

1.6 OVERVIEW OF RESEARCH DESIGN

The study is framed within two methodological research perspectives of qualitative and quantitative procedures. Qualitative research stresses the validity of multiple meaning structures and holistic analysis (Burns, 1994:11). In this study using qualitative and interview methods, Technology experts, curriculum specialists (subject advisors) and learning area heads were asked to participate in individual interviews related to the implementation of Technology. The individual interviews included questions to reflect the seven primary research questions.

Quantitative research is all about quantifying the relationships between variables (Hopkins, 1998:2). In this study, two quantitative instruments were used to collect data from senior phase learners and educators. First a Likert-type survey, Learners' attitudes toward Technology, was administered to assess learners' attitudes related to Technology and to assess learners' conceptual understanding of Technology. Secondly another survey, Technology educators' questionnaire was administered with the following aims:

- To document the profile of educators involved in technology education as well as determining In-service Education and Training (INSET) and other forms of support they receive.
- To determine educators' attitudes towards the implementation of Technology as a learning area in schools and
- To determine available technology resources in schools

Statistical procedures using the Statistical Programme for the Social Sciences (SPSS) were used to analyse responses to the Learners' attitudes and concepts of Technology survey. Learner scores were averaged across learners and by age, location, grade and gender. Qualitative procedures, including coding and scoring were used to analyse

Technology experts, learning area heads and curriculum specialists' responses to the individual interview questions.

A detailed account of the research design employed in this study appears in chapter 4.

1.7 DEFINITION OF TERMS

1.7.1 Technology

Technology is a disciplined process using knowledge, skills and resources to meet human needs and wants by designing, making and evaluating products and processes (Technology 2005 Project, 1996:12). Technology is rather a way of thinking, a new worldview, a new organization of meanings and assumptions about the world and human life (Williams, 1996:35). Technology is the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration (DoE, 2002:4). In this study Technology is assumed to be the use of knowledge, skills and resources to meet human needs and wants across all cultures by solving problems.

1.7.2 Technology Education

Technology Education derives elements of its philosophy from critical outcomes, and from those relevant sections of the society and the natural world that are related to Technology (Williams, 1996:26). For example, the critical outcomes envisage learners who are able to use Science and Technology effectively and creatively as well as being able to show responsibility towards the environment and the health of others (DoE, 2002:1). Technology Education is a planned process designed to develop learners' competence and confidence in understanding and using technologies and in creating solutions to technological problems (WCED, 2001:1). In this study Technology Education means the process of training learners to acquire knowledge and develop skills to solve technological problems in their environment.

1.7.3 General Education and Training Band (GET)

It refers to grades R to 9, that is Grade R to 3 are termed Foundation Phase, Grades 4 to 6 are termed Intermediate Phase and Grades 7 to 9 are termed Senior Phase (DoE, 2002:11). It refers to the compulsory school system that ranges from Grade R to 9 (NDoE, 2001:3). In this study the sample of educators were those who teach the senior phase learners.

1.7.4 Curriculum

Curriculum is a plan or program for all the experiences that the learner encounters under the direction of the school (Oliva, 1997:1). Curriculum is derived from the Latin word *'currere'* which means a racing chariot. Curriculum is all the learning that is planned and guided by the school, whether it is carried out in groups or individually, inside or outside the schools (Kelly, 1999:1). In this study curriculum means a plan of what learners must follow in the school.

1.8 PROGRAMME OF THE STUDY

In view of the research problem and aim, the following programme of study was followed:

In chapter one the circumstances related to the understanding of the problem statement, the aim, the research design and the study programme in the implementation of Technology education were dealt with.

In chapter two critical issues regarding the implementation of Technology Education worldwide were identified.

In chapter three an exposition to international approaches and curricula models in Technology education were explored.

In chapter four the research methodology used for inquiry in the study was presented. The chapter motivated the choice of qualitative and quantitative research designs.

In chapter five the results of both quantitative and qualitative data were analysed.

In chapter six an implementation approach for Technology Education in schools in the North West Province was presented.

In chapter seven a summary of the findings as well as recommendations, and practical guidelines for the implementation of Technology education were provided. The structure of the thesis is illustrated in Figure 1.6.

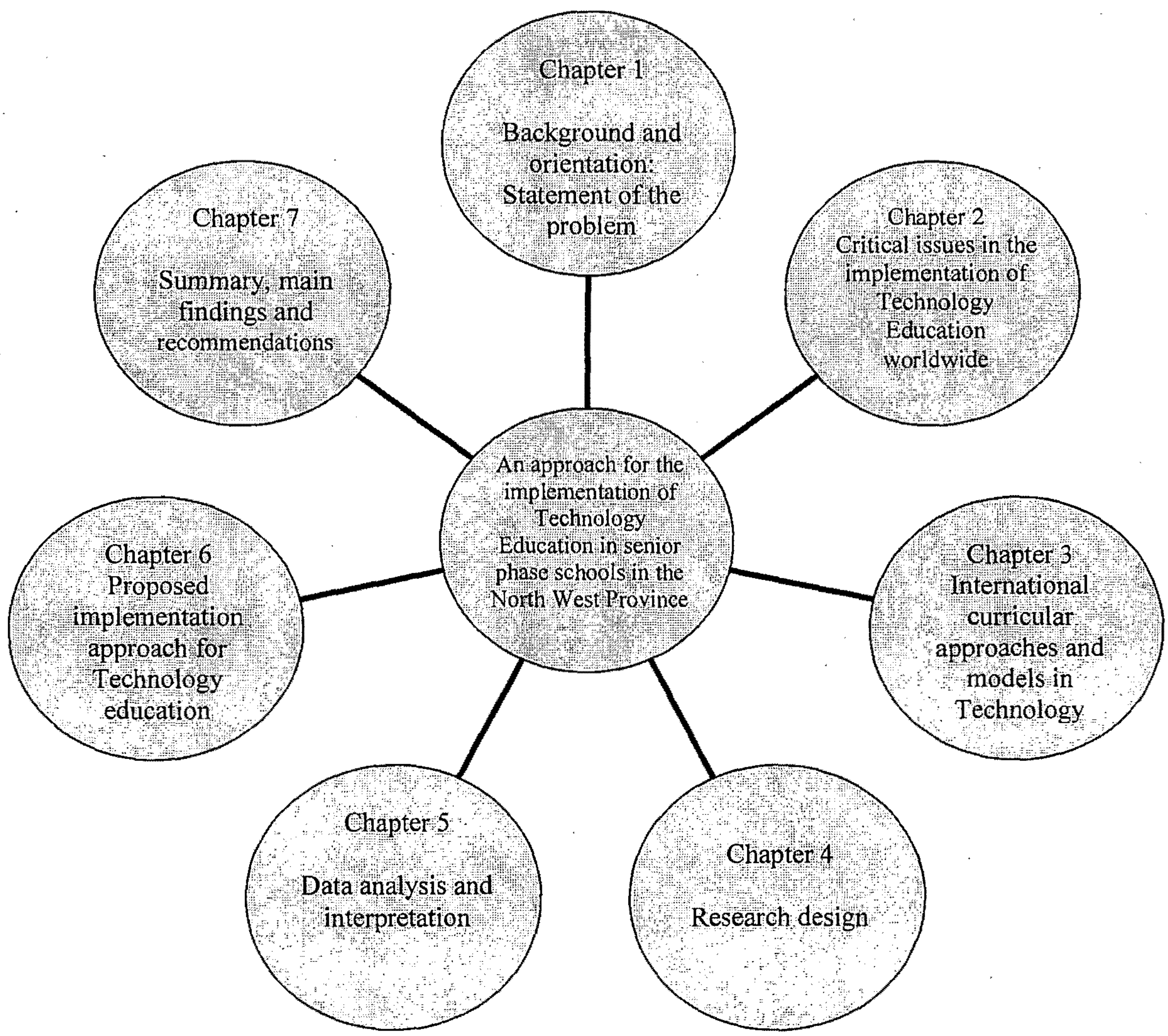

Figure 1.4: Structure of the thesis