

**THE DEVELOPMENT OF A CURRICULUM FOR TECHNOLOGY TEACHER
EDUCATION AND TRAINING - A CRITICAL ANALYSIS**

by

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DEDICATION

To my daughter Lebogang, and son Tshepiso to take the scholarly discourse of improving technology further.

In the history of the family, sons and daughters have always walked a few miles further than their parents. To my son more is expected to sustain our family motto “lions” because lions don’t give up, they are leaders of the jungle. This document is just a point of departure to all educational practitioners to improve education in the field of technology.

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All those people who always explicitly and implicitly wished me good luck, some of who helped me in the most crucial but unnoticeable manner that only God knows and shall reward. Those are the people who are not mentioned in the list above.

DECLARATION

I declare that “The development of a curriculum for technology teacher education and training - a critical analysis” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

.....

SIGNATURE

(MR MA MAKGATO)

.....

DATE

SUMMARY

THE DEVELOPMENT OF A CURRICULUM FOR TECHNOLOGY TEACHER EDUCATION AND TRAINING - A CRITICAL ANALYSIS

The study aimed at developing a curriculum for technology teacher education and training for technology teachers teaching Grade R-9 in South African schools. The study was motivated by the national implementation of Curriculum 2005 as well as the Revised National Curriculum Statements Grades R-9 to be implemented from 2004. The cognitive framework was illuminated by the conceptualisation of technology education and examined the philosophical foundation and theoretical context of technology education, including the historical background of technical education in relation to teacher training in South Africa. The Norms and Standards for Educators as a benchmark for teacher education and training programmes is explored. Moreover, a conceptual framework for the proposed curriculum was investigated. This involved an analysis of selected educational philosophies and their influence on curriculum development, various curriculum approaches and models, including outcomes-based education, a needs analysis and curriculum evaluation and assessment. A small-scale empirical investigation using qualitative and quantitative approaches was carried out. Questionnaires designed for educators of the Technology Learning Area and educators of technical subjects were used to gather data. The empirical investigation comprised a needs analysis of the curriculum development process. To ascertain validity and reliability of findings, instruments were subjected to a pilot study. Data were analysed by a MS Excell spreadsheet computer programme and findings presented in tables and graphs. The curriculum for technology teacher education and training, particularly curriculum content, was based on the empirical findings and the philosophical foundations discussed in the literature review. The proposed curriculum stresses the importance of partnership between schools and industry and resulted in the following outcomes:

- knowledge of technology education;
- applied and integrated teaching competence;

- applied and integrated assessment;
- recommendations for improving the school-industry relationships through partnerships programmes emphasising the design of technological projects.

Finally, the following recommendations emanated:

- improvement of technology teacher education and training programmes in higher education;
- development of expertise in the teaching and learning of technology;
- resurgence of research in the teaching and learning of the technological design process.

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LIST OF ABBREVIATIONS/ACRONYMS

ABET	:	Adult Basic Education and Training
CAD/CAM	:	Computer Aided Design/Computer Aided Manufacturing
CHE	:	Council of Higher Education
CEM	:	Council of Education Ministers
CBTE	:	Competence Based Training and Education
DACUM	:	Development and Curriculum
DATA	:	Design And technology Association
DET	:	Department of Education and Training
ETD	:	Education Training and Development
FET	:	Further Education and Training
GCSE	:	General Certificate of Secondary Education
GET	:	General Education and Training
HEDCOM	:	Heads of Education Department Committee
HSRC	:	Human Science Research Council

HBT	:	Historically Black Technikons
HWT	:	Historically White Technikons
HIV/AIDS	:	Human ImmunoDeficiency Virus/Acquired Immune Deficiency Syndrome
ICT	:	Information Communication technology
MET	:	Manufacturing, Engineering and Technology
NCS	:	National Curriculum Statement
NSB	:	National Standard Body
NQF	:	National Qualifications Framework
NVQ	:	National Vocational Qualification
ORT-STEP	:	Organisation for Educational Resources and Technology Training and Science of technology education Project
OBE	:	Outcomes–Based Education
OU	:	Open University
PGCE	:	PostGraduate Certificate of Education
RAU	:	Rand Afrikaans University

RNCS	:	Revised National Curriculum Statement
SACE	:	South African Council of Educators
SAQA	:	South African Qualification Authority
S.T.D	:	Secondary Teachers Diploma
SGB	:	School Governing Body
UK	:	United Kingdom
UNESCO	:	United Nations Educational, Scientific and Cultural Organisation
USA	:	United State of America
UNISA	:	University of South Africa

CHAPTER ONE

ORIENTATION, STATEMENT OF THE PROBLEM AND METHOD OF INVESTIGATION

1.1 INTRODUCTION

Since 1965 South African higher education institutions have not produced the scientists, technicians and technologists that the work force required (Department of Education, 1998:13). Therefore, the country is still facing a shortage of technically skilled workers at all levels i.e engineers, technicians and technical assistance (Department of Education, 2000a:5; Department of Education, 2001:13). Technological innovations present us with tremendous challenges and opportunities. Economic and technological forces have led to unemployment, and yet at the same time pushed our country to a new kind of global competitiveness, resulting in the invention of the products that improve the quality of our lives. Global and economic forces are changing the nature of the workforce, and impacting upon the education sector (Frantz, Friedenber, Gregson & Watter, 1996:42). This situation requires people to develop new skills and to work in a more effective way (Department of Education, 1998:6; Pratzner, 1994:5). According to Galluzo (1996:11) there is no faith in the ability of teachers and the present schools to prepare students adequately for the workplace and higher education. The loss of confidence is fueled by the beliefs that **(a)** the present configuration of schools is incapable of producing learners who can meet the increasingly complex demands of the workplaces and **(b)** the present school curriculum is outdated (Department of Education, 2000a:5). As Frantz et al. (1994:24) point out, all students who complete high school should have acquired skills needed for employment, as well as those required to continue their education. The Department of Education (2000a:5) states the following:

The present system of FET (Further Education and Training) qualifications and programmes offered by schools, colleges, industry and private providers do not

prepare learners adequately for success in further learning or for productive employment.

The quality of technology education programmes is greatly determined by the successful students having acquired the skills, knowledge and values needed by society, more specifically the workforce (Frantz et al., 1996:41)

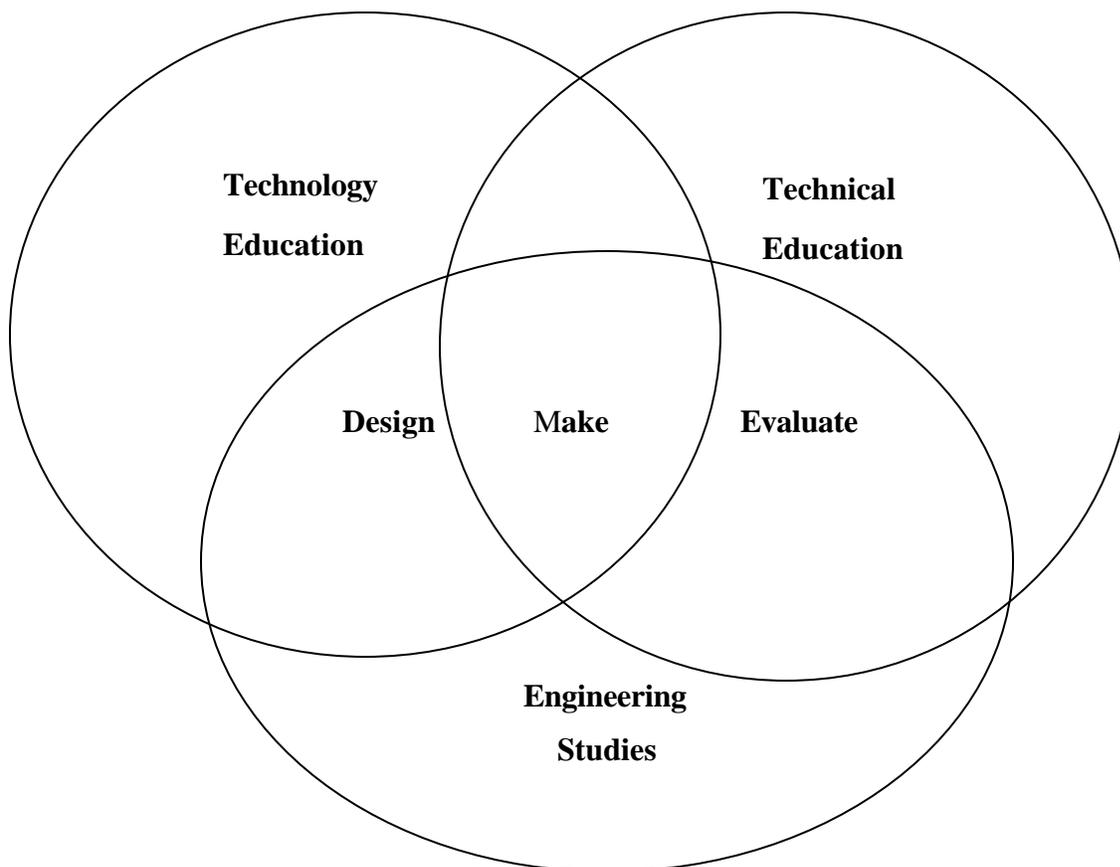
In South Africa technology education has not gained as much recognition and status as in the case of other subjects (mathematics and science). Historically, technology education, formerly known as technical education has been conceived as being associated with the acquisition of motor skills or computer related activities (Makgato, 2000:1). Modern technology involves higher cognitive processes such as creating, designing, modeling, predicting and experimenting in conjunction with practical problem-solving tasks (Wicklein & Rojewski, 1999:6). There are misunderstandings and misinterpretations surrounding technology education, because of the lack of professional development and teacher awareness of what technology education means (Linnel, 1994:9; Department of Education, 2000d:92). According to Makgato (1999:40) the basic purpose of technology education is to develop learners' abilities to demonstrate their understanding of the following concepts and tasks creatively:

- Content knowledge from technical subjects;
- Technical knowledge and skills (practical techniques and processes);
- Designing;
- Making and modeling (vocational/technical/practical skills);
- Evaluating solutions to technological problems;
- Testing products (prototype, artifact) (HEDCOM, 1996:10; Makgato, 1999:40).

It may be deduced that knowledge of technical education is a prerequisite for the effective provision of technology education. The concepts of “design” and “evaluate” require graphic knowledge and skills. The design component overlaps with engineering studies, although in

engineering studies the design involves in-depth and precise calculations and numeracy manipulation and measurement (Makgato, 1999:40). Technology education is fundamentally problem-based, whereas technical education is basically content-based consisting of advanced technical skills (Hill & Wicklein, 1999:3; Gray, 1996:91; Makgato, 1999:40). The following Venn diagram illustrates the interrelationship between technology education, technical education and engineering studies.

FIGURE 1.1
THE INTERRELATIONSHIP OF technology EDUCATION, TECHNICAL
EDUCATION AND ENGINEERING STUDIES



Source: Makgato (1999:40)

1.1.1 Technology education and the economy

Technology is a human activity of developing solutions to people's needs using knowledge, skills, values and resources by sensitively investigating, designing, developing and evaluating social and environmental factors (Department of Education, 2001:14; Department of Education, 1997b:84). The history of the world indicates that the quality of people's lives have been tied directly to science and technology. Neither science nor technology is new to humankind. Most of the origins of these disciplines including mathematics can be traced back to the early Egyptians, Greeks, Chinese and Arabic cultures. The major impact of these disciplines was highlighted firstly by the Industrial Revolution and secondly by the Technological Revolution facing the world today. Just as the Industrial Revolution dictated and revolutionized the world of the past, so the Technological Revolution dictates and revolutionizes the world of today and tomorrow (ORT-STEP Institute, 1995:9). Technology changes and provides challenges all the time. The country needs to be able to analyse problems and needs and to provide practical, economical and efficient solutions, which meet the needs of society and the environment.

The South African economy has not been doing very well over the past years. There has been a decline in growth rates. The job growth has also declined in line with the long-term economic downtrend. Since the job market has been changing, the gap between the growth of unemployment and that of the workforce widened substantially, resulting in increased unemployment (Reddy, 1995:5).

The provision of technical education did not address the developing of technological needs of the country because it was too narrow in scope (Gardener & Hill, 1999:104). The provision of technological education at schools is inadequate, to some extent, because most of the learners who have a good pass in mathematics and science see a screwdriver for the first time at a Technikon. This applies specifically to most learners from historically disadvantaged communities (Makgato, 1999:2).

To solve these problems and face the global economic challenges, people should be trained to design and develop technologies, which will provide finished products to trade in international markets. Instead of exporting raw materials, South Africa needs to develop its human resources so that the country can become more profitable and economically rewarding (Reddy, 1995:6). South Africa requires a high standard of education and technologically trained teachers. This will stimulate viable economic growth, which is based on an educational strategy for the development of creative and critical skills rather than rote learning (Makgato, 1999:2). According to Ndlovu (1997:1) the biggest challenge facing higher education institutions in South Africa today is how to improve the quality of technology teacher education and training in order to provide quality further education and training in the National Standard Body (NSB) 06 engineering fields. The quality of technology education received by learners depends on the technological knowledge and professional skills of educators (Ndlovu, 1997:1).

The technology teacher has a prominent role to play in the education of the youth by providing technical skills and the technological processes in the field of electrical, mechanical and civil education in the new Further Education and Training institutions (FET). Technology education in these fields directly influences the standard of living of the society, because specific skills and technical knowledge can be immediately utilised in the workforce (Makgato, 2000:2).

1.1.2 The current education and training of technical teachers

The education system in South Africa was laid down in several legislative enactments based on the apartheid system, founded on the ideology of discrimination. Due to the discrimination laws, different technical teacher education and training programmes were designed and developed for different races in South Africa (Makgato, 1999:25). Owing to the Industrial Revolution technical teacher education and training took some time to establish itself in South Africa despite the labour needs (Makgato, 1999:20). This was due to the inability of teachers and existing schools to prepare learners for the workplace and higher education (Galluzo, 1996:11-13). According to Nzama (1991:21) technical

education did not rank high among the priorities in educational programmes for South Africans.

Although there has been some development in the technical teacher programmes and curricula in recent years, there is still a chronic mismatch between the output of higher education and the technological needs of a modernised economy. There is still a shortage of highly trained graduates in fields such as science, engineering, technology and commerce in particular (Department of Education, 1997a:8). In fact, there is a shortage of creative and critical thinkers in these fields.

The Ministry of National Education has recently released a Revised National Curriculum Statement Grades R-9 (schools). The release of this national curriculum has enormous implications for teacher training in technology education. It also implies that higher education institutions should develop a technology teacher education curriculum to train teachers who will teach technology as a subject at schools (Department of Education, 1999:18).

1.1.3 The development of programmes for technology teacher education

If the provision of technology education is to be effective in addressing the national and global market, there are serious implications for the present preparation of those who must teach the subject or sub-field. To produce technologists and technologically literate citizens there is a need for the technology teacher programme to consider the depth of the technical content (concepts) as well as an adequate technological process (Lewis, 1994:52). The Ministry of Education, through the Norms and Standards for Educators document, has already extended the period for teacher training in South Africa to four years which gives provision for an in-depth offering of high technical skills and knowledge (Department of Education, 2000b:25).

According to Makgato (2000:9), there is need to review the present technical teacher education programmes in relation to the international technology teacher education

practice. There is a need for teachers who are competent to supervise the construction of a workable solar vehicle in the schools. What this means is that pre-service education of technology teachers requires exposure to the major process of industry in the realm of mechanics, electronics, computing and other related engineering fields. There is a need for teachers who are experts in the design, use and repair of technological products (Lewis, 1994:53). However, there should be a balance between technological concepts and the technological process (Cajas, 2000:1).

1.2 STATEMENT OF THE PROBLEM

Against this background, particularly paragraph 1.1.3, a need exists to educate, train and retrain teachers in the sub-field technology education. In the light of the national concern to provide teachers in mathematics, science and technology, the Department of Education (1999:13) states:

In order to ensure that appropriate and adequate education and training opportunities are available for educators, particularly in Mathematics, Science, Technology and Engineering, the Department will work with Higher Education institutions, the Council on Higher Education (CHE), the South African Qualifications Authority (SAQA) and other stakeholders to develop a national strategy for the training of FET educators.

The statements above trigger the following research question:

What curriculum for technology teacher education is required according to which teachers can be educated and trained for schooling? It is within the scope of this study to attempt to answer this question.

Furthermore, the problem being investigated in this study also originates from an earlier study: Technical teacher training in South Africa: A Technikon's perspective. The aim of the above-mentioned study was to investigate the training of technical teachers in order to

identify weaknesses and to provide guidelines to improve the model (Makgato, 1999:202-210).

This study focuses on the task of developing a curriculum for technology teacher education in higher education for teachers who will teach technology at schools. The terms technical and technology education will complement each other for the purpose of this study. They are not synonyms as their concerns are already outlined in paragraph 1.1 and figure 1.2. It is assumed that in doing this the following major recommendations of the earlier study will be included:

- The curricula for technology teacher programmes (B.Ed Technical/Technology) with a strong subject and educational theory competence, should enhance access to mobility and quality within education and training according to the objectives of the National Qualifications Framework, which is to create a national framework for learning and achievement (Department of Education, 2000c:24; Makgato, 1999:206).
- The syllabi and curricula for technology teacher education should be based on the philosophy of outcomes-based education (OBE), which, amongst others, proposes that all students can learn successfully (Makgato, 1999:206).
- Technical workshops and practical laboratories should be equipped with the latest equipment for practical skills. It is hoped that the partnership of higher education and industry will assist in this regard especially by accrediting these workshops and laboratories. The equipment should be sufficient for the students to complete experiments and projects (Department of Education, 2000a:5; Makgato, 1999:208).
- Technology teacher educators should use relevant teaching and learning methods which develop creativity rather than rote learning (Makgato, 1999:209).

Formulated in a more precise way, the fundamental problem that this study will address is:

❖ WHAT SHOULD COMPRISE A SUITABLE TECHNOLOGY TEACHER EDUCATION CURRICULUM?

From this fundamental question, the following sub-questions develop:

- What should the structure of the curriculum be?
- What should the learning outcomes of this curriculum be?
- What should comprise the educational and knowledge content of the curriculum?
- How should the assessment and evaluation procedures of the curriculum be designed?

1.3 AIMS OF THE STUDY

The main aim of the study is to develop a technology teacher education curriculum for teachers at schools. The following objectives if fulfilled will result in the achievement of this aim:

- ❖ To present an analysis, based on a previous study (Makagto,1999), of the present curriculum of technical teacher education and training programmes;
- ❖ To analyse curriculum theories, models and practices from literature;
- ❖ To conduct a needs analysis on a small scale on the content of technology teacher education with a few educators at selected schools in Soshanguve;
- ❖ To obtain more information on a technology teacher education curriculum from experts in Design and technology education at the Open University, United Kingdom (UK);
- ❖ To propose a curriculum for the education and training of technology teachers for schools.

1.4 RESEARCH METHODOLOGY

This study is aimed at developing a curriculum for technology teacher education programmes. According to Ndlovu (1997:24) a teacher education programme is defined as a plan intended to assist learner teachers to acquire knowledge, skills, values, attitudes and norms and standards of the profession of teaching. Within the present OBE education

system in the country, the components constituting teacher education programmes are numerous and varied. They include the following: problem-based tasks, project-based teaching, team-teaching, lectures, seminars, workshops, field trips, micro-teaching, internship in FET institutions, tutoring learners, examinations, social events, counselling, networking using the Internet, multicultural teaching and so forth (Department of Education, 2000b:15-22; Ndlovu, 1997:24). Hence, the study involves an investigation of teacher education curriculum programmes in general and programmes in the sub-field of technology education registered with South African Qualification Authority (SAQA), in particular. The following is the outline of the research methodology applicable to the study:

1.4.1 Research design

This study will use a non-experimental design as a method of collecting, processing, and analysing data. In view of the abovementioned statements and the perspective of the aim of the study, it is necessary to use both a quantitative and a qualitative research design. As a start an exploratory study will be conducted to gain a better insight and understanding of the research problem.

1.4.1.1 Quantitative approach

A descriptive study will be embarked on to outline present circumstances and relationships with the research problem. A descriptive study involves collecting data in order to answer questions concerning the current status of the subject of study (Gay, 1992:13). In this study a quantitative approach was applied through questionnaires (see 1.4.2.2).

1.4.1.2 Qualitative approach

The qualitative approach frequently utilizes observations and in-depth interviews; data are usually in the form of words. It involves description in words, exploring to find what is significant in the situation. The study begins without structure but becomes more structured as it proceeds, and operates in a natural setting (Johnson & Christensen, 2000:20;

Krathwohl, 1993:31). Crowl (1996:231) further characterises a qualitative approach as follows:

- It takes place in a natural setting and uses the researcher as the key instrument.
- It deals with descriptive data in the form of words and pictures rather than numbers.
- It focuses on process, not merely product.
- It relies on inductive rather than deductive data analysis; and
- it focuses on how different people make sense of their lives.
- Exploration refers to discovering new situations and relationships of variables in a phenomenon and to understand the phenomenon (Krathwohl, 1993:5).

In this study, qualitative approach was used through interviews (see 1.4.2.2).

1.4.2 Data collection

In order to answer the research question raised in paragraph 1.2 the researcher will use an eclectic design according to the elements of triangulation. This design will maximize the probability of validity and reliability in the findings of the study. Ngwenya (1998:16) and Jick (1994:191) define triangulation as the use of two or more methods such as questionnaires, interviews and observations in the study of human behaviour. Ngwenya further says that the purpose of using triangulation is to explain fully the richness and complexity of human behaviour by studying it from more than one standpoint.

The use of one method of data collection tends to be biased and to distort the researcher's picture of the particular slice of reality under investigation. In applying the triangulation technique in this study, the following data collection methods will be used:

1.4.2.1 Literature study

In order to provide a theoretical background to the study, various literature sources will be studied. A literature study involves the systematic identification and analysis of documents containing information related to the research problem (Gay, 1992:38). According to

Thomas (1998:73) these documents include periodicals, abstracts, reviews, books and other research reports.

Relevant documents from higher institutions preparing technology teachers and documents from the Department of Education are to be studied. It is from these documents that the analysis of the present technical teacher education curriculum will be made and the future technology teacher education curriculum framework will be reviewed. Ndlovu (1997:25) explains the following with regard to document analysis: “*Document analysis is superior in finding out retrospective information about a programme and may be the only way that certain information is available.*” Document analysis reveals the current situation about a programme as well as the future trends in education.

Neuman (1997: 89) contends that literature helps the researcher:

- to demonstrate a familiarity with a body of knowledge and to establish credibility;
- to show the path of prior research and how a current project is linked to it;
- to integrate and summarise what is known in an area; and
- to learn from others and stimulate new ideas.

For the purpose of this study, the literature to be studied will act as a point of departure in an attempt to propose a curriculum for technology teacher education and training for educators of schools.

1.4.2.2 Empirical study

The empirical study will be conducted using questionnaires and unstructured interviews.

- Questionnaires

The quantitative research approach in a form of questionnaires will be used. Both the closed-ended and open-ended format will be designed. They will be administered in person

to participating schools and the technikon in order to save time. Delport (2002:174) maintain that hand delivered questionnaires normally save time. The response rate is raised because of personal contact.

A closed-ended (structured, fixed response) question gives the respondent fixed responses from which to choose while an open-ended (unstructured, free response) question asks a question to which respondents can give any answer (Neuman, 1997:240). The closed-ended questions will be designed to seek factors and information that are regarded as important in the curriculum of technology teacher education.

Since triangulation will be implemented, the interview detailed below will also be applied in addressing the rest of the questions raised in 1.2 above.

- Unstructured interviews

Interviews are used to obtain in-depth information about a participant's thoughts, beliefs, knowledge, reasoning, motivations, and feelings about a topic (Johnson & Christensen, 2000: 144). Qualitative unstructured interviews consist of open-ended questions in order to allow participants to provide valid and meaningful information (Delport, 2002:301). In this study an unstructured interview will be conducted with technology education experts at various universities in Britain where they train technology teachers. The interview schedule will consist of open-ended questions, which will be based on the research question. Unstructured interviews are useful for exploring issues, variables and phenomena (Kratwohl, 1993:372).

1.5 SAMPLING

A non-probability purposive and convenience sampling strategy will be used in this study. Educators of technology education and technical subjects at the nearby Soshanguve schools in Gauteng Province will be identified to complete questionnaires. Similarly, purposive sampling will be used to identify the experts in technology education at the Open

University at Milton Keynes, Britain, to respond to unstructured interviews concerning technology teacher education and training.

1.6 DATA ANALYSIS

Statistical data obtained through questionnaires will be analysed using the Excel programme. The data will then be presented in a form of tables and graphs of frequency distribution. Qualitative data gathered using interviews would be analysed by categorizing the data into themes or meanings (Kratwohl, 1993: 356).

1.7 CLASSIFICATION OF CONCEPTS

1.7.1 Technology

The concept of technology has had varying interpretations over the years. Technology has been equated with machinery such as computers, cars, scissors and the list goes on (Naughton, 1986:1). This definition of machinery has its origin in various advertisements. According to Black (1998:1) technology is a creative, purposeful activity aimed at meeting needs and opportunities through the development of products, systems or the environment. Black emphasises knowledge, skills and resources, which are combined to help solve practical problems. Technological practice takes place within, and is influenced by social context. Williams (2000:1), Dugger (1997:1) and Shield (1996:3) view technology, and particularly technology education as more of a human activity than a discrete body of content. They believe that technological knowledge can be divided into procedural knowledge, which relates to the activity, and conceptual knowledge, which relates to the body of content.

Many definitions of technology have been developed. A few of them are given below:

"Technology is the use of knowledge, skills and resources to meet human needs and wants, and to recognise and solve problems by investigating, designing, developing and evaluating products, processes and systems" (Department of Education, 1997:89).

Technology is a creative, purposeful activity aimed at meeting needs and opportunities through the development of products, systems or the environment. Knowledge, skills and resources are combined to help solve practical problems. Technological practice takes place within, and is influenced by, social context (Ministry of Education, New Zealand, 1995:60).

According to Dreyer and Van den Heever (1994:30) technology is the application of knowledge and skills through the use of resources to solve problems and produce products. It is found in all aspects of life today, from the home to highly complex industries.

Technology is the satisfaction of human needs and wants by designing, making, and using/evaluating products or processes through the use of knowledge, skills and resources (ORT-STEP, 1995:5).

It is also stated that technology is applied science. According to Aitken and Mills (1993:4) historical reflection disagrees with that concept of technology because the technologies of the wheel and axle, the bow, the boat, and the melting of metals appeared many thousands years before the development of science. They contend that modern technology draws heavily on the discoveries of science, but there is still a fundamental difference between the two.

The researcher's view is that science and technology is like two side of one coin. That is, technology depends on basic scientific knowledge and understandings, while the development of science also depend on further development of technology. The major difference between the two is their purpose and emphasis. The difference between the two is detailed in section 2.7.1 and table. 2.2.

1.7.2 Technology education

Technology education is the teaching of technology to learners. Therefore, technology education concerns technological knowledge and skills, as well as technological processes and the impact of technology on both the individual and society. It is designed to develop the capability of the learner to perform effectively in the technological environment he/she lives in, and to stimulate him/her to contribute towards its improvement (ORT-STEP, 1995:5).

According to Gardner and Hill (1999:104), technology education is much broader and more challenging than the earlier form of technical education which emphasized using tools and making projects with little attention to problem-solving, creativity and design skills. They are against equating technology education with computer education. In technology education learners do not only learn to design and make numerous artifacts and physical products, but also provide various solutions to social problems. Technology education is not synonymous with technical education. In technical education one learns useful skills in order to obtain a (blue-collar) job, whereas technology education enables learners to become job providers. The study of technology education involves the design process, knowledge and context and making and evaluating (De Vore, 1998:2; Herschbach, 1997a:28; Johnsey, 1995:199).

In this study the structure of technology education covers all the stages of the technological process, content knowledge and the context. All these detailed elements of technology education are part of the envisaged curriculum for technology teacher education. The concept of technology education is therefore broad and embracing, hence it requires an academically structured curriculum programme to prepare teachers who will teach this field at schools. This study is concerned with the education of teachers who will teach technology at school. Therefore, it is important to clarify the concept of education.

1.7.3 Technical education

Technical education is oriented toward a competency-based curriculum, structured from the perspective of industry needs and standards, and presented using a pedagogy that relies on pre-determined performance objectives including condition, task, and standard (Doolittle & Camp, 1999:4). Technical education provides specific pre-determined skills demonstrated to industry standards. It provides occupations based on definable worker competency lists. According to Gardner and Hill (1999:104) technical education emphasises using tools and making artifacts, with little attention to problem-solving, creativity, design skills, social and environmental concerns.

Technical education is viewed as education, which equips learners with marketable skills after grade 12. In other countries such as Canada, technical skills training was meant to enhance the general education of students intending to join the labour force on leaving school. It offered industrial skills for youth who had completed high school and occupational skills for adults (Gardner & Hill, 1999: 107).

1.7.4 Education

The concept of curriculum can be easily explained within the broad concept of education because the aim of education is achieved by curriculum (Walker, Gregson & Frantz, 1996:1; Ndlovu, 1997:12). According to Zais (1976:317) education is described mostly as the process of actualising human potentials. This is a broader definition of education. The human potentials encompass living according to the culture of the society. Thus, the educated man of the 21st century is viewed as a person who can contribute economically in a capitalist culture (Zais, 1976:15). Gardner and Hill (1999:134) unpacked the aims of education, which should be satisfied by an "educated" man and transformed these to the ten essential outcomes for education, namely:

- To communicate effectively;
- to solve problems and make responsible decisions using critical and creative thinking;

- to use technology effectively;
- to demonstrate an understanding of the world as a set of related system;
- to apply the skills needed to work and get along with other people;
- to participate as responsible citizens in the life of the local, national and global communities;
- to explore educational and career opportunities;
- to apply aesthetic judgment in everyday life;
- to make wise and sale choices for healthy living;
- to use learning skills for effective learning.

1.7.5 Outcomes-based education

OBE is a system of education that consists of its own philosophy of education. The philosophy of OBE includes life long learning, accountability, active participation and constructivism. It is a learner-centered, result-oriented design (Makgato, 1999:51).

1.7.6 Curriculum

The concept of curriculum is as old as the education system (Carl, 1995:26). Ndlovu (1997:12) points out that the concept of curriculum is in itself broad and comprehensive, hence it lends itself to varied interpretations. Educators interpret curriculum in different ways, partly because of their own different perceptions and contexts in which they experience it. It is not the purpose of this section to analyse and discuss all the interpretations that have been advanced over the past years because it would be a massive undertaking. However, it would be scholarly important and economical to categorise major conceptions of curriculum. According to Schubert (1986:26-34) the major categories of curriculum concepts are:

- Curriculum as subject matter;
- Curriculum as a program of planned activities;
- Curriculum emphasises specific learning results;

- Curriculum is the cultural reproduction of a community reflecting the relevant culture;
- Curriculum is experienced, in other words, specific activities and experiences lead to learning;
- Curriculum sets out tasks and concepts which must be achieved, or a predetermined purpose which leads to the mastery of a new task or an improvement of a previous task;
- Curriculum is an instrument for social reconstruction where values and skills are acquired which may help to improve the community;
- The curriculum is *currere* which means the running of the race, that is, being responsible for self-learning so that self-discovery may take place. Learners will understand how they learn and get to know themselves (Carl, 1995:32). Fraser, Loubser and Van Rooy (1993:50) refer to this as metalearning where learners monitor and evaluate their own learning. The emphasis is on autobiography (Schubert, 1986:33)

By implementing a curriculum, the aims and objectives, content and context of education are illuminated (Ndlovu, 1997:13). Oliva (1998:8) makes a meaningful contribution by giving clarification of objectives, content and context as follows:

- Objectives, what is intended or what learners should do after learning (aim);
- Context or perspective within which it develops, for example, a specific word or philosophy of life which may serve as a starting point to determine the nature of the curriculum;
- Content, subject matter or a body of knowledge to be taught to learners.

Kelly (1977:3) agrees that the term curriculum is used with several meanings and a number of different definitions have been developed. According to Carl (1995:24) educational problems in this country are directly related to the curriculum. He alleges that a shortage of curriculum specialists, insufficient contributions by teachers to curriculum development on

meso and macro level as well as teachers and principals who are often skeptical towards curriculum research are factors, which detrimentally influence effective curriculum development.

The following are some of the well-known definitions of the concept of curriculum as quoted by Carl (1995:31-35):

Söhnge (1977:38) defines a curriculum as an educational racetrack on which learners move under leadership of their teacher on the way to adulthood. It is coordinated with *curro* (I run).

Tunmer (1981a:1) describes the curriculum as the whole spectrum of compulsory and optional activities, which are formally planned for students.

Tanner and Tanner (1975:48-49) sees the curriculum as the planned and guided learning experiences, formulated through the systematic reconstruction of knowledge and experiences, under the auspices of the school, for the learner's continuous and wilful growth in personal-social competence.

- Walters (1985:1-3) defines curriculum as:
 - a) Institutional curriculum, that is, the courses and their compositional subjects offered by the institution;
 - b) Course curriculum, that is, the subjects and subject compositions offered for a particular course;
 - c) Subject curriculum (e.g. the curriculum for technology education), which is a description and systematic ordering of the objectives, curriculum material and evaluation procedures for a subject.

- Barrow (1984:11) defines curriculum as a programme of activities designed so that learners will as far as possible achieve specific educational and other school objectives.
- Wheeler (1976:11) defines curriculum as the planned experiences offered to the learner under the guidance of the school.
- Curriculum is all the planned outcomes for which the school is responsible (Popham & Baker, 1970).
- Posner (1992:4) says that the concept of curriculum should focus on educational plans and intended outcomes.
- Print (1987:4) defines curriculum as all the planned learning opportunities offered to learners by the educational institutions as well as the experiences learners encounter when the curriculum is implemented.
- According to Unruh and Unruh (1984:96) curriculum is defined as a plan for achieving intended learning outcomes: a plan concerned with purpose, what is to be learned, and with the results of institutions.
- Taylor and Richards (1985:3) define curriculum as “subjects to be studied”.

According to this study, curriculum is all educational programmes, activities and experiences that enable the learner to achieve learning outcomes which are based on national critical outcomes.

Most of the definitions stated above are similar in that they refer to the learning content and are centered on the learner. They tend to overlap in some aspects such as learning

outcomes. It is therefore clear in these definitions that the curricular can be learner-centered or outcomes-based (Walker et al., 1996:43).

There are a number of concepts that describe some aspects of the curriculum. The main concepts that are significant to this study are discussed below.

1.7.6.1 Curriculum design

This term refers to a substantive structure, pattern or organisation of a curriculum (Zais, 1976:395). It is more specific than curriculum development although there are overlaps between the two. It is this overlap that results in the synonymous usage of the two concepts (Schubert, 1986:41). Curriculum design is concerned with the nature and arrangement of the four basic elements of curriculum: aims, goals and learning outcomes; content; learning activities and assessment and evaluation (Zais, 1976:395). According to Ndlovu (1997:18) curriculum design results from organising curriculum elements in particular ways. The significant feature of any curriculum is the conceptualisation and organisation of its elements, which are essential building blocks of any curriculum (Print, 1989:15). Various curriculum specialists made significant contributions to influence the nature of a particular education system, which led to the design of different curriculum models. These models enable curriculum developers to choose the model that suits a particular education system.

Taba presented a well-known model. According to Carl (1995:90), Taba's (1962) model consists of the following elements or components:

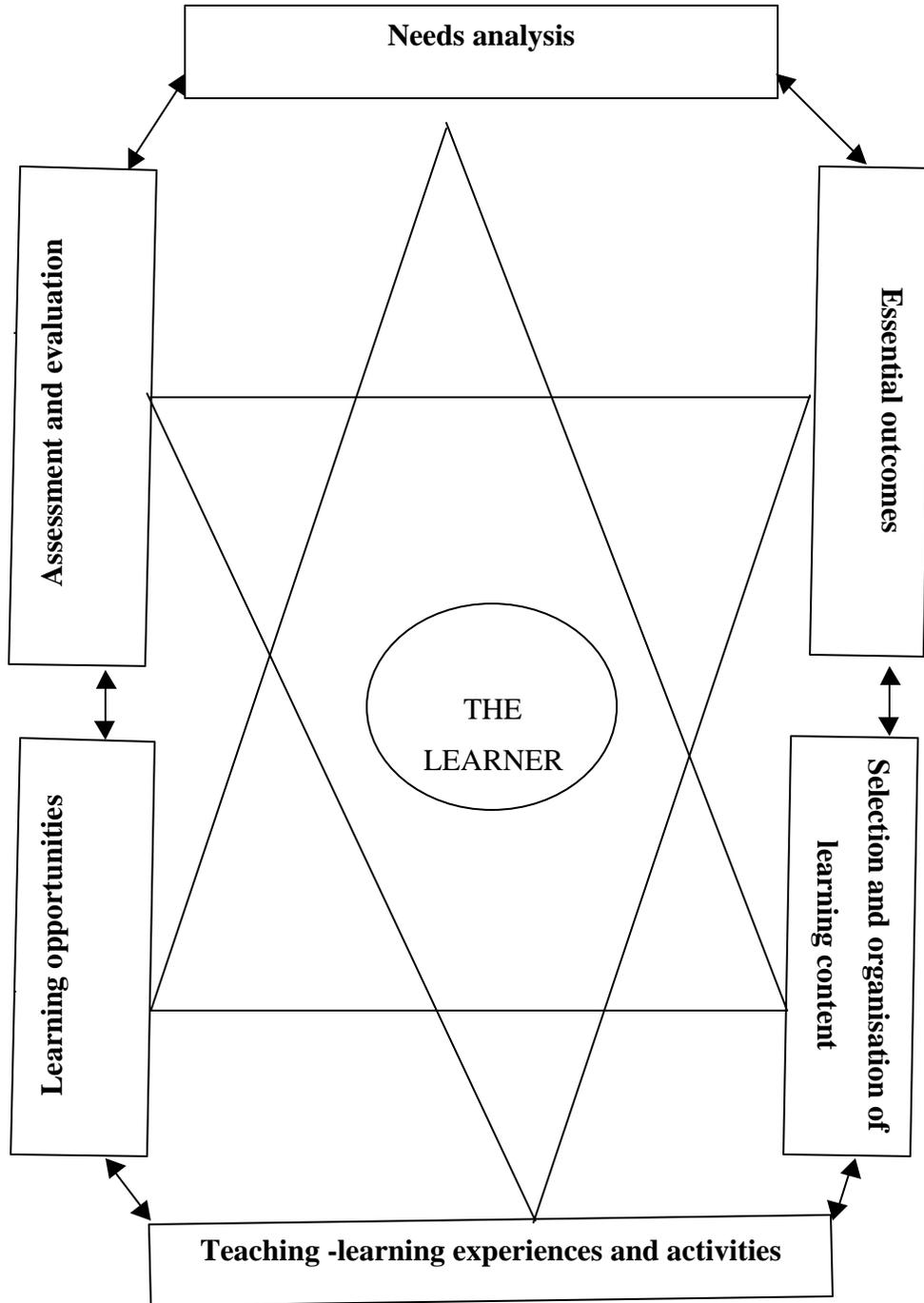
- Determining of needs;
- Formulation of objectives and goals;
- Selection of contents;
- Organisation of contents;
- Selection of learning experiences;
- Classification of learning experiences;

- Evaluation;
- Control for balance and sequence.

Curriculum design also connects all other curriculum elements. The elements of curriculum design which Kruger (1980:103) refers to are situation analysis, goal formulation, learning content, learning experiences, learning opportunities and evaluation. These form the principles for curriculum design. Van Staden (1991:3) regards these principles as steps in the curriculum design. Although these principles of curriculum design form a cyclical nature of curriculum by following a logical sequence, in real life the curriculum cycle functions in a much more complex and unpredictable fashion (Ndlovu, 1997:19). This makes curriculum design a dynamic process.

Figure 1.2 has been developed by merging the Ndlovu (1997:20) model, which illustrates the interrelationship of elements or components of the curriculum with the Zais (1976:439) model, which illustrates the relationship of curriculum components.

FIGURE 1.2
THE INTERRELATIONSHIP OF COMPONENTS OF THE CURRICULUM
WITHIN THE CURRICULUM DESIGN CYCLE



Source: Developed from Fraser et al. (1993:102); Zais (1976:439) and Kruger (1980:103)

Fraser et al. (1993:101) point out that there is an interdependent relationship between the components of the curriculum. Each component is constantly influenced by the other components, so that no reflection on the curriculum can one-sidedly emphasise any particular component. Therefore, Fraser et al. (1993:103) conclude as follows:

The most important implication of the interrelationship between the components of the curriculum is that curriculum development cannot be directed at a single component of the curriculum.

The next section discusses the other subdivision of curriculum and curriculum development.

1.7.6.2 Curriculum development

Curriculum development focuses more on the process of deciding what to teach and learn, along with all the considerations needed to make such decisions (Schubert, 1986:41). Zais (1976:17) contends that curriculum development is a process, which determines how curriculum construction will proceed. According to him curriculum development answers questions such as: Who will be involved in curriculum development- teachers, administrators, parents, and students? What procedures will be used in curriculum development? According to Carl (1995:40) curriculum development is a continuing process in which structure and systematic planning methods figure strongly from design to evaluation.

Van Staden (1991:4) contends that curriculum development is a purposeful and systematic construction of a curriculum and the continual evaluation of the term construction is used to refer vaguely to all processes involved in the making of curricular (Zais, 1976:17). Fraser et al. (1993:102) gives a similar definition of curriculum development to that of Carl. They state: "Curriculum development can be described as all the processes necessary to plan, design, implement and evaluate a functional curriculum".

These definitions and concepts of both curriculum design and curriculum development discussed above succinctly give the conceptual context within which the technology teacher education curriculum will be designed.

South Africa is going through a process of curriculum development in almost all the fields of study for further education and training (FET) institutions, which replace the former secondary schools. The design of the curriculum in this study is done within teacher education which is regulated by the Norms and Standards for Educators from the Department of Education.

1.7.7 Teacher education

This study, the development of curriculum for technology teacher education, is done within the broad context of teacher education. The term teacher education has evolved through historical development from the term teacher training. According to Turney (1997:10) the evolution from teacher training to teacher education occurred when it was realized that preparing teachers involved very much more than training. Adequate teacher preparation is commensurate with both the quality and the standards of the profession.

In arguing for the education rather than training of teachers Elvin in Hilliard (1971:17) states:

There are two traditional ideas about the preparation of a teacher. One is that he /she should be educated but need not be trained. The other is that he/she should be trained but need not be educated.

Teacher education is the education of those who have chosen the teaching profession (Ndlovu, 1997:23). This education takes place in universities and technikons. Writing on the same theme Hilliard (1971:33) states:

The attitude to teachers and their work which colours all that follows is the exact opposite to that which is reflected in Shaws's cynical dictum: 'Those who can, do; those who cannot, teach.' On the contrary it stems from the belief that teaching is a profession and that teacher education is education for a profession.

Jacobs (1989: 798) contends that the professional status of teachers is heavily dependent upon the quality of teacher education curricular.

1.8 PROGRAMME OF THE STUDY

Chapter one introduces the study and states the problem.

In **chapter two** an analysis and an overview of the current technical teacher education are done. The shortcomings of current teacher education are outlined.

The following issues are also discussed:

- The purpose of technology education;
- The essential features of technology education;
- The rationale and development of technology education;
- The implications of technology education on teacher education and training.

Chapter three focuses on the concept of curriculum design.

The following issues are analysed:

- The foundations of curriculum development ;
- Models of curriculum development;
- Outcomes-based education and Curriculum 2005;
- Norms and standards for teacher education;
- The influence of educational outcomes on curriculum development ;
- Needs analysis in curriculum development;

- Strategies of curriculum development;
- Assessment and evaluation.

It is these models of curriculum development that lay the foundation and determine the parameters to be pursued in the development of the technology teacher education and training curriculum.

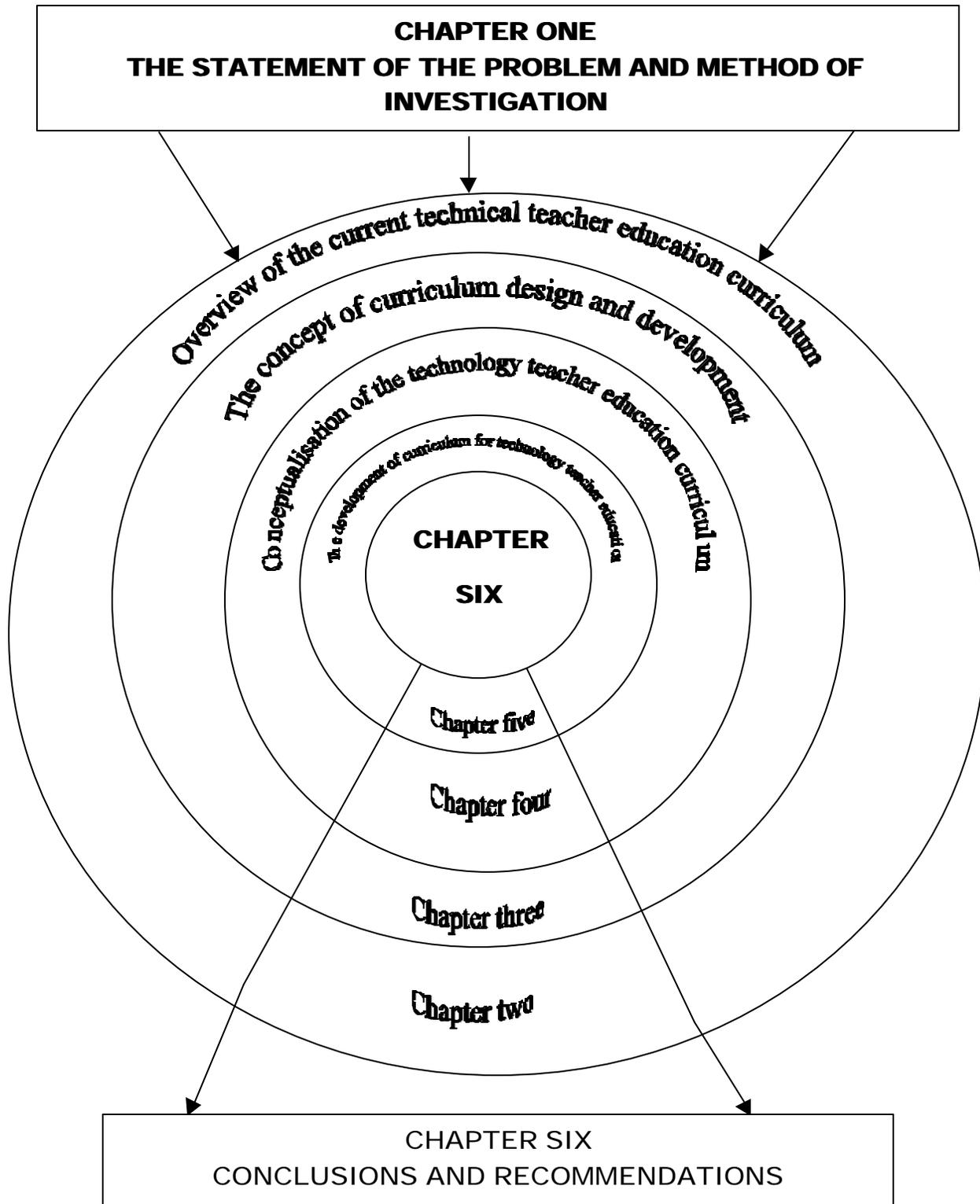
Chapter four focuses on the empirical research design, results and discussion of results.

Chapter five provides a curriculum for the technology teacher education programme. It is in this chapter that the fundamental research problems mentioned in chapter one as well as the shortcomings seen in chapter two are considered. The rationale, essential outcomes and learning outcomes, structure, content knowledge, pedagogic knowledge are outlined based on the literature analysis that took place in chapter two to four as well as the investigation done in Great Britain.

The structure of the whole thesis can be viewed as *concentric* (see fig 1.3). It starts with a broad overview of the present situation which deals with technological education and its shortcomings. It provides a general picture of curriculum and curriculum development. It narrows down to the conceptualisation of a technology teacher educator curriculum considering the National Curriculum policy in technology education, Norms and Standards for Educators policy and Outcomes-based education, culminating in the proposed technology teacher education curriculum.

In the last chapter (Chapter six) an overview, recommendations, and suggestions for further research and conclusions are made.

FIGURE 1.3
THE STRUCTURE OF THE THESIS



CHAPTER TWO

A BRIEF ANALYSIS OF TECHNICAL EDUCATION, TECHNOLOGY EDUCATION AND TECHNOLOGY TEACHER EDUCATION

2.1 INTRODUCTION

A high priority on the education agenda particularly at FET schools is the preparation of youth for the high performance workplaces in order to retain competitiveness in a global economy (Frantz, 1998:1; Department of Education, 2000:11). Technical education is a term used in high schools to identify curriculum programmes designed to prepare learners to acquire an education and job skills, enabling them to enter employment immediately after leaving grade 12 FET schools (Lynch, 2000:1). Technical teacher education is defined as a higher education programme of technical education in either electrical, mechanical or civil sub-fields that prepare educators to work in the FET schools such as technical high schools, technical colleges, community colleges and comprehensive high schools (Adams, 1994:34).

Where the technical and the technology education curriculum have been implemented successfully in South Africa, the training of teachers has been a priority. The change from technical education to technology education requires a transition from a traditional workshop approach to a creative, problem-solving, and systems approach (Linnel, 1994: 93). For the advancement of technology and global competition, the standard of education and training of technical teachers should be raised. As a result, South African schools are challenged to provide all learners with school education that prepares them for the acquisition of skills, high-wage jobs, and a high level of education. Quality teaching and teacher education are inextricably linked to that challenge (Walker et al., 1996:20). It seems that the national standards for teacher education developed in the Norms and Standards policy document issued by the Department of Education will address some of the challenges for technical teacher education. However, it has been difficult over the years to keep the balance of technical teachers who have both industrial experience and pedagogical

expertise (Walker et al., 1996:21). Given the new needs of producing a competent workforce after Grade 12, it would also be imperative to recruit teachers directly from industry and prepare them with teaching skills (Hudecki, 1994:66). However, it would be difficult to pay the latter personnel the same salary as received by their counterparts in industry. These are the challenges that the Department of Education has to grapple with, if they opt for more industry personnel to be used as technical teachers to meet the demands of FET technical education.

In order to understand the current technology education and its implications for teacher education, it is important to understand its development over the past years. It seems that technical education at schools in South Africa is lagging behind the global technological challenges. Even the present technical teacher education at higher education institutions is at the crossroads. This chapter provides the overview of the present technical teacher education, starting from the historical background as well as the development of technology education under the following themes:

- A historical review of education and training provided to technical teacher in South Africa during the pre-transformation period.;
- Technical teacher education programmes in South Africa during the pre-transformation period;
- Technical teacher education and training during transformation;
- Views of educators and learners on technical teacher education and training;
- Challenges to the current technical teacher education: international perspectives;
- The rationale and development of technology education;
- Purpose of technology education;
- The essential features of technology education.

2.2 HISTORICAL REVIEW OF TECHNICAL TEACHERS' EDUCATION AND TRAINING IN SOUTH AFRICA DURING THE PRE-TRANSFORMATION PERIOD (BEFORE 1994)

2.2.1 Education system and governance in South Africa: pre-transformation period (1980-1994)

Any meaningful discussions on technical education in South Africa have to be done against the background of the historical and political developments in the country. In broad terms, the shortcomings of the previous education system, which had a racial basis, underpinned the education system, and led to problems of disparity in education whereby a large number of learners were unable to benefit from the system. They were therefore, not marketable in industry because of the lack of technical skills (Ankiewicz, 1995:245).

The education system of the previous government was regulated by several policies which were not favourable for the provision of technical education required by the majority of people in the country. That resulted in poorly prepared technical teachers who practiced unsuitable teaching and learning methods and consequently had a poor quality of delivery. The aims and principles based on these policies resulted in many technical teachers being unable to face the challenges of the modern technological environment required by industry (Behr, 1988:86; Garbers, 1991:7; Government of South Africa, 1997).

The manner in which the schooling of White children in the RSA occurred, was laid down in several legislative enactments, the most important being the following: The National Education Policy Act, 1967 (Act 39 of 1967); the National Policy for General Education Affairs Act, 1984 (Act 76 of 1984); the National Education Policy Amendment Act (House of Assembly); 1988 (Act 70 of 1988) and the South African Certification Council Act, 1986 (Act 85 of 1986). There were also other acts that affected educational provision (for other ethnic groups in South Africa) both directly and indirectly.

These acts served as the pattern for the education of all ethnic groups in South Africa before 1994, but had in certain respects been adapted to the educational needs of Blacks, Coloureds and Indians. This study will not analyse in detail the main principles embodied in the above-mentioned acts in respect of formal schooling, as they apply to a great extent to general and academic education. What is of greater importance is that these acts did not offer provision for a sound education and technical education for Blacks. It was these needs that led to the establishment of various commissions of inquiry (Behr, 1988:86).

In order to highlight the above-mentioned situation, Harthorne (1992) identified various related problems, which will briefly be mentioned here.

2.2.1.1 Segregated education

In response to the Eiselen Commission Report, the government, through its spokesperson, Dr HF Verwoerd, passed the Bantu Education Act of 1953. According to this act, teachers were to be trained in institutions designated solely for Africans, separate and distinct from the training provided for other sectors of the South African population (Behr, 1988:86).

2.2.1.2 Distortion of the education system

The De Lange Commission did another important study of education which was commissioned by the government in 1980, following the 1976 crisis in education.

The De Lange Commission recommended a radical change in the education system. In the case of post-basic education, many of the recommendations had to do with technical and vocational (or career) education. Considerable emphasis was placed on the 'distortion' of the existing system by the undue emphasis on so-called 'academic' education, and on the 'disparity' between the school product and the demands of the work situation (Behr, 1988:86).

2.2.1.3 Teacher training quality

During the period 1976-80, pupils accused their teachers of being “badly qualified”. They were referring to the inability of their teachers to explain and clarify difficult education concepts and problems, to answer their questions and engage in discussion with them. Teachers resorted to rote learning of what was contained in the textbook. Senior pupils, who were socially and politically aware, gradually found this less and less acceptable and more and more frustrating. This frustration was directed at the system which provided teachers with limited ‘qualifications’ and a lack of teaching methods (Behr, 1988:86).

2.2.1.4 Lack of understanding by government

Even if the De Lange Commission Report highlighted possible solutions, the government’s response to the report was negative and disappointing to the majority of the people who sought joint solutions to the educational malaise of their country. The government’s memorandum showed a tragic lack of understanding of the real issues which needed to be addressed. Furthermore, the government’s response was very quickly seen as holding on to the past policies of separation and discrimination.

The above-mentioned problems pertaining particularly to technical teacher education and training in general, left negative scars on the South African education system. This resulted in the provision of a poor technical education which will take years to cure. The problem developed a negative mindset in the majority of Blacks, to such an extent that critical and creative thinking was hampered (Behr, 1988:86).

2.2.2 The provision of technical education in South Africa

The development of technical education in South Africa has its own history which was based on racial discrimination, commonly known as apartheid. It is important to briefly discuss some of the highlights of apartheid education which, ideologically is still reflected in the education system of the country.

2.2.2.1 Historical background and statistics

Technical education took some time to establish itself in South Africa, even though there was a dire need resulting from an industrial revolution. Technical education did not rank high among the priorities in educational programmes for Africans in South Africa (Nzama, 1991:21). Behr supports Nzama when he says:

The stigma of inferiority which was associated with the original industrial and vocational schools tended to persist in the minds of parents and students when technical colleges were compared with universities (Behr, 1988:139).

This poor vision resulted in a skills shortage in the technical work force.

It was commonly known that the extent of skills shortages could be gauged by the extent to which the state was providing technical education and training. Furthermore, because the modern sectors (industrial and mining) required a highly skilled and sophisticated workforce, it could not function at full capacity, owing to a serious shortage of skilled labour at all levels (HSRC, 1981:4).

Concerning the provision of Black education, Dr HF Verwoerd (as cited by Malherbe, 1977:546) said:

It is the policy of my department that Bantu Education should have its roots entirely in the native areas and in the native environment and in the native community” ... This Bantu Education had to be able to give itself complete expression and it would have to perform its real service. The Bantu had to be guided to serve his own community in all respects. There was no place for him in the European Community above the level of certain forms of labour. Within his own community, however, all doors were open. For the reason it was of no avail for him to receive a training which had its aim at absorption into the European Community, while he could and

would not be absorbed there. Up till now he was subjected to a school system which drew him away from his community and practically misled him by showing the green pastures of the Europeans but still did not allow him to graze there.

It was based on such statements that education for Blacks was tailor-made in such a way that even an educated Black could not find acceptable employment.

The number of youths receiving technical education was so small that it could not address the demands for skilled workforce. The following statistics will further indicate that technical education was not a priority in the country.

In 1936 only 12 technical centers in the Cape Province and five in Natal were established. In these centers specialised trade instruction was given to a total of 543 African male youths, while about 621 Africans female youths were trained in household work. In 1946 the Transvaal had ten such centers with 623 pupils. This number brought the total for the whole country to 2 015 African pupils receiving some form of technical education.

In 1946 the De Villiers Commission on Technical and Vocational Education was set up. The Commission found a great deal amiss with teacher education. There was little vocational guidance; little or no correlation between training and the occupational demands of the country; a lack of co-operation between industry, labour organisations and the educational leaders; and too narrow a scope of training (Behr, 1988:86).

The Commission also found that in 1946 a mere 2 000 Black pupils were receiving some form of technical training. The Commission attributed the lack of facilities for technical education; and the lack of progress in industrial training of Blacks to the fact that the trained Native work force, as it was known, could not find an outlet for the practical application of its skills (Behr, 1988:141).

In 1955 there were 22 039 students receiving technical training out of over one million at primary schools and nearly 70 000 pupils in secondary schools. In 1970, the total African school population had grown to almost 28 million of which there were 2,5 million in secondary school classes. The number attending technical and trade classes were only 3 652 compared to 6 286 Asians, 3 705 Coloured and 83 000 Whites who were receiving vocational and technical training. This proves that trade training for Blacks was on a limited scale and technical education was almost non-existent for Black students (Malherbe, 1977:196).

These statistics clearly indicate that despite large increases in the provision of education, the system had not even managed to produce enough technically skilled teachers needed by education itself (HSRC, 1981:11).

It may therefore be stated that the history of neglect, inferiority, inequality and discrimination has cost South Africa dearly, not only in human terms in the frustrations and wastage of young lives and in adding to the heritage of bitterness, anger and division in the country, but also in straight-forward economic terms. It led up to the issues which Black teachers both in general education and technical education struggle with today.

2.3 TECHNICAL TEACHER EDUCATION PROGRAMMES IN SOUTH AFRICA DURING THE PRE-TRANSFORMATION PERIOD (BEFORE 1994)

2.3.1 Some technical teacher education programmes offered by technikons

The wide range of courses for technical teacher training programmes offered at technikons becomes clear from a perusal of the information brochures and prospectuses of these institutions. It has been mentioned in section 2.2.1 that the education system in RSA was laid down in several legislative enactments based on the apartheid system of government.

As a result different technical teacher programmes were designed for different races in South Africa.

a) Secondary Teachers Diploma (Technical) 1986

This course was offered by the then Technikon Northern Transvaal. The duration of the course was three years fulltime at the Technikon.

Candidates needed the following prerequisites for admittance to the course:

- The National Senior Certificate with a pass in Mathematics and Science in addition to other subjects; or
- The National Technical Certificate N3 in either the Electrical, Mechanical or Civil field of specialisation. At least two official languages had to be included (Stander, 1991:105).

The candidate had to pass the following subjects in order to obtain the diploma:

Education III; Teaching Science III; Bible and Philosophy of Life; Teaching Practice III; Method of Technical Subjects II; Special English and four major subjects from either the Electrical, Mechanical or Civil field (Technikon Northern Gauteng, 1989:1-2)

Since the S.T.D. (Technical) was based on race it can be regarded as a non National Diploma, because it was designed only for Blacks by Department of Education and Training (DET). However, during the year 1991 a National Diploma: Technical Education was developed and implemented.

b) National Diploma: Technical Education 1991

This was a three-year National Diploma offered to technical student teachers by the then Technikon Northern Transvaal. The admission requirements for this programme were:

- A Senior Certificate with a pass mark in Mathematics and Physical Science (preferably a symbol on higher grade)

or

- A recognised equivalent such as the National Certificate in N3, a pass in four subjects, including Mathematics and Engineering Science as well as the two official languages at Senior Certificate level (Department of Education, 1992:189).

Candidates had a choice between the Electrical, Mechanical and Civil fields of specialisation. Students had to do four major subjects in one of these fields of specialisation. Candidates had to pass the following subjects in order to qualify for the diploma:

- Compulsory subjects: Communication IIIB; Subject Didactics: Mathematics IIB; General Didactics B; Subject Didactics: Workshop Theory/Practical IIIB; Technical and Learning Media B; School Media Centre Orientation B; The Bible and Philosophy of Life IIIB; Psychopedagogics B; Organisation and Administration B; First Aid and Occupational Safety; Philosophy of Education III; Education Legislation IIIB; Historical and Comparative Education III. Mathematics II was also compulsory for the Electrical field of study; Machine Drawing T1 was compulsory for the Mechanical field of study and Construction technology T1 was compulsory for the Civil Engineering field of study.

In addition to the above-mentioned compulsory subject, students had to choose at least three subjects at T1 and T2 level from many of the three fields of study (Department of Education, 1992:190).

It is clear from the above-mentioned 1991 course structure that the curriculum was overloaded and it was likely that further problems and confusion might arise out of such a curriculum. There was also an overlapping in most of the content of subject-didactics. Owing to these problems another diploma was developed, namely the National Higher Diploma: Technical Education.

In 1993 a post-graduate diploma called the National Higher Diploma: Technical Education was implemented. It had a 4th year level to the previous mentioned diploma (ND: Technical Education).

c) National Higher Diploma: Technical Education 1993

This was a one-year full time diploma offered by then Technikon Northern Transvaal. The admission requirement for this programme was:

- A National Diploma: Technical Education with an average of 60% in the final year

or

- A three-year qualification which the Academic Board of the Technikon accepted, with or without additional requirements, as being equivalent. The S.T.D. (Technical) was accepted as an equivalent three-year qualification.

The course structure was as follows:

Research Methodology; School Management; Socio-pedagogics; Sport Management I; Subject Didactics; Technical IV; Teaching Practice IV and at least four major subjects at T3 level from either the Mechanical, Electrical or Civil field of study (Department of National Education, 1992:365 and Technikon Northern Gauteng, 1991).

The National Diploma: Technical Education (1991) and National Higher Diploma: Technical Education (1993) formed a plenary session of the transformation of education at higher institutions of learning. This transformation affected technical teacher training programmes in that all the programmes for technical teacher training mentioned had to change. The following section will outline the educational transformation in South Africa with reference to technical teacher training.

2.4 TECHNICAL TEACHER EDUCATION AND TRAINING DURING TRANSFORMATION (1994 – PRESENT)

There has been educational transformation in higher education, in terms of curriculum change in technical teacher education. This was done to respond to the national educational transformation as part of the new Constitution of South Africa aspiring for a non-racial education system.

2.4.1 The educational transformation in South Africa

Educational transformation in South Africa was imperative because the attitudes and values of most of the adult South Africans of this decade were formed in the apartheid era. As a result of the divisions which existed during that era, learners were not always taught to appreciate the different aspirations and perspectives of people from whom they were distanced.

In attempting to address the need of this country to create a fruitful future, quite a number of documents regarding transformation frameworks have been produced (Nxumalo, 1990:27; Dyrenfurth, 1995:48). Planners, developers, educationalists and educational

programme providers responded to the technological changes. The need for change was echoed by Kemp and McBeath (1994:15) when they state:

We are kidding ourselves if we believe that educating people for the year 2000 is essentially the same as educating them for the year 1975. Everything has changed. Our educational institutions must change as well.

Furthermore, the situation with regard to technical education and teacher training was that the technical skills acquired should be adapted to market needs, making the labour market more flexible. The technical skills should also combat unemployment, making it easier for young people to enter the labour market, and promote the re-employment of the long-term unemployed (Vocational Education and Training, 1996:17). This quality education should prepare people who are capable of constantly adjusting in an ever-changing society.

This implies that students should be taught how to become lifelong learners by utilising knowledge and information effectively in their personal and working lives (Behrens, 1995:254).

2.4.2 Overview of the present teacher education sector in South Africa

There are quite a large number of tertiary institutions offering pure academic teacher education as compared to a few tertiary institutions offering technical teacher education. According to the 1995 National Teacher Audit, there are 95 state and five private colleges which provide distance education. In total, there are 109 teacher education colleges which provided teacher education to 150 380 student teachers. In addition, twenty universities provide contact teacher education through their departments, faculties or schools of education. Furthermore, the audit revealed there are 28 954 student teachers (Government of South Africa, 1997:4)

There are 15 technikons in the country. Five out of 15 existing technikons offer teacher education, including technical teacher education and training. These technikons cater for 1 846 students (Hofmeyr & Hall, 1995:14).

Table 2.1 shows the distribution of technikons involved in technical teacher education.

TABLE 2.1
STATISTICS OF TECHNIKONS PROVIDING TECHNICAL TEACHER
TRAINING PROGRAMMES: 1997

Province	Total No of Technikons	No of *HBT	No of *HWT
Kwa-Zulu Natal	2	1	1
Western Cape	2	1	1
Gauteng	1	1	0
TOTAL	5	3	2

*HBT = Historical Black Technikons

*HWT = Historically White Technikons

Source: Department of Education (1997: 4)

Owing to the new OBE Curriculum 2005 framework, there is a great need for technical teachers to offer technology education at schools. This means the re-training of teachers to fit them into the new system. Therefore, the role of technikons as providers of technical education becomes more important than ever before.

A technical teacher programme was developed to be in line with the demands of the technological environment. This resulted in a new programme for technical teacher

training which was developed by technikons during the period 1994-1995. The curriculum for the programme, which is known as National Diploma: Education: Technical, was implemented in 1996. The following section will outline the course structure of this programme:

a) National Diploma: Education: Technical 1996

The course entails three years of full-time study at the Technikon and practical teaching of 10 weeks at technical high schools.

* Admission requirement

A Senior Certificate with a pass mark in Physical Science and Mathematics or a recognised equivalent, e.g. N3, a pass mark in Mathematics and Engineering Science and two other subjects plus two official languages of the Senior Certificate.

* Course structure

First year

- Compulsory offerings: Third Language I, English I, Theory of Education I, Teaching and Learning Media, Philosophy of Life and Life Skills, Teaching Practice I, Educational Management I

plus the following major subjects:

Mathematics (Education) I, Graphics (Education) I, technology (Education) I, plus the following subject didactics: Subject Didactics: Mathematics I, Subject Didactics: technology I, Subject Didactics: Graphics I

Second year

- Compulsory offerings:

With the exception of Teaching and Learning Media and with the addition of Computer Literacy, these offerings are the same for first and second level.

Students can choose from the following major subjects:

Mathematics (Education) II, Graphics (Education) II, technology (Education) II

Students can also do two of the following Subject Didactics: technology II, Subject Didactics: Graphics II.

Third year

- Compulsory offerings: Except Third Language II and English II, students have to do Level III of the subjects mentioned in second year.

Students have the same choice of subjects mentioned in second year but done at Level III,

plus two of the following subject didactics:

Subject Didactics: Mathematics III, Subject Didactics: technology II, Subject Didactics: Graphics III (Department of National Education, 1997a: 219).

With regard to the major subjects technology students have a choice between Electrical, Mechanical and Civil fields of study. After completing a three-year programme students can continue to study further in a one-year full time post-graduate course.

This one-year post-graduate course plus the three-year programme would provide a learner with a B Tech degree status.

b) B Tech: Education: Technical

This course was developed during 1996-1997. The course entails one-year full-time training and is also offered by technikons.

* Admission requirements

The National Diploma: Education: Technical with an average of 60 % in the final year

or

A three-year qualification which the Academic Board of the Technikon accepts, with or without additional requirements, as being equivalents. Candidates who did not follow the ND: Education: Technical programme, have to do a bridging course which is incorporated in the B Tech: Education: Technical programme.

Candidates have to pass the following subjects before being awarded the B Tech qualification:

Compulsory offerings are Theory of Education IV; Educational Management IV and Research Methods and Techniques.

Candidates should do two of the following major subjects:

Mathematics (Education) IV, Graphics (Education) IV, technology (Education) IV

Candidates should do one of the following subject didactics:

Subject Didactics: Mathematics IV, Subject Didactics: technology IV, Subject Didactics: Graphics IV (Department of National Education, 1997:589).

Technology (Education) is divided into technology-Electrical, technology-Mechanical and technology-Civil. This means, candidates have to choose technology education according to their field of study.

2.5 VIEWS OF EDUCATORS AND LEARNERS ON APPROACHES TO TECHNICAL TEACHER EDUCATION

This section presents findings and discussions on some important selected factors in the training of the current technical teachers based on a previous study (Makgato, 1999).

2.5.1 The needs for creativity development in the technical teacher programme

The ability of a lecturer to apply activities that develop creativity in learners plays an important role in producing creative technical teachers. Conclusions made show that the use of advanced instructional methods is very important if creativity is to be developed. The following teaching and learning methods are considered important to enhance creativity:

- Problem-solving –learning by solving problems;
- Demonstration – showing how a particular teaching skill is done;
- Project-based learning by working around a task to achieve one objective;
- Individual work – one-to-one working on long-term projects;
- Team work – students work in groups around a task to achieve one objective;
- Individual work – one-to-one working on a problem or task;
- Technological process – consists of stages used to design and construct projects (Makgato, 1999:79).

It is proposed that lecturers should organise themselves (e.g. quality assurance committee) in such a way that they can learn new methods of teaching and learning in order to apply them in the training of technical teachers. Organising and planning in as far as practical skills are concerned are discussed further.

2.5.2 Practical skills

It was found that a policy committee of teachers and trainers in Germany meets four times a year to discuss ways in which subject teachers can best relate theory to practical work. The empirical investigation also indicated a high need for integrating theory and practice.

It is proposed that the programme for technical teacher education should reflect how lecturers are to organise themselves in order to improve their skills of relating theory and practice. This may be done by constantly meeting to assess their progress.

2.5.3 Time allocation in the technical workshops

According to the conclusions made in the previous study there is too little time allocated for practical workshop tasks. This may result in crash tasks which lead to poor acquisition of technical skills.

It is proposed that an entire day should be allocated on the timetable for workshop training in a technical teacher programme. Although this is not an easy task, the importance of practicals in the curriculum should be pointed out to the curriculum committee.

This will result in more credits being allocated to practicals by the government. More credits will, therefore, warrant more workshop time.

The important role of industry, educators, and students with regard to the promotion and provision of technical teacher education is discussed.

2.5.4 Establishment of a link between secondary schools and industry

It was found in the previous study that in developed countries there has been a link between schools and industry through the 'dual system' of in-firm and in-school learning. It was also found that due to ignorance concerning the importance of industry in education, South Africa has experienced a shortage of a highly skilled technical workforce.

All technical schools and comprehensive school should have a link with industry, just as there is a partnership between technicians and industry. The link will set up a channel of communication which will enable the industry to contribute to school curriculum development on technical education for technology education. There is a need for an advisory committee on the technical education curriculum which should include both school and industry representatives.

2.5.5 Duties of educators

The main tasks of a lecturer as an educator at higher education institutions is three-fold, namely, teaching, research and community service. It is important to note that the educator's role should be that of facilitating the learning process. Instead of just implementing centrally designed curricula, lecturers will have the freedom to develop their own learning programmes based on the guidelines provided by the education department.

2.5.6 Lecturing ability

The lecturer's ability for effective teaching also depends on updating themselves with the most appropriate technological developments in their subject disciplines. Visits to industry by lecturers, using relevant new methods of teaching, as opposed to talk and chalk, and an awareness of technical innovations will enhance the lecturer's ability to teach effectively. These abilities are related to a partnership with industry and practical research which is considered important.

It was concluded in the previous study that lecturers agreed that their ability might be enhanced by visits to industry, using new methods of teaching and being aware of technological developments, whereas students agreed with only the application of new teaching ability. Therefore, it is suggested that lecturers should seriously consider using new teaching methods.

2.5.7 Establishing of partnerships

As previously highlighted, institutions of higher education cannot afford to stay isolated from industry, since their training will not be addressing the needs of the country. It was also concluded that partnerships are vitally important and should be set up.

Lecturers and students should also establish partnerships between industry and providers of technical teachers through regular industrial tours. Owing to rapid technological changes, lecturers should take short practical courses in special technical skills on a regular basis. These arrangements require planning and organising of the institution. This means that there should be a programme for partnership, time scheduling for industrial tours and budgeting for the short courses. In addition, structures should be put in place to deal with industrial tours and short courses.

It is therefore proposed that all curricula for technical teacher education should very clearly state the time scheduling of tours to industry and schools in the prospectus.

Partnership should also be established between institutions at local international level.

2.5.8 Equipment

It was concluded that equipment is vitally important for the training of technical teachers, although sections on the role of government and educators should also plan by budgeting for this item. On the other hand, institutions should set up organisational structures that deal with purchasing of equipment. Furthermore, there should be control over the

equipment purchased which continuously checks the proper use of the equipment to save costs.

2.5.9 Characteristics of future learners

The philosophy of outcomes-based education envisages a new type of learner. All learners should work to become more:

- responsible for their own learning;
- able to make appropriate learning decisions;
- independent in their learning and thinking;
- self-assessing;
- successful.

Based on the above characteristics, lecturers should strive to support learners accordingly, in order to produce creative learners.

2.5.10 Secondary schools

In South Africa it is common that secondary schools are designed for mono-functional learning provision in that they largely serve as feeder institutions for universities and technikons (Makgato, 1999:197). Proposals made in the previous study regarding secondary schools in South Africa include the following:

- There should be a large percentage of schools offering technology education, where hands-on-tools and project design and building are emphasized. That means the government should spend more on this aspect.
- Students in schools should get proper guidance and counseling about careers and the economic needs of the country.
- A culture of learning and teaching should be restored in the schools
- Schools should also start to offer vocational education directed at industry. The past situation indicated that the majority of secondary schools existed as mono-functional

preparatory learning institutions, where they channeled their outputs largely to universities and technikons.

2.6 CHALLENGES TO CURRENT TECHNICAL TEACHER EDUCATION: INTERNATIONAL TRENDS

Technical education is a term used in high school to identify curriculum programmes designed to prepare learners to acquire an education and job skills, enabling them to enter employment immediately upon high school completion. The ongoing changes, where they occurred, seemed to be to prepare learners for employment and higher education (Lynch, 2000:3). The Department of Education will also ensure that FET curricular programmes prepare learners for employment and higher education (Department of Education, 1998:29). The reformed technical education is characterised by a curriculum which is based on the need for learners to demonstrate mastery of:

- a) rigorous industry standards;
- b) high academic standards and related general education knowledge;
- c) technology;
- d) general employment competencies (Lynch, 2000:3).

Where changes have been made, the names vocational and technical education has been replaced in other international localities to depict the revised actional curriculum. New names include applied technology education and workforce education (Lynch, 2000:3). Globally, technical education seems to be at a crossroads. These changes are being driven by the new technologically based economy. Technical teachers must be prepared to meet the challenges of these changing workforces in order to develop the new economy (Frantz, 1994:26).

2.6.1 The new economy

According to economists such as the world is no longer in a post-agricultural or post-industrial era. The new world is that of fast communications and information, rapid

decision-making, and intelligent social skills that are needed to deal with economic, technical, ecological, and ethical issues with complex problems facing every economic, social, or political system.

The new economic world is vastly different from the agricultural factory environment that ushered in the public school in the 19th century. It is characterised today by international activity, cyberspace, ever-changing market demands and standards, rapid product life cycle, ever increasingly sophisticated computers and a need for a more thorough knowledge of the holistic business environment rather than just specific skills or narrow job tasks (Lynch, 2000:5)

Economists and scholars are increasingly talking about the ascendancy of knowledge as a primary product and competitive edge for many businesses, that is, there is a constant need to learn and upgrade (Lynch, 2000:5). There is an increased reliance on team problem-solving often from remote locations and an incredible need to manage information and technology. The ability to analyse, synthesise, and evaluate information and use that information to solve problems, is also apparent. New versions and forms of prerequisite technical skills, flexible jobs and new repetitions of related education and skills requirements are also evident. Technical and technological skills remain important, but they must be modified and grounded in the employee's ability to think of them in context. These skills were once reserved for those in management. Today they are considered necessary for individuals at all levels of employment.

It is imperative for high school/technical education to be redirected in relation to the new economy. The need for all learners to have increasingly high levels of technology knowledge is hereby determined. Technical education should be integrated with academic education. It is imperative to teach learners and youth how to think, not just what to think (Lynch, 2000:8).

The challenges of technical education at high school requires that technical teacher education be reviewed and changed to eliminate the practices of the past and focus on the needs of the future (Frantz, 1994:25). The implication is that technical teacher education will operate in a climate that fosters reflective thinking, problem-solving skills and collaborative behaviour. Future technical teachers will develop the competence to understand and appreciate current technology and to instill such understanding among their learners (Adams, 1994:36).

2.7 THE RATIONALE AND DEVELOPMENT OF TECHNOLOGY EDUCATION

There has been a tendency in man to provide solutions continuously to problems arising from needs and wants, and this is referred to as technologies. Like any other science, technology is fundamentally the study and application of techniques to solve human problems. However, Archer (1993:42) shows the difference between technology and other fields of study as follows: science is the collected body of theoretical knowledge based on observation, measurement and test; the humanities is the collected body of interpretive knowledge based on contemplation, criticism, evaluation and discourse. According to Archer, technology is the collected body of practical knowledge based upon sensibility, invention, validation and implementation. Archer distinguishes technology from science and the humanities on the basis of the processes of ‘sensibility, invention, validation and implementation rather than on the basis of content’ (Archer, 1993). It is believed that technologies started centuries ago in central Africa. The designing and making of pyramids in Egypt, exploiting of sources of food and water and defending against attackers are just some of the few features of human cultures throughout history (ORT-STEP, 1995:9). Throughout centuries, these abilities to solve problems through the design, production, appreciation, and appropriate use of technology, improved the quality of human life. Quality of life is directly related to an ability to develop new technologies creatively while simultaneously appreciating scientific, economic, social and ecological considerations (Makgato, 1999:1). Technologies can improve the quality of life as well as increase human dependency on them sometimes resulting in unexpected consequences and even detrimental

results such as environmental pollution (Makgato, 1999:1). Rapid industrialisation and technological change placed new demands on schools to develop the scientists, engineers, technicians and skilled workers who would continue to propel the economy towards a stable future (Herschbach, 1997a:24)

Science and technology plays a big role in the economic and social development in today's world. Scientific and technological literacy must be given priority as an essential component of basic education (Makgato, 1998:1). ORT-STEP identified seven reasons why technology should be part of the school curriculum. The reasons are as follows:

- Technology is an important part of our daily life.
- It is essential for the economy of South Africa that the future technological work force is educated with an entrepreneurial attitude, innovation and creative thinking skills.
- A basic knowledge of technology is indispensable; not only for technical jobs, but for all professions.
- To survive in a technological world and cope with the technological products that surround us, technological literacy is needed.
- To have control over our technology and the affected environment, insight into its nature is essential.
- Technology Education can contribute to an informed and positive-critical consumerism. Technology education can help learners to be informed when making choices in their further education.
- To develop problem-solving skills which may be used in all aspects of life.

With technology education young people will not only be prepared to adapt to a changing world but will be prepared to create new changes for the benefit of humanity (Makgato, 1999:2). In South Africa there is need to train people to operate and maintain the technologies that the country imports. There is also a need to train learners to design and develop technologies which will eventually provide finished products to trade on the

international markets. Instead of exporting raw materials and unfinished products, there is a need to teach technology education at schools so that South Africa can produce finished products which are more profitable and economically rewarding (Makgato, 1999:2).

Technology education in a technological environment is more than simply the skills required to replicate or use existing technologies. According to ORT-STEP (1995:1) technology is not just another subject taught at school. It is a life style whereby students are equipped with thinking, problem-solving and decision-making skills which enable them to address and cope with community needs. In order to sustain the viability of the economy, the critical skills of resourcefulness, problem-solving, the ability to learn both individually and in groups and the ability to conceptualize and design novel solutions are more important than technical dexterity. All categories of skills, important as they are, cannot be developed in total ignorance of scientific, economic, social and ecological factors. Therefore, the challenges for technology education is to develop a curriculum which ensures opportunities for learners to develop shared understandings; specific personal qualities and perceptions, and a range of useful, individual skills (Makgato, 1999:2).

The ORT-STEP study concerning technology as part of general education was conducted in 37 countries. The countries included developing and highly industrialised countries. The study summarised the basic skills taught in technology education as follows:

- The mastery of basic knowledge, understanding of technology and its link with science;
- Understanding the use of materials, processes and techniques of technology and their application;
- The awareness of technology and its impact on environment;
- The ability to engage in systematic decision-making;
- The knowledge of the need-to-product process;
- The capacity to design and construct products;

- The ability to collect data;
- Understanding the use of materials and energy;
- Developing analytical, interpretative and research skills;
- Developing reasoning skills;
- The capability to engage in problem-solving and planning;
- Developing critical-thinking skills;
- The enhancement of career maturity;
- Developing technological and cognitive skills;
- Developing usage of tool and equipment;
- The capability for design, fabrication, evaluation and realisation;
- Developing positive attitudes and values;
- Awareness of the historical evolution of science and technology;
- Valuing the development, conservation and appropriate use of resources;
- The ability to work in teams;
- The understanding and ability to use communication skills, including graphic communication;
- Tendency for safe work habits;
- The appreciation of agriculture and industry;
- The fostering of creativity and innovation (ORT-STEP, 1995:5-6).

From the UNESCO (1983) study it is clear that technology is a subject in its own right and that it consists of the three attributes;

1. Knowledge items such as literacy, technology, scientific principles and concepts, mathematical terms and models, environmental studies, agriculture, materials, economics etc.;
2. Skills items such as observation, design and construction, data collection, analysis, interpretation, research skills, technological and cognitive skills,

making and manipulating skills, team work, communication, graphic communication and safe work habits;

3. Thinking such as: critical thinking, reasoning, decision-making, evaluation, analytical skills, problem-solving, positive attitudes and values, creative and innovative thinking skills (ORT-STEP, 1995:5).

According to the Department of Education (1997b:89), in the Curriculum 2005 document the rationale for the technology education learning area 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.

The understanding of technology should contribute to:

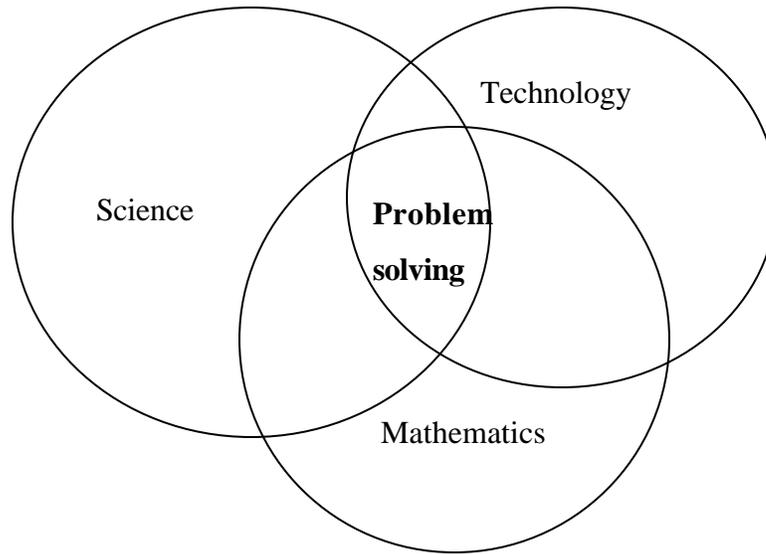
- The development of learners' ability to perform effectively in their changing environment and to stimulate them to contribute towards its improvement;
- The effective use of technological products and systems;
- The ability to evaluate technological products, processes and systems from functional, economic, ethical, social and aesthetic points of view;
- The designing and development of appropriate products, processes or systems to functional, aesthetic and other specifications set either by the learner or by others;
- The delivery of quality education; access and redress through:
 - relevance to the ever-changing modern world;
 - integration of theory and practice.

- The development of citizens who are innovative, critical, responsible and effective;
- The demystification of technology;
- The recognition of and respect for diverse technological solutions and biases that exist; and
- Creating more positive attitudes, perceptions and aspirations towards technology-based careers.

2.7.1 The interrelationship between science and technology

There is a relation between technology and science because science provides knowledge of natural phenomena that are used in technology. On the other hand, technology provides Science with new fields of research that can lead to new inventions, as well as technological means that stimulate scientific progress (ORT-STEP, 1995:7). It is too simplistic to see technology merely as applied science. Historically, this does not hold, because the steam engine was invented without the correct knowledge of the thermodynamical processes on which it is based (ORT-STEP, 1995:7). In today's knowledge-based global marketplace, international experience has shown that a vibrant economy depends on the general levels of education, especially proficiency in mathematics, science and technology, which are the foundations of the wealth generating economies (MST Strategy Report, 2003). Mathematics, science and technology have common component problem solving. ORT-STEP (1995:7) explains the interrelationship between mathematics, science and technology using a Venn diagram below.

FIGURE 2.1
THE INTERRELALATION BETWEEN MATHEMATICS, SCIENCE AND
TECHNOLOGY



Source: ORT-STEP (1995:7)

From figure 2.1 above, it is clear that technology education is regarded as a subject with its own knowledge structure. Although there are areas that overlap with both science and mathematics, it should not be considered as part of these subjects. It should also not be taught as part of one or the other (ORT-STEP, 1995:7). This implies that technology has a body of knowledge and skills of its own.

Some of the ways in which technology is different from science are indicated in table 2.2.

TABLE 2.2
RELATIONSHIP BETWEEN TECHNOLOGY AND SCIENCE

Emphasis in science	Emphasis in technology
1. Exploring existing phenomena to reach new knowledge	<ul style="list-style-type: none"> • Designing new products, that did not exist before
2. Curiosity as a driving factor	<ul style="list-style-type: none"> • Need/want as main driving factor
3. Working with an ideal and simplified world	<ul style="list-style-type: none"> • Working in the real complex world
4. Research	<ul style="list-style-type: none"> • Design for application
5. General problem statements	<ul style="list-style-type: none"> • Specific problem solution
6. Reliance on assumptions	<ul style="list-style-type: none"> • Reliance on facts
7. Truth, accuracy, the ideal	<ul style="list-style-type: none"> • Solutions should be effective, efficient, within acceptable tolerances
8. Abstract/theoretical	<ul style="list-style-type: none"> • Concrete/practical
9. Looks for uniform knowledge, that applies everywhere in the same way i.e. ideal	<ul style="list-style-type: none"> • Looks for solutions that are optimal for specific situations

Source: ORT-STEP (1995:8)

According to Pucel (1995:38) technology and science are partners not relatives. They work together, yet are fundamentally different in their history and in what they do, how they do it and what they practise. He claims that technology came before science.

Given these fundamental differences, technology education should be different from science education. It is on the basis of the above-mentioned development of technology over the past years that the purpose, goals, objectives, learning outcomes and structure of

technology education as curriculum was developed and written. It is important to note that technology education is linked both historically and conceptually with technical education or industrial arts (Herschbach, 1997:24)

2.8 PURPOSE OF TECHNOLOGY EDUCATION

Technology education came into favour in response to a widely held view that technical education was linked to an older production system and no longer had relevance (Herschbach, 1997b:20). It was a response to the perception among technical educators that the subject field had to be substantially reconstructed.

The purpose of technology education serves as a basis for unifying the technology education curriculum. Technology is about solving practical problems; it is a creative rather than investigatory activity (Hutchinson, 2000:2). According to the Ministry of Education (1996:ii) the Design and Technology course should enable students to:

- apply problem-solving skills, creatively and practically through designing, making and evaluating using real life context;
- demonstrate an understanding and appreciation of the effects of technology on society and the environment;
- contribute to their own self-sufficiency and self-reliance by practically applying technological principles to situations within the home and community;
- work together to develop a range of skills, positive values and attitudes of social responsibility and co-operation;
- exercise value judgements of a moral/ethical, aesthetic, technological, economical and environmental nature;
- demonstrate dexterity, critical thinking, curiosity, ingenuity, initiative, resourcefulness and discrimination in real life problem-solving activities in their community.

The purposes of technology education will be further specified clearly in terms of aims, and outcomes.

2.8.1 Aims and outcomes of technology education in Canada

Gardner and Hill (1999:133) identified the aims of technology education in Ontario, Canada, as follows. Students shall be given opportunities to:

1. Develop the following understandings and attitudes

- * respect for and co-operation with co-workers and supervisors in a simulated employment setting;
- * an awareness and practice of good safety habits through regular use of safety equipment and accident-prevention techniques in a practical work setting;
- * a commitment to the responsible use and conservation of the sources of energy and provide the motive power for sustaining a technological society;
- * an appreciation of the relationship between technological changes and the quality of life;
- * an awareness of the nature and frequency of technological changes that affect career plans and adapt to these changes in an intelligent manner;
- * an appreciation of the aesthetic component of design in addition to the basic functional component;
- * an appreciation of the pride satisfaction that can be found in quality craft work through practical project exercises;
- * an awareness of the quality of goods and services through knowledge of process and products, so that students may become educated consumers.

2. Develop the following kinds of technological skills and knowledge

- * the ability to analyse and solve problems and to plan and perform tasks logically and effectively;

- * a capacity for clear and creative thinking and for inventiveness in the design and production of practical projects;
- * the ability to produce, maintain, and repair objects of value through the development of competence in the use of hand tools, power tools and machines related to home maintenance as well as technological fields of interest;
- * the ability to use the correct terminology and language in identifying machine parts and describing process;
- * personal and social skills that contribute to self-reliance and positive attitudes. Students should learn to organise their time effectively; to develop a routine for maintaining clean and neat work stations; to become accountable for identifying and stringing small hand tools; and to become aware of personal strengths through exploration and involvement in various technological fields.

3. Preparation for work

- * employment, with marketable technological skills and knowledge;
- * service occupation, through exploration of various technological fields and possible concentration in a field of the student's choice;
- * apprenticeship and trades, through mastery of a specific technology;
- * further education, through mastery of specific fields of technology.

In Ontario, from 1975 to 1989 the study of technology in secondary schools followed two distinct routes, both on an elective basis. The first route was through the continuation of design and technology courses, or interest courses that began in Grade 7, which could, if a school principal chose, continue until Grade 12. A second route could be found in Grade 9 to 12, through distinct technology courses.

Approximately 75 different technology studies could be offered in secondary school programmes, for example, automotive mechanics, cosmetology, drafting, and woodworking (Gardner & Hill, 1999:116). The three major aims for technology in Grades 9 to 12 are

part of the 13 goals of education in Ontario. Students were to be given the opportunity to (1) develop understandings and attitudes about technology, (2) develop technological knowledge and skills, and (3) prepare for entering the workplace or post-secondary education.

In Ontario the main purpose of technology education, in the intermediate division (Grade 7 to 10) was seen as exploratory, especially in design and technology. In Grades 9 and 10 this exploration continued and was seen as offering “students an opportunity to learn about career opportunities and alternative training routes.” In the senior division (Grade 11 to 12) the emphasis was on problem-solving and on the student’s ability to work independently at assigned strategies involving well-organised teamwork for complex industry-oriented projects (Gardner et al., 1999:116).

In South Africa, ORT-STEP (1995:8) developed the general aims and outcomes of technology education as follows:

2.8.1.1 General aims described in terms of conceptualisation, knowledge, skills and attitudes

(a) Conceptualisation

- Develop a balanced view on the nature of technology;
- Develop an awareness of the impact of technology on everyday life: past, present and future;
- Develop an awareness of the impact of technology on society, the economy and the environment;
- Develop an understanding of the interrelationship between subjects such as maths, science and technology.

(b) Knowledge

- Acquire knowledge; develop understanding and capability in basic technological concepts and principles.

(c) Skills

- Develop problem-solving skills through technological processes such as designing, making and using/evaluating;
- Identify and investigate individual/social/environmental needs, problems and opportunities and accordingly design and make appropriate products, systems and processes;
- Acquire mastery of skills required for the realisation of technological processes;
- Foster both innovative and creative thinking and decision making throughout the programme;
- Conduct research and investigation to solve design problems in a technological way;
- Develop personal techniques for information collection including, where possible, the use of electronic media;
- Develop communication skills and techniques;
- Develop entrepreneurial skills.

(d) Attitudes

- Develop a positive attitude towards the industrial sector and the world of work;
- Motivate pupils to become self-confident and to encourage positive attitudes towards life in a changing technological environment;
- Emphasize the individual's contribution and impact on his/her technologically affected environment;

- Appraise their own and others' accomplishments as individuals of a group, suggesting modifications and/or improvements.

2.8.1.2 Specific learning outcomes in technology described in terms of designing, making, testing, management, entrepreneurial and communication skills

(a) Design Skills:

At the end of senior phase technology education learners should be able to:

- Design and/or select an optimal and marketable solution to a problem;
- Develop appropriate working prototypes using design processes;
- Select and use the appropriate information, materials and equipment to solve problems;
- Consider and apply the ergonomics of the products and systems.

(b) Make skills:

At the end of senior phase technology education learners should be able to:

- Use tools and equipment appropriately;
- Exercise safety rules and regulations;
- Use appropriate equipment and systems according to written or oral instructions;
- Conduct quality assurance with specific reference to technological processes and products.

(c) Testing/evaluating skills:

At the end of senior phase technology education learners should be able to:

- Assess whether the end products comply with needs and specifications;
- Analyse existing products with a view to suggesting improvements;
- Become a discerning consumer.

(d) Management skills:

At the end of senior phase technology education learners should be able to:

- Work individually and within a team, sharing responsibilities for technological tasks and projects;
- Plan and manage the realisation of technological processes.

(e) Entrepreneurial skills:

At the end of senior phase technology education learners should be able to:

- Conduct and conclude market research for relevant assignments;
- Promote self-confidence and create an awareness of needs and opportunities.

(f) Communication skills:

At the end of senior phase technology education learners should be able to:

- Use drawings/symbols, written explanations, models and other forms of communication to communicate technological information.

The above-mentioned aims and outcomes were proposed for the primary schools' technology curriculum by ORT-STEP Institute. The aims and outcomes were developed and informed by the national essential outcomes for education. Later, in 1997 the Department of Education in South Africa developed specific outcomes for technology in its first National Curriculum Statement (NCS) commonly known as Curriculum 2005 (C2005). The outcomes were developed for the General Education and Training band (Grade R to 9). Due to problems experienced during implementation, C2005 as the first NCS was revised and replaced by the second draft, NCS for Grades R to 9 which was released in 2001. It is in the second draft NCS where the specific outcomes for technology were consolidated into three learning outcomes as follows:

Learning Outcome 1

The learner is able to demonstrate an understanding of the inter-relationships between technology, society and the environment.

Learning Outcome 2

The learner is able to apply technological processes and skills ethically and responsibly, using relevant conceptual knowledge.

Learning Outcome 3

The learner is able to access, process and use information in a variety of contexts.

These Learning Outcomes will be achieved when learners develop and use:

- Knowledge of how technology, society and the environment interact with one another.
- Technological Processes (e.g. Design Process, Manufacturing) to develop solutions to people's needs and wants.
- Knowledge and understanding of concepts used in Processing, Structures, Systems and Control.
- Skills to access, process and use information (Department of Education, 2001:18 National Curriculum Statement)

These outcomes express what is expected of learners in each grade of:

- The Foundation Phase (Grades R-3);
- The Intermediate Phase (Grades 4-6);
- The Senior Phase (Grades 7-9).

In South Africa, the National Standard Body (NSB) 06: Manufacturing, Engineering and Technology (MET) is currently proposing the features and scope of technology education for Further Education and Training (FET) band (Grades 10 to 12). These proposals are considering as a point of departure the current technology for GET band as reflected in the draft National Curriculum Statement for Grades R to 9. It is likely that the Technology

component of the NSB06: MET will cut across all the other sub-fields identified. The sub-fields of NSB06: MET are:

1. Engineering and related design;
2. Manufacturing and assembly;
3. Fabrication and extraction.

The proposed scope and coverage of each sub-field is as follows:

1. Engineering and related design

- Agriculture;
- Aeronautical;
- Automotive;
- Civil/Building;
- Electrical;
- Electronic;
- Metallurgical;
- Mechanical;
- Mining.

2. Manufacturing and assembly

- Wood products;
- Textile products;
- Packaging materials and paper/pulp products;
- Metal products;
- Graphic arts and printing;
- Glass, crockery and pottery products;
- Automotive components;
- Biotechnological systems;

- Electrical and electronic components and products.

3. Fabrication and extraction

- Construction materials;
- Wood products;
- Primary plastics;
- Textiles: natural and artificial;
- Glass and fiberglass;
- Ore extraction, metals and mining by-products.

It seems that the process approach applied in technology will be used in the teaching and learning of the above-mentioned sub-fields as opposed to the previous narrow skills training of technical education.

As in Ontario, Canada, the South African technology education programme at FET (Further Education and Training) institutions (Grades 9-12) is likely to be a specialised technology programme. This implies that learners at FET institutions will specialise in a particular distinct technology such as Civil, Electrical or Automotive technology which will be an elective component or a choice by the school principal depending on the human resource availability. The purpose, aims and outcomes of technology education will guide the structure of technology education programmes at schools. The next section will unpack the structure of technology education and its essential features.

2.9 THE ESSENTIAL FEATURES OF TECHNOLOGY EDUCATION

Technology is a fundamental aspect of human activity. The acceleration of technological change is constant in everyone's life (ITEA Executive summary, 1996:2). Technology and certainly technology education is more of an activity than a discrete body of content (Williams, 2000:1). Technology is considered to be critical to the success of individuals, entire societies, and to the earth's ecological balance. The promise of the future lies not

only in technology alone, but also in people's ability to use, manage and understand it. According to Herschbach (1997b:22) technology is a multidimensional concept, and it does not reflect a formal structure like maths, economics, or physics. He says structures that exist come from the application of technological knowledge to specific activities. The structure developed for the study of technology focuses on the universals of technology that are considered to be significant and timeless, even in an era dominated by uncertainties and accelerated change (Dugger, 1997:11). As the definition indicated in chapter one, there is a knowledge and process base for technology that is quantifiable and timeless. Technological knowledge includes the nature and evolution of technology, linkages, and technological concepts and principles. The processes are those actions that people take to create, invent, design, transform, produce, make, control, maintain, and use systems. They include designing and developing technological systems; determining and controlling their behaviour; utilising them; and assessing the impacts and consequences. Both knowledge and processes are critical to the existence and advancement of technology. One exists without the other, for they are mutually dependent. With technological knowledge people engage in the processes, it is through the processes that technological knowledge is developed (Dugger, 1997:11).

According to Wicklein (1997:1) curriculum design and development should center around the following five categories:

- a) Technical performance or processes;
- b) Academic focus on the specific body of knowledge relating to industry and technology;
- c) Intellectual processes that concentrate on critical thinking and problem-solving;
- d) Social reconstruction through realistic or real world situations; and
- e) Personal, learner-centered focus on individual needs and interests.

Before technology education can determine the curriculum, there should be an understanding of what technology is supposed to achieve. Significant debate over the past years came up with reasonable explanation of technology. It is supposed to achieve what

was stated by Wicklein (1997:1) when he said, “Technology is the practice used to develop, produce and use artifacts and the impacts these practices have on humans and the natural world”. Therefore, technology education should encourage students to study the:

- a) processes used by practitioners (technologists) to develop new technology. The process includes research and designing;
- b) areas of technology which represent the accumulated knowledge of practice; and
- c) impacts of technology on society and the environment.

According to Devore (1998:8), the International Technology Education Association (ITEA) has produced a model of technology constructed from what is termed the three universals. These are the processes, knowledge and contexts. The models of technology vary in their complexity. However, they all attempt to illustrate a logical or step-by-step approach to designing, breaking each step down to specific activities such as research, generating ideas and evaluation. Knowledge, processes and contexts, then, have been identified in this study as the universals of technology, and are considered the foundation of the structure for the study of technology. Each of the universals is discussed in detail in this study. The three universals are also regarded by ORT-STEP (1995:10) as three types of knowledge needed to be taught in technology education activities. The next sections will discuss the three types of knowledge in detail. They are not independent. One depends on the other, hence should be taught in relation to each other.

2.9.1 Technology education as content knowledge

In order to design technological products and solutions, knowledge is needed. Throughout history emphasis has been placed on scientific knowledge. This is based on the fact that little distinction is being made between science and technology. The media has been referring to science and technology as the solution for various problems, ranging from poverty to HIV/AIDS (Custer, 1995:226). Naughton (1986:14-15) has proved that it is not only scientific knowledge applied to technology. However, for many years it was believed that technology is the application of scientific knowledge. It is true that the influence of science on technology has grown tremendously for the past years. This is evident by the

development of transistor families. However, the partnership of science and technology still exists in modern industry (Makgato, 1999:3). As far as technology education is concerned, the types of knowledge required will depend on the distinct technology, particularly at the senior secondary schools. Designing depends to a large extent upon the knowledge and skill base of the designer (DeVore, 1998:8). The Ministry of Education (1996:19-52) in Botswana and ORT-STEP (1995:16-33) in South Africa identified knowledge and skills for technology education. This knowledge and these skills are represented as follows:

2.9.1.1 Safety

Students should acquire sound knowledge of workshop/laboratory safety regulations.
Students should gain practical experience needed to work safely in a workshop/laboratory.

2.9.1.2 First Aid

Students should acquire knowledge and understanding of basic First Aid.
Students should gain practical experience of basic First Aid skills.

2.9.1.3 Materials

(a) Timbers

Students should acquire theoretical of different kinds of timbers eg Mukwa, Pine, Meranti and Jelutong.
Students should gain practical experience of the different kinds of timbers.

(b) Manufactured

Students should acquire theoretical knowledge of Medium Density Fibre Board (MDF)/Supawood, Hardboard and Plywood.
Students should gain practical experience of different types of manufactured boards.

(c) *Metals*

Students should acquire theoretical knowledge of the following metals: Mild Steel (sheets and sections), Copper, Brass and Aluminum.

Students should gain practical experience of mild steel and non-ferrous metals.

(d) *Plastics*

Students should acquire theoretical knowledge of the following plastics: Acrylic, and Acrylonitrile Butadiene Styrenes.

Students should acquire practical experience of different kinds of plastics.

(e) *Adhesives*

Students should acquire theoretical knowledge of the following adhesives: Paper glue, Polyvinyl Acetate, Glue stick for Hot Glue Gun and Tensol Cement.

Students should gain practical knowledge of all the above adhesives.

(f) *Abrasives*

Students should acquire theoretical knowledge of the following: Glass Paper, Emery Cloth, Wet and Dry and Steel Wool.

Students should gain practical experience of all the above abrasives

(g) *Finishes*

Students should acquire theoretical knowledge of the following:

- Pre-finishes: Sanding sealer and paint (premier & undercoat)
- Finishes: Lacquer, Varnish and Paint (matt & gloss)

Students should gain practical experience of the above pre-finishes and their appropriate finishes.

(h) *Fixings*

Students should acquire theoretical knowledge of the following fixings:

- Wood screws: Countersunk, Round and Raised heads
- Self-tapping: Countersunk, Round and Raised heads
- Nails: Wire, Oval and Panel
- Rivets: Pop

Students should acquire practical experience of the above fixings.

(i) *Fittings*

Students should acquire theoretical knowledge of the following fittings:

- Hinges: Piano and back flap
- Catches: Magnetic, ball and spring
- Handles/Knobs: Wooden, metal and plastic
- Hasp and staples

Students should gain practical experience of the above fittings

2.9.1.4 Communication and Information

- * Graphics
- * Plane Geometry
- * Presentation techniques
- * Solid Geometry
- * Orthographic projection

Students should acquire knowledge and understanding of graphic communication

Students should gain practical experience of graphic communication

2.9.1.5 Technology, pollution prevention and the environment

- Impact of technology on the natural environment (Flora, Fauna, Marine life, geophysical etc.;
- Water: storage, purification;
- Impact of technology on agriculture e.g. irrigation, harvesting etc.;

- Waste technology: disposal, recycling etc.;
- Basic pollution: soil, water and air pollution;
- Energy Pollution e.g. noise, radiation etc.;
- Environment pollution and health problem-impact on people.

Students should discuss types of waste material around us.
They should investigate and look at the impact of technology on immediate environment.
They should research and investigate effects of technology on different types of farming.
They should analyse and investigate types of pollution in the immediate environment e.g. air, water, land, energy pollution (noise etc.)
They should investigate and analyse waste disposal by the mining industry, chemical plants, power stations, steel industry, paper and pulp factory, etc.

2.9.1.6 Man, society and technology

- Introduction to technology: related to history, everyday life and the role man plays;
- Technologists through the ages.

Students will learn to recognise the role that technology plays in their personal/school life.
They will recognise that technology was different in the past and how it has an impact on their own society.
They will learn consumership skills, the role of transportation and community services in their society.
They will realize how technology could be different in the future and how it is different in other societies/cultures.
They will learn about the role of technological infrastructures and systems in society, and about leisure and space technology.

2.9.1.7 Structure

- Function and design of structure, e.g. need specification;
- Types of structures e.g. chair, bridge, building;
- Types of materials to be used in structures;
- Construction and testing;
- Design Aesthetics;
- Shape principle e.g. triangle for stabilizing.

Students will learn about different types of structures and their properties (e.g. stability).
--

Students will learn to use properties of structures in building/making structures.
--

Students will learn to combine structures in technological systems.

2.9.1.8 Mechanisms

- Mechanism and systems;
- Simple levers;
- Wheels and axles;
- Belts and pulleys;
- Driving systems;
- Hydraulics and pneumatics;
- Cams (followers).

Students should acquire a working knowledge of mechanisms.
--

They should be able to apply concepts and principles of mechanisms where appropriate to solve real life problems in their community.
--

2.9.1.9 Energy

- Electrostatics;
- Electrical circuits and appliances;
- Simple electronics;
- Electricity's impact on man's life;
- Source of energy e.g. wind, water, sun;
- Safety aspects;
- Electricity in the home;
- Micro-electronics-control technology.

Students will learn about types of energy and forces in their surroundings, the properties of those types and simple ways of processing energy.

They will learn about advanced types of energy and their properties and ways to process them: transformation, storage and distribution.

2.9.1.10 Food technology: Natural and processed

- Production farming methods;
- Storage and preservation;
- Industrial processing equipment;
- Domestic cooking;
- Packaging;
- Distribution;
- Marketing and advertising;
- Processed food/supplements;
- Food hygiene.

Students will learn about different types of food and their properties (e.g. taste) and use of simple tools for processing food.

They will learn about food storage and preservation.
They will learn more about sophisticated technological means for food processing in the home.
They will learn how food is processed in industry.
They will learn why and how food is packaged.
They will learn how it can be marketed and distributed.
They will learn to do simple food packaging and distributing.

These knowledge themes mentioned above are learned in a spiral way, that is the knowledge will be built upon wherever that similar theme is handled or taught in following years. Therefore the students' circle of knowledge will increase in an ever-widening spiral (ORT-STEP, 1995:11).

This knowledge is also known as conceptual knowledge where learners learn about new concepts and principles used in technology education (McCormick, 2000:2). The next type of knowledge, technological process, also known as procedural knowledge is developed through the creation of a process, as when a solution to a particular need or brief is sought (Williams, 2000:2).

2.9.2 Technology education as process

Another view regards technology as a process or skill to be taught to learners. In this view, technology is often referred to as design technology (Foster, 1999:10). Design technology is about identifying needs, generating ideas, planning and creating, testing, and finding the best solutions. Thus, it differs from content knowledge discussed above in that it focuses more on technological capabilities than on knowledge. According to Pucel (1995:39), the technological process is presented as a set of generic steps which can be applied to any area of technology. According to him technological process focuses on doing, making and implementing things. The generic steps of the technological process is to:

- Identify an unmet human need requiring a technical solution (e.g. product, system, design);
- Clarify the specific technical problem underlying the unmet need;
- Identify relevant existing technical methods, knowledge and resources;
- Invent a probable solution using available resources;
- Determine the social acceptability and economic feasibility of the solution;
- Modify the solution if needed to maximize efficiency and acceptability;
- Implement the solution.

According to Custer (1995:232) the technological process signify is efficient action, and appropriate design. It implies a range of activities. It includes everything from designing and building highly complex nuclear power plants to configuring gear ratios on ten-speed bicycles.

Naughton (1986:2) refers to the technological process as a social process, based on the fact that it is a process by organisations that involve people and machines. According to Custer (1995:232) the technological process is seen as a technological problem-solving activity. In analysing technological problem-solving Custer (1995:233) formalised it to include three basic dimensions: resources, primary processes and goal thrust. By resources he meant physical, material, psychological and knowledge resources. Primary process includes designing, repairing, negotiating, counseling, hypothesis testing, and investigating. These are the activities or techniques that are employed to solve problems.

Vandeleur (1997:1) differentiates between processes and skills as follows “To be able to describe an event accurately is a skill; providing an accurate description is a process” She goes on to say that some people run the two words together and describe them as “process-skills”. This description shows the relationship between skills and processes, but does not clarify what a process is. However, Johnsey (1995:199) gives a clear and precise definition: “A process can be taken as a way of going about achieving an end and the separate parts of a process can be described as process skills”. This definition rendered

technology as a process, and it was regarded as most acceptable description of technology education (Shield, 1996:11).

ORT-STEP (1995:12) identified the main steps of technological process.

Below are more details about stages of the process:

1. Designing

a) Briefing

Identifying the need; recognition of the problem and situation; defining the problem or need.

b) Investigation

Researching the problem; location of useful information, analysis of topic; specification of requirements.

c) Solutions

Generate solutions for designing a product through

- brainstorming initial ideas;
- drawings/graphical representations of models;
- preparing a portfolio.

d) Analysis and Evaluation

Identifying and justifying the optima solutions, and evaluating the ideas against the specifications.

e) Planning and Design

Designing the product and making of a model/prototype.

2. Making

a) Production Planning

Constraints specified i.e. time, materials, tools, skills, knowledge required and who will make it.

b) Production

Making of the product according to the design and specifications.

3. Evaluating

a) Testing and Quality Assurance

Testing of the product (is it working?) and evaluating the finished product against the specifications.

b) Documentation and Presentation

Preparing the customer's documentation (where necessary), report on the project.

c) Marketing/Advertising

Advertising the product, selling and distribution.

Delport (2002:9) explains some of the steps of the process as follows:

TABLE 2.3**EXPLANATION OF TERMS USED IN TECHNOLOGICAL PROCESS**

Element	Description	Activity/Skills
Identify	This normally refers to 'problem' to be solved, the 'needs' of an individual or group/market.	Comprehension
Clarify	Requires tighter specification of the problem. It relies on analytical skills and knowledge of process and materials.	Comprehension
Researching	Operation in which relevant information and data are gathered and assembled for later use.	Analysis/Discrimination
Generating Ideas	Initial ideas are now synthesised and thoughts shown on paper.	Ability to synthesise
Selecting	Strategy of selection from alternative solutions. Choosing the best, explaining and developing ideas.	Application of prior knowledge
Production of working drawing	Formal working drawings may be required.	Analysis, psycho-motor skills communication skills
Modelling	Developing and testing ideas through manipulating materials and also by producing simulations can reach solutions reached quicker, in a more efficient manner.	Communication testing Discrimination
Planning	The manufacturing process is defined and planned, intentions are detailed and strategies proposed.	Organisation synthesizing
Making	The manufacturing process is implemented by using tools and instruments. The solutions may be modified as manufacturing proceeds.	Skills of adoption

Testing	An assessment is made of the effectiveness of the solution. Tests are carried out and judgements validated.	Comparing Judging
Modifying	Alterations are carried out in the light of the tests carried out, adjustments made if possible.	Evaluation Interpretation
Evaluating	Judgements made of the solution in terms of the brief and specification. It involves a critical appraisal of the outcomes.	Judging
Report writing	In this context the report is normally an account of the project used as a learning strategy. It may also be used as part of the consultation process with the client.	Synthesizing Summarizing Justifying

Source: Delpont (2002:9)

If the process steps mentioned above are analysed more precisely, the evaluation of a student's technological understanding from work produced will lack precision. A further precision is required if the process steps are to be used effectively for assessment purposes. It is claimed that technological process enhances problem-solving skills, technical skills and knowledge (Shield, 1996:8).

2.9.2.1 Problem-solving process and technological process

There seems to be an ongoing lack of clarity as to what constitutes a process model. Some advocates propose a design process as used in England and Wales and others propose a problem-solving process as is evident in Scotland and the UDA (McCormick, Murphy & Hennessey, 1994:5). The activities of design process are not the same as the activities of problem-solving, although they overlap (Shield, 1996:3). The main difference is that the design process requires the students to "call upon the intellectual application of knowledge, skills, attitudes and values as opposed to problem-solving which is a form of active learning used to acquire knowledge and concepts" (Shield, 1996:3). There appears to be very little

difference in the way the design processes and the problem-solving processes are described. To some authors, design and problem-solving are synonymous (Johnsey, 1995:213). This study will take a closer look at each of the processes mentioned.

(a) The problem-solving process

Problem-solving is seen as a broad skill which should be taught to all children. The proponents of this concept regard the process as more important than the content of the problem being solved. Technology education is seen as supporting the problem-solving activity (Vandeleur, 1997:2). Johnsey (1995:208) argues that technology is not the only way of solving a practical problem; the solution is technological if it involves designing and making something. Johnsey (1995:199) describes the problem-solving process as: “If the ‘end’ is the solution to a practical, open-ended problem then, in a broad sense, it can be called the problem-solving process”.

The essence of a technological approach to problem solving is the interaction between mind and age which comes to be expressed through action (Vandeleur, 1997:2).

The problem-solving process as stated by McCormick et al. (1994:5) includes the following steps, namely, to:

- Recognise or define a problem;
- develop alternative solutions;
- select one solution;
- implement it;
- evaluate the solution.

(b) The design process

Johnsey (1995:199) describes the design process as: “If the end is the fulfillment of a need or a designed product then the design process has been used”. In the design concept students design solutions to problems and the proponents of this concept see “design and technology” as a new paradigm for education itself (Vandeleur, 1997:3).

The design process is seen as a manifestation of the problem-solving process (Vandeleur, 1997:3). According to Gardner and Hill (1999:129) the process is regarded as an approach which promotes “open-ended problem-solving” and it is considered as the best way to prepare students for the challenges they will meet in the world outside school. Design is conceptualised as consisting of five steps:

- Developing a focus;
- developing a framework;
- choosing the best solution;
- implementing a plan;
- reflecting on the process and product.

These five steps are almost identical to the six steps listed in The Common Curriculum of Ontario, Canada. The National Curriculum of England and Wales have identified the process steps in the form of Attainment Targets, which are:

- Identifying needs and opportunities;
- generating a design;
- planning and making;
- evaluating (Vandeleur,1997:3).

Attainment Target 1 required that pupils identify needs and opportunities through the context of home, school, recreation, community, business and recreation. Generating a

design requires the students to draw up a design specification, explore ideas to produce a design proposal and to be able to develop it into an appropriate design. The planning and making requires that students should be able to produce artifacts, systems and environment, to work to a plan and to use resources, including knowledge and process appropriately. The Attainment Target 4 of evaluation requires students to evaluate the processes, products and effects of their design (Vandelaar, 1997:3).

Treagust and Mather (1990:54) identified ten processes steps in technology education which was implemented at a school in Australia. Kent Street School implemented technology across the curriculum, with the first and last stages being added by teachers at the school. The ten steps were:

1. Identification of problem;
2. Analysis and investigation;
3. Framing a design brief;
4. Information gathering;
5. Generation of alternate solutions;
6. Development work on the chosen solution;
7. Prototype;
8. Testing and evaluation;
9. Re- designing;
10. Marketing (Treagust & Mather, 1990:54).

These steps are clearer than the four processes described by the National Curriculum for England and Wales and those from Ontario, Canada. The inclusion of a marketing step is similar to the one identified by ORT-STEP (1995:12) and seems to be a relevant and worthwhile one. The emphasis of an entrepreneurs component in many South African educational programmes, including technology education, makes marketing a valuable step. Williams (2000:5) describes the process steps as a range of activities in which students are engaged when they 'do' technology. Students complete a task, and certainly do not do

them in the same order every time. The activities depend on the nature of the students and the nature of the problem. The most important activities include the following:

- Evaluation;
- Communication;
- Modelling;
- Generating ideas;
- Research and investigation;
- Producing;
- Documenting (Williams, 2000:5).

Williams (2000:5) prefers to call these activities aspects rather than stages of the process; stages have sequential connotation which is not appropriate as a technology process. It seems that technology education is process-driven and there is probably more international agreement among technology educators about the activity of technology than about the content knowledge (Williams, 200:1). The activities of technology education should occur within the context of the real world.

2.9.3 Technology education as context

In chapter one, definitions of technology were provided. The common issue is that technology is about solving practical problems by designing, investigating, developing and evaluating products and systems. Technological practice takes place within, and is influenced by social contexts (Ministry of Education, 1995:60). Students should be given an opportunity to design and make artifacts within the context of the school or home and within certain parameters of expertise. Restraining factors should be applied so that the experience can be structured and the student can obtain the greatest benefit from the time available (Shield, 1996:5).

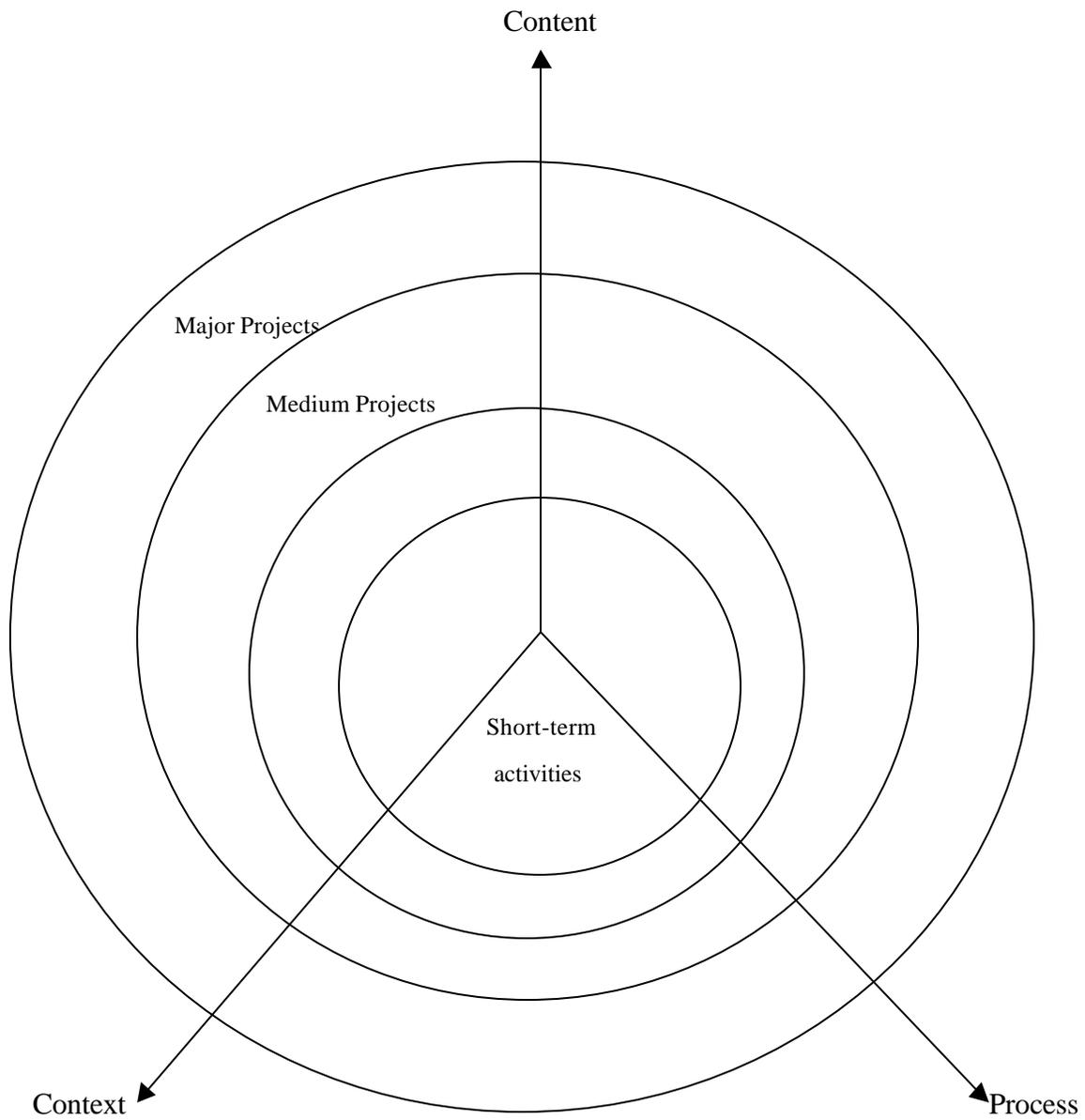
The context in which technological practice occurs include the following:

- Home;
- School;
- Community;
- District;
- Province;
- Nation;
- Urban;
- Rural;
- Industry (ORT-STEP, 1995:10).

At senior secondary schools (FET institutions) the context may be distinct, in that the school may choose to concentrate on a particular context in its practice of technology. As already mentioned time is the limiting factor, to include the relevant real-world environment.

Figure 2.8 consolidates what has been mentioned as the three universals of technology education or three types of knowledge needed to address technology education activities. These are also referred to as the essential features of technology education.

FIGURE 2.2
THE UNIVERSALS OF TECHNOLOGY EDUCATION



Source: Dugger (1997:11); ORT-STEP (1995:10)

The discussions on the essential features of technology education have implications for teacher education. The development of effective implementation has to take place. The

following section addresses the implication of the development of technology education on teacher education.

2.9.4 The implication of technology education on teacher education and development

Implementing a new subject always has implications for teacher education. For the majority of teachers in South Africa technology education will be a new concept and thus a frightening one. This learning area will represent a new paradigm for the majority of teachers, in that they have been used to a system which relies on rote learning and teaching and therefore may find the shift towards a process approach difficult.

Various technology teacher education programmes are being developed by education institutions with the purpose of preparing and producing teachers who can teach technology education at both GET and FET institutions within the South African context. The purpose of this study is to propose a curriculum programme for technology teacher education. It is therefore necessary to highlight some of the features of the technology education programme from the international perspective.

In Finland, technology education can be characterised as mainly a design approach that has evolved from the craft-oriented approach. Additionally, it involves elements of the high tech approach, using computers, computer-aided design, and electronics. Although designing and making products is a central part of the national curriculum guidelines, the curriculum also refers to the need for broader technological understanding (Alamäki, 2000:1). The Department of Teacher Education in Rauma, University of Turku, is the only institute that prepares Finnish-speaking technology teachers with a technology education major. The technology teacher education programme has a single entrance selection procedure that includes a written examination, an individual interview, a technological reasoning test and a practical product-making test. Since 1979, all technology teachers have received a master's degree in technology education. Teachers in comprehensive

schools must hold a master's degree from a university. The aim of the master's programme is to enable students to:

- Become familiar with the relevant terminology, materials, and technology; follow the general development of technology; gain a sufficiently broad mastery of practical work in their field, be able to convey the central knowledge and skills of the subject to their students;
- become familiar with the physical, psychological, and social development of children and young people, with scientific theories and their applications in education, technology education, and the teaching process, thus enabling them as teachers to promote the development of the whole personality of a child, or young person and to achieve the goals set in their education;
- acquire the expertise in technology education and education in general that will enable them to master the main basic theories and terminology of education, general didactics, and the didactics of technology education;
- acquire knowledge of society and the sectors of business, professions, and production, enabling them as teachers to comprehend current situations and changing needs of society, and to use these as a basis for solving and observing problems in their subject in accordance with the requirements of technology and the nature of the work (Alamäki, 2000:3).

In the technology teacher education programme, students study a variety of technologies, namely, mechanical and electrical engineering, product design, project studies, research methodology and statistics, educational sciences and ethics, developmental psychology, didactics of technology education, administration, evaluation, and sociology of education (Alamäki, 2000:3).

In the USA the competencies needed by technology education teachers have been categorized into three areas. Rogers (1996:1) identified those competencies as personal, professional, and technical. Rogers classified the three programme elements of technology

teacher education as general education, professional education, and technical content. The general education component, which in many cases is dictated by the college and university graduation requirements, has been discussed by all teacher education standards.

The professional preparation element of technology teacher education includes teaching method courses and teaching practice (Rogers, 1996:2). The technical content of technology teacher education is grouped into bio-technical, communication, construction, manufacturing, and transportation, electricity and electronics, industrial safety, woodworking, graphics/desktop publishing, computer-aided drafting, materials and processes, metal working, plastics, automotive mechanics, power and energy (Rogers, 1996:8). However, the programmes of technology teacher education around the USA lack consistency in what technical courses are required. This lack of consistency can have a detrimental impact on the programmes, as graduates from its teacher education programme do not possess a common base of technical competencies (Rogers, 1996:8).

In New Zealand, the teacher professional development programmes are designed to be consistent with both New Zealand's national curriculum statement in technology and relevant research findings (Forret, Jones & Moreland, 2000:3). The following key features of teacher professional development in technology education are central to the programme success:

- Robust concepts of technology and technology education;
- Understanding of technological practice in a variety of contexts;
- Technological knowledge in a number of technological areas;
- Technological skills in a number of technological areas;
- Understanding of the way in which people's past experiences, both within and outside education, impact on their conceptualisation of technology education;
- Understanding of the way in which technology education can become part of the school and classroom curriculum. This must be based on a sound pedagogy in keeping with the concept of technology education (Forret et al., 2000:3).

The above-mentioned example of some technology teacher education programmes serves as just a guide, not a prescription. Research findings on curriculum and national curriculum statements should be used to develop relevant technology teacher programmes. The retraining of teachers in technology education should be addressed by means of in-service training programme. An intensive technology awareness and literacy programmes ought to be developed especially for those teachers who will be responsible for teaching technology across the curriculum.

2.10 SUMMARY

In chapter two, a historical development of technical education in relation to teacher training in South Africa was discussed. This involved identifying various technical teacher education programmes offered during the pre-transformation period to the present state by a few technikons involved with technical teacher education and training. It also involved the discussion of the technical teacher education within outcomes-based education and the implications of the Norms and Standards for Educators on teacher education and training. This chapter also presented the views of educators and learners from the earlier study on the present approaches to technical teacher education.

It was revealed that the challenges to the current technical education requires that technical teacher education be reviewed and transformed to eliminate the practices of the past and focus on the technological needs of the future. Future technical teachers should develop the competence to understand and appreciate current technology and instill reflective thinking and problem-solving in the learners. The technological process which emphasises designing and making technology products was shown to be the rationale for technology education. This chapter concluded by discussing the purpose of technology education, the essential features of technology education as well as its implications for teacher education and development.

In the next chapter conceptions of curriculum development will be discussed. This will be done as a prelude to developing the proposed technology teacher education curriculum.

CHAPTER THREE

CONCEPTIONS OF CURRICULUM DEVELOPMENT

3.1 INTRODUCTION

Conception of curriculum development implies a theoretical framework used to develop a curriculum (Sowell, 2000,41; Ndlovu, 1997:29). History shows that because of social changes more than one conception for developing a curriculum is viable (Sowell, 2000:4). It is necessary to devise a conception for developing a curriculum which will be used as a theoretical framework for the development of the technology teacher education curriculum envisaged in this study. The conceptions will focus on the following:

- Educational philosophies and their influence on curriculum development
- Approaches and models to curriculum development
- The South African approach to curriculum development
- Purpose of an education curriculum
- Norms and standards for educators
- Needs assessment in curriculum development
- Curriculum evaluation

These conceptions are based on the foundational work laid by classical writers on curriculum development and designs like Tyler (1949) and Taba (1962) and later writers like Schubert (1986), Walker (1990), Print (1987), Fraser et al. (1993), McNeil (1996) and Ornstein and Hunkens (1998). It is important to realize that the concept 'curriculum' has never been an easy matter to understand. Perhaps the most common definition of curriculum is derived from the words Latin root, which means 'race course'. For learners, the school curriculum is a race to be run, a series of obstacles or hurdles (subjects) to be passed (Marsh & Willis, 1999:7). It is important to keep in mind that schools in the Western Civilization have been heavily influenced since the fourth century B.C. by the philosophies of Plato and Aristotle and that curriculum has been used historically to

describe the subjects taught during the classical period of Greek civilization (Rosen, 2000:xiii).

Today school documents, newspaper articles, committee reports, and many academic textbooks are referred to as 'the curriculum of the school' (Marsh & Willis, 1999:7). Learning that occurs in schools, colleges and higher education institutions is based on what certain people want them to learn. The educational philosophies lead to a certain perspective in people and further influence certain approaches to curriculum development. This issue will be discussed further when the influence of education philosophies on curriculum perspectives and approaches is discussed.

A curriculum is based on human needs and enhances those qualities that are of essence to humanity. One such quality is intention or purpose. The significance of purpose is indicated by such terms as aim, ambitions, end, goal, intent, objectives and target (Pratt, 1980:139). Developing and implementing a curriculum are intentional activities and are therefore goal-oriented. The purpose of the curriculum is expressed by the intended goals to be achieved through implementation of the curriculum. The purpose serves as a basis for selecting the learning content of the curriculum (Fraser et al., 1993:99). Activities of curriculum development are intentional activities directed at producing a purposeful curriculum which will result in a particular educational and learning result. The purpose should be stated and described explicitly so that achievement can take place and be monitored in a formal manner (Fraser et al., 1993:111). This implies that curriculum development must take full account of the social situation as well as the pressures and the needs of society. It is with this consideration that Finch and Crunkilton (1989:16) pointed out that a curriculum should thrive on relevance. A curriculum which assists learners to enter and succeed in the world of work spells out success. Amongst various social pressures impacting on curriculum development, the most explicit ones are those of economic survival and learner's personal growth (Kelly, 1982:12-13; Finch & Crunkilton, 1989:9). Economic pressure on curriculum development is derived from the premise that the education system has an economic function. Education has been seen partly as a

national investment wherein society should benefit. An irrelevant curriculum does not benefit society. In fact it is a waste of governmental financial resources when considering the state subsidies to all learners at public institutions. It is invariably a waste of taxpayers' money. According to Zais we are living in a capitalist technological culture (Zais, 1976:15).

Some of the contemporary social needs of curriculum include:

- reducing unemployment;
- providing qualified labour for new and expanding businesses;
- retraining of the unemployed;
- providing more educational opportunities for females (Finch & Crunkilton, 1989:96).

The social, economic, political, physical and organisational contexts are some of the national pressures in which a curriculum occurs and may affect curriculum development. However, the above-mentioned context impact on influences, rather than principles of curriculum development (Posner, 1992:142).

Curriculum process is a collective term that encompasses all of the considerations about which curriculum workers ponder and ultimately use to make choices in the development and evaluation of a curriculum (Sowell, 2000:9). Curriculum development refers to recreating or modifying what is taught to learners. It includes a number of decisions whose outcomes result in curriculum designs. Curriculum evaluation encompasses the process used in the systematic investigation of the worth or merit of a curriculum (Sowell, 2000:10). This implies that all the conceptions of curriculum development which will be discussed in this chapter are interrelated.

3.2 THE INFLUENCE OF EDUCATIONAL PHILOSOPHIES ON CURRICULUM APPROACHES

There are different types of philosophies, such as philosophy of science, social and political philosophy and philosophy of religion (Rosen, 2000:vii). Generally, the original meaning

of philosophy is the love for wisdom and knowledge. It is an expression of human nature (Rosen, 2000:xviii). However such an expression may be subject to distortion, since the word can apply to any human understanding, such as 'my philosophy of investment'. The discussion of general philosophy is beyond the scope of this study. But all philosophy shares common issues. Philosophy in general deals with the large aspects of life, the problems and prospects of living, and the way people organise thoughts and facts. Educational philosophy is central to curriculum because it advocates and influences a particular purpose or aim and content, as well as the organisation of the curriculum. Usually, a national school curriculum reflects several philosophies, which add to the dynamics of the curriculum within the school (Ornstein & Hunkins, 1998:31). Educational philosophy assists us with the perception of the world in which we live through school subjects or body of knowledge. Learning educational philosophy helps in understanding school curricula. Schubert (1986:117) acknowledges that philosophical assumptions are always present in a curriculum, whether we consciously reflect on them or not. These assumptions underlie our practical work as educators, that is, some set of assumptions always rules. Ornstein and Behar (1995:12) state that philosophic issues always have and still impacts on schools and society.

Ornstein and Behar observe that there is urgency that dictates continuous appraisal and reappraisal of the role of schools, and calls for a philosophy of education. Without philosophy, educators are without direction as a base foundation of organising and implementing what they are trying to achieve. Philosophy is a description, explanation, and evaluation of the world as seen from a personal perspective, or 'social lens'. Ornstein and Behar (1995:11) point out that almost all elements of curriculum are based on philosophy. Philosophy is the beginning point in curriculum decision-making. Philosophy becomes the criterion for determining the aims, means and ends of a curriculum. Aims or purpose are statements of value, based on philosophical beliefs. The means represent the processes and methods which reflect philosophical choices. The ends connote the facts, concepts, and principles of the knowledge or behaviour learned, that is, what is considered to be important to learning. Philosophy is essential in formulating and justifying an educational

basis of procedures and activities (Ornsten & Behar, 1995:11). Four major philosophies received the attention of educators over the years. Although these philosophies are known by various names, the four are referred to as Social reconstructionism, Progressivism, Essentialism, and Perennialism. Synonymous names will be used where necessary.

According to Oliva (1997:177) only two of these philosophies appear to have large followings in today's schools.

3.2.1 Social reconstructionism

The social reconstructionist philosophy is based on early socialistic and utopian ideas of the nineteenth century. It was economic pressure that gave birth to this philosophy (Orstein & Hunkins, 1998:50). At the beginning of social reconstructionism, the progressive educational movement was still popular, but a few significant progressive educators became disillusioned and impatient with American education reform. These educators argued that progressivism put too much emphasis on child-centered education which mainly served the individual child in middle class and private schools. What was needed was more emphasis on society-centered education that took into consideration the needs of society and all classes of people, not only the middle-class. McNeil (1996:33) contends that social reconstructionism is interested in the relationship between the curriculum and the social, political, and economic development of society.

Social reconstructionists are convinced that schools should bring improvements in society (Oliva, 1997:178). At the 1932 Annual Meeting of the Progressive Education Association, George Counts challenged progressive educators to reconsider the role of schools in our society. In essence, social reconstructionism holds the view that schools should not simply transmit the cultural heritage or simply study social problems but should become an agency for solving political and social problems (Oliva, 1997:178). (The social problems of the 1930s: racial and class discrimination, poverty, and unemployment indicate that the progressive education had ignored these pertinent issues). The social problems of today are similar to those mentioned in the 1930s, although the list has increased over the years.

Today's social problems are based on racial, ethnic and gender inequality, poverty, unemployment, welfare, computer and technology illiteracy, political oppression and war, environmental pollution, disease, hunger, HIV/AIDS and depletion of the earth's resources (Ornstein & Hunkins, 1998:51). The subject matter to which learners should be exposed must consist of these unsolved, often controversial problems of the day. In 1950, Theodore Brameld, who is considered the originator of the term reconstructionism, believed that social reconstructionism is a crisis philosophy which is appropriate for a society in crisis, such as society today. McNeil (1996:34) states that Brameld believed in a commitment to building a new culture. He had a conviction that we are in the midst of a revolutionary period from which the common people will emerge as controllers of the industrial system, public services and of cultural and natural resources. He felt that working people should control all principal institutions and resources if the world is to become genuinely democratic. Teachers should ally themselves with the organised working people. Brameld also believed that schools should assist the learner, not only to develop socially but to learn how to participate in social planning as well. Learners should be convinced of the validity and urgency of change (McNeil, 1996:34). Brameld identified the following values of constructionism as sought by society:

- Sufficient nourishment;
- Adequate clothing;
- Shelter and privacy;
- Erotic expression and celebration;
- Steady work, steady income;
- Companionship, mutual devotion, belongingness;
- Recognition, appreciation, status;
- Novelty, curiosity, variation, recreation, adventure, growth, creativity;
- Literacy, skill, information;
- Participation sharing;
- Fairly immediate meaning, significance, order, direction (Oliva, 1997:1178).

Orstein & Hunkins (1998:51) points out that society is always changing; therefore the curriculum has to change accordingly. The curriculum should be transformed to coincide with a new social-economic-political education. For social reconstructionists, analysis, interpretation and evaluation of problems are insufficient; commitment and action by learners and teachers is needed. Learners and teachers should be change agents. A curriculum based on social issues and social services is ideal. A social reconstructionist curriculum should (1) critically examine the cultural heritage of a society as well as the entire civilization (2) not be afraid to examine controversial issues, (3) deliberately be committed to bring about social and constructive change, (4) cultivate a future planning attitude that considers the realities of the world.

The primary purpose of the social reconstructionist curriculum is to confront the learner with various severe problems that society faces. Social reconstructionists believe that every discipline such as economics, aesthetics, chemistry and mathematics should contain social problems. The social reconstructionist curriculum has no fixed objectives and content. For example, the first year of such a curriculum might focus on goals for political and economic reconstruction activities of which the learning objective include the following: (1) a critical survey of the community (collecting information on local patterns of savings and expenditures), (2) a study relating the local economy to national and world wide situations, (3) a study treating the influence of historic causes and trends on the local economic situation, (4) an examination of political practices in relation to economic factors, (5) a consideration of proposals for change in political practices, and (6) a determination of proposals which satisfy the needs of most people.

Objectives in ensuing years of the curriculum might include the identification of problems, methods, needs, and goals in science and art, the evaluation of the relationship between education and human relations (McNeil, 1996:35).

Teachers must relate national, world, and local problems to the learning outcomes. Learners can thus use their interests to help find solutions to the social problems emphasised in their classes. The teacher stresses co-operation with the community and its resources. Learners may, for example, spend time away from the school participating in community health projects (for science classes) or in community acting, writing, or dance programmes (for arts and literature classes). For the social reconstructionist a learning opportunity should fulfill three criteria: (1) it must be real, (2) it must require action, and (3) it must teach values (McNeil, 1996:36). Learners must focus on an aspect of the community which they believe can change and to which they will devote their efforts. Passive learning, simulations and role-playing do not meet this criterion. Learners should have the opportunity to recognise the real importance of what they are to do (McNeil, 1996:37).

3.2.2 Progressivism

Progressivism emerged in the late nineteenth and early twentieth centuries through the educational structures of America, challenging the doctrines of essentialism and perennialism (McNeil, 1996:182; Ornstein & Hunkins, 1998:44). The progressive movement in education was also part of the largest social and political movement of reform in America. The educational roots of progressivism can be traced back to the work of John Dewey in the early twentieth century. In his most comprehensive work, *Democracy and Education*, Dewey claims that democracy and education go hand in hand. Dewey viewed the school as a miniature democratic society in which learners could learn and practise the skills and tools necessary for democratic living (Ornstein & Hunkins, 1998:46). According to progressivist thought, the skills and tools of learning include problem-solving methods and scientific enquiry. Progressivism placed more emphasis on how to think, not on what to think. The progressive movement consisted of many components. Among the most influential were the learner-centered and the activity-centered curriculum.

As Ornstein and Hunkins (1998:86) point out, the emphasis on subject matter was replaced by emphasis on the learner, that is, the need and interests of the learner dominated the

teaching practice. The cognitive process was replaced by social processes. The curriculum was organised around classroom and school activities, group work and group projects.

The following features reflect the characteristics of a progressivist curriculum:

- Studying the cumulative record of each learner;
- Comparing the achievement score with the ability criteria;
- Assessing learners' creative ability for words, symbols and topics that are used frequently;
- Listening to learners talk about themselves;
- Providing the opportunity for a choice of activities;
- Visiting each learner's home if possible;
- Assisting each pupil in learning as much as possible about his or her values, attitudes, purposes, skills, interests, and abilities;
- A willingness to allow learners to say what they think;
- Encouraging learners to reflect on their beliefs and values;
- Assisting learners to analyse their interpretations of in-class and out-of class experiences;
- Organising class activities which encompass individual and group analysis of individual problems;
- Assisting learners in stating their immediate long-term purposes. Sharing information relating to learners' present situations;
- Clarifying the limitations (in time, materials, and resources) of the situation with learners;
- Asking learners to formulate a plan of action;
- Encouraging each learners to collect and share materials;
- Making the collection of information from out of school possible (Orstein & Hunkins, 1998:87).

Much of our present curriculum and teaching practices reflect a progressivist mode of thinking. From the previous discussions on social reconstructionism, it becomes clear that

a combination of progressivism and social reconstructionism is dominating the curriculum and education (Ornstein & Hunkins, 1998:557). The major goals of the learner-centered movement in progressivism were creativity and freedom. This was a reaction against the rigid influence of the traditional curriculum (Ornstein & Hunkins, 1998:86). The progressivist curriculum had to be derived from real-life experiences and not from organised bodies of subject matter expressed in terms of purposeful activities (Ornstein & Hunkins, 1998:88).

3.2.3 Essentialism

As stated by Ornstein and Hunkins (1998:41), this is another form of a traditional and conservative philosophy. Rooted philosophically in both idealism and realism, essentialism emphasises an academic subject-matter curriculum and encourages educators to stress order, discipline and effort (Ornstein & Levine, 1993:464). It is important to note that during the period of essentialism, progressivism emerged for a short period of time as the most popular educational philosophy (Oliva, 1997:180). Due to essentialist criticism, progressivism experienced a somewhat rocky path. In 1957 essentialism reclaimed its predominant position (Oliva, 1997:188).

The purpose of an essentialist curriculum is the transmission of the cultural heritage. Unlike the social reconstructionists, who want to change society, the essentialists want to preserve it (Oliva, 1997:180). According to Ornstein and Behar (1995:13) an essentialist curriculum seeks to promote the intellectual growth of the learner as well as produce a competent person. Ornstein and Hunkins, (1998:41) contend that the essentialist school curriculum is geared towards the fundamentals or essentials, such as the three R's at the elementary school level or the five academic or essential subjects, namely: English, mathematics, science, history, and foreign languages at the secondary level. Essentialism rejects subjects such as art, music, physical education, and homemaking and vocational education as fads and frills, because these subjects are more expensive in terms of facilities, materials and student-teacher ratios than academic subjects.

Ornstein and Behar (1995:13) acknowledge that, according to essentialists, knowledge is based on essential skills, academic subjects, and mastery of concepts and principles of subject matter. Oliva (1997:180) contends that academic subjects form the core of the essentialist curriculum. Organised courses are the vehicles for transmitting the culture and promoting mental discipline. In a sense, the essentialist tailors the learner to the curriculum, whereas the progressivist tailors the curriculum to suit the learners' needs and interests (Oliva, 1997:180). It is interesting to note that essentialists do not want to spend more money on subjects which will contribute to economic growth. The influence of essentialism is still felt today in the South African education system where this country still experiences shortage of technologists, engineers and technicians (Department of Education, 2000a:7). Tough, 'hard' academic rigour and training, and a good deal of homework permeate the curriculum of essentialists. The student must be made to work hard at his or her own studies with no fun in the work (Ornstein & Hunkins, 1998:42). In essentialism, the teacher is considered a master of a particular subject or discipline. In this consideration, the teacher is to be respected as an authority because of the knowledge and high standards he or she holds. The teacher is very much in control of the classroom curriculum with minimum learner input.

The essentialists found the principles of the behaviouristic school of psychology to be particularly harmonious with their philosophical beliefs (Oliva, 1997:181). Posner (1992:61) contends that, according to psychologists, curriculum development should not only focus on content, but on what learners should be able to do, that is, the behaviours they learn as a consequence of teaching. According to Oliva (1997:181) behaviourism casts the learner in a passive role as the recipient of the many stimuli to which he or she must respond. Behaviourism is characterised by a connectionism association, a S-R (Stimuli-response) bond, conditioning, classroom drill, programmed instruction, teaching machines, standardised testing and course behavioral objectives. Current and continuing emphasis on the basic skills are clearly derived from the essentialists. Essentialism today is reflected in the public demand to raise academic standards.

3.2.4 Perennialism

Ornstein and Hunkins (1998:38) regard Perennialism as the oldest and most conservative education philosophy rooted in realism. The purpose of education in perennialism is the disciplining of the mind, the development of the ability to reason, the pursuit of the truth and the cultivation of the intellect (Oliva, 1997:178; Ornstein & Behar, 1995:13). Unlike progressivists who believe that truth is relative and changing, the perennialists believe that the truth is eternal, everlasting and unchanging (Oliva, 1997:179). Ornstein and Hunkins (1998:38) contend that perennialism relies on the past, universal knowledge and cherished values of society. Perennialist holds the view of the unchanging nature of the universe, human nature, truth, knowledge, virtue, beauty and so on. To them the aim of education is the same in every age and in every society. With this view, education becomes constant, absolute and universal (Ornstein & Hunkins, 1998:38).

The perennialist curriculum is subject centered. It draws heavily on defined disciplines or logically organised bodies of content, what proponents call 'liberal' education with emphasis on language, literature, mathematics, grammar, rhetoric, and great books of the Western World (Oliva, 1997:179; Ornstein & Hunkins, 1998:38). Like essentialism, the perennialists view the teacher as the authority in the field whose knowledge and expertise are unquestionable. Teaching is primarily based on the Socratic method 'oral exposition' lecture, and explication. Learners' interests are irrelevant for curriculum development because learners are immature and lack the judgement to determine what are the best knowledge and values to learn (Ornstein & Hunkins, 1998:38; Ornstein & Behar, 1995:13). The perennialists look backwards for the answers to social problems. It is clear that the perennialist curriculum will not solve prevalent social problems. Perennialism has proved an attractive philosophy for the education system, yet it does not address the prevalent economic needs.

Philosophy gives meaning to people's decisions and actions. In the absence of educational philosophy, the educator is vulnerable to externally impose prescriptions, fads and frills,

authorization schemes, and other ‘isms’. It becomes evident that the curriculum is developed around a philosophy. Very few schools adopt a single philosophy, in practice most schools combine various philosophies (Ornstein & Hunkins, 1998:55). Ornstein and Hunkins (1998:58) also caution that too much emphasis on any one philosophy at the expense of the other might do harm and cause conflict in a democratic society. Table 3.1 outlines an overview of traditional and contemporary educational philosophies.

TABLE 3.1
OVERVIEW OF TRADITIONAL AND CONTEMPORARY EDUCATIONAL PHILOSOPHIES

TRADITIONAL EDUCATIONAL PHILOSOPHY (PERENNIALISM, ESSENTIALISM)	CONTEMPORARY EDUCATIONAL PHILOSOPHY (PROGRESSIVISM, RECONSTRUCTIONISM)
Society and Education	
<ul style="list-style-type: none"> • Formal education begins with the school; schools are considered the major institution in the child’s education. • School transmits the common culture; an individual’s major responsibility is to society, performing societal roles, conformity and cooperation are important. • Education is for the aims of society; it involves authority and moral restraint. • Certain subjects and knowledge prepare students for democracy and 	<ul style="list-style-type: none"> • Formal education begins with the family; the parents are considered the most important influence in the child’s education. • School improves society; an individual’s fulfillment and development can benefit society; independence and creativity are important. • Education involves varied opportunities to develop one’s potential and to engage in personal choices. • Democratic experiences in school help prepare students for democracy and

<p>freedom.</p> <ul style="list-style-type: none"> • Education is formulated mainly in cognitive terms; the focus is on academic subjects. • Values and beliefs tend to be objective and, if not absolute, then based on agreed standards or truths. 	<p>freedom.</p> <ul style="list-style-type: none"> • Education is concerned with social, moral and cognitive terms; the focus is on the whole child. • Values and beliefs are subjective, based on the individual's view of the world.
Knowledge and learning	
<ul style="list-style-type: none"> • Emphasis is on knowledge and information. • Emphasis is on subjects (content). • Subject matter is selected and organised by the teacher. • Subject matter is organised in terms of simple to complex, emphasising the past. • Units/lesson plans are organised according to topics or concepts. • Subject matter is compartmentalised according to distinct fields, disciplines, or study areas. 	<ul style="list-style-type: none"> • Emphasis is on resolving problems and functioning in one's social environment. • Emphasis is on students (learners). • Subject matter is planned by the teacher and students. • Subject matter is organised in terms of understanding relationships, and is centered on fields, disciplines, or study areas. • Problems or student interests. • Subject matter is integrated; includes more than one related subject.
Instruction	

<ul style="list-style-type: none"> • Textbooks and workbooks dominate; teaching and learning largely confined to classroom. • Whole-group learning, fixed schedules, and uniform time periods. • Homogenous grouping; tracking of students into special programmes. • Passive involvement of students in assimilating what the teacher or textbook says. • Emphasis is on uniformity of classroom experiences and instructional situations. 	<ul style="list-style-type: none"> • Varied instructional materials; teaching and learning includes community resources. • Whole, small, and individualised groups, flexible schedules, and adjustable time periods. • Heterogeneous grouping; some tracking of students but widely differentiated programs. • Active involvement of students in seeking information that can be used or applied. • Emphasis on variability of classroom experiences and instructional situations.
Purpose and Programs	
<ul style="list-style-type: none"> • Emphasis is on liberal arts and science. • Emphasis is on specialisation or scholarship. • Curriculum is prescribed; little room for electives. • Excellence and high standards; special consideration for high achievers. 	<ul style="list-style-type: none"> • Mix of liberal arts, practical, and vocational subjects. • Emphasis is general and for the layperson. • Curriculum is based on student needs or interests; room for electives exist. • Equality and flexible standards; special consideration for low achievers.

Source: Ornstein and Hunkins (1998:58)

Educational philosophies discussed implicitly or explicitly represent a particular perspective to curriculum and its proponents which in turn determine a particular approach

to curriculum development. Carl (1995:49) admits that there are various approaches to the process of curriculum development which serve as a theoretical foundation. The approaches to curriculum development normally reflect a particular philosophy or a combination of educational philosophies.

3.2.5 The approaches to curriculum development

Different approaches to curriculum development can be considered as different ways of thinking about curriculum connecting theory to practice, whether the many philosophies or beliefs that constitute any particular curriculum approach are made explicit or remain implicit (Marsh & Willis, 1999:18). Ornstein and Hunkins (1998:2) contend that what an individual perceives as reality, the values he or she deems important, and the amount of knowledge he or she possesses determines his or her specialisation. By understanding one's curriculum approach, and the prevailing curriculum approach of the schools' national department of education, it is possible to establish whether one's professional view conflicts with the formal organisational view. This section analyses what Marsh and Willis (1999:18) regard as the three well-known, highly influential approaches to curriculum: Tyler's rational-linear approach; Walker's deliberative approach; and Eisner's artistic approach. Tyler's approach to curriculum development is linear, hence it is partly reflecting philosophies of perennialism and essentialism (see table 3.1). However, in developing learning experience Tyler emphasise that learners should be taken into consideration. This forms part of learner-centered reflect progressivism and social reconstruction. One or a combination of different philosophies underpins all these approaches.

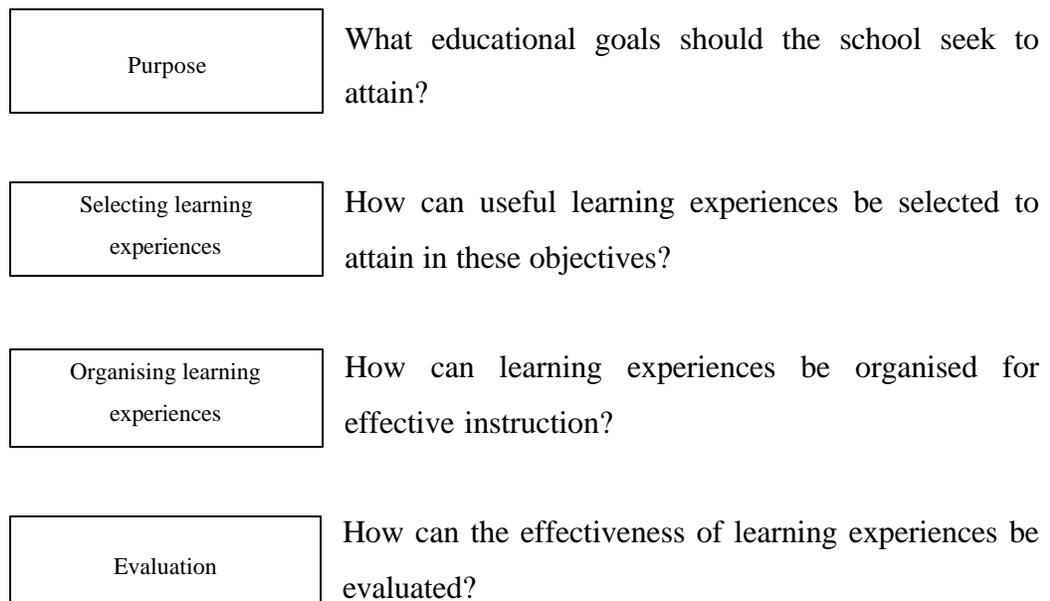
3.2.5.1 Tyler's rational-linear approach

One of the best-known approaches to curriculum development with special references to planning sequence is Ralph W. Tyler's classic little book, *Basic Principles of curriculum and Instruction* known as *The Tyler Rationale* (Oliva, 1997:45). Tyler's approach to curriculum development is regarded as the best representative of the procedural question. Marsh and Willis (1999:21) refer to Tyler's approach as "technical production" because it considers educational decisions objectively and views schooling as a means to produce

learning. The Tyler's Rationale has been widely considered as a fine example of common sense and clarity in developing curriculum. After a century, his book is still in print and profoundly influences how curricula are developed throughout the world (Marsh & Willis, 1999:23).

Tyler organises his rationale around four fundamental questions that he says must be answered in developing any curriculum. The questions are illustrated in Figure 3.1 below:

FIGURE 3.1
THE TYLER RATIONALE



Source: Marsh and Stafford (1988:6); Marsh and Willis (1999:24)

These questions can be answered systematically, if they are posed in this order, hence the approach is referred to as 'rational-linear'. The questions form the four basic steps of Tyler's rationale.

(a) **Purpose**

According to Tyler it is reasonable and fruitful to start curriculum development with purposes. Tyler's first question was "*What educational purposes should the school seek to attain*" (Madaus & Stufflebeam, 1989:202). To address this, Tyler recommends that curriculum planners should gather data from three main sources: the **subject specialist**, the **learners** and the **society** (Ornstein & Hunkins, 1998:197). Since learners at lower levels might not give you valid data regarding the purpose, Tyler suggests that curriculum planners do studies of learners by observation of interests, problems, prior knowledge and deficiencies. Presumably the gap between norms and standards of learners populations, for example, backgrounds of learners in a particular class would give an indication of which objectives should be selected (Marsh & Stafford, 1988:6). Tyler recommends observations by interviews with learners, interviews with parents, questionnaires and tests as techniques for collecting data about learners (Oliva, 1997:145). Tyler understands the complexity of gathering data from society, but he suggests that there are areas that are more important than others such as societal needs regarding health, family, recreation, vocation, religion, unemployment and poverty. From the needs of society flow many potential educational objectives (Marsh & Stafford, 1988:7; Schubert, 1986:197; Oliva, 1997:145). Further problems are experienced when gathering data from a subject specialist. Marsh and Stafford (1988:7) argue that a subject specialist is not a source but a means of teaching. However, Tyler (1949:26) views subject specialists rather differently. He seems to be looking for contributions from subject specialists beyond specifics of their particular subjects.

From the three sources of data, curriculum planners derive general or broad objectives that lack precision and cut across disciplines (Oliva, 1997:145). Once these objectives are determined a screening process is necessary to eliminate unimportant and contradictory objectives (Oliva, 1997:146). Marsh and Willis (1999:25) contend that the three sources for determining objectives are diverse and hence some screening to weigh the potential value of each objective is required. Tyler (1949:33-43) suggests that schools' educational

philosophy and the psychology of learning can be used as a screening standard for the objectives.

Philosophical screen

Tyler's discussion does not assist in deciding which educational philosophy should be used. However, the curriculum planners should study the school's philosophy or contemporary national education system to determine the education philosophy, for example, OBE is the prevalent philosophy to assist in curriculum development and screening in South Africa. Tyler also urged curriculum workers to outline their values by emphasising the following democratic goals:

- Recognition of the importance of every individual human being regardless of race, national, social, or economic status; opportunities for wide participation in all phases of activities in the social groups in the society;
- Encouragement of variability rather than demanding a single type of personality;
- Faith in intelligence as a method of dealing with important problems rather than depending upon the authority of an autocratic group (Oliva, 1997:146)

The curriculum worker will screen the general objectives and omit those that do not keep up with the agreed school's philosophy. In Tyler's view each school has its own stated or implied values about the nature of a good life and a society and can use this in the curriculum.

Psychological screen

Here, it was also a challenge to decide on which psychological principles of learning are more appropriate than others, for example, stimulus-response-reinforcement (Marsh & Willis, 1999:26). According to Oliva (1997:46) the curriculum workers and teachers should clarify the principles of sound learning that they believe learners have. Principles of learning involve a unified formulation of a theory of learning which helps to outline the

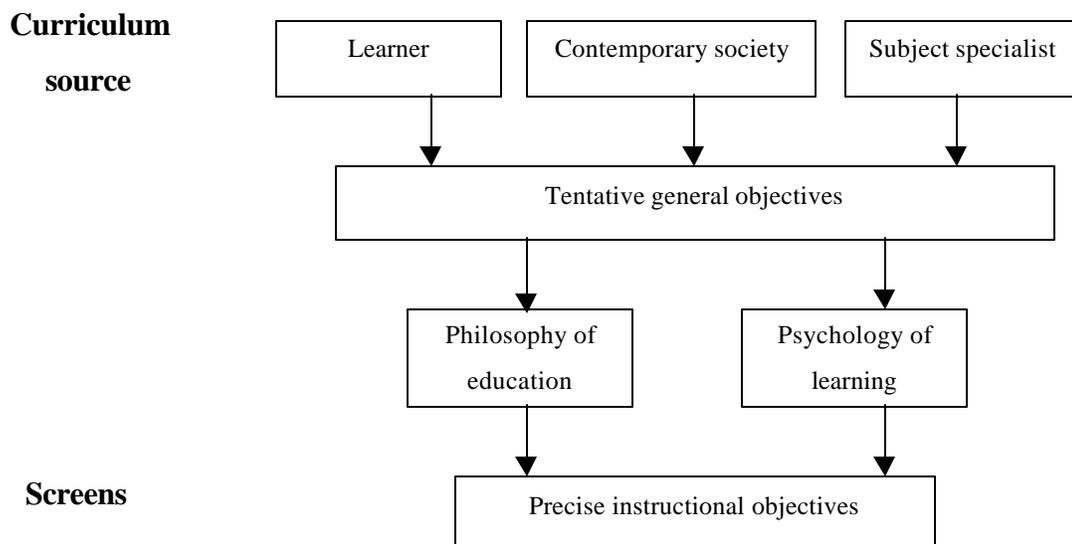
nature of the learning process. Tyler explained the significance of the psychological screen as follows:

- Knowledge of the psychology of learning enables us to distinguish between expected changes in human beings resulting from a learning process (from those that cannot).
- Knowledge of the psychology of learning enables us to distinguish between goals that are feasible and those that are likely to take a very long time.
- Psychology of learning gives us some idea of the length of time required to attain an objective and the age levels at which the effort is most efficiently employed (Oliva, 1997:146).

After the curriculum worker has applied this second screen, a list of objectives will be reduced, specific and clear. Objectives should be stated in behavioural or action terms which turns them into classroom objectives (Oliva, 1997:147).

Figure 3.2 illustrates briefly how to answer the first question in Tyler Rationale: Purpose.

FIGURE 3.2
DETERMINING OF PURPOSE IN TYLER'S RATIONALE



Source: Marsh and Stafford (1988:7); Oliva (1997:147)

According to Gress (1988:228), selecting and defining the purpose for curriculum is a continuing task. This is due to the societal changes occurring on a continuous base. A curriculum should always be relevant and keep up with time. As seen from figure 3.1, the next stage in the Tyler approach is the selection of learning experiences.

(b) Selection of learning experience

Learning experiences are actually activities that are written into the curriculum which provide opportunities for learners to reach the objectives specified in the purpose of the curriculum. For example, in technology education, objectives might require the learner to apply specific skills to solve technological problems, and a learning experience might involve the learner doing specific tasks such as drawing, cutting and soldering in order to solve the technological problem (Marsh & Stafford, 1999:27). According to Marsh and Stafford (1988:8), **learning experiences** are not '**content**' which should be selected and organised. The emphasis is on the activities undertaken by learners, that is, the **means** to achieve the **ends** (objectives). Gress (1988:229) adds that in developing learning experiences, the context (academic background) of the learner should be taken into consideration. The activities should be within the ability of the learner so that he or she can successfully and confidently carry out further activities. Schubert (1986:216) cited Tyler stating the following:

The term experience is not the same as the content with which a course deals nor the activities performed by the teachers. The term learning experience refers to the interaction between the learner and the external conditions in the environment to which he can react.

Tyler expected learners to be aware of the behaviour expected of them and that the kinds of learning experiences should be designed so that they could complete them successfully. Further, Tyler suggested that teachers should provide opportunities for their learners to practise the desired behaviours and to get appropriate assistance to help them with the task

(Marsh & Stafford, 1988:8). The next stage in Tyler's rationale answers the third question: How can learning experiences be organised for effective instruction?

(c) Organisation of learning experience

According to Gress (1988:231), Tyler suggested that learning experiences be organised in such a way that each subsequent experience should allow the learner to perceive the connection between learning experiences. Furthermore, Tyler suggested that attention be given to both the sequence (vertical organisation) of experiences within each subject, such as mathematics, social studies and technology, and the integration (horizontal organisation) among the subjects. In Tyler's view, as Marsh and Willis (1999:28) point out, it is essential for curriculum workers and teachers to identify the major concepts, skills and values to be taught. These concepts, skills and values are then introduced and reintroduced in successive teaching units. Tyler stresses that continuity, sequence, and integration have to be experienced by the learners and are not merely tools for teachers to use. As Gress (1988:23) points out, the concepts, skills and values may also be related to phenomena in other subjects or problems that cut across several subjects so that they are useful elements for assisting integration of learning. Furthermore, curriculum workers can also identify significant skills that are sufficiently complex and pervasive to serve as organising elements to achieve sequence and integration. Marsh and Stafford (1988:28) contend that to reinforce the continuity of particular concepts, learners need to go into greater detail each time a concept is reintroduced within the sequence curriculum. As they do so, they will be increasingly able to attain deeper levels of understanding of the concepts by integrating new details. The last stage of Tyler rationale is evaluation.

(d) Evaluation

This stage involves evaluating the effectiveness of the learning experiences. Tyler states that evaluation is a continuous activity. He suggested that learner's behaviours should be checked continuously (Marsh & Stafford, 1988:9). The purpose is to check whether the

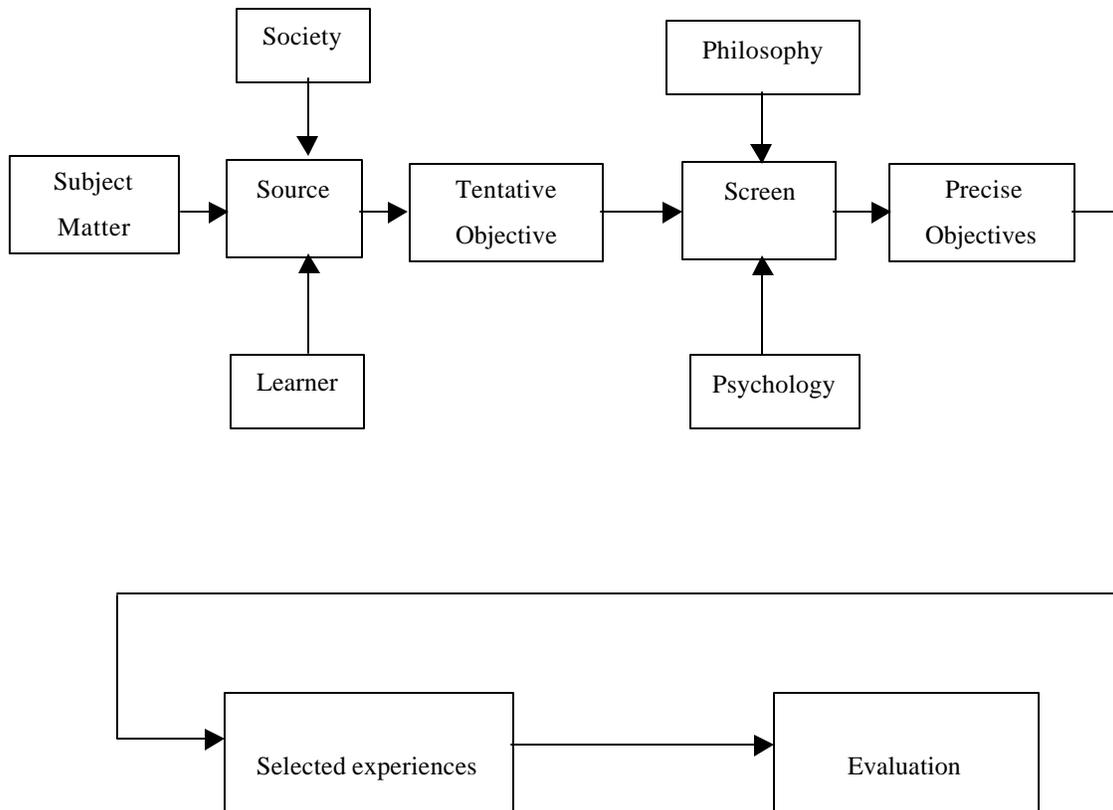
learning experiences that have been developed and organised produce the desired results. This is the end-means notion of evaluation, which was widely accepted and used in education systems up to today. It is important to note that the principles of OBE are also based on the notion of end-means to ensure accountability. This is the idea which was described a half-century ago by Tyler in 1949.

It is still innovative and includes the need to evaluate learners throughout the lesson, course, and modules. Gress (1988:232) contends that checking processes should be applied at different stages in curriculum development. Tyler emphasises that evaluation involves getting evidence about changes in the behaviour of learners and that doing so is not confined merely to giving paper and pencil tests. He advocates other techniques such as observation, interviews, questionnaires and samples of learners' work as well as formal and informal techniques (Marsh & Stafford, 1988:28). Tyler was disappointed to find that on several curriculum development projects evaluation information was not effectively used to improve the curriculum. He mentions that many of the project directors were newcomers to curriculum development, hence there was no continuity of improving curricula (Gress, 1988:2322). Tyler also emphasized the importance of developing appropriate testing instruments that can be demonstrated to be valid and reliable. In this case he suggests that all testing instruments for evaluation be scientific.

There is no denying that Tyler's idea has greatly influenced the field of curriculum, especially curriculum development. The four questions that Tyler raised had and still have great appeal because they appear so reasonable (Ornstein & Hunkins, 1998:198). Marsh and Willis (1999:29) contend that many other approaches, such as OBE have been based on Tyler's rationale. However, the Tylerian curriculum approach is not without criticism. According to Ornstein and Hunkins (1998), Tyler' work was criticized for being too linear. But, despite such criticism at national curriculum conferences, Tyler's work is still evident. Individuals continue to be guided by his rationale in their curriculum development. Although Tyler did not display his approach to curriculum development graphically,

several other people did. Figure 3.3 outlines a broad picture of Tyler’s curriculum development approach.

FIGURE 3.3
TYLER’S CURRICULUM DEVELOPMENT MODEL



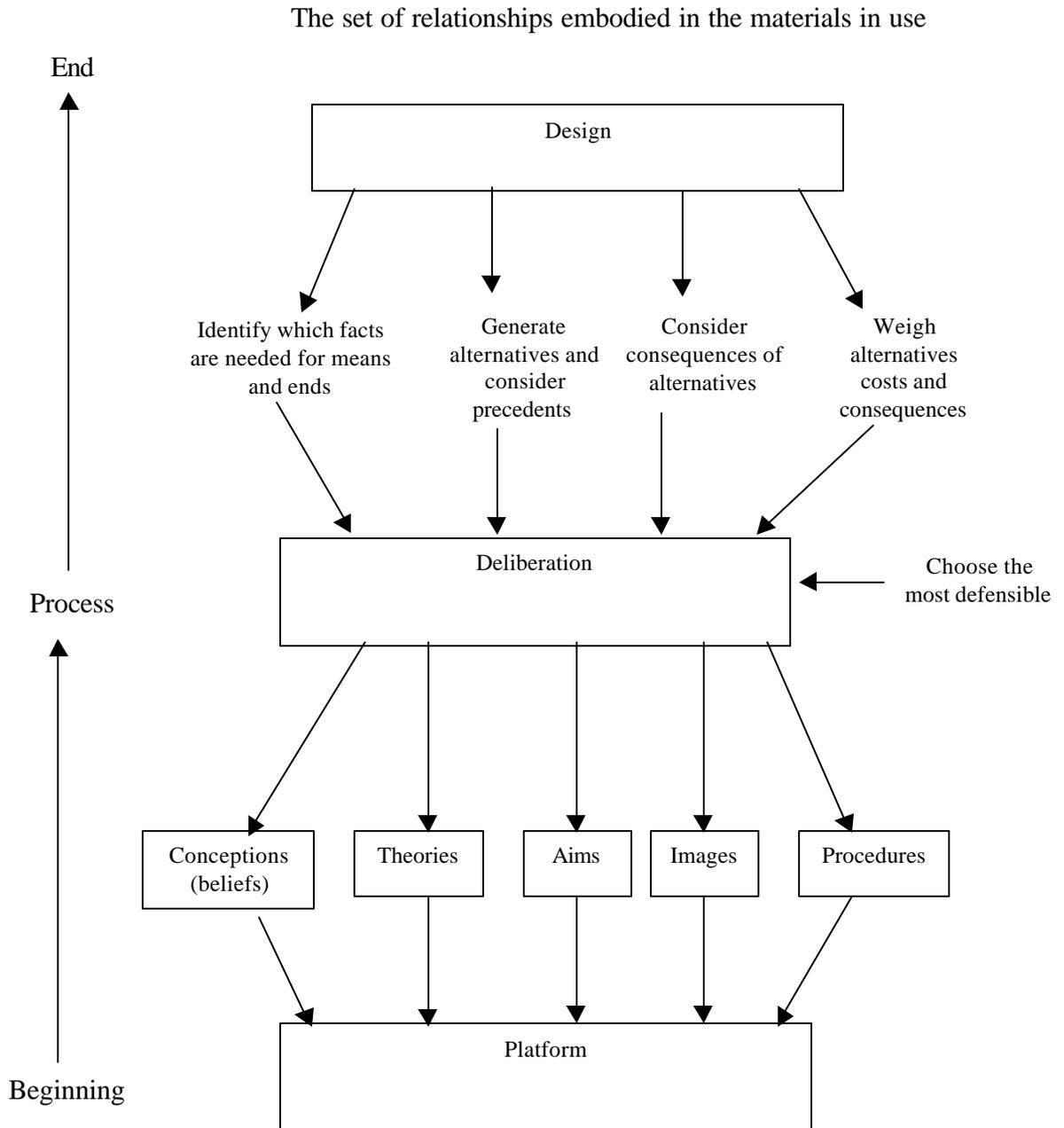
Source: Ornstein and Hunkins (1998:198)

3.2.5.2 Walker’s deliberative approach

The deliberative approach represents a means of reasoning about the practical problems of what to include in the curriculum. Deliberation means to talk seriously about or discuss issues. In this case, curriculum developers engage in curriculum matters during the process as opposed to top-down approach by authorities. This approach is generally known as the non-technical – non-scientific approach, whereas Tyler’s rationale approach is called the

technical – scientific approach (Ornstein & Hunkins, 1998:203-4). The technical scientific approach to curriculum discussed previously represents the belief in modernism, a view that praises rationality, objectivity, and certainty. This approach views the world as a complex machine that can be observed and manipulated. In contrast the non-technical approach exemplifies the belief in postmodernism or post-positivism which stresses subjectivity, the personal, the aesthetic, the heuristic and transaction. This approach stresses the learner rather than outputs of production, especially through activity-oriented approaches to teaching and learning (Ornstein & Hunkins, 1998:203). As a result, this approach is influenced by mostly progressivism and social reconstruction (see table 3.1). Decker Walker developed his deliberative approach after studying how national curriculum projects developed curriculum. Marsh and Willis (1999:39) add that Walker was studying what curriculum developers actually do when developing curricula. Tyler assumes that better curricula will result when those involved in it follow linear specific steps. Walker assumes that better curricula will result when those involved in it understand the complexity of the process. According to Marsh and Stafford (1988:10) Walker's approach is termed 'naturalistic' because it attempts to describe what actually takes place during curriculum development activities, as compared to linear approaches such as Tyler's which prescribe the activities (linear steps) that should occur. After analysing data collected during a natural curriculum project, Walker was able to identify three basic phases, which he termed platform, deliberation, and design. The model of Walker's deliberative approach is depicted in Figure 3.4.

FIGURE 3.4
WALKER'S NATURALISTIC MODEL



Source: Marsh and Willis, (1999:31)

(a) Platform

The system of beliefs and values that the curriculum developer brings to curriculum development is what Walker call the curriculum's platform (Gress, 1988:236). Marsh and Willis (1999:32) contend that this preliminary phase will kick-start the deliberation and even argue about conflicting beliefs, concerning what should be. According to Walker (1990:474) the platform provides terms and concepts that the curriculum developers use to pose issues, describe alternatives and frame arguments. The platform also provides principles, theories and models that explain how these terms and concepts and the phenomena they represent are presumed to be related. The platform serves as both factual and logical bases for design decisions, and in so doing, it is an essential ingredient in curriculum materials design. The developer's platform of ideas usually includes:

- a conception of the educational problem, including its origin, causes and the potential contributions of curriculum materials to its resolution.
- a recognition of the constraints to which the materials and the process of development are subjected, including, in the case of the materials themselves, the client group that the materials must satisfy.
- fundamental educational and curriculum conceptions and values to be embodied in the design, including priorities among purposes of curriculum, conceptions of the subject to be taught, models of the learner, the teaching/learning process, and social ideals to be pursued through education.
- a repertoire of models (good, positive models or bad) for the kinds of things that they might design, and a repertoire of strategies for going about the process of design. (Walker, 1990:475).

Walker also concluded that the platform typically consists of various conception (beliefs about what exists and about what is possible), theories (beliefs about relations between existing facts) and aims (beliefs about what is desirable) that are relatively well formulated. Furthermore, platform consists of less carefully thought out notions which Walker terms

images (indicating something is desirable without specifying why) and procedures (indicating courses of action without specifying why they are desirable) (Marsh & Stafford, 1988:11). According to Marsh and Willis (1999:32), a group of curriculum developers will discuss these issues, and whether they achieve much or little consensus about the platform, they eventually move into the second phase-deliberation.

(b) Deliberation

The second formal component in Walker's model is deliberation. According to Walker (1990:185), full and fair curriculum deliberation would

- explain the problem in the most defensible way(s);
- consider all the most promising alternative courses of action;
- consider in full the merits of each alternative, taking into account all relevant knowledge and using valid arguments to examine the bearing of this knowledge on the issue;
- explore the points of view and values of all interested parties to the decision; and reach fair and balanced judgements.

Gress (1988:238) contends that the main operations in curriculum deliberation are formulating decision points, devising alternative choices at these decision points, considering arguments for and against suggested decision points and decision alternatives, and, finally, choosing the most defensible alternative subject to acknowledge constraints. Gress points out that the heart of the deliberative process is the justification of choices.

Reid (1988) notes that deliberation does not go in for ready-made solutions or axiomatic forms of reasoning. It suggests that good actions have to be discovered, and that the means for their discovery is the inventive behaviour of people. Marsh and Willis (1999:33) observe that deliberation may seem very chaotic and frustrating for those people involved, as participants enter deliberation with different beliefs and feelings running high. Deliberation finally leads to some decision for action and design, when participants have

achieved sufficient consensus about beliefs, problematic circumstances and potential solutions. Specific courses of action can be taken more or less automatically, without further consideration of alternatives (Marsh & Willis, 1999:33).

(c) Design

A design stands at the apex of the model to indicate both its status as the ultimate end of the process and its dependence upon the other elements (Gress, 1988:242). Walker argues that the design phase of a curriculum development project typically contains both implicit and explicit considerations. The culminating activity for the design phase is the creation of the curriculum, which may include whatever specific subjects, instructions, teaching materials or activities the participants view as important (Marsh & Willis, 1999:33).

Walker's deliberative approach attempts to portray accurately what actually happens during curriculum development. The approach is viewed as normative as well as descriptive. The specifics within it are empirically based (Marsh & Willis, 1999:33). Gress (1988:242) agrees that the approach is primarily descriptive, whereas the classical approaches (technical models such as Tyler's rationale) are prescriptive. Walker's approach is basically a temporal one: it postulates a beginning (the platform), a process (deliberation) and an end (design with a clear progression from beginning to end). In contrast, the classical approach is a means-end model: it postulates a desired end (the objective), a means for attaining this end (the learning experience), and a process (evaluation) for determining whether the means does indeed bring about the end. The two approaches differ radically in the roles they assign to objectives and to evaluation in the process of curriculum development (Gress, 1988:242). Table 3.2 gives an overview of the technical approach (Tyler's rationale) and the non-technical approach (Walker's deliberative approach) as discussed.

TABLE 3.2
OVERVIEW OF CURRICULUM DEVELOPMENT APPROACHES

APPROACH	MAJOR ASSUMPTIONS	VIEW OF CURRICULUM	MAJOR APPROACHES
Technical scientific	Major steps can be identified, managed	Knowable components that can be selected and organised	Tyler's four basic principles
Non-technical	Curriculum development is "specialised talk"	Curriculum viewed as conversation	The deliberation model: conversational approaches

Source: Marsh and Stafford (1998:213)

In retrospect, Eisner (1985) noted after being involved in the Kettering project that Tyler's sources of objectives (learner, society, subject specialist) were only considered in terms of subject matter. He questioned whether the planning process, as analysed by Walker, occurs in curriculum development activities across all levels and all subjects. Eisner's questions include: *To what extent does Walker emphasize and portray his own preferences for deliberation? Is it an approach which overtly attempts to describe but covertly emphasises certain value stances? Does the approach satisfactorily explain the processes of curriculum development occurring in primary and secondary schools?* (Marsh & Stafford, 1988: 213)

3.2.5.3 Eisner's artistic approach

Eisner (1985:136) does not believe that it is possible in the field of education to prescribe formulas that one has to follow, but it is possible to provide guidelines that can heighten one's sensitivity to issues, problems and possibilities to which one might attend. This

approach has been influenced by both progressivism and social reconstruction (see table 3.1). To Eisner, curriculum development is the process of transforming images and aspirations about education into programmes that will effectively realise the visions that initiated the process. The initial conditions of curriculum development are seldom clear-cut, specific objectives. They are rather conceptions that are general, visions that are vague and aspirations that are fleeting (Eisner, 1985:128). In his artistic approach, Eisner identified steps that can be used in curriculum development. Figure 3.5 is an outline of this approach. The sequence of the step is, to a large extent, arbitrary. Initially the headings of the steps seem very similar to the steps that Tyler advocates, but the underlying rationality and the practical emphasis are quite different (Marsh & Willis, 1999:35). Below is the description of steps, which he called “dimensions” of curriculum development.

(a) Goals and their priorities

Eisner (1985:128) distinguishes between aims, goals and objectives. He refers to aims as the most general statement that proclaims the values of education, goals as specific statements of intent and objectives as the most specific statements of all. He regards goals as the midway between aims and objectives. For example, the goal of this course is to help learners solve human problems by using the design process in technology education (Eisner, 1985:137). He pointed out that it is not always possible, nor even desirable to have highly specific objectives. He argued that some activities that may be included in a curriculum cannot be predetermined and in that case it is quite legitimate to express the objectives in general terms. Eisner emphasises that the formulation of objectives does not necessarily have to precede teaching. He maintains that the artful process of arriving at consensus about priorities among goals has to involve participants in considerable discussion (deliberation) (Marsh & Willis, 1999:36).

FIGURE 3.5

OUTLINE OF EISNER'S ARTISTIC APPROACH

1.

Goals and their priorities

 - * The need to consider implicit and explicit objectives
 - * The need for deliberation in deciding on priorities
2.

The content of the curriculum

 - * Options to consider in selecting curriculum
 - * Caveats about the null curriculum
3.

Types of learning opportunities

 - * Emphasis on transforming goals and content into learning events that will be of significance to learners
4.

Organisation of learning opportunities
--

 - * Emphasis on a nonlinear approach in order to encourage diverse learners' outcomes
5.

Organisation of content areas

 - * Emphasis on cross-curriculum organisation of content
6.

Mode of presentation and mode of response

 - * Use of a number of modes of communication to widen education opportunities for learners
7.

Types of evaluation procedures

 - * Use of a comprehensive range of procedures at different stages of the process of curriculum development

Source: Marsh and Willis (1999:35)

(b) The content of the curriculum

Like Tyler and Walker, Eisner emphasises the need for the selection of content in curriculum development to achieve the goals of curriculum. The point here is that the groups concerned with curriculum development have options in content selection. The group considers the needs of the community and learners (Marsh & Willis, 1999:36). However, the group has limitations on the number of options that can be provided. Content selection, like goals, can be considered against the limitations of options (Eisner, 1985:140). Eisner concludes that very important content (e.g. law, anthropology and arts) has traditionally been excluded from schools. What is not taught he calls “null curriculum” (Marsh & Willis, 1999:36).

(c) Types of learning opportunities

Eisner (1985:140) notes that goals and content are necessary but not sufficient for the development of a curriculum. His central message is as follows:

The educational imagination must come into play in order to transform goals and content to the kinds of events that will have educational consequences for learners.

Eisner makes a clear distinction between the planned curriculum and the enacted curriculum, implying that, although academic specialists may know their subject matter well, it is curriculum planners and teachers who have the responsibility of transforming the content into forms that are appropriate for learners. He states that it is here that educational events must be planned and curriculum materials prepared to enable teachers and learners to grasp those concepts and generalisations and perform in a form that is consistent with one’s view of education (Eisner, 1985:140). For example, the teacher might provide a demonstration of soldering an electric circuit while the learners observe. He mentions that those who emphasise the importance of process tend to formulate learning opportunities

that stimulate learners to active tasks. Teachers value projects that appear interesting and events that will be attractive and engaging to learners.

(d) Organisation of learning opportunities

Here, Eisner refers to how events are planned within a period of time. It should be one of the decisions curriculum developers can make. This is because all educational programmes occur over time. Eisner identifies what he calls two 'images' of curriculum sequences that may be useful. One of these is the 'staircase model', and the other is a 'spider-web' model (Eisner, 1985:143). In the staircase model, Eisner suggest that the tasks that the developer-teacher selects are arranged one after the other like climbing of a staircase. He admits that the linear approach to the tasks has some benefits but not in an oversimplification of form (Marsh & Willis, 1999:37). With the use of the spider-web, Eisner emphasises a variety where he asserts materials and activities that encourage a diverse range of outcomes and experiences. He argues that engagement in this model is more important than attempting to control its outcomes. This places great demands on the inventiveness of the teacher (Eisner, 1985:144).

(e) The organisation of content areas

Eisner asserts that curriculum developers should consider organising content in an integrated variety of ways. He acknowledges the history of organising content in a so-called structure of the disciplines but argues that the problems that citizens confront in their daily lives seldom come in the forms with which the disciplines can deal. He observes that the most practical problems of life are 'messy'. They require the use of diverse kinds of knowledge, not using criteria that might be suitable for a single discipline (Eisner, 1985: 147-148).

(f) Mode of presentation and mode of response

Eisner notes that one of the least considered options in curriculum development is modalities through which learners encounter and express what they learn. He observes that traditional expectations have inadvertently allowed one mode to dominate evaluation methods and that educators believe that for learners to understand, they should demonstrate knowledge in verbal or written forms (Eisner, 1985:149). He points out that the syntactical rules that apply to discursive statements (especially to scientific statements) do not apply to poetic statements or to metaphors in general. He states that metaphors have their own purposes, which they fulfill by deliberately bending ordinary logic. Such modes of delivery can be more powerful than that which can be communicated through the mode of ordinary language (Marsh & Willis, 1999:37). What Eisner suggests here is that curriculum designers can intentionally exploit the variety of modalities humans use to conceptualise and experience the world and to express what they have learned about it. Eisner asserts that learning fields have indigenous expressive modalities, namely, historians write prose, physicists express what they have learned in equations, musicians perform with voice or instrument, painters create visual images. Eisner points out that to know whether a learner knows history, we ask him or her to speak or write. To determine whether a learner knows physics, we ask him or her to explain physical theory or to do a physics experiment. This implies that learners should express themselves within the mode that is indigenous to the discipline implying that mode should dominate (Eisner, 1985:151).

(g) Types of evaluation procedures

Related to the type of presentation and response in the learning environment is the type of evaluation procedures used to determine whether learners have learned and experienced. For Eisner, evaluation is not simply an activity that occurs after learners have completed a field of study or after a final step in curriculum development, it is something that pervades the entire process (Marsh & Willis, 1999:38; Eisner, 1985:152). Eisner believes that evaluation is basically the same natural process in which people constantly engage,

attempting to make sense of the world around them and of their own lives. He argues that the traditional summative evaluation of the classical test theory cannot determine how learners have learned and experienced at school. He emphasises that test and measurement specialists should follow our needs in education rather than we follow theirs (Eisner, 1985:152). With regard to the procedures for evaluation in the curriculum development process, Eisner agrees that the curriculum developers involved often go through several steps or stages. As he has indicated already, evaluation occurs throughout the process of curriculum development. Eisner maintains that the skills of perceiving, valuing and portraying are essentially artistic. They can be enhanced through practice and experience, but they cannot be reduced to a specific method. For Eisner, creating a curriculum is basically an artistic process throughout, and he advocates artistic means of evaluating both the process and the emerging curriculum (Marsh & Willis, 1999:38). Eisner makes it clear that the planned curriculum, the enacted curriculum and the experienced curriculum cannot be considered as the same thing within an artistic approach to curriculum development.

Eisner's approach to curriculum differs from Tyler's and Walker's approaches in several basic ways. Both Tyler and Eisner suggest that the curriculum developer must attend to some similar things. They then diverge where Tyler considers a sequence of steps under a logic in which means (the curriculum) are valued only in so far as they contribute to the end (the objectives selected by the planner). Conversely, Eisner portrays an open-ended process in which steps may be taken and retaken in any order under a logic in which means (the process) are one with ends (the curriculum as planned, enacted and experienced), all valued for their intrinsic qualities. Both Walker and Eisner see curriculum development as problematic and proceeding through deliberation. However, Walker describes deliberation only as it has occurred in problematic situations to develop curriculum, whereas Eisner describes how artistry within deliberation can enhance the intrinsic values of the planned, the enacted, and the experienced curriculum. One of the critics of Eisner's approach is that he has overstated the metaphor of artistry. Levin (1980:187) asks:

How are these artistic portrayals supposed to be used to stimulate reflection and discussion about important curricular issues? To what extent is the process of developing a curriculum actually like art? And what characteristics do this process and artistic endeavors have in common?

Regardless of how one answers these questions, Eisner's approach to curriculum development, far more than Tyler's or Walker's, insists that the process is inherently problematic in the sense that his approach uses the process of developing art field of study to develop other curriculum study. His approach offers general guidelines, not specific steps, and therefore thrusts the teacher to the forefront of the process of deliberation and enactment (Marsh & Willis, 1999:39).

The discussion of the three curriculum approaches to curriculum development has also shown how curriculum as a field of study has developed over the years. There are linkages in almost all the three approaches of curriculum development, in that the latest approaches are the improvements of the earlier approaches. There are debates around Tylers's approach being suitable for the era of positivism (Newtonian era) or modernism while the other two approaches (Walker and Eisner) being appropriate to postmodernist society. However, this does place one approach over the other. In fact, a combination (triangulation) of two or more approaches, depending on the situation is useful.

The and Curriculum 2005 approach to curriculum development cannot be taken as a pure, new approach, but as combination of two or more components of the earlier approaches to curriculum development. For instance, part of Eisner's approach is picked up by OBE and Curriculum 2005. In OBE and Curriculum 2005 the idea of progressivism becomes visible. Like any other approach to curriculum development OBE and Curriculum 2005 are not without pitfalls. The next section will discuss the OBE approach to curriculum development as adopted, albeit not in its purest form, by South Africa.

3.2.5.4 Outcomes-based education (OBE)

According to Spady, the well known proponent of this approach, it is about a transformational way of doing business in education (1993:ii).

Furthermore, it is about preparing students for life, not simply getting them ready for university, TAFE or employment. This means focusing and organizing a school's entire programmes and instructional efforts around the clearly defined outcomes we want all students to demonstrate when they leave school (1993:1).

According to Kgatitsoe (2002:40) OBE has been defined differently by various authors as follows:

“OBE is an educational philosophy organized around several basic assumptions and principles. It starts with the assumption that all learners can learn and succeed ... organized from a focus on learner exit outcomes and designed downward to the subject and unit levels, it focuses on teaching strategies, on clearly defined learner outcomes getting high standards with high expectations for all learners and includes expanded opportunities for enrichment and remediation” (Schwarz, 1994:327-328).

“OBE means organizing for results: basing what we do instructionally on the outcomes we want to achieve ... outcomes-based practitioners start by determining the knowledge, competencies, and qualities they want learners to be able to demonstrate when they finish school and face the challenges and opportunities of the adult world ... OBE therefore is not a ‘program;’ but a way of designing, delivering and documenting instruction in terms of its intended goals and outcomes” (Spady, 1988:5).

“OBE means clearly focusing and organizing everything in an educational system around what is essential for all learners to be able to do successfully at the end of their learning experiences. This means starting with a clear picture of what is important for students to be

able to do, then organizing curriculum, teaching and assessment to make sure that this learning ultimately happens (Van Niekerk & Killen, 2000:93).

The following commonalities are identified in the definitions given above:

- develop clearly defined outcomes that all learners must demonstrate
- define teaching and learning that ensures the demonstration of these outcomes
- monitor individual learner progress on the basis of demonstrated performance
- use criterion-referenced assessment both to monitor progress and to group learners
- provide remediation for learners who do not achieve the learning outcomes quickly and enrichment for those who do.

3.2.5.4.1 The roots of OBE

Outcomes-based education has its roots in earlier work on educational intent and assessment. Schwarz (1994:334) and Baxen and Soudin (1999:133) trace the roots of OBE in competency-based education (CBE) and mastery learning. However, King and Evans (1991:13) argue that the origin of OBE is more of CBE than mastery learning (see 3.2.5.4.6). CBE was a reaction to the changing job market in the late 1960s in the USA when there were queries regarding the role of education (Baxen & Soudin, 1999:133).

The mastery learning movement, established by Benjamin Bloom, is built around the assumptions that all learners are able to master desired outcomes if educators reconstruct the time and instructional parameters in which learning is set (Baxen & Soudin, 1999:133).

The next sections will briefly discuss some of original roots of OBE.

□ **Educational objectives**

Jansen (1999:146) states that OBE does not have any single historical legacy. OBE can be traced back to behavioural objective associated with BF Skinner while others associate it with the curriculum objectives of Ralph Tyler. The well-known *Bloom's taxonomy* where intellectual objectives are placed in system from simple to complex has often used in curriculum development and instructional design (Van der Horst et al., 1997:9). The details of six levels cognitive domain are discussed in section 3.4.3.1.

□ **Competency-based education**

Competency-based education was introduced in America (Jansen, 1999:146; Kgatitsoe, 2002:37; Prinsloo, 1999:79 and Van der Horst et al., 1997:10). The reason was that there was a concern from business people that education was not adequately preparing scholars for life after school. The concern was that learners were not taught the actual skills that they would need in a real world (Van der Horst et al., 1997:10). According to Ornstein and Levine (1993:23), a programme using competency-based teacher education (CBTE) requires prospective teachers to demonstrate minimum levels of performance on specified teaching tasks. The idea at that time was that competency-based education would focus on an integration of:

- Outcome (in terms of specific skills);
 - Instructional experiences (to teach the outcomes);
 - Assessment devices (to determine whether the learners had mastered the outcomes)
- (Van der Horst et al., 1997:10).

Competency-based education was a great departure from the traditional experiential education to the behavioral objective era. To some extent CBE hopes to alleviate duplication of content in traditional education, to establish and maintain consistency of competencies taught within courses. CBE was intended to improve individualization of

instruction, refine accreditation practices, revise and implement appropriate systems of evaluation and reporting of learner achievement, to better communication with learners about outcomes they are supposed to achieve and how success will be determined, to better provide learners with ongoing information regarding their personal progress, to be able to be accountable to public and finally to improve learner achievement of desired competencies (Kgatitsoe, 2002:38). Competency-based education has the following effects:

- CBE redefines the role of the teacher. The teacher has to be a researcher, curriculum developer, determine outcomes, certify, advices, design the learning programmes and facilitate learning.
- CBE removes the autocratic power of the educator; the learner and the educator have to share power.
- CBE forces teachers to rethink what they teach
- CBE calls for reflection (Kgatitsoe, 2002:39).

Brady (1996:9-12) and Baron & Boschee (1996:575) agree that there are close similarities between CBE and OBE principles. Competency-based education was in practice merely reduced to a testing and remedial programme. Lack of agreement on what were considered essential “competencies” led to the failure of this education system (Van de Horst et al., 1997:10). When properly designed CBE could be very valuable and improvements could be noted (Kgatitsoe, 2002:39).

Competency-based education focuses on the achievement of specific competencies (often skills in isolation), whereas OBE focuses on three aspects: knowledge, skills and attitudes (Kraak, 1999:40). Hager et al. (1998:56) contend that competency is the capacity to perform successfully a series of discrete observable tasks. Both OBE and CBE emphasize responsibility and accountability for learning (Van der Horst et al., 1997:11).

Table 3.3 illustrates the difference of the previous system of education and OBE in South Africa.

TABLE 3.3
DIFFERENCE BETWEEN OLD SYSTEM OF EDUCATION AND NEW
OUTCOMES-BASED EDUCATION

OLD SYSTEM OF EDUCATION	OUTCOMES-BASED EDUCATION
Passive learners	Active learners
Exam-driven	Learners are assessed on an on-going basis
Rote-learning	Critical thinking, reasoning, reflection and action
Syllabus is content-based and broken down into subjects	An integration of knowledge; learning is relevant and connected to real-life situations
Textbook/worksheet-bound and teacher centred	Learner-centred; teacher facilitator; teacher constantly uses group-work and teamwork to consolidate the new approach
Sees syllabus as rigid and non-negotiable	Learning programmes seen as guides that allow teachers to be innovative and creative in designing programmes
Teachers responsible for learning; motivation dependent on the personality of teacher	Learners take responsibility for their learning; pupils motivated by constant feedback
Emphasis on what teacher hopes to achieve	Emphasis on outcomes what learner becomes and understands
Content placed into rigid time-frames	Flexible time-frames allow learners to work at their own pace
Curriculum development process not open to public comment	Comment and input from wider community is encouraged

Source: Van der Horst and McDonald (1997:27)

The next section will discuss OBE with particular reference to some of its implications.

3.2.5.4.2 Implications of outcomes

Teachers are familiar with some of the words used to describe what educators want to achieve at the end of the learning process, words such as aims, goals and objectives. The important thing to remember is that statements of aims, goals or objectives all describe the

intent of an educational process (what the teacher wants to achieve, what the learner must be able to do). When these intentions are realized, the end product is called an educational or learning outcome. In outcomes-based education the part from purpose (or intent) to results is crucial for instructional decision making.

Van Niekerk and Killen (2000:93) contend that OBE is centered around what is essential for all learners to be able to do successfully at the end of their learning experiences. The outcomes-based approach to teaching and learning has a number of implications for methodology. This means that learning will have to be directed towards acquiring abilities and skills, rather than memorizing information (Gultig et al., 1998:22). The following implications to teaching and learning are identified:

- an emphasis on activity-based learning, with opportunity for learners to explore ideas and approaches to learning and to practice skills;
- co-operative as well as individual learning contexts so that learners can develop skills of working collaboratively in a groups, and individually, and the ability to recognize when each mode is appropriate;
- an emphasis on formative assessment, so that the process and developmental nature of learning, as well as the products, are seen as important;
- the setting of tasks that integrate theory and practice, and manual and mental learning where practicable, and which link classroom learning to the broader society in which it is located (Gultig et al., 1998:22 & Department of Education, 2002:1).

The intended outcomes in OBE are explicitly stated. Such explicit statement serves to guide the teaching and process, and makes possible appropriate assessment of the learning process. Since OBE is about preparing learners for life, not only preparing them for higher education or employment. The outcomes should be practical and primarily significant to life after school. What matters most in OBE is what learners can do when they exit the system. Spady (1993:2) emphasises that in OBE, the intended learning results are the start-up points in defining the system. Curriculum is designed from the exit outcomes. To

develop outcomes is a process which requires people to engage with a body of research, a set of ideas, ideas and all kinds of information which have to do with real life (Spady, 1993:2).

OBE entails curriculum design down, content and delivery on the assessment of the knowledge, skills, attitudes and values needed by both learners and society. According to Spady (1998:27 and Gultig et al, 1998) design down means educators begin their curriculum and teaching planning where they want learners to ultimately end up and build back from there. Spady sees outcomes as falling into three broad categories: culminating, enabling, and discrete.

Culminating outcomes define what the system wants all learners to be able to do when their official learning experiences are complete. In a fully developed OBE system, the term “culminating” is synonymous with exit outcomes. In a less fully developed system, culminating might refer to what are called program outcomes and course outcomes (Spady, 1998:28).

Enabling outcomes are the key building blocks on which those culminating outcomes depend. They are essential to learners’ ultimate performance success (Spady, 1998:28). Discrete outcomes, however, are curriculum details that are ‘nice to know’, but not essential to a learner’s culminating outcomes (Spady, 1998:28). Therefore, the challenges in design down process are to determine classroom specific learning outcomes that truly underlie a culminating outcome.

From a critical point of view one has to accept that the OBE approach creates questions. Some of these will be dealt with under section 3.2.5.5.

3.2.5.5 The South African approach: Curriculum 2005 and RNCS

The introduction of full democracy to South Africa since 1994 started a process whereby all domains of society and practices have been scrutinised in view of necessary changes to

bring them in line with the new democracy. Education, evidently, was in need of a paradigm shift and the process has been started to change the system and the curriculum against the background of progressivism and social reconstruction. The democratic society, emphasis on resolving current challenges, active involvement of learners and learner centeredness are all issues that reflect the two educational philosophies (table 3.1). To be in line with the democratic change the curriculum endeavour acknowledged the new Constitution as the basic source of guidelines. The Constitution of the Republic of South Africa (Act 108 of 1996), and the Manifesto on Values, Education and Democracy (2001), stipulate, among others, the principles of democracy, human rights, social justice, equity, non-sexism and ubuntu. Systemic changes involved changes to a New Qualification Framework (NQF) and the establishment of a quality assurance agency (SAQA). Furthermore, on the level of curriculum design and development the three different points of departure, namely, learner centredness, outcomes-based education and the integration of disciplines are accepted. Learner centredness and the integration of disciplines are issues reflected on by scholarly concerns as is evident from table 3.1. The role Outcomes-based Education plays in South Africa considerations will receive further attention. A new curriculum (C2005) was introduced, but urgently required revision which resulted in a Revised National Curriculum Statement Grades R-9 (schools) in 2002.

The next section will describe key principles and design features of national curriculum for schools.

3.2.5.5.1 Principles of the National Curriculum Statements

a) Social transformation

The Constitution of South Africa forms a basis for social transformation in a post-apartheid society. The imperative to transform South African society through various transformative tools stems from a need to address the legacy of apartheid in all areas of human activity, and in education in particular. Social transformation in education is aimed at ensuring that

the educational imbalances of the past are addressed, and that equal educational opportunities are provided for all sections of our population.

If social transformation is to be achieved, all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications.

(b) Critical Outcomes

Outcomes-based education forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential. This it does by setting the outcomes to be achieved at the end of the process. The outcomes encourage a learner-centred and activity-based approach to education. The National Curriculum Statement (NCS) builds its Learning Outcomes for the Grades 10-12 (Schools) on the Critical and Developmental Outcomes that were inspired by the Constitution and developed in a democratic process. The Critical and Developmental Outcomes describe the kind of citizen the education institutions must produce. The NCS is designed down from these Critical and Developmental Outcomes. The Learning Outcomes describe knowledge, skills and values that learners should attain at the end of the school education, higher education as well as non-formal education.

(c) High knowledge, high skills

The National Curriculum Statement Grades 10-12 (schools) aims to develop a high level of knowledge and skills for learners. It sets up high expectations of what South African learners can achieve. Social justice requires that those sections of the population previously disempowered by the lack of knowledge and skills should be empowered. The NCS specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high achievable standards in all subjects.

(d) Integration and applied competence

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the NQF. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting integration and applied competence, the NCS Grades 10-12 (schools) seeks to promote an integrated learning of theory, practice and reflection.

(e) Progression

Assessment standards for each learning outcome specify more complex, deeper and broader knowledge, skills, values and understanding to be achieved in each grade. Conceptual progression is a term used to define this feature of the curriculum. Progression by grade is central to the NCS.

(f) Articulation and portability

Assessment standards in Subject Statements were formulated with a view to creating equivalence with unit standards at appropriate NQF levels. This should allow mobility across and within the FET band. Recognition of prior learning, which is defined as “granting of credit for a unit of learning on the basis of an assessment of formal and non-formal learning/experience to establish whether the learner possesses the capabilities specified in the outcomes statement” (Department of Education, 20002:11), is also promoted.

(g) Human rights, inclusivity, environmental and social justice

The NCS seeks to promote human rights, social and environmental justice. All newly developed Subject Statements are infused with the principles and practices of social and

environmental justice and human rights as defined in the Constitution of the Republic of South Africa. In particular, the NCS is sensitive to issues of diversity, for example, poverty, inequality, race, gender, age, disability and sexual preference.

The NCS adopts an inclusive approach by specifying minimum requirements for all learners. The special educational, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate learning programmes.

Issues such as poverty, inequality, race, gender, age, disability and challenges such as HIV/AIDS influence the degree and way in which learners can participate in schooling. The Revised National Curriculum Statement Grades R-9 (schools) adopts an inclusive approach by specifying the minimum requirements for all learners. All the Learning Area Statements try to create an awareness of the relationship between social justices, human rights, a healthy environment and inclusivity. Learners are also encouraged to develop knowledge and understanding of the rich diversity of this country, including the cultural, religious and ethnic components of this diversity.

(h) Valuing indigenous knowledge systems

The NCS departs from the standpoint that all knowledge is contested. This requires that different perspectives and worldviews be recognised in the curriculum. In our context, the recognition and valuing of indigenous knowledge systems is crucial for affirming a great majority of our people. All subjects that form part of the NCS have gone a long way in integrating elements of indigenous knowledge into their discursive terrains.

(i) Credibility, quality and efficiency

The assessment standards are comparable in quality, breadth and depth to those of other countries. This provides a basis for recognition of the FETC (Schools) qualification gained

at different sites and transfer within and between sites and countries. Quality is to be assured through national and provincial moderation, among other mechanisms.

3.2.5.5.2 The design features of the National Curriculum Statement

□ Outcomes

Outcomes are not only reflected as a principle in Curriculum 2005 but is a basic design feature in terms of Critical Outcomes and learning Outcomes.

The Critical Outcomes require learners to be able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively with others as members of a team, group, organisation and community;
- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically showing responsibility towards the environment and the health of others;
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

The Developmental Outcomes require learners to be able to:

- reflect on and explore a variety of strategies to learn more effectively;
- participate as responsible citizens in the life of local, national, and global communities;
- be culturally and aesthetically sensitive across a range of social contexts;

- explore education and career opportunities;
- develop entrepreneurial opportunities.

□ **Learning Areas**

The Revised National Curriculum Statement Grades R-9 (Schools) consists of the overview document and eight Learning Area Statements for:

- Languages;
- Mathematics;
- Natural Sciences;
- Social sciences;
- Arts and Culture;
- Life Orientation;
- Economic and Management Sciences; and
- Technology (Department of Education, 2002).

Each Learning Area Statement identifies the main Learning Outcomes to be achieved by the end of Grade 9. Each Learning Area Statement also specifies the Assessment Standards that will enable the Learning Outcomes to be achieved.

(a) Learning outcome

A learning outcome is derived from the Critical and Developmental Outcomes. It describes knowledge, skills and values that learners should learn by the end of the FET band. Learning outcomes are packaged into subjects. Learning outcomes do not prescribe content or method. Learning outcomes elaborated on through assessment standards.

(b) Assessment standard

Assessment standards describe the level at which the learning outcomes should be achieved. They embody the knowledge, skills and values required to achieve the outcomes. They are grade specific and show how conceptual progression occurs in a subject or learning area. Assessment standards can be integrated within grades as well as across grades. The achievement of an optimal relationship between integration across learning areas, and conceptual progression from grade to grade, are central to the curriculum (Department of Education, 2002).

(c) Learning programmes

The Revised National Curriculum Statement is aimed at promoting commitment as well as competence among teachers, who will be responsible for the development of their own learning programmes. In order to support teachers, the Department of Education will provide policy guidelines based on each learning area statement. Provinces will develop further guidelines where necessary in order to accommodate diversity.

Based on the framework discussed above, curriculum developers are encouraged to start with intended outcomes and design back from there. Designing down from the end point helps to develop a much more complex picture of the real demonstrations for learners. The main purposes of Outcomes-based education are:

- to equip all learners with the knowledge and competencies, and attitudes needed for future success; and
- to implement programmes and environment that maximise learning success for all learners (Spady, 1993:21).

3.2.5.5.3 The criticism of outcomes-based education in South Africa

It was widely believed that OBE would bring vast improvements on the traditional content-based education system. OBE has now brought some confusion among educators and some higher education institutions. This section will highlight some critiques labeled against OBE, both from the philosophical perception and its implementation.

Outcomes make explicit what learners should attend to. Outcomes signal what is worth learning in a curriculum. Although these are universal claims about OBE, Jansen (1999:146) question whether outcomes deliver what they claim, particularly in a poor-resourced environment. In some cases OBE curriculum policy in South Africa was just a change of terminology from the old to the new word without a philosophical explanation of the meaning of the word, e.g. ‘competencies’ to ‘outcomes’ (Jansen, 1999:146). There are strong philosophical rationales for questioning the desirability of OBE in democratic school systems. According to Jansen (1999:150), one needs to take a radical position that specifying outcomes in advance might be anti-democratic. Jansen argues that such a curriculum policy offers an instrumentalist view of knowledge that violates the epistemology of the structure of certain subjects and discipline (McKernan, 1994:2).

Much of the criticisms of OBE revolve around its implementation. Given the number of unqualified and underqualified teachers in the teaching crop, the extreme paradigm shift from the implementation of OBE is huge (Prinsloo, 1999:38). It is believed that ‘transformational’ OBE is too idealistic for South African teachers. The OBE curriculum policy requires not only the application of a skill but understanding of its theoretical underpinnings of demonstrating capacity to transfer such application and understanding across different context. There is no process, systematic and ongoing, in which teachers are allowed to conceptualise and make sense of OBE as a national curriculum (Jansen, 1999:150). According to Jansen (1999:147) and Prinsloo (1999:60-61), the language of innovation associated with OBE is too complex, confusing and time-consuming for the

teacher who has not been trained or attended a workshop on OBE. In a study that was done by Kgatitsoe (2002:94) the following key problems on OBE curriculum were highlighted:

- Lack of alignment between curriculum and assessment
- Inadequate orientation, training and development of teachers
- Learning support materials that are variable in quality, often unavailable and not sufficient for classroom use
- Shortage of personnel and resources to implement OBE curriculum

The management of OBE will multiply the administration burdens placed on teachers. This is evident in implementing continuous assessment which too many teachers imply means assessing continuously in schools (Jansen, 1998:5). The range of assessment tasks multiplied significantly. To manage this innovation teachers will have to reorganize the curriculum and increase time allocated to monitoring individual learner progress against outcomes, administer appropriate forms of assessment and maintain comprehensive records. Kundlas (1994:33) also noted generic OBE flaws which were also highlighted by teachers:

- Learner boredom is a problem especially high achiever learners
- Grading is confusing
- Assessment is a big problem
- Enrichment preparations are problematic
- OBE is not well accepted by higher education
- Keeping track of outcomes could be taxing

The researcher's opinion about the criticisms discussed above is that they could be reduced if proper teacher education and training programmes on OBE curriculum could be developed and implemented.

3.2.5.5.4 South African Qualifications Authority (SAQA)

SAQA identified eight (8) critical cross-field outcomes plus five developmental outcomes, which underpin all education and training. These outcomes form the basis for the development of the curriculum at GET, FET and HET of the NQF (3.2.5.4.4) structure. These outcomes (mentioned in 3.2.5.4.1) inform teaching and learning at all NQF levels and are rooted in the South African Constitution.

The primary function of SAQA (also called ‘the Authority’) is to oversee the development and implementation of the NQF (‘the Framework’). In terms of section 5(1) of the South African Qualification Authority Act (1995), SAQA must:

- Oversee the development of the NQF.
- Formulate and publish policies and criteria for:
 - registering bodies responsible for establishing education and training qualifications and standards (NSBs and SGBs);
 - accrediting bodies responsible for monitoring and auditing achievements in terms of such qualifications and standards (ETQAs).
- Oversee the implementation of the NQF, including:
 - registering or accrediting the above mentioned bodies and assigning their functions;
 - registering national qualifications and standards;
 - ensuring compliance with provisions for accreditation;
 - benchmarking standards and registered qualifications internationally.
- Advise the Minister on the registration of qualifications and standards.
- Be responsible for the control of the finances of the Authority (SAQA, 2000:4).

These critical outcomes underpin Outcomes-based education. The philosophy of Outcomes-based education is discussed in the next section. It is evident from the SAQA critical cross-

field outcomes that it provides a person with the opportunity to release his or her potential and maximise it for the benefit of the country.

3.2.5.5.5 The National Qualification Framework (NQF)

The development and implementation of a National Qualifications Framework (NQF) in South Africa is aimed at reconstructing and developing the current education and training systems into a system that reflects an integrated approach which addresses the learner's and nation's needs (Department of Education, 1997c:14).

The objectives of the NQF are to create a national framework for learning achievements and to enhance access to, and mobility and quality within education and training (SAQA Act, 1995:[2]). The objectives of the NQF, according to the SAQA Act are the following:

- Create an integrated national framework for learning achievements.
- Facilitate access to, and mobility and progression within education, training and career paths.
- Enhance the quality of education and training.
- Accelerate the redress of past unfair discrimination in education, training and employment opportunities, and thereby
- Contribute to the full personal development of each learner and the social and economic development of the nation at large (SAQA, 2000:4).

The National Qualifications Framework specifies an eight-level framework. Level 1 is the least complex, and level 8 the most complex. Both levels 1 and 8 are regarded as open-ended. This means that there is learning below Level 1 that will be formally recognised by SAQA at Level 1. as illustrated in table 3.4.

According to the NQF structure, the technology teacher education and training programmes form part of post-school qualifications which are located in the Higher Education and Training band. They start from NQF level 5 onwards.

TABLE 3.4

THE NATIONAL QUALIFICATIONS FRAMEWORK STRUCTURE

HIGHER EDUCATION AND TRAINING BAND	
TERTIARY AND RESEARCH	
NQF LEVEL	TYPES OF QUALIFICATIONS AND CERTIFICATES
NQF LEVEL 8	Doctorates and Further Research Degrees
NQF LEVEL 7	Higher Degrees Professional Qualifications
NQF LEVEL 6	First Degrees Higher Diplomas
NQF LEVEL 5	Diplomas Occupational Certificates
FURTHER EDUCATION AND TRAINING BAND	
CORE AND APPLIED; GENERIC AND OPTIONS	
NQF LEVEL 4 GRADE 12 (STD 10)	School/College/Training Certificates
NQF LEVEL 3 GRADE 11 (STD 9)	School/College/Training Certificates
NQF LEVEL 2 GRADE 10 (STD 8)	School/College/Training Certificates
NQF LEVEL 1 – GENERAL EDUCATION AND TRAINING BAND	
(ABET Level 4)	
COMPULSORY SCHOOLING	
Senior Phase Grade 7 to 9 (Std 5 to 7)	ABET Level 3 and 4
Intermediate Phase Grade 4 to 6 (Std 2 to 4)	ABET Level 2
Foundation Phase Grade 1 to 3	ABET Level 1
Pre-school Phase	

Source: Coetzee (1998:11); SAQA (2000:5)

The NQF is an eight-level framework with three identified bands:

- NQF LEVEL 1: General Education and Training Band, consisting of a pre-school phase, a foundation phase (Grades 1-3), an intermediate phase (Grades 4-6) and a senior phase (Grades 7-9). Parallel to these phases are ABET levels 1-4, both culminating in a General Education and Training Certificate. Education at this level will be compulsory and 'free'.
- NQF LEVELS 2 to 4: Further Education and Training Band, corresponding to present Grades 10 –12 including training at colleges and other educational institutions and culminating in a Further Education and Training Certificate. Education at these levels will be voluntary and will probably be very expensive.
- NQF LEVELS 5 to 8: Higher Education and Training Band, corresponding to the present higher education provision.

These are standards for the different levels and certificates for each of the three NQF bands. The next section will analyse the norms and standards for teacher education and training.

3.3 NORMS AND STANDARDS: IMPLICATIONS TO TECHNOLOGY TEACHER EDUCATION

The quality of technology education programmes at schools is determined largely by the success students have in acquiring the skills, knowledge, and values needed by society, particularly at the workplace. The modern technological workplace has significant implications for the type of instruction learners receive from teachers in order to enter into and succeed in a changing work environment (Frantz, 1994:41).

3.3.1 The context for quality standards

The workplace of today is being driven by, amongst others,

- The emergence of a competitive global market place;
- The use of new technologies in producing goods and services; and

- The introduction of different forms of work organisation. Global and economic forces are changing the workplace and have an impact on technical education (Frantz, 1996:42).

The Department of Education (2000a:11) contends these statements as follows:

We are living in a rapidly changing world, where old skills are no longer relevant and new skills are required to adapt to rapidly changing demands. Today's work place is characterised by global competition, cultural diversity, and technological and management process that require workers to think critically, solve problems and communicate effectively.

These diverse backgrounds set up standards which require technical skills and knowledge necessary for making a successful transition from school to the workplace as well as higher education institutions (Frantz et al., 1996:43). This also implies that technology teachers must be better prepared than ever before to teach learners technical skills and conceptual knowledge. According to Frantz et al. (1996:45), the standard to obtain a minimum level of academic, technical and professional education is important if technical teachers are to present a high level of skill and knowledge to learners. Technology teacher education programmes should consist of experiences and activities which will assist aspiring teachers learn how to make instructional content meaningful by connecting it to learners' everyday lives (Frantz et al., 1996:47). It is imperative that aspiring teachers develop techniques that promote learner-centered, rather than teacher-centered classrooms. Cooperative learning, problem-solving, role-playing and experimentation are just some of the techniques that can assist classroom teacher prompt passive learners to become active learners (Frantz et al., 1996:48). Programmes and curricular are in many cases academic, theoretical and out of touch with the needs of learners and the labour market (Department of Education, 1998:13).

Standards provide a basis for benchmarking the technology teacher education programme needed to produce qualified teachers required for satisfactory performance (Moss, 1996:75).

Standards promise to restore the social order in technology teacher education programmes. They clarify what students should know and be able to do in a given curriculum. Standards provide the guidelines around which instruction should be designed because they define the content knowledge and skills that practicing professionals believe learners need. In this case, standards promise mastery of subject matter whether it be in a content field or pedagogy. Standards promise excellence for all learners through the efforts of better teachers (Galluzzo, 1996:15).

Contemporary technology teachers require different skills than has been the case historically. Technology teacher education programmes must prepare teachers to:

- Use more technology in the classroom and expose learners to technology in the workplace;
- Teach problem-solving, decision-making, and teamwork to better prepare technical learners for high performance places of work (Walker, 1996:22). According to Moss (1990:78) the actual trend of technology education programmes is moving from:
 - o Occupationally specific content to content drawn from more broadly defined career clusters or industry-based groupings;
 - o A focus on entry-level job skills to an exploration of all aspects of industry, a range of career paths;
 - o Teaching in relative isolation to working collaboratively with others from several academic fields as well as the workplace;
 - o A behavioural model of instruction to a more learner-centered, project-based, problem-oriented and cooperative learning environment.

The development of standards for training and certifying all teachers including technology education teachers is grounded in the Norms and Standards for Educators released by the Department of Education in South Africa. These standards are described in terms of the seven roles and associated competencies of educators at schools and provide exit level outcomes. These roles and competencies are in fact the norms for teacher education and training.

The roles and competencies must be integrated in the learning programme and should inform the exit level outcomes of a qualification and their associated assessment criteria. Every teacher education qualification should reflect applied and integrated competencies (Department of Education, 2000b:13).

The complete norms and standards in terms of roles and competencies are described below. The description of the seven roles is done in a manner appropriate for an initial teacher qualification (Department of Education, 2000b:13).

The seven roles are:

(a) Learning mediator

The educator will mediate learning in a manner which is sensitive to the diverse needs of learners, including those with obstacles to learning; developing and designing learning environments that are appropriately conceptualised and inspirational; communicate effectively showing recognition of and respect for the differences of others. In addition, an educator will demonstrate sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context.

(b) Interpreter and designer of learning programmes and materials

The educator will understand and interpret provided learning programmes; design original learning programmes; identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources of learning. The educator will also select, sequence and pace the learning in a manner sensitive to the differing needs of the subject and learners.

(c) Leader, administration and manager

The educator will make decisions appropriate to the level, manage learning in the classroom, carry out classroom administrative duties efficiently and participate in school decision-making structures. These competences will be performed in ways that are democratic, sensitive to learners and colleagues and responsive to changing circumstances and needs.

(d) Scholar, researcher and lifelong learner

The educator will achieve ongoing personal, academic, occupational and professional growth through pursuing reflective study and research in their field of study or subject, in broader professional and educational matters, and in other related study fields.

(e) Community citizenship and pastoral role

The educator will practise and promote a critical, committed and ethical attitude towards developing a sense of respect and responsibility towards others. The educator will uphold the constitution and promote democratic values and practices in schools and society. Within the school, the educator will demonstrate an ability to develop a supportive and empowering learning environment and respond to the educational and other needs of learners and fellow educators. It should be part of the educator to impart HIV/AIDS education to the learners within the school environment.

(f) Assessor

The educator will understand that assessment is an essential feature of the teaching and learning process and know how to integrate it into this process. The educator will understand the purpose of various types of assessment and use them to assist learners. The educator will design and manage both formative and summative assessment in ways that are appropriate to

the level and purpose of the learning and meet the requirements of accrediting bodies. The educator will use assessment results to improve learning programmes.

(g) Specialist in Study Field/subject/discipline

The educator will be well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area, study field, professional or occupational practice. The educator will know about different approaches to teaching and learning (research and management), and how these may be used in ways which are appropriate to the learners and the context. The educator will have a well-developed understanding of the knowledge appropriate to the specialism.

The above-mentioned roles serve as a measure for quality technology teachers. This implies that a well-qualified technology teacher should execute these roles. It is critical that teacher education programmes also prepare technology teachers to teach their learners broad, general skills. This shift from narrow, industrial job focused education within a vocational area is caused by the diverse population of learners which include higher drop out rates, unemployment and underemployment, higher crime rates and increased dependence on public and government assistance (Frantz, 1994:51). It is to this end that the Department of Education undertook the work of developing quality standards for teacher education in general.

The roles will be further described in terms of the applied competencies.

3.3.1.1 Applied competencies and roles

The underlying notion of the Norms and Standards policy is the applied competence and its associated assessment criteria. Applied competence is the overarching term for the following three interconnected kinds of competences:

- Practical competence is the demonstrated ability, in an authentic content to consider a range of possibilities for action, make considerable decisions about which possibility to follow, and to perform the chosen action;
- Foundational competence requires the learner to demonstrate an understanding of the knowledge and thinking that underpins action taken;
- Reflexive competence requires the learner to demonstrate the ability to integrate or connect performances and decision-making with understanding and with an ability to change an unforeseen circumstances and to explain the reasons behind these adaptations (Department of Education, 2000e:10);
- Applied competence is assessed in each of the seven educator roles. In turn, the seven roles should also be assessed in an integrated and applied manner.

The three types of applied competence are demonstrated in each of the seven roles in table 3.5 below.

TABLE 3.5
EDUCATOR ROLES AND APPLIED COMPETENCIES

Learning mediator		
Practical Competencies	Foundation Competencies	Reflexive Competencies
<p>Learners should demonstrate the ability in an authentic context, consider a range of possibilities for action, make considerable decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Using the language of instruction appropriated to explain, describe and discuss key concepts in the particular learning field/discipline/ • Using a second official language to explain, describe and discuss key concepts in a conversational style. • Employing appropriate strategies for working with learner’s needs and 	<p>Learner should demonstrate an understanding of knowledge and thinking which underpins action taken</p> <ul style="list-style-type: none"> • Understanding different explanations of how language mediates learning: the principles of language in learning; language across the curriculum; language and power; and a strong emphasis on language in multi-lingual classrooms • Understanding different learning styles, preferences and motivations. • Understanding different explanations of how learners learn at different ages, and potential causes of success or 	<p>Learners should demonstrate the ability to integrate or connect performances and decision making with understanding and with ability to adapt to change an unforeseen circumstances and explain reasons behind actions taken</p> <ul style="list-style-type: none"> • Reflecting on the extent to which the objectives of the learning experience have been achieved and deciding on adaptations where required. • Defending the choice of learning mediating undertaken and arguing why other learning mediation possibilities were rejected. • Analysing the learning that occurs in

<p>disabilities, including sign language where appropriate.</p> <ul style="list-style-type: none"> • Preparing thoroughly and thoughtfully for teaching by drawing on a variety of resources; the knowledge, skills and process of relevant learning areas; learners' existing knowledge skills and experience. • Using key teaching strategies such as higher level questioning, problem-based tasks and projects; and appropriate use of group-work, whole class teaching and individual self-study. • Adjusting teaching strategies to: match the developmental stages of learners; meet the knowledge requirements of the particular learning area; cater for cultural, gender, ethnic, language and other differences among learners. 	<p>failure in these learning processes.</p> <ul style="list-style-type: none"> • Understanding the pedagogics content knowledge – the concepts, methods and disciplinary rules – of the particular learning area being taught • Understanding the learning assumptions that underpin key teaching strategies and that inform the use of media to support teaching. • Understanding the nature of barriers to learning and the principles underlying different strategies that can be used to address them. • Understanding sociological, philosophical, psychological, historical, political and economic explanations of key concepts in education with particular reference to education in a diverse and developing country like South Africa. • Exploring, understanding, explaining, 	<p>observed classroom interactions and in case studies.</p> <ul style="list-style-type: none"> • Making judgments on the effect that language has on learning in various situations and how to make necessary adaptations. • Assessing the effects of existing practices of discipline and conflict management on learning • Reflecting on how teaching in different contexts in South Africa affects teaching strategies and proposing adaptations. • Reflecting on the value of various learning experiences within an African and developing world context. • Reflecting on how race, class, grade, language, geographical and other differences impact on learning, and making appropriate adaptations to teaching strategies.
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<ul style="list-style-type: none"> • Adjusting teaching strategies to cater for different learning styles and preferences and to mainstream learners with barriers to learning. • Creating a learning environment in which: critical and creative thinking is encouraged; learners challenge stereotypes about language, race, gender, ethnicity, geographic location and culture. • Using media and everyday resources appropriately in teaching including judicious use of: common teaching resources like text-books, chalkboards, and charts; other useful media like overhead projectors, computers, video and audio (etc); and popular media and resources, like newspapers and magazines as well as other artifacts from everyday life. 	<p>utilizing and utilizing knowledge, skills and values underpinning ETD practices.</p>	<ul style="list-style-type: none"> • Critically reflecting on the ways barriers to learning can be overcome. • Critically reflecting on the degree to which issues around HIV/AIDS have been integrated into learning. • Analysing the strengths and weakness of the ways in which environmental, human rights and other cross-field issues have been addressed.
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Interpreter and designer of learning programmes and materials		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Interpreting and adapting learning programmes so that they are appropriate for the context in which teaching will occur. • Designing original learning programmes so that they meet the desired outcomes and are appropriate for the context in which they occur. • Adapting and/or selecting learning resources that are appropriate for the age, language competences, culture and 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding the principles of curriculum, how decisions are made; who makes the decisions on what basis and in whose interests they are made. • Understanding various approaches to curriculum and programme design, and their relationship to particular kinds of learning required by the discipline; age, race, culture and gender of the learners. • Understanding the learning area to be taught, including appropriate content knowledge, pedagogic content knowledge, and how to integrate this 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision-making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Reflecting on changing circumstances and conditions and adapting existing programmes and materials accordingly. • Critically evaluating different programmes in real contexts and/or through case studies both in terms of their educational validity as well as their socio-political significance.

<p>gender of learning groups or learners.</p> <ul style="list-style-type: none"> • Designing original learning resources including charts, models, worksheets and more sustained learning texts. These resources should be appropriate for subject; appropriate to the age, language competence, gender, and culture of learning groups or learners. • Designing original learning resources including charts, models, worksheets and more sustained learning texts. These resources should be appropriate for subject; appropriate to the age, language competence, gender, and culture of learners; cognizant of barriers to learning. • Writing clearly and convincingly in the language of instruction. • Using a common word processing programme for developing basic materials. • Evaluating and adapting learning 	<p>knowledge with other subjects.</p> <ul style="list-style-type: none"> • Knowing about sound practice in curriculum, learning programmes and learning and learning materials design including: how learners learn from texts and resources; how language and cultural differences impact on learning. • Understanding common barriers to learning and how materials can be used to construct more flexible and individualized learning environments. 	
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programmes and resources through the use of learner assessment and feedback.		
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Leader, administrator and manager		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Managing classroom teaching of various kinds (individualized, small group etc.) in different educational contexts and particularly with large and diverse groups. • Constructing a classroom atmosphere which is democratic but disciplined, and which is sensitive to culture, race and gender differences as well as to disabilities. 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding various approaches to problem-solving, conflict resolution and group dynamics within a South African and developing world context characterised by diversity. • Understanding various approaches to the organisation of integrated teaching programmes and team teaching. • Understanding various approaches to the management of classrooms, with particular emphasis on large, under-resources and diverse classrooms. 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Reflecting on strategies to assist educators working on integrated teaching programmes and in team teaching. • Critically examining a variety of management options, making choices based on existing and potential conditions, and defending these choices. • Adapting systems, procedures and conditions according to circumstances

<ul style="list-style-type: none"> • Resolving conflict situations within classrooms in an ethical sensitive manner. • Promoting the values and principles of the constitution particularly those related to human rights and the environment. • Maintaining efficient financial controls. • Working with other practitioners in team-teaching and participative decision making. • Accessing and working in partnership with professional services and other resources in order to provide support for learners. • Respecting the role of parents and the community and assisting in building structures to facilitate this. 	<ul style="list-style-type: none"> • Having a knowledge of available professional and community support services and strategies for using their expertise. • Understanding current legislation on the management of learners and schools • Having a knowledge of educators' unions, the South African Council for Educators and other relevant professional bodies. • Understanding constitutional commitments to human rights and the environment. 	
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Scholar, researcher and lifelong learner		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Being numerically, technologically and media literate. • Reading academic and professional texts critically • Writing the language of learning clearly and accurately. • Applying research meaningfully to educational problems. • Demonstrating an interest in, appreciation and understanding of current affairs, various kinds of arts, culture and 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding current thinking about technological, numerical and media literacy's with particular reference to educators in a diverse and developing country like South Africa. • Understanding the reasons and uses for, and various approaches to, educational research. • Understanding how to access and use common information sources like libraries, community resource centers, and computer information systems like the internet. 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Reflecting on critical responses to, literature, arts and culture as well as social, political and economic issues. • Reflecting on knowledge and experience of environmental and human rights issues and adapting own practices.

<p>socio-political events.</p> <ul style="list-style-type: none">• Upholding the principles of academic integrity and the pursuit of excellence in the field of education.	<ul style="list-style-type: none">• Understanding and using effective study methods.	
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Assessor		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Making appropriate use of different assessment practices, with a particular emphasis on competence-based assessment and the formative use of assessment, in particular continuous and diagnostic forms of assessment. • Assessing in a manner appropriate to the phase/subject/learning area. • Providing feedback to learners in sensitive and educationally helpful ways. • Judging learners' competence and 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding the assumptions that underlie a range of assessment approaches and their particular strengths and weaknesses in relation to the age of the learner and learning area being assessed. • Understanding the different learning principles underpinning the structuring of different tasks. • Understanding a range of assessment approaches and methods appropriate to the learning area/subject/discipline/phase. 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision-making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Justifying assessment design decisions and choices about assessment tasks and approaches. • Reflecting on appropriateness of assessment decisions made in particular learning situations and adjusting the assessment tasks and approaches where necessary. • Interpreting and using assessment results to feed into process for the improvement

<p>performance in ways that are fair, valid and reliable.</p> <ul style="list-style-type: none"> • Maintaining efficient recording and reporting of academic progress 	<ul style="list-style-type: none"> • Understanding language terminology and content to be used in the assessment task and the degree to which this is gender and culturally sensitive. • Understanding descriptive and diagnostic reporting within a context of high illiteracy rates among parents. 	<p>of learning programmes.</p>
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Learning area/subject/discipline/phase specialist		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Adapting general educational principles to the phase/subject/learning area. • Selecting sequencing and pacing content in a manner appropriate to the phase/subject/learning area; the needs of the learners and the context. • Selecting methodologies appropriate to learners and contexts. 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding the assumption underlying the descriptions of competence in a particular discipline/subject/learning area. • Understanding the ways of thinking and doing involved in a particular discipline/subject/learning area. • Knowing and understanding the content knowledge of the discipline/subject/learning area • Knowing and understanding the content and skills prescribed by the national 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt, to change unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Reflecting on and assessing own practice • Analysing lesson plans, learning programmes and assessment tasks and demonstrating an understanding of appropriate selection, sequencing and pacing of content. • Identifying and critically evaluating what counts as undisputed knowledge, necessary skills, important values

<ul style="list-style-type: none"> • Integrating subjects into learning areas into learning programmes. • Teaching concepts in a manner which allows learners to transfer this knowledge and use it in different contexts. 	<p>curriculum</p> <ul style="list-style-type: none"> • Understanding the role that a particular discipline/subject/learning area plays in the work and life of citizens in South African society – particularly with regards to human rights and the environment. 	<ul style="list-style-type: none"> • Making educational judgments on educational issues arising from real practice or from authentic case study exercises. • Researching real educational problems and demonstrating an understanding of the implications of this research. • Reflecting on the relations between subject/disciplines and making judgements on the possibilities of integrating them
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Community, citizenship and pastoral role		
<p>Practical Competencies</p> <p>Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action</p> <ul style="list-style-type: none"> • Developing life-skills a critical, ethical and committed political attitude, and a healthy lifestyle in learners. • Providing guidance to learners about work and study possibilities. • Showing an appreciation of and respect for, people with different values, beliefs, practices and cultures. • Being able to respond to current social and educational problems with particular 	<p>Foundation Competencies</p> <p>Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken</p> <ul style="list-style-type: none"> • Understanding various approaches to education for citizenship with particular reference to South Africa as a diverse, developing, constitutional democracy. • Understanding key community problems with particular emphasis on issues of poverty, health, environment and political democracy. • Knowing about the principles and practices of the main religions of South Africa, the customs, values and beliefs of the main cultures of SA, the Constitution 	<p>Reflexive Competencies</p> <p>Where the learner demonstrates the ability to integrate or connect performances and decision-making with understanding and with the ability to adapt to or change unforeseen circumstances and explain the reasons behind these actions</p> <ul style="list-style-type: none"> • Recognising and judging appropriate intervention strategies to cope with learning and other difficulties. • Reflecting on systems of ongoing professional development for existing and new educators. • Adapting school extra curriculum programmes in response to need, comments and criticism.

<p>emphasis on the issues of violence, drug abuse, poverty, child and women abuse,</p> <ul style="list-style-type: none"> • HIV/AIDS and environmental degrading. Accessing and working in partnership with professional services to deal with these issues. • Counseling and/or tutoring learners in need of assistance with social or learning problems. • Demonstrating caring, committed and ethical professional behaviour and an understanding of education as dealing with the protection of children and the development of the whole person. • Conceptualising and planning a school extra-mural programme including sport, artistic and cultural activities. • Operating as a mentor through providing a mentoring support system to student educators and colleagues. 	<p>and the Bill of Rights.</p> <ul style="list-style-type: none"> • Understanding the possibilities for life skill and work-skill education and training in local communities, organisations and business. • Knowing about ethical debates in religion, politics, economics, human rights and the environment. • Understanding child and adolescent development and theories of learning and behaviour with emphasis on their applicability in a diverse and developing country like South Africa. • Understanding the impact of class, race and the impact of abuse at individual, familial, and communal levels. • Understanding common barriers to learning and the kinds of school structures and processes that help to overcome these barriers. • Knowing about available support 	<ul style="list-style-type: none"> • Reflecting on ethical ways of developing and maintaining environmentally responsible approaches to the community and local development. • Adapting learning programmes and other activities to promote an awareness of citizenship, human rights and the principles and values of the constitution. • Critically analysing the degree to which the school curriculum promotes HIV/AIDS awareness. • Critically analysing the degree to which the school curriculum addresses barriers to learning environmental and human rights issues.
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	<p>services and how they may be utilized.</p> <ul style="list-style-type: none">• Knowing about the kinds of impact school extra-mural activities can have on learning and the development of children and how these may best be developed in co-operation with local communities and business.	
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Source: Department of Education (2000b:15)

These seven roles and their associated applied competencies mentioned above allow higher education institutions, through the Standard Generating Body (SGB) for educators to develop qualifications and programmes that are designed for specific purposes and contents. The roles and applied competences promote national standards, to recognise and evaluate teacher qualifications for employment in education (Department of Education, 2000b:13).

3.4 THE INFLUENCE OF THE PURPOSE OF EDUCATION ON CURRICULUM DEVELOPMENT

The purpose or purposes of education influences curriculum development. That is, curricula are developed and designed for both general and specific intents. Statements of intent appear in different forms and terms such as goals, outcomes, aims, ends, objectives, purposes and functions, and are often used interchangeably (Ornstein & Hunkins, 1998:268; Oliva, 1997:164). Oliva (1997:164) asserts that although these terms may be used synonymously in common language, it is helpful to make distinctions in academic language. Ornstein and Hunkins (1998:268) emphasised that education is enacted for a reason. The reason may be emergent and random, nevertheless, it is an intentional activity created to allow learners to attain certain understandings, skills or attitude. Since education is an intentional activity, it is imperative to be clear as to its purpose. Curriculum developers and educators must be conscious of purpose. Ornstein and Hunkins (1998:269) and Finch and Crunkilton (1989:173) assert that the purpose of curriculum is influenced and reflects the philosophy of the community. Posner (1992:76) contends that the purpose of education describes expected life outcomes based on some values either consciously or unconsciously chosen. Ornstein and Hunkins (1998:269) asserts that internationality of education is usually expressed at several different levels. The most general level is reflected in statements of aims, and the most specific is exhibited in statements of objectives. Ornstein and Hunkins (1998) asserts that while the detail of these statements of intent is influenced by educators' philosophical positions, all such statements serve to guide

the development, implementation, and evaluation of the educational curriculum. This section will discuss some of terms used for internationality of education expressed at different levels. It is important to note that the main distinctions of these terms are the levels at which they are stated (Ornstein & Hunkins, 1998:269). Posner (1992:75) contends that there is no consensus on the meaning of these terms (aims, goals, objective and outcome). However, academically, distinctions should be made between different sorts of purposes that have an educational significance.

3.4.1 Aim of education and curriculum

According to Oliva (1997:164), the aims of education are the very broad, general statements of the purposes of education. Aims are meant to give general direction to education throughout the country. Pratt (1980:139) asserts that aims refer to a statement of the general change to be brought about in a learner. Ornstein and Hunkins (1998:269) contend that aims are starting points that suggest an ideal or inspirational vision. Aims reflect value judgments and value-laden statements, and they furnish educators with guides for the educational process. Because of their global quality, only a few are necessary to guide education. According to Oliva (1997:165) the following statements of purposes represent aims of education:

- to inculcate family values;
- to prepare youth to fit into a planned society;
- to promote free enterprise;
- to prepare an enlightened citizenry; and
- to correct social ills.

According to Ndlovu (1997:33), the basic questions that relate to curriculum and aims of education are:

- * What kind of education would best ensure every person's attainment of effective and responsible membership in a democratic society?

- * What kind of education would prepare each person for any situation they may encounter in life?

Ndlovu (1997) asserts that the aim of general education is to find the most appropriate common curriculum aims of honouring individuality while serving the democratic purposes of society. Another example for aims of education by Ralph Tyler as quoted by Ornstein and Hunkins (1998) is:

- developing self-realisation;
- making individuals literate;
- encouraging social mobility;
- providing the skills and understanding necessary for productive employment;
- furnishing tools required requisite for making effective choices regarding material and non-material things and services; and
- furnishing the tools necessary for lifelong learning (Ornstein & Hunkins, 1998:269).

3.4.1.1 Sources of curriculum aims

According to Kruger (1980:57), the primary source of curriculum aims is the totality of human culture. This source comprises the life world and the world of experience of man as well as the acts, thoughts and feelings which a community values. These cultural aspects must be taught by means of systematised cultural content, but must be expressed meaningfully as curriculum aims. Ornstein and Hunkins (1998:270) assert that prestigious, nationwide commissions and task forces in the context of the overriding concerns and problems of a changing society usually develop these aims. Fraser et al. (1993:119) assert that the point of departure for the identification of aims is usually situation or needs analysis. Many aims arise out of the alteration, adjustment and replacement of existing aims following a critical observation and evaluation of the current curriculum. Oliva (1997:166) contends that the aims of curriculum which fulfil the aims of education are derived from examining the needs of children and youth in the country and studying the various needs of society. technology for example, has become a 'need' for

South African high school youth, if we value the dependency on technology by the society. Fraser et al. (1993:119) point out that the needs of society and possible directions in which society may develop usually indicate a range of viable aims for educational institutions. Needs analysis is discussed in depth, in the next sections of this chapter. Furthermore, it may also be stated that the rapid extension of knowledge, such as technology and entrepreneurship are sources for curriculum aims. Aims and the ability to realize them will have to keep up with such developments. The need for complex hi-tech skills and the new demands made will have to be satisfied by means of justified aims (Fraser et al., 1993:119).

3.4.2 Goals of education

Curriculum goals are defined as general, programmatic expectations without criteria of achievement or mastery (Oliva, 1997:164). According to Ornstein and Hunkins (1998:272) goals are statements of purpose with some outcomes in mind. Sowell (2000:200) perceives goals as operational subsets of an aim that provide answers to the following question: *What destination do you have in mind for learners as far as particular curriculum or subject is concerned?* Because goals represent destination, goals are less broadly stated than aims and provide indicators of curriculum scope. According to Finch and Crunkilton (1989:175), the purpose of goals is to give direction and provide a basis for the development of more detailed objectives. Ornstein and Hunkins (1998:272) contend that curriculum goals address the desired outcomes for learners as a result of experiencing the curriculum. Goals, in contrast to aims, are not open statements. They are derived from various aims and thus provide educators with broad statements of what they should accomplish in terms of a learner learning a particular subject or educational program. Goals can be written at several levels of generality. The distinction between aims and goals of education is one of generality. Aims deal with the general process of education, such as creating technological literacy (Ornstein & Hunkins, 1998:273). According to Ornstein and Hunkins (1998), aims become goals when they are more specific and refer to a particular school system and to a specific subject area of the curriculum. Examples of major goals identified by the Association for Supervision and Curriculum Development are:

- * learning self conceptualisation (self-esteem);
- * understanding others;
- * developing basic skills;
- * encouraging interest in and capability for life-long learning;
- * becoming responsible members of society;
- * developing mental and physical health;
- * enhancing creativity;
- * participating in the economic world of production and consumption;
- * using accumulated knowledge to understand the world; and
- * coping with change (Ornstein & Hunkins, 1998:274).

According to Eisner (1985:137), statements of goals are more specific than aims, but insufficiently specific. For example, each of the above statement of goals contains several sub-goals. Sowell (2000:201) asserts that depending on their generality, goals may be achievable within a semester. Having deduced goals from aims, one can then deduce learning objectives (Eisner, 1985:137).

3.4.3 Learning objectives

Within the context of aims and goals of education, it is imperative to formulate learning objectives that will indicate in more specific terms the outcomes of the curriculum. Table 3.6 provides an overview of important information about the levels of the purpose of the curriculum.

TABLE 3.6
OVERVIEW OF LEVELS OF PURPOSE OF CURRICULUM

Purpose	Question Answered	Function	Measurability	Degree of generality
Aim	Why is this curriculum being taught?	Gives shape and direction to curriculum	None	Very general
Goal	What destination do you have in mind?	Provide scope for curriculum	Some	General
Objectives	What specific destination do you have in mind?	Provides direction for instruction	Much	Less general

Source: Sowell (2000:201)

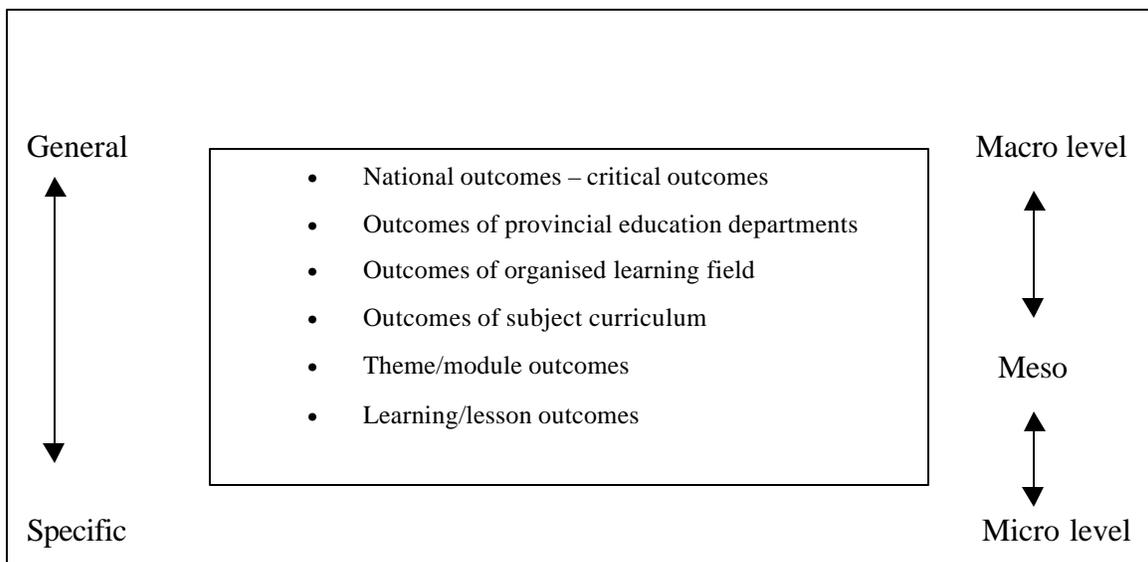
Objectives are more time-bound than goals and, due to their specificity, enable evaluation of a curriculum. Regardless of their learning domain, objectives reveal levels of learning by their wording (Sowell, 2000:201). Ornstein and Hunkins (1998:274) assert that historically, objectives have been stated vaguely; they are often confused with goals and aims. To keep aims, goals and objectives clearly separated, it is important to remember that in translating aims into goals and finally into learning objectives we proceed from the very general in a long-term framework, to the more specific, in a short-term time sequence (Ornstein & Hunkins, 1998:274). The sequence is illustrated as follows:

Philosophy —————> **Aims** —————> **Goals** —————> **Objectives**

That means the aims of education will be influenced by what one believes about valuable knowledge, or what knowledge is worth learning. The aims will further influence the goals to be achieved at a specific time. Goals will affect the learning objectives to be met at more micro level.

Fraser et al. (1993:114) assert that there is no absolute independence or clear line dividing the levels of purpose, that is aims, goals and objectives. Fraser et al. contend that all these purposes or outcomes lie on a continuum, the more concrete the outcome, the more it represents the learning objective. Figure 3.6 is a schematic representation of the levels of specificity of curriculum.

FIGURE 3.6
THE CONTINUUM OF CURRICULUM OUTCOMES



Source: Fraser et al. (1993:114)

According to Posner (1992:80), learning objectives are the intended educational consequences of particular courses or units of study. They may vary in specificity from objectives of single lessons (i.e. lesson objectives), to objectives of an entire course, (i.e. course objectives). The psychologists categorise learning outcomes as cognitive, affective and psychomotor to reflect the way one conceptualizes learning.

3.4.3.1 Taxonomies of learning outcomes

'The Taxonomy of Educational Objectives' was edited by the psychologist, Benjamin Bloom and published in 1956 (Posner, 1992:82). The word taxonomy means a scientifically based classification scheme. The taxonomies of educational objectives are based on the fact that learning outcomes can readily be classified into particular categories (Fraser et al., 1993:114). Posner (1992:82) contended that Bloom's taxonomies proposed three "domains" of learning, but provided details on one of them only. Among the three domains, cognitive, affective and psychomotor, Bloom and his colleagues detailed the cognitive domain which they thought was more relevant at that period. However, the other two domains were later developed.

(a) Cognitive domain

Learning in the cognitive domain relates to the functionalisation of knowledge and skills acquired (Fraser et al., 1993:115). According to Posner (1992:82), the cognitive domain deals with the recall or recognition of knowledge and the development of intellectual abilities and skills. In this domain, learning outcomes are divided into the following six major divisions:

- Knowledge: to remember and recall information in more or less the same form in which it was initially presented.
- Comprehension: to use an idea without necessarily relating it to other ideas or without understanding all of its implications.

- Application to select and use a concept in a new situation. Information used in the application includes general ideas, rules, methods, principles or theories that must be applied.
- Analysis: to divide information into its components so that the relationship between the parts is apparent.
- Synthesis: to combine elements to form a unique structure or system.
- Evaluation: to make value judgments about certain aspects (Fraser et al., 1993:115).

These divisions are rated in such a way that application of learning content must be preceded by knowledge and comprehension thereof. Corresponding and appropriate learning content, learner behavior and test items can be classified for each division.

(b) Affective domain

Krathwohl, (1965:88) and his colleagues presented a taxonomy of learning outcomes, consisting of five major divisions in the affective domain to the educational community. This domain has to do with attitudes, interests and appreciation. The divisions in the affective domain include receiving, responding, valuing, organisation and characterisation and are arranged in a sequence similar to the cognitive domain (Ornstein & Hunkins, 1998:280; Fraser et a, 1993:117). Below is a brief listing of major divisions n the cognitive domain stated in terms of increasing levels:

1. Receiving or attending this level refers to the learner's sensitivity to the existence of something (stimuli). This includes awareness, willingness to receive and selected attention.
2. Responding: this level refers to the learner's motivation to learn. For example, the learner displays an interest in the topic of conversation by actively participating in a research project.

3. Valuing: this level refers to the learner expressing a value orientation. For example, the learner's commitment to improving people's socio-economic circumstances by taking part in a project to establish vegetable gardens in an impoverished area.
4. Organising: learning outcomes at this level refer to internalization of values and beliefs involving conceptualisation of values and organisation of a value system. For example, a learner may develop a value system concerning personal relations with members of another cultural group after willingly having been exposed to them (receiving), responding to them by interacting with them (responding), attaching a value to their interaction and finally valuing their interaction.
5. Characterisation: this is the highest level of internalisation in the taxonomy. At this level a learner's behaviour consistently reflects the values that he or she has organised into some kind of system. For example, learners have formed principles and they are willing to practise what they preach (Orstein & Hunkins, 1998:280-281; Van der Horst & McDonald, 1997:40).

(c) The psychomotor domain

Fraser et al. (1993:116) assert that learning outcomes in the psychomotor domain emphasise certain muscular or motor skills. These include the manipulation of objects and neuromuscular skills and co-ordination. Harrow developed a taxonomy with several divisions for the psychomotor domain:

1. Reflex movements - involuntary movements present at birth or developed during maturation, such as the grasping reflex of a baby;
2. Fundamental movements - this level addresses behaviours related to walking, running, jumping, pushing, pulling, and manipulating;

3. Perceptual abilities – the ability of the brain to receive and transmit messages from sensory stimuli, such as responding to visual, auditory and other sensory stimuli;
4. Physical abilities – the outcome related to this level include endurance, strength, flexibility, reaction-response time, and dexterity. For example, at the end of the lesson the learner will do at least five push-ups;
5. Skilled movements – simple and complex movements that have been learnt, such as using a computer or playing a musical instrument;
6. Non-verbal communication – learning outcomes at this final level of the taxonomy relate to expressive movements through posture, gesture, facial expressions, mime, dance and creative movements. For example, the learner will be able to create his or her own movement sequence and perform it to music (Ornstein & Hunkins, 1998:281; Van der Horst & McDonald, 1997:42-43).

The categories of the three taxonomies are arranged in a hierarchy in which the levels increase in complexity from simple to the more advanced. Each level depends on the acquisition of the previous level. The taxonomies are useful for developing educational outcomes and for grouping sets of learning outcomes.

3.5 NEEDS ASSESSMENT

There are some fundamental questions that need to be asked when developing curriculum. The first question asked is **Who is being taught?** This implies a needs assessment or 'situation analysis' of the persons and institutions to which the curriculum relates. The question of **What is taught?** focuses on the organisation of content in a curriculum. The question of **why particular** learning content is taught seeks clarity regarding the purpose of the curriculum. The question of **What results are achieved?** by teaching implies evaluation of the curriculum (Fraser et al., 1993:93). Section 2.11 answers the question of 'what is taught' and 'who is taught', the question of what is to be taught in a curriculum is

also answered in this section. The question of why learning content is taught was addressed by the previous section 3.3 and the question of what results are achieved by the curriculum will be discussed in the next sections.

According to Pratt (1980:79) the term needs assessment refers to an array of procedures for identifying and validating needs and establishing priorities among them. McNeil (1996:122) asserts that needs assessment is the process by which educational needs are defined and priorities set. In the context of curriculum, a need is defined as a condition in which a discrepancy exists between the present curriculum of a learner and the envisaged or required curriculum. McNeil further asserts that needs assessment is one of the most frequently used ways of justifying curriculum aims and learning outcomes. Needs assessment is used as a tool for formulating desired outcomes. According to Oliva, (1997:222) curriculum needs assessment is a process for identifying programmatic needs that must be addressed by curriculum developers. Oliva describes the process of needs assessment as follows:

- Needs assessment is a process of defining the desired end (outcome, product or result) of a given sequence of curriculum development;
- Needs assessment is a process of specifying in some intelligible manner, what school curriculum should be about and how it can be assessed. Needs assessment is not by itself a curricular innovation, it is a method for determining if innovation is necessary and/or desirable;
- Needs assessment is an empirical process for defining the outcomes of education, and as such a set of criteria by which curricular may be developed and compared;
- Needs assessment is a process for determining the validity of behavioural objectives and ascertaining if standardised tests and/or criterion-referenced tests are appropriate and under what conditions;
- Needs assessment is a logical problem-solving tool by which a variety of means may be selected and which related to each other in the development of a curriculum;

- Needs assessment is a tool which formally harvests the gaps between current results (or outcomes, products) and required or desired results, it places the gaps in priority order, and selects those gaps (needs) of the high priority for action, usually through the implementation of a new or existing curriculum (Oliva, 1997:224).

Oliva (1997:224) contends that the objectives of a needs assessment are twofold:

- To identify needs of the learners not being met by the existing curriculum;
- To form a basis for revising the curriculum in such a way as to fulfill as many unmet needs as possible.

The conduct of a needs assessment is not a single, one-time operation but a continuing and periodic activity. Some curriculum developers perceive a needs assessment as a task to be accomplished at the beginning of an extensive study of the curriculum. Sowell (2000:181) and Carl (1995: 97) agree that needs assessment may be a start for curriculum development unless the revised curriculum has a purpose different from the current curriculum or the curriculum to be designed is brand-new. In either of these cases, curriculum developers must decide on the purpose and select curriculum content before engaging in a needs assessment. A needs assessment in these cases enables developers to determine priorities in the content (Sowell, 2000:181). Sowell and Carl also perceive needs assessment as a method of evaluation comprising of the collection and interpretation of all information, which may influence curriculum development. However, this process must take place on an ongoing basis in order to be able to make ongoing adjustments. The results of a need assessment should serve as a strong guideline for the design of curriculum. Carl (1995:97) asserts that curriculum developers at national level, who are looking at the broad curriculum, will first determine the needs of the country and the broad school population, and accordingly formulate broad outcomes for the phase. The subject teacher will also determine the needs of learners at classroom level and, according to their prior results, design instructional classroom environment. The process of needs assessment is the same

but the nature and extent at various levels (national, district, departmental, school and classroom) lend a different dimension to each other.

As discussed in section 3.2.5.1, Ralph Tyler's rationale is regarded as the best-known rational model for answering questions about formulating educational purposes, selecting and organising learning experiences, and determining the extent to which purposes are being attained. Tyler suggests that the needs assessment should be conducted to the intended learners, contemporary society, and subject specialists. The following outlines the sources of objectives for curriculum.

(a) Learners

Firstly, needs assessment involves a detailed study of the target groups at which the curriculum is directed. The learning activities must link up with the learner's life world. New knowledge, skills and values can be acquired meaningfully only if they relate to the learner's existing field of experience (Fraser et al., 1993:94). Oliva (1997:206) asserts that educational needs of learners shift as society changes due to socio-economic problems. The current school-to work movement, however, is effecting changes in curriculum, teaching and learning. McNeil (1996:129) contends that learners should be studied in terms of their deficiencies in knowledge and application of a broad range of values in daily living. Essentially the process of deriving an objective from studies of the learner demands that an inference be drawn about what to teach after looking at the data.

(b) Contemporary society

Facts about the contemporary society-local, national and international must be known and taken into account if what is to be taught is to be made relevant to the contemporary life. However, the type of facts to be collected must be evaluated. One might collect data on health, economics, politics, religion, family conservation, teaching, literacy, career matters, technological education and peace, if such data is relevant to a curriculum being developed

(McNeil, 1996:129; Carl, 1995:100). Fraser et al. (1993:97) assert that contemporary society is dynamic and is characterised, inter alia, by rapid social, political and technological change. Society expects the curriculum to keep abreast with latest developments and future trends, especially as they manifest in technology. Fraser et al. (1993:98) contend that technology is currently part of society's life to such an extent that society can be labelled as technocratic. Examples of some of the manifestations of technology, which have implications for the curriculum, are the following (Van Rooy, 1992:231):

- Industries require an increasing number of skilled and sophisticated workers amidst a shortage of skilled manpower.
- Education for the masses is becoming increasingly important and the quality of education must improve.
- The focus of communication is more on generating and transmitting information and conveying practical knowledge.
- Tailor-made narrow vocations become redundant and new problem-based vocations are generated, which necessitates more training, retraining and further training.
- Increased wealth leads to urbanization and materialism, which changes in lifestyles and values system.

(c) Subject specialists

According to McNeil (1996:130), in technical- rational curriculum development where subject contents still dominate curriculum, scientists, scholars, and the discoverers of disciplined knowledge are consulted in order to determine their contribution to the education of the intended learners. An important feature of contemporary subject content is the rapid rate at which knowledge increases. New branches of subject sciences come to the fore constantly and this leads to new approaches to subject content, which in turn requires continuous revision of curriculum content (Fraser et al., 1993:97). Oliva (1997:218) regards subject content as a major source of curriculum, as it relates to the

'structure of a subject' which he refers to as the 'basic ideas' or fundamental principles. According to Oliva, grasping the structure of a subject is to learn how things are related. He gave examples with biology, communication, mathematics and languages where their content is defined in terms of certain essential areas or topics (the bases for determining the scope of a course). If a learner is to achieve mastery of the subject, he or she must be taught at certain times and in a certain prescribed order (sequence).

There are different methods, which may be used to collect data from the three sources discussed. These methods include questionnaires, conducting interviews, observation, think-tanks, Delphi techniques, the DACUM approach and available research results (Carl, 1995:100; Finch et al., 1989:135-139). It is not within the scope of this chapter to discuss each of these methods of data collection.

Evaluation is one of the important conceptions and processes of curriculum development. There are various views regarding the purposes and implementation of evaluation. These views are equal to the number of different perspectives and approaches to curriculum development. Educators interested in evaluation as a way of understanding their learners' inadequacies as well as value judging the curriculum, stated that national standardised tests are inadequate for diagnosing and motivating learners (McNeil, 1996:263). The next section will deal with some of the important issues of curriculum evaluation.

3.6 CURRICULUM EVALUATION

The task of developing a curriculum is not complete until evaluation is done. The developer's work reaches fruition only when the curriculum makes an impact on the learners. Excellent curricula have failed because developers only terminated their work at production rather than implementing the program (Pratt, 1980:409). Sowell (2000:258) agrees that evaluation of curriculum begins whenever revised curriculum are completed and put to use in classrooms. Sowell asserts that curriculum evaluation refers to the formal determination of the quality, effectiveness or value of curriculum. Curriculum evaluation answers the question of how well that curriculum enables learners to meet the intended

purpose of education. Fraser and Crunkilton (1993:189) perceive evaluation as having a strong relationship with teaching, most evaluation efforts are directed at improving teaching and monitoring the outcome of teaching practice. According to Marsh and Willis (1999:266), current conceptions of curriculum development assume that evaluation is ongoing during the entire process of developing and implementing a curriculum and that it may lead directly to a further cycle of improvement.

Evaluation involves an assessment based on values, norms and criteria (Fraser et al., 1993:189). Marsh and Willis, (1999:267) and Van der Horst and McDonald (1997:169) assert that the term evaluation and assessment are often used synonymously in education, yet there are differences in implication. Marsh and Willis (1999:267) contend that the process of evaluation, whether formal or informal, is philosophical, that is, it is an attempt to weigh and appropriately value something. They point out that evaluations can be made in terms of merit and worth. Merit refers to how well something is done. It has to do with the skillfulness of carrying out the activity. Worth refers to the importance of doing something. This applies to the intrinsic value of the object (curriculum) or activity. It is possible for something to have more merit than worth, and vice versa. Curriculum too, can be evaluated in terms of merit and worth. In contrast to the broad philosophic process of evaluation, the term assessment refers to more narrow and technical process of determining how much a learner has learned (Marsh & Willis, 1999:267). Therefore, measurement of student learning-usually through formal, paper-and-pencil testing is often seen as a component of assessment. According to Van der Horst and McDonald (1997:170) assessment is a strategy for measuring knowledge, behaviour or performance, values or attitudes. Assessment is a data-gathering strategy. The measurement or data gained from assessment helps with the evaluation process. Therefore, there is no clear-cut distinction between the two terms; they complement each other. A complete evaluation therefore includes assessment. This implies that if the process is continuous, evaluation is assessment and if it is done at end of the activity it is evaluation. Ornstein and Hunkins (1998:320) assert that the demand to ensure quality education is higher than in the past. These demands are connected with a new realisation of the importance of education and the

expectation of making schools accountable. To meet such demands, educators are required to conceive and carry out an effective evaluation and reporting process. It requires educators to possess an in-depth understanding of the nature and purpose of evaluation.

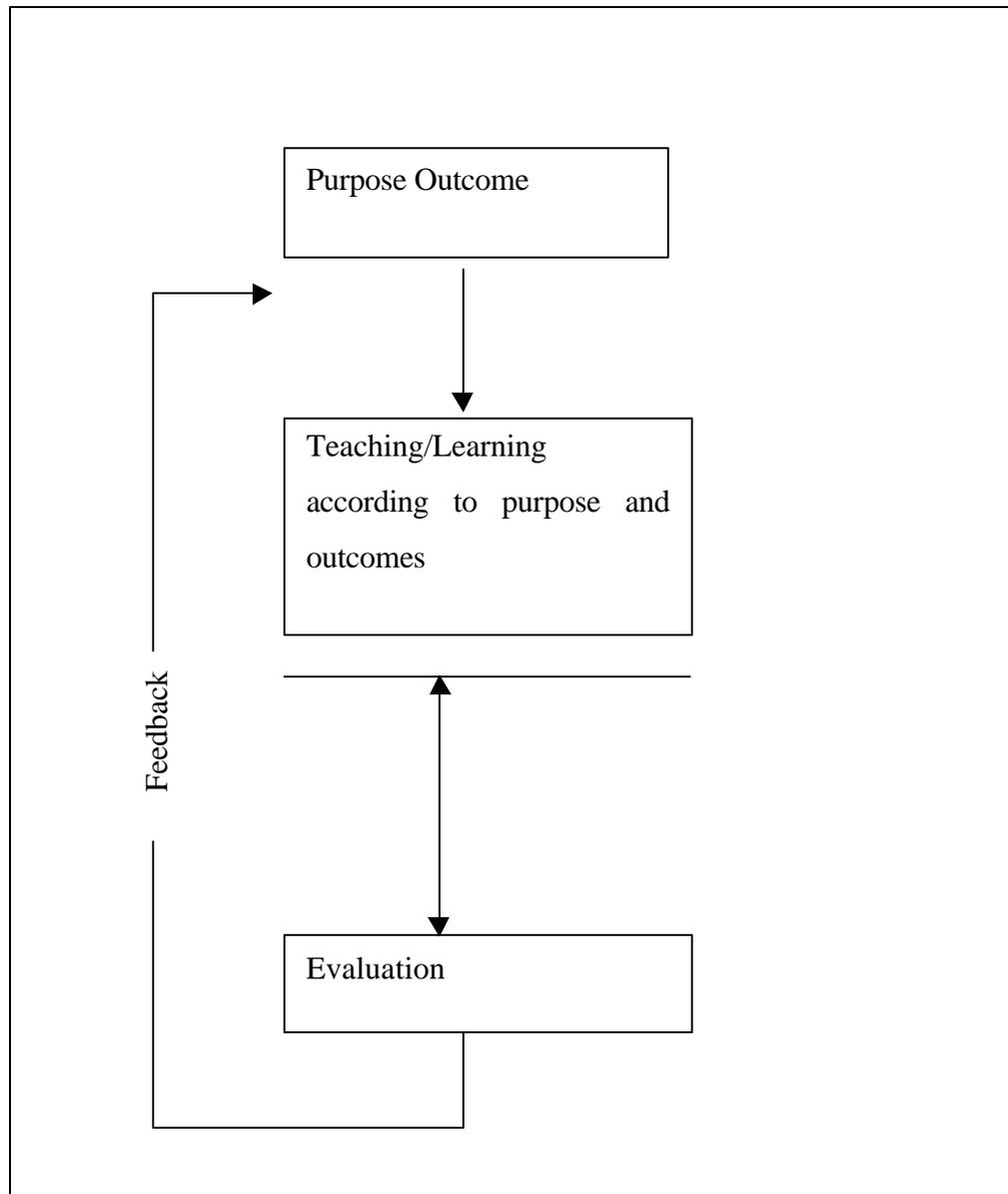
3.6.1 The nature and purpose of evaluation

Sowell (2000:258) contends that evaluation of a curriculum takes place in the same context as needs assessment (See section 3.4). Outcomes of curriculum evaluation are compared with outcomes of needs assessment to determine how well needs were met. Fraser et al. (1993:194) indicate the relationship between evaluations and needs assessment as the following:

- It is essential that the needs of learners are taken into account when learning outcomes are determined so that the purpose of curriculum is worthwhile;
- Efficient planning of learning outcomes is essential for effective assessment and evaluation of learning events;
- Long-term educational outcomes provide the framework for learning activities and the evaluation thereof;
- Teaching and learning outcomes are important for the planning and evaluation of cognitive, psychomotor aspects and affective moulding;
- Cognitive learning, psychomotor aspects and affective moulding relate to each other. Therefore, teaching and learning outcomes should include all three domains of learning;

The relationship between evaluation and educational purpose is illustrated in figure 3.7.

FIGURE 3.7
RELATIONSHIP BETWEEN PURPOSE AND EVALUATION



Source: Fraser et al. (1993:194)

In evaluation, educators are concerned with determining the relative values of whatever they are judging. They are obtaining information during assessment that they can use to

make statements of worth. Curriculum evaluation focuses on discovering whether the educational purpose and learning outcomes are met.

Curriculum evaluation focuses on discovering whether the curriculum as designed, developed, and implemented is producing or can produce the desired results. Evaluation serves to identify the strengths and weaknesses of the curriculum before implementation as well as after implementation for the effectiveness of its delivery (Orstein & Hunkins, 1998:320). The nature and purpose of evaluation today, is highly influenced by Tyler's approach which is dominated by outcomes. Educational outcomes are identified and clearly stated and serve as criteria for evaluation (Schubert, 1986:271). Schubert (1986: 271) cites Tyler who defines evaluation as follows:

The process of evaluation is essentially the process of determining to what extent the educational objectives are actually being realized by the program of curriculum and instruction.

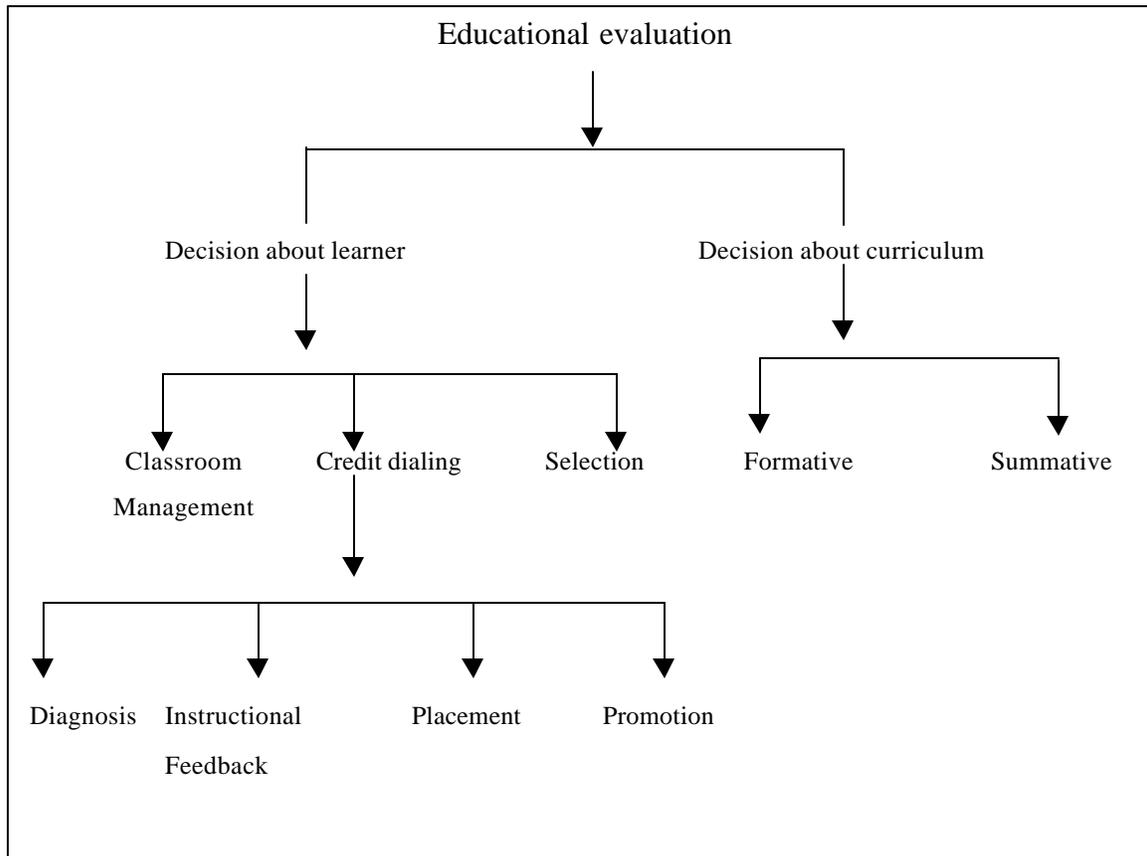
Posner (1992:231) contends that the purpose of conducting evaluation in a curriculum is to provide information for making decisions about the learner or the curriculum. Posner identifies six purposes for providing information about the learner: diagnosis, instructional feedback, placement, promotion, credentialing and selection. The diagnostic decisions require information about strengths and weaknesses and determination of areas that need special instructional attention. Diagnostic methods include

- Observations of learners performance;
- Attitude, interest and behavioural scales; and
- Standardised achievement and aptitude tests scores.

Instructional feedback decisions refer to adjustments learners need to make to the approach of learning a subject based on their knowledge of the progress they are making. Questions and teacher tests assist learners to adjust their approach. To make placement

decisions, information about the level of proficiency of learners in particular skills is required, so that groups are relatively homogeneous. Grouping can occur similarly, decisions about promotions or its opposite retention are based on information about the proficiency and maturity of learners' information necessary in order to decide whether or not to promote to the next grade level. Credentialing decisions have to do with certification, licensure and otherwise attesting to the competence of a graduate. This requires that an internal quality assurance body, or professional body such as south African Council of Educators (SACE) in teacher education evaluate the learner. Selection decisions, such as those made by technikons and universities when admitting learners, typically use existing data about learner achievement like grades, national standardized examination results such as Grade 12 or Matric results (Posner, 1992:231). Figure 3.8 illustrates the purpose of evaluation.

FIGURE 3.8
PURPOSE OF EVALUATION



Source: Posner (1992:232)

With regard to decisions about the worth of a curriculum, Posner (1992:232) points out that it is important to check for the meaning of a curriculum. If 'curriculum' refers to a document such as content outline, scope and sequence, or syllabus, then curriculum evaluation might mean a judgment regarding the value or worth of such a document. *Is the document complete, internally consistent, and well written? Does the document represent a curriculum that has sufficient depth and breadth and is well organised, rigorous and up to date?* These are some of questions education specialists and curriculum workers ask

when evaluating a curriculum as a document. It is important to first establish the basis upon which the curriculum evaluation is done. The next section outlines further the various methods of curriculum evaluation.

3.6.2 Methods of evaluation

The level at which curriculum development is done will determine what method of evaluation will be utilised. At macro-level the curriculum developer wants to determine how effective the broad curriculum or core syllabus is and for that purpose specific methods of evaluation are used. The micro-level developer (educator) will want to determine the effectiveness of the subject curriculum or lesson curriculum and from that determine specific assessment methods (3.5.1). The subject educators will however want to evaluate the effectiveness of their syllabi and the progress of their learners. Although this is focused on the learner, the evaluation is a component of whole curriculum evaluation (see figure 3.8). The respective methods of evaluation are only briefly discussed. The important aspect is that curriculum developers and educators must be aware of different methods and be able to utilise them in their particular field.

The following different forms of evaluation are found:

(1) Diagnostic and formative versus summative evaluation

When diagnostic assessment is used prior to teaching or at the beginning of a lesson, it provides planning information (Van der Horst & McDonald, 1997:17). This is done under the assumption that learners come into the classroom with varying backgrounds and interests. Therefore, beginning a new lesson curriculum without checking learners' knowledge and understandings may be inappropriate, because some learners may lack prerequisite skills, or their interests may consist of topics other than the ones to be taught (Marsh & Willis, 1999:272). Formative assessment is an ongoing evaluation, which takes place in the course of the instructional learning process (Carl, 1995:121). Marsh and Willis (1999:273) assert that formative evaluation evolves while the lesson is in progress.

Both diagnostic and formative data assist the educators to improve teaching and learning of the learners. Oliva (1998:445) is of the opinion that this may take place in a formal or informal manner.

In contrast, summative evaluation is usually conducted at the end of lesson curriculum, a unit module or a course (Van der Horst & McDonald, 1997:172). Marsh and Willis (1999:273) assert that summative evaluation strives for data that indicate the degree to which learners have reached the final purpose of the curriculum. The curriculum is considered as given, and learners are expected to change in accordance with it. Tables 3.7 and 3.8 list some techniques that can be used to obtain diagnostic, formative, and summative data from learners and teaching practices respectively.

TABLE 3.7
TECHNIQUES USED TO OBTAIN DATA FROM LEARNERS

TECHNIQUES	DIAGNOSTICS	FORMATIVE	SUMMATIVE
Informal observation and recording of learners behaviour	Anecdotal/records; Case histories Check list; Unobtrusive techniques	Anecdotal/records; Case histories Check list; Unobtrusive techniques	Anecdotal/records; Case histories Check lists; Unobtrusive techniques
Informal collecting of information from learners	Questionnaires; Interviews; Self-reports	Anecdotal/records; Case histories Check list; Unobtrusive techniques	Anecdotal/records; Case histories Check list; Unobtrusive techniques
Analysis of examples of learner work	Individual and group projects; content analysis of work books; Logbooks and journals; Portfolios	Anecdotal/records; Case histories Check list; Unobtrusive techniques	Anecdotal/records; Case histories Check list; Unobtrusive techniques
Testing of learners	Objective tests Standardized tests Essay tests Assessment tasks	Anecdotal/records; Case histories Check list; Unobtrusive techniques	Anecdotal/records; Case histories Check list; Unobtrusive techniques

Source: Marsh and Willis (1999: 274)

Education curriculum evaluation may not be complete, depending on the purpose of evaluation, if data from teaching practices are not gathered.

TABLE 3.8
TECHNIQUES USED TO COLLECT DATA FROM TEACHING PRACTICE

TECHNIQUES	DIAGNOSTICS	FORMATIVE	SUMMATIVE
Informal observation and recording of teacher and learner behaviour		Audio taping and Videotaping colleagues Observation Self-assessment	Self-evaluation
Information evaluation by learners	Questionnaires Interviews Group discussions	Questionnaires Post lesson reaction Sheets Interviews Rating scales Group discussions	Questionnaires Interviews Rating Scales Group discussion
Analysis of materials used educators and learners	Observing materials, use sample of learner workbooks Rating of syllabus by educators		Rating syllabus by educators Rating of materials by educators
Formal observing of educators		External rating Peer rating	External rating Peer rating

Source: Marsh and Willis (1999: 276)

(2) Criterion-referenced versus norm-referenced evaluation

Criterion- referenced assessment shows how learners compare to an external standard by specifically defining a level (or criterion) the learner is supposed to reach. The challenge

lies in defining learning in terms of tasks to be mastered. Subjects such as mathematics and electrical engineering are particular amenable to this kind of specificity, but other subjects, such as creative writing and art, are not (Marsh & Willis, 1999: 273). According to Carl (1995: 122) in these methods of assessment the educator emphasises total mastery of performance, and the pass level is very high.

Norm - referenced assessment usually compares similar learners with one another (Marsh & Willis, 1999: 273). Carl (1995: 122) contends that the learners' achievements are compared with the average achievement of the group or class. The educator accepts that his/her class is a representative sample and aims for an average of approximately 50% in order to ensure an even spread.

(3) **Process versus Product**

Process evaluation is most closely associated with classroom teaching. Process evaluation deals directly with the operation of the curriculum (Finch & Crunkilton, 1989: 278). According to Sowell (2000: 258), process evaluation has three purposes:

- To provide information about the extent to which plans for curriculum implementation are executed and resources used;
- To provide assistance for changing or clarifying implementation plans;
- To assess the degree to which educators and change facilitators carry out their roles.

The phrase 'Performance assessment' is associated with **process** and refers to learners' demonstrating their understanding and application of knowledge and skills through a variety of tasks (Marsh & Willis, 1999: 275).

Product evaluation has its main purpose, that is, gathering, interpreting and appraising curricular attainment, not only at the end of an implementation or enactment cycle, but as often as necessary (Sowell, 2000: 259). The main intention of product evaluation is to

determine how well the curriculum meets the needs of the learners it is intended to serve. Orstein & Hunkins (1998:331) contend that product evaluators gather data to determine whether the final curriculum product presently in use is accomplishing what they had hoped. Product evaluation provides evaluators with information that will enable them to decide whether to continue, terminate or modify the new curriculum.

4) Illuminative evaluation

Illuminative evaluation is a form of process evaluation during which change/renewal of a curriculum as a whole is intensively studied (Carl, 1995:122). Orstein and Hunkins (1998:235) agree that illuminative evaluation provides a complete picture of the educational curriculum. Carl (1995:122) asserts that instruments such as observation, interviews, questionnaires and analysis of documents form part of this whole process. According to Orstein and Hunkins (1998:335), illuminative evaluation assumes an artistic perspective, insisting that education is a complex and dynamic set of instruction. Illuminative evaluators try to avoid taking sides on a particular perspective. They wish to accept the validity of both scientific and humanistic approaches to evaluation; they contend there are weaknesses and strengths in both approaches.

3.7 SUMMARY

In this chapter the conceptions of curriculum development was discussed. This involved analysing various educational philosophies and how they influence curriculum theory and curriculum development. The discussions included different approaches and models to curriculum development, the influence of the purpose of education on curriculum development, needs analysis, as well as curriculum evaluation. The discussions are indicative of the strong influence of the technical approach. However, the OBE and Curriculum 2005 approach display the influences of progressivism and reconstruction.

The purpose of the detailed exposition of fundamental curriculum issues was basically to put this study into the context of trends in the area of curriculum development. The

discussions on curriculum models and approaches to curriculum development were done to set a stage for the selection and discussions of the proposed curriculum model and curriculum for technology teacher education and training which is the outcome of this study. The chapter includes the norms and standards that every learner teacher must achieve to enter the teaching profession. The new Norms and Standards should ensure that all new teachers have the subject knowledge and the teaching and learning expertise, and are well prepared for the wider professional demands of being a teacher. The Norms and Standards underpin the curriculum model to be developed in this study.

It is clear from this chapter that any approach to curriculum development is influenced by one or more educational philosophies. Tyler's approach to curriculum development is linear, and curriculum is prescribed, hence it is reflecting philosophies of perennialism and essentialism (table 3.1). However, in developing learning experience Tyler emphasises that learners should be taken into consideration..

Walker's approach to curriculum development stresses the learner rather than outputs of production, especially through activity-oriented approaches to teaching and learning. As a result, this approach is influenced by progressivism and social reconstruction (table 3.1). Tyler assumes that better curricula will result when those involved in it follow linear specific steps, whereas Walker assumes that better curricula will result when those involved in it understand the complexity of the process.

Eisner's approach to curriculum development has been influenced by both progressivism and social reconstruction (table 3.1). To Eisner, curriculum development is the process of transforming images and aspirations about education into programmes that will effectively realise the visions that initiated the process. The initial conditions of curriculum development are seldom clear-cut, specific objectives. They are rather conceptions that are general, visions that are vague and aspirations that are fleeting.

OBE curriculum is mostly influenced by progressivism. The democratic society, emphasis on resolving current challenges' active involvement of learners and learner centeredness are all issues that reflect the two educational philosophies (table 3.1).

The discussions on curriculum models and approaches to curriculum development were done to set a stage for the selection and discussions of the curriculum model for technology teacher education and training which is to be used in this study.

The construction of the conception of curriculum development involved an elucidation of the influence of educational philosophies on curriculum approaches, various models to curriculum development as well as the needs assessment in curriculum development. The chapter concluded with curriculum evaluation and assessment. The purpose of the detailed exposition of fundamental curriculum issues was to put this study into the context of trends in the area of curriculum development.

In the next chapter empirical research design, results and discussions will receive attention. This is done as a needs assessment in technology teacher education curriculum development.

CHAPTER FOUR

EMPIRICAL RESEARCH DESIGN, RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

The previous chapters have given a theoretical background for a technology teacher education curriculum to be developed in this study. A detailed review of some theories on technical and technology education was made in chapter two and chapter three reviewed literature on curriculum development in detail. The previous chapters serve as a foundation for the present chapter which gives an account of the empirical study design and findings. This chapter discusses the manner in which data were obtained and the methods that were used. An analysis of data with the help of tables and graphs that support some arguments is also made in this chapter. The results of the analysis will be tabulated and discussed as well. The conducted investigation is a form of needs analysis which is aimed at identifying knowledge gaps in technology education of educators. This prepares for the development of the technology teacher education curriculum which is proposed in chapter five.

4.2 INSTRUMENTS USED IN THE STUDY

Research instruments are tools that are used to gather data from the field. For this study, the following research instruments were used.

4.2.1 Interviews

The study of technology education at schools is a new study in South Africa, resulting from the implementation of Curriculum 2005 which started in 1997 in the Foundation Phase of the General Education and Training (GET) band. There are other countries that have developed and implemented technology education, for example, in 1992 Botswana developed a national curriculum policy in which Design and technology (Technology) became one of the eight core subjects (Molwane, 2002: 12). In 1990, England introduced Design and technology into schools (Gwyneth Owen-Jackson, 2002:39). It is important to

learn from those who have experience in the field; hence an interview with experts in developed countries was significant.

The researcher visited the Open University at Milton Keynes United Kingdom (UK), and interviewed a few experts in the field of technology education. The interviews conducted were not formal or structured making it possible to obtain more information around the curriculum of technology teacher education. According to Krathwohl (1993: 372) unstructured interviews are useful for exploring issues.

4.2.2 Questionnaire

The nature of the study is such that a variety of data gathering techniques could be used. As a result questionnaires were designed for and administered to educators of technology education and technical subjects at schools. The questionnaires had to be completed on a small scale. Although the questionnaire as a method of data collection and measurement has certain advantages, it is not without disadvantages. Molefe (1997:154) identifies the advantages and disadvantages of the questionnaire:

**TABLE 4.1
ADVANTAGES AND DISADVANTAGES OF THE QUESTIONNAIRE**

ADVANTAGES	DISADVANTAGES
It saves time	Lacks flexibility
It reduces issues to their basic element	Inadequate response
Respondents have more time	No control over the environment
Low costs involved	Subject response

Source: Molefe (1997:154)

Appendix 2 contains the questionnaire designed for educators. The purpose of this questionnaire was to determine the knowledge gap of educators in technology education.

As a result, the content of the questionnaire focused on the following aspects of technology education:

- Attitudes towards technology;
- Rationale for technology education;
- Purpose of technology education;
- Knowledge of technology education;
- Technological process and skills in technology education;
- Pedagogic knowledge.

It must be noted that section A of the questionnaire solicits auxiliary information that forms the basis for interpretation. Furthermore, careful consideration was given to the questionnaire's introduction, format, question sequencing, question content and the cover letter. Special attempt was made to ensure that:

- The wording of the questions were clear.
- Time was not wasted in responding to questions.
- The questionnaire did not appear cluttered.
- The questions were arranged in a logical sequence (Makgato, 1999:116).

Based on the use of triangulation technique, the questionnaire does not take a uniform pattern throughout. It is flexible and combines both the closed-ended and the open-ended structures because both the qualitative and the quantitative research approaches are being followed in this study.

Respondents were mainly required to make their responses by putting a cross (X) on a particular square or rectangle. They were also required to write short sentences in response to the question of the open-ended section.

4.3 THE RESEARCH SAMPLE

A non-probability purposive and convenience sampling was used in this study. A purposive sampling was used for identifying the experts of technology education in Open University, UK for the interview, and a purposive and convenience sampling was used for identifying educators of technology education and technical subjects at schools. In purposive sampling, the researcher identifies respondents who have expertise and an interest in the field under study, while convenience sampling assists the researcher in including respondents who are available, volunteers or people who can be easily recruited and are willing to participate in the research study (Johnson & Christensen, 2000:174-5). Given that technology education is relatively a new subject at South African schools, the above-mentioned sampling techniques are relevant for the purpose of this study.

4.3.1 The sample for the interview

A non-probability purposive sampling strategy was used with the technology education experts at the Open University. Purposive sampling entails approaching participants who are known or judged to be good sources of information and recruiting them for participation. Only a few experts were approached for the interview. The unstructured interviews conducted are as shown in table 4.2 below.

TABLE 4.2
DATE SCHEDULE FOR INTERVIEWS

DESIGNATION OF RESPONDENT	LOCATION	DATE OF INTERVIEW	TIME
Nuffield Design & technology project director	London	08 July 2002	Afternoon
Research fellow in Young Foresight project	The Open University Milton Keynes	09 July 2002	Morning
Engineering council director for D & T at schools	London	15 July 2002	Afternoon
Senior lecturer for student teachers of D & T	Middlesex University	16 July 2002	Afternoon
Lecturer for student teachers of D & T	Sheffield Hallam University	17 July 2002	Afternoon
Deputy dean: Education and Languages	Open University Milton Keynes	18 July 2002	Morning

4.3.2 The sample for the questionnaire respondents

Selection of respondents was based on non-probability purposive and convenience sampling. Educators who are teaching in the Technology Learning Area and technical subjects were identified in seven schools at Soshanguve Township, Gauteng Province. Among the respondents, three were from Technikon Northern Gauteng involved in teaching technology education and technical subjects. The researcher personally delivered the questionnaires to schools, and through the correct channels asked the relevant educators to complete the questionnaires. In a few cases, the researcher collected the questionnaires the following day, some were collected on the same day. The researcher had 100% response.

Three lecturers from Technikon Northern Gauteng and 28 educators from various schools completed 31 questionnaires. In the final analysis the sample size was as shown below.

TABLE 4.3
THE NON-PROBABILITY SAMPLE SIZE

SCHOOL/INSTITUTION	EDUCATORS
A High School	2
B High School	3
C High School	3
D Technical High School	8
E Comprehensive High School	5
F Junior Sec School	4
G Jun. Sec School	3
H Technikon	3
Total	31

4.4 RELIABILITY AND VALIDITY

The description of quality instruments used to collect data typically deals with two measurement –related concepts: reliability and validity. Reliability means consistency of the research instruments used to measure particular variables. Obtaining the same results when the instruments are administered again in a stable condition guarantees reliable instruments (Mlangeni, 2001:176). According to Schuyler (1995:86), researchers evaluate reliability of instruments from different perspectives, but the basic question that cuts across various perspectives (and techniques) is always the same: *To what extent can we say that the data are reliable?*

When speaking about reliability, the researcher is trying to answer the question: *To what degree does a respondent's measured performance remain consistent across repeated testing?* (Schuyler, 1995: 86)

Validity addresses itself on the following two questions (Bless & Higson-Smith, 1995:135):

- What does the research instrument measure?
- What do the results mean?

The core essence of validity is captured nicely by the word *accuracy*. From this general perspective, a researcher's data are valid to the extent that results of the measurement process are accurate. Stated differently, a measuring instrument is valid to the extent that it measures what it purports to measure (Schuyler, 2000:100). Validity can be viewed in two dimensions, namely internal validity and external validity. Internal validity entails accurate answering of the two questions raised above and the ability to control intervening variables that are likely to distort the final results (Bless & Higson-Smith, 1995:82). For example, some educators may be teaching in the Gauteng Province but residing within the North West Province and crossing the border to and from work. Their discussion and sharing of documents with colleagues from the other province may change their attitudes, way of doing things, and their commitment. Therefore, their responses on the questionnaire may give a distorted picture about the education situation in a particular place.

External validity means the extent to which the results of a study can be generalised to the entire population. External validity is achieved through drawing a representative sample and gathering data from a normal daily operation of participants that is free from reactivity (Bless & Higson-Smith, 1995:82).

Validity and reliability complement each other. The accuracy and consistency of the instrument has an effect on the meaning of the results. If reliability is low, obviously the meaning of the results may not be accurate.

To determine the reliability and validity of the instrument, the following techniques were employed.

4.4.1 Content validity

Before the instruments were administered to educators, they were verified by experts at academic institutions who were not only requested to complete the questionnaire, but also to consider the instruments and make their inputs. A pilot study is a process of validating the research instruments. It is a process where instruments are tested on a small scale. Any existing mistakes in the instruments and or research design are identified and corrected before the instruments are administered (Mlangeni, 2001:177). For this purpose, an educator responsible for technology teacher education was identified at Johannesburg College of Education, now part of Wits University. The educator was requested to complete and comment on the usefulness of the questionnaire. One senior lecturer who holds a PhD degree teaching technology education at Randse Universiteit (RAU) was identified and requested to look into the instruments. His opinion on content, semantics and relevancy were sought. The instrument was also sent to senior academic staff and are well experienced in research at UNISA. The instrument was also sent to the Promotor who is well experienced in the field of research for evaluation and comments. On the basis of feedback, the questionnaire was amended. Therefore, after such a wide exercise of opinions and comments, it may be concluded with confidence that the reliability and validity of the instruments were achieved.

4.4.2 Reputability study

The reputability study entails the identification of experts from the community, academic institutions, government organisations and non-government organisations who are requested to make their inputs on the study (Bless & Higson-Smith, 1995:50). Therefore, a reputable professor who has researched and written extensively on technology education at the Open University, Milton Keynes was visited with the purpose of learning more and seeking information about the study of technology education. My host professor at the Open University provided me with more leads for experts in the field. **Section 4.3.1** gives

more details on experts interviewed in the UK. The information obtained during this visit is comprehensive. This exercise makes the data in the study more valid.

4.5 DATA COLLECTION ARRANGEMENTS

As a process towards completion of the study, data had to be collected and analysed. Before analysing data it is essential to discuss briefly how it was collected. The main research instruments that were used to collect data are the questionnaires that were discussed in detail in sections **4.2.2** and **4.3.2** respectively. A brief discussion was held with principals or their deputies explaining the purpose of the study. After permission was sought, the principal or deputy called the relevant educator. The researcher explained the purpose of the study to the respondent; thereafter the respondents completed the questionnaires.

The schedule for the interviews conducted with international experts was discussed in section **4.3.1**. The researcher personally visited the respondents at their work places. Before visiting the respondents, the researcher explained the purpose of the interviews telephonically. In some cases, the researcher's host professor or his secretary arranged the interviews with the respondents. The data from interviews were collected by means of field notes.

Section **4.6** discusses how the data gathered from interviews were analysed and section **4.7** deals with data based on questionnaires.

4.6 ANALYSIS OF INTERVIEW DATA

Since it was an unstructured interview, an open-ended question was asked in all interviews with UK experts as shown in **Table 4.2**. The main question throughout interviews was around content of curriculum for technology teacher education. In-depth probing during the interviews enabled several issues on technology education and teachers to emerge. The interviews were also used to gather new and supplementary information for developing the technology teacher education curriculum. The field notes from interviews and documents (technology teacher programmes from Sheffield Hallam University) given were arranged

into themes and categories. The analysis of data was done based on various issues around technology education and teacher education. The next sections provide an analysis of Design and Technology (D & T) in British schools, the teaching and learning of D & T in British schools as well as D & T teacher training programmes.

4.6.1 Design and Technology at schools in Britain

This section analyses the Design and technology in Britain schools based on the interviews and documents.

Design and technology prepares learners to participate in tomorrow's rapidly changing technologies. They learn to think and intervene creatively to improve the quality of life. The subject calls for learners to become autonomous, creative problem solvers, as individuals and members of a team (Department for Education and Employment, 1999:15).

It is important to understand the structure of the national curriculum for D & T in schools in England as it will assist in the development of technology teacher education curriculum. With regard to D & T at schools the interviewee outlined the structure of the national curriculum in their country. The National Curriculum is a set of subjects that applies to all learners of compulsory school age. It is split into four key stages broadly defined by age range.

- Key Stage 1 is for learners aged 5-7 (years 1-2);
- Key Stage 2 is for learners aged 7-11 (years 3-6);
- Key Stage 3 is for learners aged 11-14 (years 7-9);
- Key Stage 4 is for learners aged 14-16 (years 10-11).

At key stage 1 pupils learn how to think imaginatively and talk about what they like and dislike when designing and making. They build on their early childhood experiences of investigating objects around them. They explore how familiar things work and talk about, draw and model their ideas. They learn how to design and make products ensuring safety

and could start to use ICT (Information Communication technology) as part of their designing and making. This stage is equivalent to the Foundation Phase of the GET band in South Africa, although there is no technology as an isolated learning area. The years 1 to 11 are school going years or years of formal education and may be equivalent to grades 1 to 12 in the South African school system. It is also important to note that their school going age is five years whereas it has just been changed to six years in South Africa.

During key stage 2 pupils work on their own and as part of a team on a range of designing and making activities. They think about uses of products and the needs of the people who use them. They plan what has to be done and identify what works well and what could be improved in their own and other people's designs. They draw on knowledge and understanding from other areas of the curriculum and use computers in a range of ways.

During key stage 3 pupils use a wide range of materials to design and make products. They work out their ideas with some precision, taking into account how products will be used, who will use them, how much they cost and their appearance. They develop their understanding of designing and making by investigating products and finding out about the work of professional designers and the manufacturing industry. They use computers, including computer-aided design and manufacture (CAD/CAM) and control software, as an integral part of designing and making. They draw on knowledge and understanding from other areas of the curriculum.

During key stage 4 learners take part in design and make projects that are linked to their own interest, industrial practice and the community. Projects may involve an enterprise activity, where learners identify an opportunity, design to meet a need, manufacture products and evaluate the whole design and make process. Learners use ICT to help with their work, including computer-aided design and manufacture (CAD/CAM) software, control programs and ICT-based sources for research. They consider how technology affects society and their own lives, and learn that new technologies have both advantages

and disadvantages. The general teaching requirements of health and safety applies in all stages in this subject.

4.6.2 The teaching and learning of D & T in England schools

This section analyses the teaching and learning of D & T in schools based on the interviews and documents.

The important aspect discussed during interviews was the issue around the teaching and learning of D & T at schools. The National Curriculum for D & T can be divided into generic or core skills and the fields of knowledge. The core consist of the following sub-headings:

- Designing and making;
- Communication skills;
- Products and applications;
- Technological concepts;
- Information technology and related skills;
- Health and safety.

The fields of knowledge are as follows:

- Resistant materials;
- Control and systems;
- Food technology;
- Textile technology.

During the key stages, learners study all the fields of knowledge in an integrated form. Various specialist teachers, resulting in teachers not getting the opportunity to know learners well enough, teach them the above-mentioned fields. In each school where D & T

is offered there is department of D & T where all teachers with various specialisation are found. Each field of knowledge is taught three days a term per year.

At key stage 3 and 4 learners choose at least two fields of knowledge, such as Materials and Systems and Control, depending on the availability of human resources at schools. The generic skills are taught throughout all key stages because they act as tools or methodology of learning the field of knowledge. At key stage 4 public examinations are the main means of assessing attainment. All learners will have prepared for such examinations.

Vocational engineering education, such as manufacturing is still offered at some schools, parallel with the GCSE (General Certificate of Secondary Education) D & T. An interviewee stated that the NVQ (National Vocational Qualification) is becoming unpopular with learners and parents and are being gradually replaced by GCSE D &T at key stage 4. This is also due to the fact that the old type of manufacturing and related technical skills have began to shrink and is being replaced by Design and technology using the computer aided and manufacturing (CAD/CAM) software.

4.6.3 D & T teacher training programmes

This section analyses the D & T teacher training programmes based on the interviews and documents.

The purpose of interviews was, inter alia, to understand the features of Design and technology (D & T) teacher training programmes in some universities in the UK. However, the information obtained about D & T teacher training programmes was not only based on interviews but on documents provided at different universities in Britain. The supportive documents provided are referenced accordingly in this section. It was found that in some universities D & T, candidates' teachers were recruited from people who hold degrees in product design, electrical engineering or any other related degree. These student teachers study an intensive one-year PGCE (Postgraduate Certificate in Education) in D & T. This is a partnership programme between the university and a local school(s). This means that

during the training student teachers spend 30% of the academic year at the university and 70% at schools under mentors. At the university they learn the national school curriculum in D & T as discussed in section 4.6.2. That means they learn fields of knowledge (e.g. Systems and Control) and core knowledge (e.g. design and making process). In developing the programme for D & T teacher training the university takes the Teacher Training Standards which is similar to Norms and Standards for Educators in South Africa plus the National Curriculum for Technology Learning Area. The interviewee said that they chose this model because it produces well-qualified D & T teachers rather than taking learners fresh from school.

In the other university, it was found that they have a two years, a three years as well as a one year PGCE teacher training programmes for D & T. There are overlaps between the programme. The 3rd year is a professional year where all learners from the three types of programmes learn the same content of knowledge. The education aim of each level or year is outlined below:

Year One

The aims of year 1 are to enable learners to:

- Acquire key skills of communication, numeracy, literacy, ICT, information retrieval processing, resource use and management;
- Acquire a sound subject knowledge base from which to develop wider and more complex subject knowledge both within education and their own subject specialist areas;
- Begin to develop the personal skills necessary for beginning teachers;
- Begin to appreciate the complexity of the educational process and the factors that influence and contribute to education of children and young people;
- Begin to take responsibility for their own academic and professional development (Sheffield Hallam University, 2002:10).

Year Two

The aims of year 2 are to enable the learners to:

- Consolidate and extend their subject knowledge base both within education and their own subject specialism;
- Consolidate their literacy and numeracy skills within a professional educational context;
- Acquire research and evaluative skills;
- Extend their own personal skills and the ability to work professionally with others;
- Explore and investigate selected areas of work (Sheffield Hallam University, 2002:10).

Year three: Professional year

The aims of the professional year are to enable the learners to:

- Develop the pedagogic knowledge required by beginner teachers;
- Develop the professional skills needed in employment including those of literacy and numeracy demanded by the professional context within which they will work;
- Be able to relate professional practice to theoretical discussion and identified educational knowledge;
- Take responsibility for their own professional development;
- Work collaboratively with colleagues (Sheffield Hallam University, 2002: 11).

To address the challenges of shortages of D & T teachers in the UK, the Open University introduced a flexible part-time PGCE. Since its inception, OU PGCE became has become popular and demonstrated a great demand for this type of teacher training course. The course is normally tailor- made to individuals taking into account prior learning and experience.

The course includes four blocks of work in school viz:

- A ‘need analysis’; starting after registration, for ten days (flexible) in an OU Training School;
- Level 1 ‘familiarization’ working with individual children in small groups for five weeks in a secondary school and an additional week in a linked primary school;
- Level 2 ‘consolidation’ closely supported teaching of whole classes, for seven weeks in a secondary school and an additional week in a linked primary school;
- Level 3 ‘autonomy’ solo, supported teaching of a whole class, for eight weeks in a secondary school. This will normally be in a different secondary school from level 1 and 2.

The analyses of technology education in England provides rich information and lessons to learn from. This information does not only assist in the development of technology teacher education and training programmes for this study, but provides guidelines to the current educators and principals at schools concerning the implementation of technology education.

These unstructured interview responses helped, in addition to questionnaire responses, to develop a model curriculum for a technology teacher education programme, which is the main purpose for this study. The questionnaire responses are a form of ‘needs analysis’ which attempts to identify the technology knowledge gap experienced by educators and what is supposed to be known by educators. The next section analyses the questionnaire results.

4.7 QUESTIONNAIRE DATA ANALYSIS

Thirty-one questionnaires were administered and collected from educators as shown in section 4.3.2. A simple computer Excel spreadsheet programme was used to analyse the data. An Excel spreadsheet was first created where all questions in the questionnaire were programmed as variables. When this was done, responses from each questionnaire were punched into the computer. When all questionnaires were captured, the researcher manually determined the statistical frequencies of each question from the questionnaires. Thereafter,

the researcher used the computer to create tables and graphs that contain information which form the base for quantitative analysis, interpretation and findings of the study. The study is partly based on empirical investigation, hence the interpretation will also be based on specific variables which are important in curriculum development of technology teacher education and training rather than on the averages of the tables in data presentation. Each variable containing a list of items was analysed quantitatively using frequency tables and graphs. The next sections will provide an analysis of educators' qualifications; teaching experience; educator's age; attitudes towards technology; rationale for technology education; purpose of technology education; knowledge of technology education; technological process and skills as well the pedagogic knowledge.

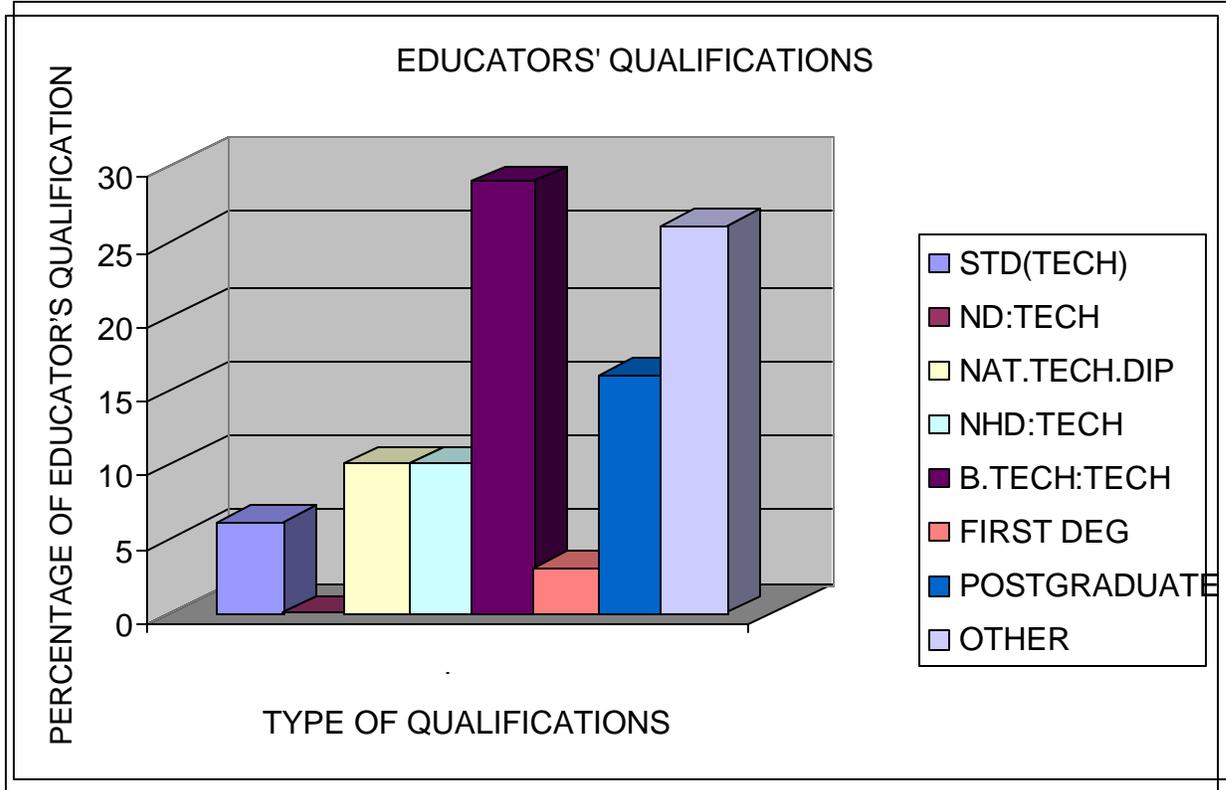
4.7.1 Educators' qualifications

Background and qualifications may affect one's understanding, perceptions and attitudes towards technology education. The educational level and experiences of respondents in **Figure 4.1** gives details about the educational qualifications of respondents.

This table indicates that majority (55%) of educators meet the minimum of 1st degree or diploma in technical qualification for an educator to understand the technological world in which we live. This may be seen as a positive sign because of the relation between technical education and technology education as discussed in chapter one. Further, the table indicates that less than a quarter (26%) educators have post graduate degrees. On the basis of this data educators are not only aware but knowledgeable of technology education.

The researcher used technical education qualifications because very few educators have formal qualifications in technology education. Technology is a new learning area at schools (HEDCOM, 1999:29). The other reason is that those having technical education qualifications may easily meet the entry requirements for technology teacher education programmes.

FIGURE 4.1
EDUCATORS' QUALIFICATIONS



4.7.2 Educators' teaching experience

Table 4.4 indicates the level of experience of educators at the schools visited. This table indicates that only 13% of educators have a teaching experience of less than four years. The majority of educators (87%) have experience of more than three years.

TABLE 4.4
TEACHING EXPERIENCE OF EDUCATORS

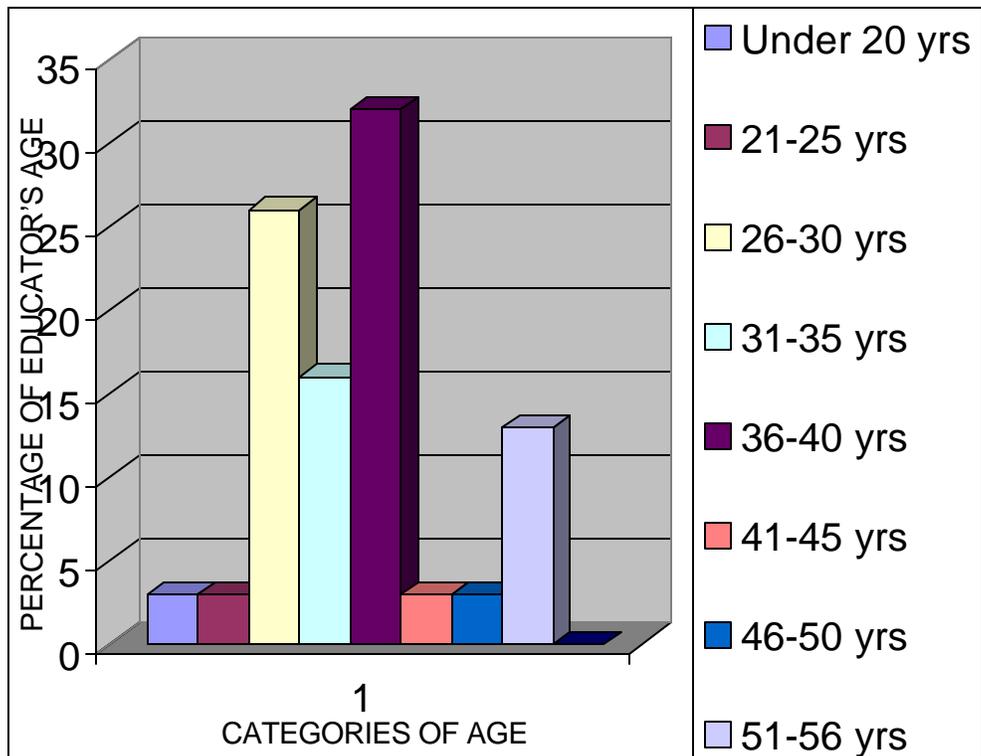
EXPERIENCE CATEGORY	YEARS OF EXPERIENCE N=31	PERCENT
0-3 years	4	13
4-7 years	10	32
8-11 years	8	26
12-15 years	7	23
16-19 years	-	-
20 years and more	2	6
TOTAL	31	100

Based on the years of experience educators can understand curriculum changes within the broader education transformation in the country. They are aware of technological changes as it affects their lives as well as the purpose of learning technology at schools. They can therefore make significant inputs to the curriculum of technology teacher education.

4.7.3 Educators' age

The age of educator has some implications for his or her maturity to understand the education system and the purposes of educational curricular. However, some educators who may be just about to retire may not be eager to contribute to curriculum changes, saying that it might not assist him or her with regard to economic survival anymore. The age distribution of the respondents was as follows in figure 4.2 below:

FIGURE 4.2
EDUCATORS' AGE



The graph indicates that nearly a third (32%) of educators were between 36 and 40 years old. The age group 26-30 years follows which is 26% of the educators. There is a small percentage (13%) of educators that is above 50 years. An educator who is 50 years old may still continue working for a period of 15 years if he or she chooses to retire at the age of 65 years. In brief, the graph indicates that almost all educators (99%) are less than 57 years. They still have more than five years to go before retirement. In this period of curriculum changes most educators are in a position to contribute to the development of an appropriate technology teacher education programme, and effective implementation of the revised NCS (National Curriculum Statement) for technology at schools.

4.7.4 Attitudes towards technology

Some aspects that determine the attitudes towards technology were listed and respondents were required to indicate their choices to each statement. They were expected to make a choice by writing a number from **1-Strongly disagree, 2-Disagree, 3-Do not know, 4-Agree to 5-Strongly agree**. Table 4.5 indicates the responses.

TABLE 4.5
ATTITUDES OF EDUCATORS TOWARDS technology

Aspects of attitudes	1-SD	2-D	3-DNK	4-A	5-SA
When something new is discovered, I want to know more about it immediately.	-	-	-	17(55)	14(45)
I would enjoy teaching technology education.	-	-	3(10)	6(19)	22(71)
There should be education about technology.	-	-	-	5(16)	26(84)
Technology causes large unemployment.	13(42)	5(16)	3(10)	6(19)	4(13)
Technology as a subject should be taken by all learners.	-	1(3)	1(3)	8(26)	21(68)
Technology is good for the future of this country.	-	-	--	6(19)	25(81)
Technology makes everything work much better.	-	2(6)	1(3)	9(29)	19(61)
You have to be intelligent to study technology.	8(26)	15(48)	5(16)	2(6)	1(3)
Technology is very important in life.	-	-	-	12(39)	19(61)

Everyone needs technology.	-	2(6)	3(10)	13(42)	13(42)
Technology has brought more good things than bad things.	-	13(42)	2(6)	14(45)	12(39)
The world would be a better place without technology.	16(52)	11(35)	3(10)	1(3)	-
Boys are more capable of doing technological jobs than girls.	12(39)	7(22)	4(13)	7(22)	1(3)
Learn technology only when you are good at both mathematics and science.	7(22)	14(45)	4(13)	5(16)	1(3)
Technology does not need a lot of mathematics.	2(6)	10(32)	5(16)	13(42)	1(3)
Because technology causes pollution, we should use less of it.	9(29)	14(45)	6(19)	1(3)	1(3)
Technology is a subject of the future.				13(42)	18(58)
Average percent	9%	18%	7%	26%	37%

Most aspects of attitudes towards technology education as reflected in table 4.5 are derived from the international study on PATT (Ankiewicz, 1995), and adapted based on the researcher's experience to suit this study. All educators (100%) indicated that they would like to know more about new things. This reflects the attributes of technologist, particularly in the area of analysing technological products in the technology curriculum.

Most of educators (90%) indicated that they would enjoy teaching technology education. This is an indication that it would not be difficult for educators to implement the Technology Learning Area at schools. Even if educators might not know much of technology, willingness would make it easy to change. The fact that all educators (100%) agreed that there should be education about technology, is an indication that educators are

aware of the importance of technology. Most educators (94%) agreed that technology as a subject should be taken by all learners. This response corresponds with the vision and mission of the HEDCOM technology project which states that technology education will be part of the education of every boy and girl (Mapotse, 2001:46). It is also important for the development of technology teacher education that all educators (100%) are aware that technology is good for the future of this country. This implies that trainers would not have to spend much time on the advocacy of the technology teacher education curriculum.

The majority of educators (74%) disagreed that learners have to be intelligent to study technology. This is partly in line with OBE philosophy that all learners can learn if given the opportunity. This understanding will enable educators to be ready to learn technology with the purpose of teaching it to learners at schools. Most educators (61%) disagreed with the myth that boys are more capable of doing technological jobs than girls. This becomes more important since one of the gender principles state that no one should be discriminated on the basis of gender. According to most educators (67%), mathematics and science should not be a strong prerequisite to study technology education. However, basic mathematics and science are necessary to the study of technology. Although technology might cause pollution, most educators (74%) did not agree that people should use less of it. technology teacher education curriculum should include the area of environmental awareness. It is interesting to note that, in average, the majority of educators (63%) agreed with aspects mentioned in the table. Seven percent of them were uncertain about some of the aspects. About a quarter (27%) of the educators were in agreement with some of the items. This indicates that educators do have positive attitudes towards technology. The majority of educators (81%) agreed that technology is good for the country. These indications show that educators are ready to learn and understand technology.

4.7.5 Rationale for technology education

Technology is essential because it satisfies the human desire for comfort, transport, power, communication, and identity. Technology is built upon dissatisfaction; upon the tendency of humans to constantly seek to improve their lives (Van Winkel, 2003:24). In order to

teach technology education at schools effectively educators should understand its rationale as a school subject. Table 4.6 provides a list of aspects for the rationale of teaching technology as a school subject. This list of aspects was derived from literature as discussed in chapter 2 (2.7) as well as from the researcher's experience and adapted to suit the purpose of the study. The purpose of this needs analysis was to determine what educators know about the rationale for technology, in order to assist in the development of a technology teacher education and training curriculum programme.

Almost all educators (94%) agreed that the quality of human life can be improved by the abilities to solve problems through design. Only 6% of educators were uncertain about some of the items. The majority of educators (96%) agreed that the design and make process should be the methodology of teaching technology education. The implication of such a response is that educators would find it easy to learn the methodology of teaching technology. Most educators (94%) agreed that technology education can help learners to make informed choices about careers and further education. It is expected that learners should understand different career opportunities in technology. The majority of educators (97%) agreed that technology education trains learners to design and develop technological products to trade on international markets. For economical reasons this country cannot afford to import technologies from overseas. Therefore, it is important for educators to know that the technology teacher education training programme is aimed at producing people who can design products that can be traded internationally. One of the features of OBE curriculum is integration. It is important for the GET Technology Learning Area to be integrated with FET technology subjects. Most educators (87%) agreed that there should be integration between GET technology and FET technology subjects. However, the integration should not compromise the specialisation aspects in FET technology subjects (HEDCOM, 1999:36).

Studying the average percentages of the ratings in table 4.6, the following becomes discernible:

It is clear from the table that almost all aspects were agreed upon by most respondents. The mean sum score for both the **strongly agree** and **agree** ratings is 91%. This means that educators in most schools understand why technology as a school subject has been introduced.

TABLE 4.6
RATIONALE FOR TECHNOLOGY EDUCATION

ASPECTS OF RATIONALE	FREQUENCIES AND PERCENTAGES				
	1-SD	2-D	3-DNK	4-A	5-SA
The abilities to solve problems through design and the use of technologies improves the quality of human life.			2(6)	12(39)	17(55)
Quality of life is directly related to the ability to creatively develop new technologies.			1(3)	16(52)	14(45)
Science and technology play a big role in the economic and social development of today's world.				10(32)	21(68)
Science and technological literacy must be given priority as an essential component of education.			3(10)	9(29)	19(61)
Technology is an important part of our daily life.				10(32)	21(68)
Technology education at high schools (FET: grade 10-12) should be a distinct specialised field of study.		4(13)	3(10)	8(26)	16(52)
Design and make should be the methodology of teaching technology education.			1(3)	19(61)	11(35)
Technology education at FET schools should focus on acquisition of specific technical skills.	1(3)	2(6)	6(19)	8(26)	14(45)
To survive in a technological world, technological literacy is needed.		1(3)	1(3)	12(39)	17(55)
Technology education can help learners to make informed choices about their further education.			2(6)	12(39)	17(55)
Technology education develops problem-solving skills which may be used in all aspects of life.		2(6)	-	15(48)	14(45)
Technology education trains learners to design and develop technological products to trade on international		3(10)	1(3)	14(45)	13(42)

markets.					
Technology education equips learners with thinking, problem-solving and decision making skills to enable them to address community needs.		1(3)	1(3)	11(35)	17(55)
Technology education should be integrated with technical/vocational subjects at FET schools.	1(3)	-	3(10)	8(26)	19(61)
Average percentage	0%	3%	5%	38%	53%

It can be concluded from data that educators in those schools visited are aware of reasons for introducing technology at schools and can contribute to its implementation if given the opportunity.

4.7.6 Purpose of technology education

The aim of the study is to develop a curriculum for technology teacher education. That is, after studying the curriculum programme educators should be able to teach technology at schools, particularly in the GET band. As part of the programme educators should learn about the purpose of the technology curriculum.

Educators were given a list of aspects related to the purpose of technology teacher education and were asked to indicate the extent to which they agree with the statements listed. The statements of purpose was derived from literature as discussed in chapter 2 (2.8) as well as from the researcher's experience and adapted to suit the purpose of the study. The items listed in table 4.7 was to determine how much educators know about the purpose of technology education, in order to assist the development of a technology teacher education and training curriculum programme.

Table 4.7 lists these statements and responses gathered from the sample. Most educators (91%) agreed that technology education enables learners to develop and apply specific skills to solve technological problems. It is expected that educators should understand the purpose of technology education as this will make it easier for technology curriculum at schools to be implemented. The majority of educators (93%) responded positively to the

statement that learners should understand the concepts and knowledge used in technology. Technology as a subject at schools consists of new concepts which learners should know before solving technological problems. The development of creativity in design as part of technological process is also one of the critical outcomes in the OBE curriculum. Almost all educators (93%) indicated that creativity is significant in technology. This indicates that educators are aware of the critical and developmental outcomes in OBE. In one of the NBI (National Business Initiative) newsletters, the CEO of NBI stressed that skills development can prepare learners for employment and entrepreneurship (National Business Initiative newsletter, 2002) . Most educators (81%) agreed that technology provides technical skills and knowledge for employment. This is significant for the study in order to know which learning content to include in the development of technology teacher education curriculum. The provision of learnership in some trades skills remains one of the strategies for human resource development in South Africa (Department of Labour, Skills Development Act, 2000:5). Most educators (84%) agreed that technology can provide opportunity for learnership in some trades skills. According to majority of educators (84%), technology promotes a well-organised teamwork which is important for industry-oriented projects. The majority of educators (70%) agreed that technology enables learners to explore both the positive and negative impacts of technology on the environment and economic development.

It is interesting to note that an average of only one (1%) of educators disagreed with some items mentioned in the table 4.7. Five percent (5%) of them were uncertain about some of the items. The mean sum score for both the “Agree” and “Strongly agree” ratings is 88%. This means that the respondents are aware of the purpose of technology education.

TABLE 4.7
EDUCATORS RATINGS ON PURPOSE OF TECHNOLOGY EDUCATION

ASPECTS OF PURPOSE	FREQUENCIES AND PECENTAGES				
To develop and apply specific skills to solve technological problems			2(6)	12(39)	16(52)
To understand the concepts and knowledge used in technology			1(3)	14(45)	15(48)
To develop creative thinking and inventiveness in design and production of practical projects			1(3)	10(32)	19(61)
To produce, maintain, and repair products, and systems in technological fields of interest		1(3)	1(3)	12(39)	15(48)
To use correct terminology and language in identifying machine parts and describing processes			1(3)	16(52)	12(39)
To provide employment, with marketable technical skills and knowledge		1(3)	1(3)	8(26)	19(61)
To provide service in technology-based occupation, through exploration of various technological fields			3(10)	12(39)	1(3)
To provide learnership and trades, thorough mastery of a specific technology		1(3)	2(6)	12(39)	14(45)
To prepare learners for entering the workplace or continue with higher education			2(6)	12(39)	15(45)
To promote a well-organised teamwork for complex industry-orientated projects		1(3)	2(6)	13(42)	13(42)
To enable learners to cope with the challenges of a technological society			1(3)	10(32)	17(55)
To enable learners to explore both the positive and negative impacts of technology on their political, social, economical and biophysical environment			1(3)	11(35)	16(35)
Average percent	-	1%	5%	38%	50%

4.7.7 Knowledge of technology education

One of the important components of the technology teacher education curriculum is the subject knowledge. The knowledge section forms the ‘minimum competences’ for student teachers’ training to teach technology education at schools within the GET band. The knowledge component is one of the means to assist learners to achieve outcomes of technology education. A list of core knowledge content of technology education is mentioned in table 4.8. The knowledge content was derived from literature as discussed in chapter 2 (2.9.1) as well as from the researcher’s experience and adapted to suit the purpose of the study. Educators were requested to indicate the extent to which they agree with the knowledge content statements listed in the table. The responses are contained in table 4.8. The knowledge content was included in the needs analysis in order to assist the development of a technology teacher education and training curriculum programme. The responses to items on knowledge content can be summed up as follows:

- 84% of educators agreed that ‘**structures**’ as learning content is important.
- Almost all (94%) educators agreed that ‘**resistant materials and processing**’ is essential as part of learning content.
- The majority of educators (91%) agreed that ‘**control and systems**’ is significant as part of technology subject.
- Most educators (93%) agreed that ‘**designing of products**’ should be part of knowledge content in technology education.
- 90% of educators agreed that ‘**energy conservation**’ is important in technology education.
- The majority of educators (81%) agreed that GET technology should be linked with FET technology education.

TABLE 4.8
KNOWLEDGE OF TECHNOLOGY EDUCATION

KEY KNOWLEDGE	FREQUENCIES AND PERCENTAGES				
	1-SD	2-D	3-DNK	4-A	5-SA
Structures	1(3)	1(3)	2(6)	13(42)	13(42)
Resistant materials and processing		1(3)	-	16(52)	13(42)
Control and systems			2(6)	12(39)	16(52)
Interrelationships between science, technology, society and the environment	1(3)	-	-	13(42)	16(52)
Designing of products, artifacts and prototypes as a solution to human needs			1(3)	14(45)	15(48)
Understanding energy types and the use of concepts of energy transfer, conservation and efficiency	1(3)	-	1(3)	14(45)	14(45)
Understanding the current rationale for technology education within the national curriculum		1(3)	3(10)	11(35)	15(48)
Understanding the historical development of technology education		1(3)	7(22)	13(42)	9(29)
Linking of technology education within GET and FET bands at schools	1(3)	1(3)	3(10)	16(52)	9(29)
Averages	1%	2%	7%	44%	43%

According to the ratings, it is clear that most respondents (87%) agreed with the necessity of the key knowledge as listed in the table above. This means that educators at the schools in the district are aware of the key knowledge components of technology education. This will make the task of professional development for educators in technology education much easier.

4.7.8 Specialisation areas in technology education at FET schools

The knowledge and skills gained in GET technology education should link very well with FET technology subjects to ensure continuity. It is important for the technology teacher education curriculum to show the link of GET technology education with the technology education subjects at the FET schools. It is envisaged that the technology education at FET schools will focus on specialised areas unlike GET technology education which covers a range of areas. A list of the various specialisation areas in the FET band were listed and educators were requested to indicate YES to those they regard as relevant; NO to those they regard as irrelevant and DO NOT KNOW if educators do not know whether relevant or not.

Two of the educators did not respond to this question. Table 4.9 below summarises the views of the respondents.

TABLE 4.9
SPECIALISATION AREAS OF TECHNOLOGY EDUCATION AT SCHOOLS AS
OBSERVED BY EDUCATORS

Technological areas	n = 29	YES	NO	DO NOT KNOW
Materials technology		26		3
Information technology		25	2	2
Electronics and control technology		27		2
Biotechnology		20	4	5
Structures and mechanisms		28		1
Process and production technology		28		1
Food technology		26	1	2
Hydraulics and pneumatics		25	1	3
Averages and percentages		25.6 76%	1 3%	2.3 8%

On average, the above table indicates that 76% of educators rated the eight technological areas as important for FET technology education as well. A negative rating of 3% has been observed. Only 8% of educators were uncertain about the importance of specialisation areas.

Although the average percent under the “YES” column is positive, it is important to note that not all of them will be taught at FET schools. Owing to the fact that FET schools focus on career education only two or three areas may be taught to learners following the Manufacturing, Engineering and technology field.

It is clear from the table that educators from the chosen schools in the district know and understand the link between GET technology education and FET technological subjects. This is important for educators, because in the real school situation most educators who teach GET technology also teach Grade 10 FET subjects. There is usually no physical separation between teaching in the GET and FET bands. They often occur in the same school.

4.7.9 Specific field of technology at FET schools

It is important for educators teaching technology at the GET band to know the particular technological subjects being followed in the FET band. The specialised areas mentioned above in section 4.7.8 are the major themes within technological subjects in the FET band. A list of possible subjects for the FET band were listed and educators were requested to indicate YES to the relevant ones in their views; NO to the irrelevant ones and DO NOT KNOW if they are uncertain. Two of the educators did not respond to this question.

The following table 4.10 summarises views of respondents.

TABLE 4.10
TECHNOLOGICAL SUBJECTS AT FET SCHOOLS AS VIEWED BY
EDUCATORS

Technological subjects	n = 29	YES	NO	DO NOT KNOW
Agriculture		23	3	3
Aeronautical		18	2	9
Automotive		23	1	5
Civil and building		25		4
Electrical		27		2
Electronics		26		3
Metallurgical		21		7
Mechanical		26	1	2
Mining		23	1	5
Averages and percentages		23.5	0.9	4.4
		76%	3%	14%

The table indicates that most educators (76%) educators rated the nine technological subjects as relevant for the FET band, in their own views. Three percent of educators responded negatively to relevant subjects. Less than a quarter of educators (14%) were uncertain about the relevance of these subjects. Although the average percent under the “YES” column is positive, it is important to note that not all of the subjects will be taught at FET schools. Owing to the fact that FET schools focus on career education only two or three subjects may be taught to learners following the Manufacturing, Engineering and technology field.

It is clear from the table that educators from the chosen schools in the district were not sure of the relevant technological subjects at FET band. This is important for educators, because in the real school situation most educators who teach GET technology also teach Grade 10

FET subjects. This is also true in that there is no physical separation between GET and FET bands. They are often found in the same school.

4.7.10 Technological areas for manufacturing and assembly practicals

The technology education curriculum should meet the needs of the manufacturing industry in terms of designing and manufacturing products which solve human problems. Educators of technology education should be exposed to industrial practicals, that include hands-on experience at manufacturing industries. According to the technological needs more industrial practicals should be done in some areas of technology (Makgato, 2003:145-148). A list of possible areas that require industrial practicals at the FET band were listed and educators were requested to indicate YES to the relevant ones (in their views); NO to the irrelevant ones and DO NOT KNOW if they were uncertain.

Two of the educators did not respond to this question. The following table 4.11 summarises views of the respondents.

**TABLE 4.11
AREAS FOR MANUFACTURING AND ASSEMBLY PRACTICALS**

Practical areas	YES	NO	DO NOT KNOW
Wood products	25	1	3
Textile products	26		3
Packaging & paper products	26		3
Metal products	27		2
Graphic arts and printing	24	1	4
Glass, crockery and pottery products	22		7
Automotive components	27		2
Biotechnological systems	18	1	10

Electrical & electronic products	27		2
Plastic products	23	2	4
Averages and percentages	24.5	0.5	4
	79%	2%	13%

On average, the above table indicates that 79% of educators responded positively to the ten areas in which learners at FET band should conduct industrial practicals. The negative rating was 2%. 13% of educators were uncertain if these areas are important or not.

It will be expected where possible for learners to be exposed regularly to industrial practicals, otherwise, schools offering technological subjects at FET are expected to have industry accredited workshops in which learners simulate industrial designing, and manufacturing. The areas in which learners perform practical work will depend on the technological subjects they are studying as shown in table 4.11.

It is clear from the table that educators from the chosen schools in the district are aware that industrial experience is important for learners in the FET band. This implies that all educators teaching technology education in both the GET and FET band should have industrial experience through either regular visits to industry or visits coming from industry.

4.7.11 Technological process and skills in technology education

Technological process forms the core of the National Curriculum Statement in Technology Learning Area in the GET (grades R-9) (Van Winkel, 2003: 25). Newly qualified educators should have skills of designing and making products which meet human needs. A list of key skills of technological process was mentioned in the table below. This list of skills was derived from literature as discussed in chapter 2 (2.8.1.1) as well as from the researcher's experience and adapted to suit the purpose of the study. Educators were requested to indicate the extent to which they agree with the list of the skills in table 4.12. The responses are contained in table 4.12 below. Most educators (97%) agreed that identifying and

clarifying design problems is important in technology subjects. This indicates that educators are aware of the first stage of the technological process. All educators (100%) agreed that producing design briefs is one of the essential skills of technological process. All educators (100%) agreed that evaluation is important throughout the process of design.

TABLE 4.12
SKILLS OF TECHNOLOGICAL PROCESS AS VIEWED BY EDUCATORS

SKILLS OF TECHNOLOGICAL PROCESS	FREQUENCIES AND PERCENTAGES				
	1-SD	2-D	3-DNK	4-A	5-SA
Identify and clarify design problems			1(3)	11(37)	18(60)
Produce design briefs and specifications to model and generate solutions				12(40)	18(60)
Investigate a situation to gain information during design process			1(3)	10(33)	19(63)
Making using tools, equipment and materials to develop a solution to the identified problem			1(3)	10(33)	19(63)
Evaluate actions, decisions and results throughout the design process				10(33)	20(67)
Communicate using graphic strategies and techniques including sketching, scaled and annotated drawings			1(3)	9(30)	20(67)
Averages	-	-	2%	34%	63%

Studying the percentages of these ratings, the following is discernible:

- “Do not know” had an average rating of 2%;

- “Agree” and “Strongly agree” ratings added together equals 97%.

According to the ratings, it is clear that most respondents (97%) accepted the skills of technological process listed in table 4.12. This implies that respondents in district D3 are aware of the design process. Two percent of educators were uncertain about some of the skills of technological process. No response was given for “Strongly disagree” and “Disagree”.

4.7.12 Pedagogic knowledge

The purpose of this study is to develop a model curriculum for technology teacher education. Knowing what to teach and learn is one thing and knowing how to teach a particular subject is another. Pedagogic knowledge is imperative for every teacher education curriculum. Teaching and learning in technology education includes among others: managing classrooms; teaching and learning strategies; lesson preparation; year plans; assessment strategies; managing diversity and teaching practices (DATA,1995). A list of key pedagogic components to effect teaching and learning of technology was presented to respondents, as indicated in table 4.13. Educators were requested to indicate the extent to which they agree with the inclusion of the items. The responses are contained in table 4.13. The responses to some of the components of pedagogic knowledge can be summed up as follows:

- All educators (100%) agreed that developing learners’ conceptual understanding is essential in the teaching of technology subject.
- 96 % of educators agreed to questioning, instruction and demonstration.
- Planning and implementing technology activities to motivate learners received 94% of positive responses.
- Most of the educators (86%) agreed that organising industrial visits regularly should be part of pedagogic knowledge.

TABLE 4.13
PEDAGOGIC KNOWLEDGE TO EFFECT TEACHING AND LEARNING OF
TECHNOLOGY

ASPECTS OF PEDAGOGIC KNOWLEDGE	FREQUENCIES AND PERCENTAGES				
	1-SD	2-D	3-DNK	4-A	5-SA
Teaching technical knowledge and understanding, design strategies, and practical techniques and skills			1(3)	9(30)	20(67)
Developing learners' conceptual understanding				12(40)	18(60)
Questioning strategies, instruction and demonstration, facilitating to meet learners' needs			1(4)	16(59)	10(37)
Planning and implementing technology activities that motivate both boys and girls, avoiding unjustified assumptions about gender differences	1(3)	1(3)		11(37)	17(57)
Plan and implement technology activities considering diversity and cultural origins of learners	1(3)	2(7)		8(28)	17(61)
Organising industrial visits regularly		1(3)	3(10)	6(21)	19(65)
Selecting, using and producing a range of appropriate resource to support teaching and learning				11(38)	18(62)
Baseline assessment of prior learning which establish what learners already know	1(3)		1(3)	16(55)	11(38)
Diagnostic assessment	1(3)	1(3)	4(14)	10(34)	13(45)
Formative assessment	1(3)		2(7)	12(41)	14(48)
Summative assessment	2(7)	1(3)		10(34)	16(55)
Averages	2 %	2%	4 %	38 %	54 %

- Adding “Strongly disagree” and “Disagree” ratings together, gives 4%.
- “Do not know” has an average rating of 4%.
- “Agree” and “Strongly agree” ratings added together equals 92%.

It is important to note that not all the respondents responded to each item on the list of pedagogic knowledge. The majority of educators (92%) accepted some the items listed as pedagogic knowledge. Only 4 % of respondents expressed disagreement with the inclusion of some of the items listed.

It can be concluded that educators are aware of importance of how to teach technology. However, that does not mean they can teach technology. Most of the pedagogic items are generic to other subjects. To determine the teaching and learning of technology will require another study to observe the teaching of technology in classrooms.

4.8 LIMITATIONS OF THE STUDY

Due to time constraint the researcher could not conduct a large-scale empirical investigation which would include a large sample of schools and educators in Gauteng province. More rich information would have been obtained if the interview schedules with England technology experts were added with observations and interviews at schools in England. The researcher experienced some problems in obtaining sufficient sources for OBE, in that many sources that were searched were not available due to high demand of OBE information. The researcher has however, gained a lot of insight and invaluable experience in the process of conducting this study.

The researcher, therefore, suggests that:

- The questionnaires could have been followed by focus group interviews with educators to gain more information about the implementation of OBE curriculum, particularly technology education,

- Data collection could have been conducted over a longer period to allow the researcher time to think over the instruments to be used and obtain more information from literature, particularly for OBE.

However, this study can make a valuable contribution to the implementation, not only for technology education but also for OBE curriculum at schools.

4.9 SUMMARY

This chapter has given an account of the empirical research design, results and discussion. It details the instruments used, the sample design and size, procedures used in administering the instruments and processes in validating them. The chapter went on to analyse data using charts and tables.

In the case of unstructured interviews, data analysis was done to issues that emerged in the discussions and from documents supplied by technology education experts in England. These issues were about technology education at schools and technology teacher education and training at higher education institutions. With regard to questionnaires responses, analysis was organised in themes that relate to content of **technology teacher education curriculum**. Therefore, the information gathered from interview discussions and the results from the needs analysis questions were integrated with the literature in developing a curriculum model for technology teacher education and training which will be presented in the next chapter.

The next chapter recommends a curriculum model and a curriculum for technology teacher education and training that can help in the implementation of the Revised National Curriculum Statements Grades R-9 (Schools).

CHAPTER FIVE

A PROPOSED CURRICULUM MODEL FOR TECHNOLOGY TEACHER EDUCATION

5.1 INTRODUCTION

This study, the development of a curriculum model and curriculum for technology teacher education and training to enable the implementation of Technology Learning Area at Grades R-9 schools, suggests that a curriculum be developed. There are other factors that must be considered in this study for example, the nature of the problem as detailed in chapter one. Chapter two provides the background and nature of technology education. This involved the historical development of technology as a school subject as well as theoretical contexts of technology education. The chapter begins with the historical background of technical education in relation to teacher training in South Africa. The development of technical education has been perceived to be addressing the technological challenges over the years.

In chapter three, the focus was on conceptions of curriculum development. The conception will be used in this chapter to develop a curriculum model and curriculum for technology teacher education and training.

This chapter suggests a curriculum for technology teacher education that, if properly applied, can make the implementation of NCS technology at Grade R-9 in school much easier. The researcher suggests that the model be called the cyclical OBE model for curriculum development. Before developing the curriculum, a justification for the technology teacher curriculum, and theoretical tenets of curriculum will be made where necessary, while references to discussions already made will be done through cross-referencing.

5.2 JUSTIFICATION FOR THE DEVELOPMENT OF A CURRICULUM FOR TECHNOLOGY TEACHER EDUCATION

A brief discussion of the justification for the development of a curriculum model for technology teacher education is necessary at this stage, mainly to draw threads on the issues that have been discussed in the first four chapters in this study. The Constitution of the Republic of South Africa (Act 108 of 1996) provides the basis for curriculum transformation and development in South Africa. Education and the curriculum have an important role to play in realising this educational development. The curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa. All teachers and other educators are key contributors to the educational transformation in South Africa. The revised National Curriculum Statement Grades R-9 (schools) envisions teachers who are qualified, competent, dedicated and caring.

The release of the Revised National Curriculum Statement Grades R-9 (schools) policy and its implication for implementation, as well as the background problem discussed in chapter one clearly reveal a need for the development of a curriculum in technology teacher education (**see section 1.2**). This would set in motion moves to resolve the weakness and problems in the current implementation of Curriculum 2005 at schools. The report of the review committee revealed that the majority of South African schools that offer the GET band do not have teachers who have any education or training in Technology Learning Area (Report of Review Committee, 2000: 92). The committee recommended that higher education should be involved in the planning of the curriculum and support for its implementation. Technology education is a component course of the teacher education programme for learner teachers who want to teach the Technology Learning Area at GET band. The development of the technology teacher education curriculum is underpinned by the two policy documents namely the Revised NCS for technology in Grades R-9 (schools) and the Norms and Standards for Educators.

5.3 TECHNOLOGY AS A SCHOOL SUBJECT

It is imperative for all learner teachers for technology to know the National Curriculum for technology as a school subject. The National Curriculum Statement Grades R-9 (schools) is based on the principles of social transformation; Outcomes-based education; high knowledge and high skills; integration and applied competence; progression; human rights and inclusivity. The structure of the technology curriculum at schools is based on the principles of the National Curriculum Statement as discussed in chapter three (see 3.2.5.4.1)

5.3.1 Technology Learning Area

This section will outline the structure of RNCS technology education as a national policy. The section will discuss definition, purpose, and scope which covers learning outcomes and content knowledge.

5.3.1.1 Definition

Technology has existed throughout history, but the science of technology was not well organised until recently. People use the combination of knowledge, skills and available resources to develop solutions that meet their daily needs and wants. Some of these solutions have been in the form of products (e.g. shaping bones into fishhooks and needles, making clay cooking pots), while some solutions have involved combining products into working systems (e.g. bow and arrow, moving water and a wheel, pestle and mortar).

People still have the needs and wants today. However, the knowledge, skills and resources used to find solutions are of a different nature because of accelerating developments in technology. Today's society is complicated and diverse. Economic and environmental factors and a wide range of attitudes and values need to be taken into account when developing technological solutions. The development of products and systems in modern times must show sensitivity to these issues. It is in this context that technology is defined (Department of Education, 2002:4):

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.

5.3.1.2 Purpose (see also 2.8) (Department of Education, 2002)

The Technology Learning Area will contribute towards learners' technological literacy by giving them opportunities to:

- develop and apply specific skills to solve technological problems;
- understand the concepts and knowledge used in technology, and use them responsibly and purposefully; and
- appreciate the interaction between people's values and attitudes, technology, society and the environment.

The significance of the Technology Learning Area is directly related to the overall goal of the Revised National Curriculum Statement Grades R-9 (schools), which is to develop citizens who can display the competencies and values encapsulated in the critical and developmental outcomes. The essence of the Technology Learning Area activities in the General Education and Training Band involves the following:

- The application of the design process: At the heart of this process is the identification of everyday problems, needs or wants of people, and the selection and application of appropriate resources, knowledge, skills and values to develop practical solutions. The design process encourages the development of critical and creative thinking skills.
- The Technology Learning Area offers authentic, real-life opportunities for learners to interact with each other within teams when they develop technological solutions. They also interact with their communities when, for example, they test and market products that they made themselves.

- On a personal level, technology learners become more and more aware of their responsibilities within their classrooms, schools, families and society. They learn to manage the technological resources at their disposal when developing products, and they also learn to minimise the potentially negative impact that their solutions could have on the environment and on human rights (Department of Education, 2002).
- Learners in technology classrooms work in groups to analyse the given information in order to create practical solutions. Learners co-operate and communicate with each other, often combining verbal and graphic modes of communication. Discussing and reporting techniques and the use of appropriate terminology are encouraged during technological activities.
- The Technology Learning Area contributes to the intellectual and practical development of learners, to enable them to cope with the challenges of a technological society. Through its open-ended, problem-solving approach, the Technology Learning Area Statement links knowing with doing; it affords learners opportunities to apply and integrate their knowledge and skills from other Learning Areas in real and practical situations. These skills can be further developed throughout their lives.
- Learners explore both the positive and negative impacts of technology on their political, social, economical and biophysical environment. This will be done when they evaluate the product they have made, using criteria like affordability, safety, fit for purpose, effect on the environment, and so on. This will enable learners to develop into critical consumers.
- In the Technology Learning Area, learners are provided with opportunities to interact with business and various industries that help them to understand and adapt to changing economic realities. They learn to generate creative and innovative ideas, and to co-operate in translating their ideas into action. Learners gain skills,

knowledge, competencies and confidence that equip them to explore entrepreneurial initiatives, which will enable them to contribute to South Africa's social and economic development. This process also allows learners to explore various opportunities for education and future careers.

5.3.1.3 Scope (Department of Education, 2002)

The Technology Learning Area gives learners the opportunity to:

- Learn by solving problems in creative ways;
- Learn while using authentic context that are real situations outside the classroom;
- Combine thinking and doing in a way that links abstract concepts to concrete understanding;
- Carry out practical projects using a variety of technological skills – investigating, designing, making, evaluating, communicating – that suit different learning styles;
- Use and engage with knowledge in a purposeful way;
- Learn by dealing directly with inclusivity, human rights, social and environmental issues in their project work;
- Use variety of life skills in authentic context (e.g. decision making, critical and creative thinking, co-operation, needs identification); and
- Create more positive attitudes, perceptions and aspirations towards technology-based careers.

5.3.1.4 Technology Learning Outcomes

5.3.1.4.1 Learning Outcome 1

The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technologies.

(a) The backbone outcome for the Technology Learning Area

During technological activities, the learner engages in investigating, designing, making, evaluating and communicating solutions. When used together, these skills are sometimes known as the ‘design process’. In addition to the design process, there are many other processes that can be described as technological processes.

(b) Practical, solution-oriented learning

This Learning Outcome describes a core set of skills that can be developed through projects that are ‘needs driven’ – that is, they are built around developing and implementing practical solutions to realistic problems or needs. Since Learning Outcome 1 aims to develop technological skills (investigating, designing, making, evaluating and communicating), it should be used as an integrating Learning Outcome, to structure projects that develop the learner’s skills, knowledge, values and attitudes in a holistic way.

(c) The design process

This is a creative and interactive approach used to develop solutions, to identify problems or human needs. It is part of the ‘technological process’. The skills associated with the design process are: investigate, design (development of initial ideas), make, evaluate, and communicate. The elements of the design process can be explained more fully as follows:

- *Investigate:*

Investigating a situation to gain information is an important starting point for technology. Research, or finding of information, takes place mainly at this point. The learner gathers data and information, grasps concepts and gains insight, finds out about new techniques, and so on. Skills needed for investigating include information accessing and processing skills, recording, identifying, predicting, comparing, observing, classifying, interpreting and collating.

- *Design:*

Once a problem is fully understood, the design brief needs to be written. Possible solutions should then be generated. These ideas may be drawn on paper. The first idea may not necessarily be the best, so it is better if several possible solutions are considered. This part of the design process requires the knowledge and skills related to graphics (e.g. use of colour, rendering techniques, two-dimensional and three dimensional drawings, planning, sketching, drawing, calculating, modeling) and managing resources. Once possible solutions are available, a decision must be made. The chosen solution will be the one that best satisfies the specifications. The learner is expected to justify the choices made. Final working drawings or sketches should then be prepared. These drawings should contain all the details needed for making the product or system – instructions, dimensions, annotated notes and so on. Testing, simulating or modeling the solution may be done at this stage, before final manufacture is carried out.

- *Make:*

This aspect provides opportunities for the learner to use tools, equipment and materials to develop a solution to the problem or need. It involves building, testing and modifying the product or system to satisfy the design specifications. The learner will cut, join, shape, finish, form, combine, assemble, measure, mark, separate, mix and so on. The ‘making’ should be according to the design, although it is acceptable to make modifications if necessary. Making must always be undertaken in a safe and healthy atmosphere and manner.

- *Evaluate:*

The learner needs to evaluate actions, decisions and results throughout the design process. The solutions and the processes followed to arrive at them, must be evaluated by the learner. Changes or improvements should be suggested where necessary. Some evaluation should be done against the criteria (e.g. constraints) that may be given or self-generated. This stage requires the use of probing questions, fair testing and analysing.

- *Communicate:*

The assessment evidence of the processes followed in any project – that is, the ability to analyse, investigate, plan, design, draw, evaluate and communicate – is presented. This could be done in oral, written, graphic or electronic form. A record of the design process from conception to realisation of the solution should be kept in the form of a Project Portfolio.

(d) Information and communication technology (2.11.1.4)

One of the features of a rapidly changing world is the communication of vast amounts of information and data. This has an impact on all aspects of modern life. Learners need to be equipped with knowledge and skills to be competent and confident in accessing various forms of information and data.

These skills are included in Learning Outcome 1 as Assessment Standards related to investigation (e.g. information gathering, storing, processing, management) and communication skills (e.g. presenting information, identifying sources).

The approach to information and communication technology focuses on the use of learning support materials and equipment to access, process and use information in the most appropriate ways.

Where resources are available, schools should interpret the use of information and communication technology as including the following skills:

- Word processing (skill needed in all learning areas);
- Spread sheets (skill needed mostly by Mathematics, Economic and Management Sciences);
- Database management (skill needed mostly by Social Sciences, Economic and Management Sciences);

- Graphics (skill needed mostly by Arts and Culture, technology, Languages, Social Sciences); and
- CD-ROM referencing (needed by all Learning Areas).

5.3.1.4.2 Learning Outcome 2: Technological Knowledge and Understanding

The learner will be able to understand and apply relevant technological knowledge ethically and responsibly. There are three core content areas in this Learning Outcome in the GET Band. They are Structures, Processing, and Systems and Control.

- *Structures (2.11.1.7)*

This area focuses on practical solutions that involve supporting loads and ways of making products that are stiff, 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, packing, transport, storage, and so on.

- *Processing (2.11.2)*

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. The learner should embrace a balanced range of materials in this content area in order to get broad feel of how materials and their properties interrelate (e.g. paper, resin, cement, sand, plaster of paris). The learner explores processing in various ways (e.g. moulding, drying, casting, extracting, preserving, heating, laminating, forming). These methods of processing are used to alter the properties of materials for the purposes of ennobling and enhancing (e.g. taste, texture, hardness, weather resistance). The learner engages with projects that establish a need in a processing context (e.g. a farm wishing to produce sun-dried tomatoes, a system for grinding grain).

- The assessment Standards under ‘Processing’ are written to allow for flexibility in the choice of material used. The learner does not have to engage with all the material and processes listed.

- Processing of many materials can be integrated with Structures or Systems and Control content areas.

- *Systems and Control:*

This content area is divided into mechanical systems (including hydraulic and pneumatic systems) and electrical systems.

- The study of mechanical systems focuses on producing movement in some way, and examines how energy sources can be used to power products to produce movement. In the higher grades, the learner should engage with the concept of mechanical advantage and how mechanical systems are used to achieve suitable speed, forces or drive ratios.
- The study of electrical systems focuses on the practical use of electrical energy in circuits to satisfy specific needs.

Electronics, covered at higher levels, is seen as closely related to electrical circuits but deals more closely with low current signaling and sensing.

The learner explores the Systems and Control content area through context like transport, lighting, household, devices, simple machines, and so on.

5.3.1.4.3 Learning Outcome 3: Technology, Society and the Environment (2.9.1.6)

The learner will be able to demonstrate an understanding of the interrelationships between science, technology, society and environment. All technological development takes place in an economic, political, social and environmental context. Values, beliefs and traditions shape the way people view and accept technology, and this may have a major influence on the use of technological projects. In choosing a technical solution, the costs and benefits of the choice must be taken into account. There is a need for learners to understand the interconnection between technology, society and the environment. As technology is now one of the central drivers of economic activity, every learner should have the opportunities and access to learning in technology. The provision of such opportunities should not discriminate against any learner (e.g. because of gender or disability).

The achievement of this Learning Outcome will ensure that learners are aware of:

- indigenous technology and culture: changes in technology over time, indigenous solution to problems, cultural influences;
- impacts of technology: how technology has benefited or been detrimental to society and the environment; and
- biases created by technology: the influences of technology on values, attitudes and behaviours (e.g. around gender, race, ethics, religion and culture).

5.4 APPLICATION OF NORMS AND STANDARDS AND REVISED NCS FOR GET (SCHOOLS) IN TECHNOLOGY TEACHER EDUCATION

In chapter three, the Norms and Standards policy described the roles and applied competences that educators should demonstrate as qualified educators. These norms and standards provide a basis for higher education to develop teacher education programmes that will be recognised by the Department of Education for purposes of quality assurance and accountability. The policy is a major landmark in the development of teacher education in South Africa at the dawn of democracy after 1994.

Publically funded teacher education qualifications must meet certain criteria in order to be approved as quality national programmes. A brief description of the criteria for the development of technology teacher education is provided below.

5.4.1 Purpose of the qualification (Department of Education, Norms and Standards for Educators: 2000)

- The purpose of the qualification states clearly the roles, specialism(s), level of study, target learners and employability.
- The purpose should be in line with national and local needs.
- The purpose informs the statement of applied competence, curriculum design and assessment strategy.

The purpose of technology teacher education is outlined according to the following competences:

- Knowledge of specialization;
- Applied and integrated teaching competence;
- Applied and integrated assessment.

A brief description of these competences in relation to technology teacher education follows

5.4.1.1 Knowledge of technology subject as specialisation

One of the applied competences that a newly qualified technology educator should demonstrate is the knowledge and understanding of the subject. The roles of educators and related applied competences are described in chapter three (see 3.3)

In technology teacher education the types of knowledge (foundational competence), skills (practical competence) and values and attitudes (reflexive competences) discussed are in chapter three (3.3). The applied competence for preservice teacher education in technology education can be summarised as an exit level outcome as follows:

Newly qualified educators should be able to demonstrate:

- capability in and an understanding of the knowledge, concepts and skills outlined in the Learning Outcome of Technology Learning Area (See also 2.8.1.1; 2.8.1.2 and 4.7.7)
- integrated knowledge and skills of technology knowledge content sufficient to teach learners at Intermediate phase. A depth of subject knowledge in two of the content knowledge areas (e.g. Electronic control systems, structures, mechanical control systems) is required to teach at Senior phase of GET band and beyond (2.9.1 and 4.7.8)

- knowledge and understanding of the National Curriculum Statement for the GET band including the National Qualification Framework and assessment standards in Technology Learning Area.

5.4.1.2 Applied and integrated teaching competence

The pedagogic knowledge in technology teacher education is equally important as the subject knowledge. Two of the seven roles of educators (learning mediator and leader) and applied competence focus on the pedagogic area of the educators (Table 3.5 and 4.7.12). The applied competence in the pedagogic area can be summarised as follows.

Newly qualified educators should be able to:

- reflect upon and demonstrate an understanding of the nature and purpose of technology education and how it contributes to learners' conceptual, creative and practical development (2.8 and 4.7.6).
- plan, manage and evaluate technology activities and lessons taking into account NCS assessment standards.
- ensure continuity and progression within and between classes and technology content knowledge at Intermediate and Senior Phase, reflecting and understanding of Foundation Phase and FET technology subjects (Department of Education draft FET NCS policy, 2002).
- employ a suitable range of teaching and learning strategies for technology activities.

5.4.1.3 Applied and integrated assessment

The assessment strategy is an integrated part of teaching and learning technology at school. Learners and teachers should know how the technology subject is assessed. According to the Norms and Standards for Educators, the assessment strategy should be reflected in the purpose and learning outcomes of the education programme. Applied competences provide a basis for assessment criteria (Norms and Standards for Educators, 2000:31). Evidence of assessment may be based on portfolios, case studies, class work, home work and observations of learners. Educators of technology should be able to:

- plan and carry out both formal and informal formative and summative assessment and record learners' achievements according to the requirements of NCS in technology; they should also be able to use such assessment to inform their teaching in technology (DATA, 1995:12);
- determine whether learning required to achieve learning outcomes has taken place;
- report to the learners, parents and to other role-players and stakeholders on the levels of achievement during the learning process and build learners' profile of achievement across the curriculum;
- provide information for the evaluation and review of learning programmes used in the classroom; and
- maximise the learner's access to the knowledge, skills, attitudes and values defined in the National Curriculum Statement Policy (Department of Education, 2000a:27).

According to Department of Education (2000a:27) effective assessment must be underpinned by the following principles:

The purpose of assessment must always be made explicit.

- A criterion-referenced approach must be used.
- Assessment must be authentic, continuous, multi-dimensional, varied and balanced.
- Assessment must be an on-going, integral part of the learning process.
- It must be accurate, objective, valid, fair, practicable, effective and time-efficient.
- Assessment must gather information from several contexts and use a variety of methods according to what is being assessed and what the needs of the learners are.
- The methods and techniques used must be appropriate to the knowledge, skills or attitudes to be assessed, as well as to the age and the development level of the learner.
- It must be bias-free and sensitive to gender, race, cultural background and abilities.
- Assessment results must be communicated clearly, accurately, timely and meaningfully.
- Evidence of progress in achieving outcomes must be used to identify areas where learners need support and remedial intervention.

The principle of assessment for learning underpins the concept of CASS (Continuous assessment). CASS is an ongoing process that measures a learner's achievement during the course of a grade or level, providing information that is used to support a learner's development and to enable improvements to be made in the learning and teaching process (Department of Education, 2000a:28).

5.5 THE PROPOSED CURRICULUM MODEL

The purpose of discussing the broad spectrum of curriculum models in chapter three as depicted by the continuum of curriculum models mentioned by Ndlovu (1997:62) was to make it possible to devise a curriculum model suitable for the purpose of this study which is *“The development of curriculum for technology teacher education and training: A critical analysis”*. The model proposed for the curriculum for technology teacher education is based on OBE. As a result the curriculum model is influenced by progressivism and social reconstruction (3.2.5.4).

The preceding discussion of curriculum development models has shown that they have been reviewed and modified over the years to suit the ongoing changes in education. Each curriculum model and approach has its strengths and weaknesses. In adopting a model for this study the main guiding feature has been the underlying philosophy of Outcomes-based education and critical outcomes for education in South Africa. The approach to the development of technology as a school subject according to the RNCS as well as the requirements for teacher programmes, according to the Norms and Standards policy for Educators is outcomes-based as opposed to content-based. The model adopted for this study has to have the following features:

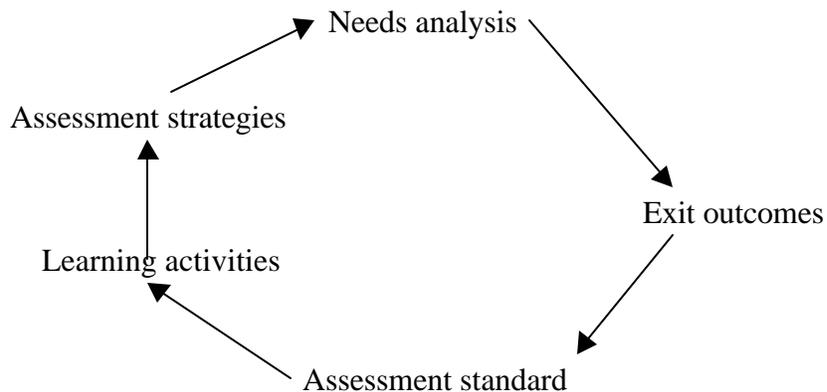
- The rationality of the outcomes-based model with its scientific approach and logical sequence. This means that the model is outcome-driven, based on tested knowledge accountability and follows certain steps, but not in a rigid way (Spady, 1993).
- The dynamism of the interactional model, with its inbuilt flexibility and creativity. This means that the model is open to various creative ideas to address the current challenges and encourage interactions (own emphasis).
- The in-between approach of the cyclical OBE model which draws on the strengths of the rational model while discarding its weaknesses. The model provides a cycle or a

spiral process which allows moving backwards and forward, but not in a linear pattern (own emphasis).

As indicated in section 5.1 below, the model that fits the OBE principles and approach and is therefore being adopted for this study is basically an OBE model. The structure of this cyclical model is adapted from Carl's model which is depicted in figure 5.1

The weakness of Tyler's rationale is the linear process that should be followed. However, Tyler indicated that his model should not be followed linearly (Ornstein & Hunkins, 1998:198). The model seems to be content-based whereas the OBE model moves towards outcomes-based. The proposed cyclic OBE model draws from Tyler's model of being purposeful, as well as deliberating and critical in curriculum development (Walker's and Eisner's approaches: chapter 3).

FIGURE 5.1
THE CYCLICAL OBE MODEL ADOPTED FOR THE STUDY



Source: Adapted from Carl (1986:93)

5.6 THE PROPOSED CURRICULUM

Now that all the fundamental aspects and elements of the technology teacher education curriculum proposed in this study have been identified and discussed, the curriculum document is presented. For clarity of presentation and understanding this is done through a schematic presentation with brief explanatory comments as well as cross referencing to sections within the thesis. The approach adopted is not prescriptive. It allows those who adopt the curriculum the latitude to fit in and include what is suitable and relevant to their particular situation.

FIGURE 5.2
A SCHEMATIC REPRESENTATION OF HOW THE VARIOUS SECTIONS AND ELEMENTS OF THE PROPOSED TECHNOLOGY TEACHER CURRICULUM FIT INTO THE CYCLIC OBE MODEL ADOPTED

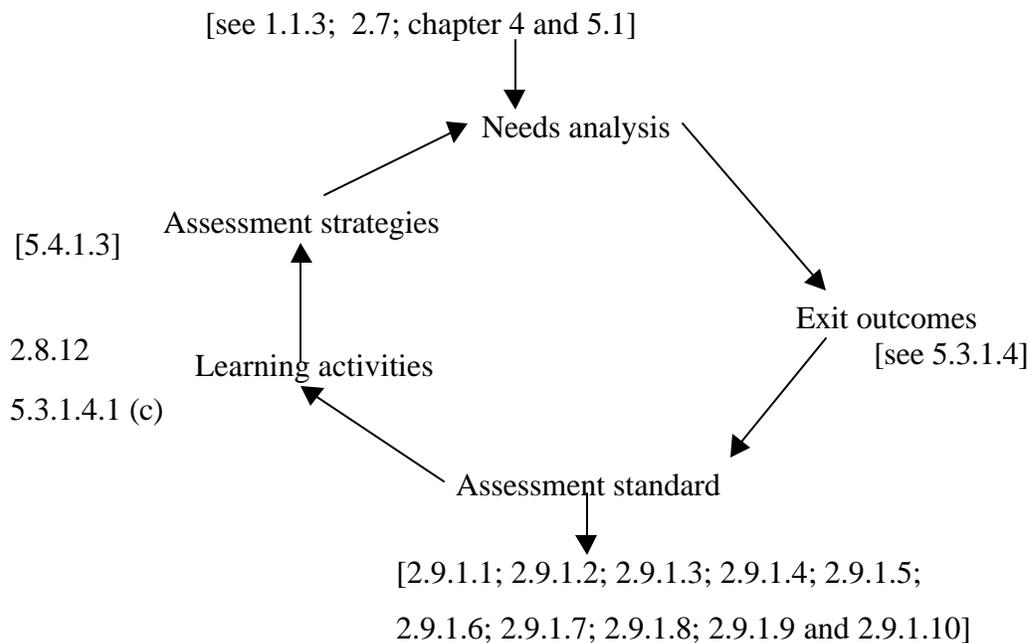


Figure 5.2 shows how the whole study was carried out leading to the cyclic OBE model of curriculum development which brings together the strengths of other models of curriculum development.

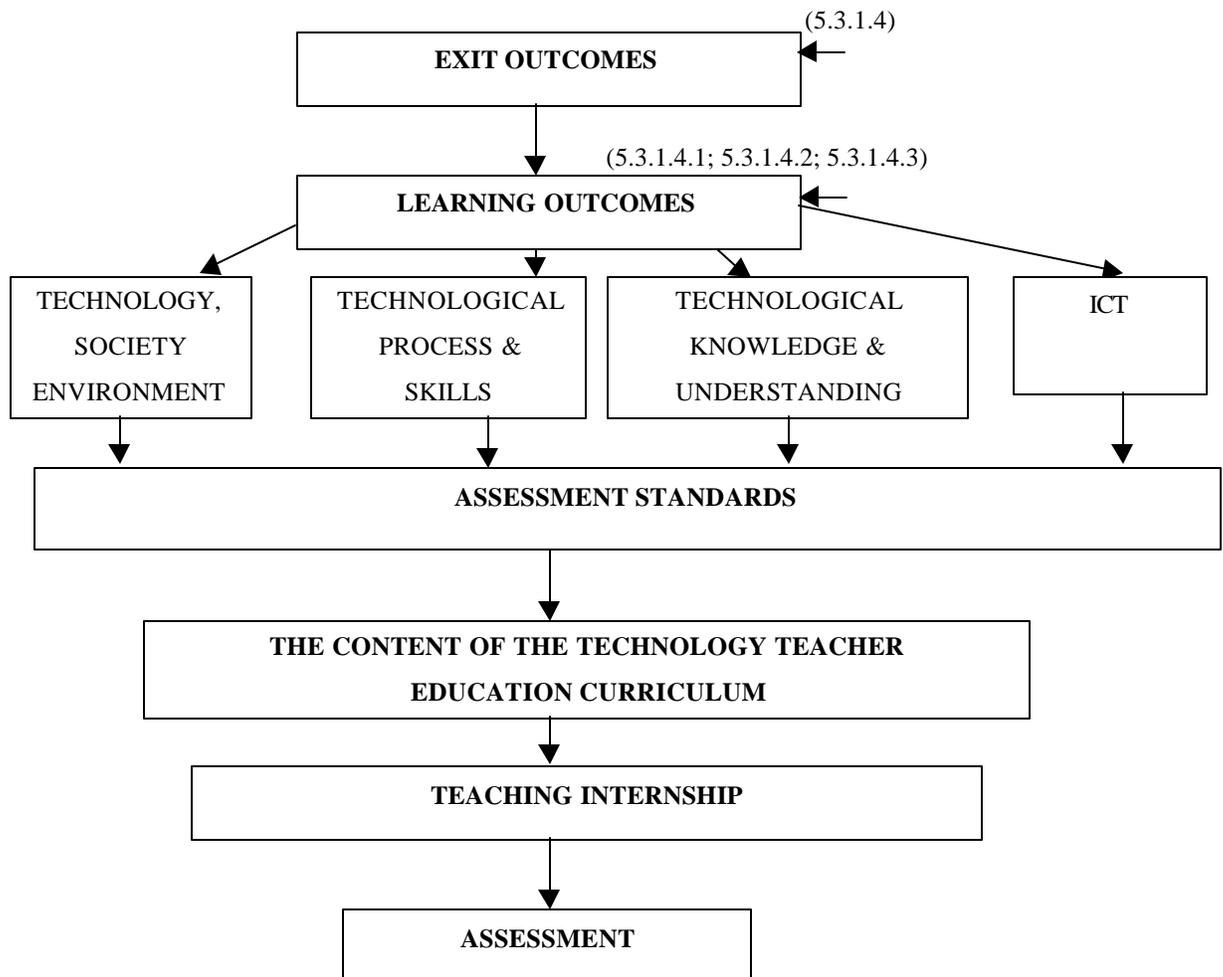
The major features of the cyclic OBE model as indicated in figure 5.2 are described as follows:

- First, the **needs analysis** which refers to these activities and forces that influence curriculum developers in their decision making. These activities and forces include the needs of society, that is, employer's needs; society's values and the economic milieu. These needs underpin the background context of this study leading to the fundamental research question stated in section 1.2. Furthermore, the empirical investigation conducted in chapter four strengthens the needs analysis by specifically determining the gap between what educators know and what they are supposed to know within the technology area.
- Thereafter, come **exit outcomes** of the cyclic OBE model of curriculum development which refers to the product/results or outcome of the learning process, that is, knowledge, skills and values/attitude within the curriculum of the technology teacher education. Within the context of this study exit outcomes are underpinned by the SAQA critical outcomes, National Curriculum of technology education in section 5.3 and Norms and Standards for Educators in section 3.3.
- Assessment standards describe the level at which the learning outcomes within exit outcomes should be achieved. They embody the knowledge, skills and values required to achieve the outcomes. The assessment standards of the proposed technology teacher curriculum are derived from chapter two.

- Learning activities are derived from assessment standards and content knowledge facilitated the learner’s acquisition of skills, roles and attitudes. This is derived from the National Curriculum discussed regarding technology in this chapter (5.3).

Figure 5.3 is a structure of the proposed technology teacher education curriculum outlining the four major anchors of the curriculum, namely, learning outcomes, assessment standards and content and how they logically relate to and grow out of each other.

FIGURE 5.3
A SCHEMATIC REPRESENTATION OF THE TECHNOLOGY TEACHER
EDUCATION CURRICULUM OUTLINE



5.6.1 Exit outcomes of the technology teacher education

The exit outcomes of the technology teacher education curriculum being proposed are informed by national needs which are captured in the SAQA critical and developmental outcomes [see 3.2.5.4(b)]. They emerged because of political, philosophical and cultural factors peculiar to a particular country, state or nation. The specific exit outcomes of the proposed technology teacher education and training curriculum are:

- Knowledge of technology education (see 5.4.1.1);
- Applied and integrated teaching competence (see 5.4.1.2);
- Applied and integrated assessment (see 5.4.1.3).

5.6.2 Learning outcomes

The learning outcomes of the proposed technology teacher education are logically derived from and further elaborate the exit outcomes given. The learning outcomes derived from knowledge of the Technology Learning Area are detailed in 5.3.1.4.1; 5.3.1.4.2; 5.3.1.4.3. The use of Information Communication and technology (ICT) enables the educator to:

- use information technology for communicating and data handling, e.g. use of databases, art, drawing, publishing and design packages;
- use information technology for modelling, controlling and manufacturing, e.g. computer-aided design and manufacturing (CAD/CAM).

Learning outcomes relating to teaching technology is detailed in 5.3.1.4.

5.6.3 Assessment standards

The proposed technology teacher education curriculum will provide student educators with the opportunity to enable the achievement of the learning outcomes mentioned. The assessment standards for each learning outcome will be given for each year.

5.6.3.1 Learning Outcome 1: Technology, society and environment

The student educator will be able to demonstrate an understanding of the interrelationships between science, society and environment.

Year One

- Explain how indigenous technology and cultures in South African history have used specific materials to satisfy needs.
- Express some reasons why products of technology affect the quality of people's lives positively and negatively.
- Express an opinion that explains how certain groups of society might be favoured or disadvantaged by technology products.

Year Two

- Compares how different indigenous technologies and cultures solved similar problems.
- Expresses and details opinions about the positive and negative impacts of technology products.

Year three

- Explore, compare and explain how different cultures across the world have effectively adapted technological solutions to meet their needs.
- Recognise and identify the impact of technological developments on the quality of people's lives and on the environment in which they live.
- Produce factual evidence about bias (e.g. gender, age, access) in making technological decisions, and suggests strategies for redress.

Year four

- Conduct research to identify community problems.
- Explore and evaluation African technologies with a view to improve them.

5.6.3.2 Learning Outcome 2: Technological process and skills

The student educator will be able to apply technological process and skills ethically.

Year one

- investigate the background context, the nature of the need, and the environment situations.
- investigate by performing simple practical tests relating to aspects of the technological knowledge areas (e.g. structures, materials and processing).
- write or communicate a design brief for the development of the product or system related to a given problem , need or opportunity.
- write design specifications and constraints for a solution.
- generate at least two alternative solutions and annotate the ideas .
- choose possible solutions.
- develop a plan for making an artefact (prototype, product) based on resources needed and dimensions stipulated.
- choose and use appropriate tools and materials to make products by measuring, marking, cutting and shaping with some accuracy.
- use safe working practices.
- evaluate the product or system based on criteria linked directly to the design brief and specifications and constraints.

Year two

- investigate the background context, nature of the need and the environmental situation.
- analyse existing products for relevance to safety; suitability of materials, fitness for purpose and cost.
- develop and perform practical tests in the technological knowledge areas (e.g. structures, materials and process).
- use appropriate technologies and methods to collect relevant data.
- write and communicate a design brief for the development of a product or system.
- develop product and design specification and constraints for a solution to an identified problem.
- generate alternative solutions related to the design brief, specifications and constraints.
- choose possible solutions.
- develop a plan for making a prototype product based on resources needed and dimensions stipulated.
- choose and use appropriate tools and materials to make products by measuring, marking, cutting, and shaping with some accuracy.
- make changes and adapt designs where appropriate to improve the quality of the finished product.
- use safe working practices when using materials and tools.
- test and evaluate the products or systems with some objectivity based on design brief, specifications and constraints.

Year three

- identify and define a problem, need or opportunity .

- analyse existing products relevant to an identified problem, need or opportunity based on safety, cost and manufacturing method.
- develop and perform practical testing procedures.
- use a variety of available technologies and methods to locate, collect, compare, sort and verify.
- develop and write a design brief for the development of a product or system related to a context, problem, need or opportunity based on people, purpose, appearance, environment and cost etc.
- generate a range of possible solutions.
- choose possible solutions based on well-reasoned argument related to specifications.
- develop plans for making a product, system based on resources.
- choose and use appropriate tools and materials to make designed products.
- use measuring and checking procedures while making to monitor quality and changes.
- demonstrate knowledge and understanding of safe working practices and efficient use of materials and tools.
- evaluate the product or system based on self-generated objective, design brief, specifications and constraints.

Year four

- Analyse other design process.
- Develop appropriate design process.
- Conduct action research in order to assist educators and learners with problem-solving and design process.
- Analyse technology education curriculum.

5.6.3.3 Learning Outcome 3: Technological knowledge and understanding

The student educator will be able to demonstrate an understanding of and apply technological knowledge and skills ethically and responsibly.

Year one

- demonstrate knowledge and understanding of structures .
- demonstrate knowledge and understanding of how materials can be processed to change or improve properties.
- demonstrate knowledge and understanding of mechanical systems.
- demonstrate knowledge and understanding of electrical circuits.

Year two

- apply knowledge and understanding of structures in designing and making bridges.
- apply knowledge and understanding of how materials can be processed to design and make structural products.
- demonstrate knowledge and understanding of how mechanical systems convert motion and force to give mechanical advantage.
- demonstrate knowledge and understanding of how electrical circuits with more than one input or control device work.

Year three

- apply knowledge and understanding of structures in designing and making product.
- apply knowledge and understanding of how materials can be processed to design and make structural products.
- demonstrate knowledge and understanding of interacting mechanical systems and sub-systems.
- demonstrate knowledge and understanding of how simple electronic circuits and devices are used to make and output respond to an input signal (e.g LED, transistors, thermistors etc.).

Year four

- Investigate and analyse mechanical and electrical systems.
- Develop relevant systems to solve problems for a particular community.
- Demonstrate and apply entrepreneurialship skills.
- Embark on and guide the community in business projects.

5.6.3.4 Learning Outcome 4: Graphical communication

The student educator will be able to demonstrate an understanding and apply a variety of graphical communication techniques in the design and making of products.

Year one

- use a variety of graphic strategies and techniques (e.g. sketching, scaled and annotated drawings) and record and communicate progress .
- present ideas (in project portfolio) using two-dimensional or three-dimensional sketches, circuit diagrams or system diagrams.

Year two

- use a variety of graphic strategies and techniques including computer-aided design (CAD) to record and communicate progress.
- present ideas (in project portfolio) using two-dimensional or three-dimensional sketches, circuit diagram or systems diagrams.
- choose and use appropriate knowledge to produce project portfolios and poster presentations suitable for the target audience.

Year three

- use in addition to traditional techniques, the CAD/CAM technologies to communicate designs.
- present ideas (in a project portfolio) using formal drawing techniques, in two-dimensional or three-dimensional sketches, circuit diagrams or systems diagrams.
- choose and use appropriate technologies to produce project portfolios, poster presentations, case studies, reports etc. to a target audience.

Year four

- Conduct action research in technology education.
- Analyse technology education curriculum.

5.6.3.5 Learning Outcome 5: Applied and integrated teaching competence and internship

Student educators will be able to demonstrate an understanding of and apply teaching and learning competences in their professional development.

Year four

- develop the pedagogic knowledge required according to the roles and competence of educators (see section 2.6 Norms and Standards for Educators).
- apply didactic skills in the teaching of technology at school during the internship period under the supervision of experienced educator.
- structure their teaching and students learning to provide opportunities for work with industry, commerce and the local community.

5.6.4 The content/context to be used to achieve assessment in the technology teacher education curriculum

The content of the technology teacher education curriculum has been discussed (see section 2.9). Below is a list of the content in a condensed manner. The sequence of the content coverage is not important because the curriculum is outcome-based in that the assessment standards and the relevant content are outlined in a progression form one year to the other. That means, the same content can be used in an advanced way through progression. The list of content is as follows:

- Safety;
- First Aid;
- Materials;
- Graphic communication (e.g. free hand drawing, CAD/CAM etc.);
- Technology, pollution prevention and environment;
- Man, society and technology;
- Structure;
- Mechanism;
- Energy;
- Food technology: natural and processed;

- Technological process;
- Context of technology includes: home, school, community, district, province, national urban, rural and industry;
- Pedagogic knowledge;
- Didactic knowledge in technology education.

Technology education is relatively a new subject in South African schools. To ensure effective teaching and learning of the subject at schools, educators of this subject should be well trained. Similarly, the trainers of technology educators at higher education institutions should have also undergone through the relevant training.

5.6.5 Teaching internship in technology education

Internship is basically a new component of the teacher education curriculum which is becoming compulsory at the fourth year of training. It will be carried out for six months at schools. This is done to provide quality teachers in all school subjects because of concern about poorly trained teachers over the past years (Makgato, 1999:3).

For internship to be effective in technology teacher education it is important that the following is taken into account:

- The school supervisors/mentors should be well trained for their tasks.
- The student educators should spend most of the time in a well equipped technology laboratory or class with the school learners under the supervision of experienced educator in technology.
- There has to be joint planning and constant or regular interaction and consultation between the higher education institution and school supervisors.

- These has to be a deliberate move to separate supervision and assessment to give student educators the latitude to experiment with a variety of teaching and learning methods and approaches without fear of being marked.

5.6.6 Assessment

The assessment framework of the Revised National Curriculum for schools is based on the principles of Outcomes-based education. Assessment should provide indications of learner achievement in the most effective and efficient manner, and ensure that learners integrate and apply knowledge and skills. Assessment should also help learners to make judgements about their own performance, set goals for progress and provoke further learning. (Department of Education, 2002:53). Assessment in OBE refers to methods and techniques that do not focus only on pen-and-paper-tests or a narrow measurement of learner's achievements, but on alternative assessment, performance assessment, holistic assessment, and observation assessment.

The assessment in technology teacher education is based on formal assessment during the year and summative assessment at the end of the year. During the year the assessment strategies are based on, inter alia, assignments, tests, case, studies and technology portfolios. However, the assessment at the end of the year is based on a pen-and-paper examination of three hours.

5.7 SUMMARY

As the study suggests, this chapter has developed a model curriculum for a technology teacher education through the presentation of the major elements of the OBE curriculum which are: needs analysis, exit outcomes, assessment standards, learning activities and assessment strategies. The model was further used to develop a proposed curriculum for technology teacher education. The proposed curriculum is offering proposed content to achieve the assessment standards in order to achieve the learning outcomes. It allows the implementer of the curriculum freedom in the choice of approaches where necessary. The objective in adopting a flexible approach, rather than a prescriptive one, is to allow higher

education institutions who want to adopt the suggested approach to develop curriculum documents or course programmes for INSET training to suit their particular individual situation.

The next chapter entails a general overview of the study. It makes concluding remarks and some general recommendations that can be helpful to higher education institutions, schools and the department of education.

CHAPTER SIX

OVERVIEW, RECOMMENDATIONS, RECOMMENDATIONS FOR FURTHER RESEARCH AND CONCLUSIONS

6.1 OVERVIEW

This study aimed at the development of a curriculum model and a technology teacher education and training curriculum based on this model to be used by higher education institutions to train technology teachers for schools, particularly in the GET band (Grade R-9) in South Africa.

Modern technology involves higher cognitive processes such as creating, designing, and modelling in conjunction with practical problem-solving tasks. In order to have an understanding of technological development which is aimed at responding to the technological challenges, a historical development of technical education and teacher development was discussed (see chapter 2). In the examination of the current situation regarding technical teacher education, the views of educators and learners gathered through a survey were analysed. The development of modern technical education led to the rationale for technology education. The exploration and analysis of the purpose of technology education, the essential features of technology education as well as the Norms and Standards for Educators policy document logically prepared the ground for the development of the proposed curriculum for technology teacher education and training. In order to develop this curriculum, conceptions of curriculum development were explored based on research in the field of curriculum theory and practice (**consult chapter three**). This was done to give the theoretical context in which the proposed curriculum is embedded. This cognitive framework makes it possible for one to be aware of curriculum issues that need to be addressed to achieve the aim of the study. The empirical investigation was done particularly to determine the gap between what educators presently know in technology education and what they should know. This needs assessment will assist in the designing of knowledge content, skills and values of the technology teacher education and

training curriculum (**see chapter four**). This needs assessment conducted to educators prepared the ground for the development of the proposed curriculum (**see chapter five**).

6.2 RECOMMENDATIONS

In the light of the findings listed in chapter four and the literature study, the following recommendations are made.

6.2.1 The adoption of the proposed curriculum model and curriculum for technology teacher education and training

The major recommendation is for the adoption of the curriculum model and curriculum for technology teacher education and training that has been developed in this study. Its adoption can take a number of forms. Firstly, there could be the realisation and acceptance by some higher education institutions who want to participate in the implementation of the Revised National Curriculum Statement from 2004, to have a fully developed technology teacher education and training curriculum. This is fundamental as it was one of the researcher's major aims in carrying out this study, that is, to indicate the need for this curriculum and how it could improve the quality of implementation of the Revised National Curriculum at schools. Secondly, the adoption of the proposed curriculum model could take the form of adopting the developed cyclic OBE model, the principles, the content knowledge and elements suggested. These could be used as a point of departure in developing a curriculum for technology teacher education and training that is most suited to the particular prevailing conditions at schools and higher education institutions. Thirdly, this proposed curriculum that has been developed can be adopted in its entirety, with minor modifications, to suit prevailing specific conditions in a particular higher education institution, as well as the implementation needs of the Revised National Curriculum at schools.

The adoption of the proposed curriculum that has been developed has the following implications:

- **Effective teaching and learning of the content/concepts of the technology education**

The researcher had the opportunity of being involved in managing the transition project of the Department of Education where educators are learning how to infuse the OBE approach into the current curriculum. It was noticed that some educators who teach Curriculum 2005 technology do not have technical knowledge or any technological background. Technology education, particularly at the senior phase of GET band requires that educators have expertise in technology education or have acquired technical knowledge and skills in electrical and mechanical fields. A well developed curriculum for technology teacher education and training makes it possible for technology education at schools to be effectively taught, provided that adequate lecturers with the necessary expertise in the area be available. This implies that lecturers involved in teacher training in technology education should have a thorough understanding of the technological process of designing and making prototypes and products.

- **Allocation of adequate time for design and projects**

The nature of technology education is that of design and make of technical products using technical knowledge and skills. This implies that the teaching and learning of technology is that of a project-based approach. This requires sufficient time to accomplish. It is recommended that a total of at least four hours per week be allocated to the teaching and learning of technology at schools.

- **The development of a partnership between schools and industry**

Owing to rapid technological changes, it is imperative that technology educators understand the needs of industry at all times. This implies that there should be programmes for partnerships and industrial tours by both learners and educators. From the senior phase of the GET band to the FET band learners should be involved with community and industry

design projects. In this case, the partnership will increase the enterprising culture which is fundamental in the technological products designed and made by learners (Shimeld, Curtain & Blight, 2001:1).

6.3 SUGGESTIONS FOR FURTHER RESEARCH

Research in education is never ending. The mentality that should control education specialists is the one that says if there is nothing wrong with education, people should be looking into possibilities of improving it before wrong happens. In the case of technology education, and education in general, one can say there is already something wrong because of findings and recommendations in the Report of the Review Committee on Curriculum 2005. The main focus should be on how can schools be helped to improve the teaching and learning of technology. The following areas are recommended for further research:

- Evaluation of the implementation of the proposed curriculum of technology teacher education and training.
- Evaluation case studies of the teaching and learning of Technology Learning Area at schools in terms of the following areas:
 - Technological capability;
 - Problem-solving;
 - Modelling;
 - Children learning in design;
 - Gender issues in the curriculum;
 - Assessment issues (CASS).
- The continuation of the GET senior phase technology and the FET technological subjects in terms of the concept of design and make process.

- The relation between schools and industry to establish an enterprising culture in the technology projects.

6.4 CONCLUDING REMARKS

6.4.1 A need to review existing technology teacher education and training curricula

In the process of developing a curriculum for technology teacher education and training for higher education institutions, it became apparent that the existing technology teacher programmes need to be reviewed, especially now that the National Curriculum Statements Grades 10-12 (schools) is completed. The review would make it possible for teacher educators at higher education institutions to evaluate the courses being taught as well as the approaches being used to teach them. Time is now opportune for teacher educators (lecturers) to develop teacher education programmes through research into the field rather to react directly to curriculum policy and political interventions.

6.4.2 A need to improve the higher education institution-school relationship

Current world trends requires higher education institutions to develop partnerships with schools thereby opening new ground for lecturers from schools of education or relevant departments to work towards building a positive relationship with schools. This would enable lecturers to conduct action research and case study research in order to improve teaching and learning at schools. It was clear during the administering of questionnaires to schools that several educators are eager to have partnerships with higher education teacher educators to assist with the teaching and learning of technology which is currently a new learning area at South African schools. Education departments at higher education institutions should meaningfully involve teachers in teacher education, as has been in the past, by involving them in teaching practice. For the partnership to be of benefit to both parties, there should be equality of power with the partners sharing responsibility and

benefits. The existing partnership through community service by higher education institutions can always be improved.

6.4.3 The conceptualisation of a technological process in technology

The conceptualisation of the design and make process is the essential component of technology education. All other components (concepts, skills attitudes) of technology are driven by the process of designing and making a product (TASA, 2003). This study made it possible to examine these important aspects of technology education which form the content of the curriculum for technology teacher education and training (see 2.8; 2.9.1; 2.9.2 and 2.9.3). These sections provide details of the development of the body of knowledge in technology.

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APPENDIX 1

INTRODUCTORY LETTER REGARDING QUESTIONNAIRES TO EDUCATORS

P.O. Box 58134
Karenpark
0118

Dear Colleague

I am presently conducting a study titled: **THE DEVELOPMENT OF CURRICULUM FOR TECHNOLOGY TEACHER EDUCATION AND TRAINING: A CRITICAL ANALYSIS**

The national curriculum statement for schools in the GET band has just been released as a national schools policy. The policy contains the school learning area or subjects including Technology, in a form of Learning Outcomes and Assessment Standards. The national curriculum has implications in teacher education and professional development.

This study is aimed at developing curriculum programme for training Technology teachers. Therefore your sincere respond and additional comments are highly appreciated. You have been purposefully selected to participate by responding to the attached questionnaire. It will take you approximately 20 to 30 minutes to respond to the questionnaire.

All principles of confidentiality will be adhered to.

May I thank you in advance for your time that you will spend in responding to the questionnaire.

Yours faithfully

M. Makgato

Tel : 799 9394

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APPENDIX 2

INTERVIEWS CONDUCTED IN GREAT BRITAIN

INTERVIEWS CONDUCTED REGARDING THE DESIGN AND TECHNOLOGY IN
UK

**1. UNSTRUCTURED INTERVIEW/DISCUSSIONS WITH DR DAVID
BARLEX ON 08 JULY 2002 AT NUFFIELD CURRICULUM PROJECT
CENTER IN EUSTON, LONDON**

The main question was around the factors that are considered in the development of D & T teacher education curriculum

A background of SA situation regarding the C2005 and the latest Revised NCS including Technology was highlighted to Barlex.

- Dr Barlex gave an outline of D &T at schools in grade 1 to grade 10 i.e KS1 - KS4 (up to 14 yrs of age)
- At KS1 - KS4 learners learn integrated D&T i.e design process in Food, Materials, Systems and Control & Textile.
- They learn these from different teachers, which is disturbing because educators don't get to know learners properly.
- To secure enough time learners do design and make at least 3 days a term in a year
- Due to shortage of educators in D& T a support of professional development by Nuffield center is provided in a form of teaching materials on CD rom (Primary solutions in D&T) as a teachers handbook
- At secondary school learners study distinct, specific D&T e.g choose between Food, Textile, System & Control, Materials depending on the human resource at school
- Engineering manufacturing differ with that of D&T, but there is some overlapping

How do go about developing D&T curriculum for teacher education.

- You can hold group discussions with few teachers
- If you use a questionnaire, it is better they complete and you take immediately
- In questionnaire you can include questions covering, Knowledge, Skills and Pedagogy (strong point)
- Use NCS Technology and Norms and Standard for educators as a point of departure for drafting questions

On the question of Technology survey at schools you may include questions around

- Resource availability
- What is technology
- Do you understand the rationale of introducing technology at schools
- Do you think technology is important
- Do you teach technology at school - if No, why, If yes do you enjoy it
- Are you familiar with the NCS of Technology

Look at DATA website for annual survey for D &T or phone Jill Keast to

Idea of forming Technology Education Association (TEA) will be good , you may include such idea in the questionnaire, See model of DATA

The purpose of association will be to promote designing in the youth

Technological awareness may be done by developing leaflet etc., see the pamphlet of D&T

2. 09 JULY 2002 : UNSTRUCTURED INTERVIEW WITH MARIAN DAVIDSON AND PATRICIA MURPHY AT OPEN UNIVERSITY IN MILTON KEYNES

- Both are involved in evaluation of D&T materials from supporting groups e.g D. Barlex
- Marian explained the research methodology used to gather data from teachers. They use Observation, Video recording the teacher with the whole class as well as 4 learners doing the project
- Audio recording interview of learners (how they feel about the task). See the given reports

3. 15 JULY 2002 : MEETING WITH RUTH WRIGHT AT LONDON CITY, THE ENGINEERING COUNCIL MEMBER FOR SCHOOLS

- Ruth is responsible for schools sector
- Ruth ensures that the standards of GCSE & Vocational engineering education (14 - 16 ages), and post 16 is according to engineering council requirements
- She is also responsible for D & T (14 - 16) and post 16

- Further education colleges are very much responsible for providing engineering education to youth and adults (apprenticeship)
- See materials given

4. 16 JULY 2002: MEETING WITH IAN HOLDSMITH, SENIOR LECTURER AT MIDDLESEX UNIVERSITY

- Ian Holdsmith explained how they trained educators for D&T (GCSE) schools sector.
- They recruit candidates teachers who have undergraduate degree in Product design, Electrical engineering
- The student teachers undergo through a PGCE in D & T, it is a partnership programme schools (under mentor)
- In such a training teachers spend 30% at the university and 70% at schools
- At the university they learn all the national school curriculum field of knowledge (e.g System & Control) and the Core curriculum (Design and making process)
- Study the tta standards: 139/9 - 00; 36/5 -99 and TPO 0803/02 - 02
- In their program development the Middlesex take the tta teacher standards which is general plus D&T national curriculum and implement it to ensure that the trainee teachers knows and apply those standards through their assessment systems.
- Ian said that they chose this model because it produces well qualified D&T teachers than the one of taking learners fresh from school.

5. 17 JULY 2002 : MEETING /DISCUSSIONS WITH COLIN CHAPMAN (WHO REPRESENTED PETER GROOVE) AT SHEFFIELD HALLAM UNIVERSITY

- Colin explained that they have 3 yrs, 2yrs and 1 year (PGCE) D & T teacher education programme
- The programme is in such a way that in the 3rd yr, 2nd yr and PGCE students teacher do the same courses/ curriculum - see outline of the programme/document given
- He stated that they do other programmes/projects to support schools in D & T
- According to Colin NVQ (Vocational engineering) is starting to be replaced by GCSE D &T at KS4
- The old type of manufacturing of skills based start to shrink and replaced by D&T design using the computer tools e.g CAD/CAM

**6. 18 JULY 2002 : MEETINGS/DISCUSSIONS WITH FRANK BANKS
(SUB-DEAN EDUCATION & LANGUAGE AT OPEN UNIVERSITY)**

- Frank was part of HEDCOM Technology 2005 invited to promote Technology at schools. During that period he proposed a Macdonald model to SA schools, the cost was too high and it was accepted.
- He presented a paper on mix model modes of approaches to technology teacher education curriculum (see his paper)

**7. 18 JULY 2002 MEETING/DISCUSSIONS WITH STEVE LUNN OF OPEN
UNIVERSITY AT 16:00**

- Steve is involved in research of evaluating different strategies applied by companies to 7 regions of UK introduced to promote the teaching of Electronics at schools - the initiative is called Young Foresight (see given document/report)

APPENDIX 3

QUESTIONNAIRES FOR EDUCATORS

**QUESTIONNAIRE ON TECHNOLOGY TEACHER EDUCATION CURRICULUM
FOR TEACHERS AT SCHOOLS**

PLEASE READ THE INSTRUCTIONS IN EACH SECTION BEFORE ANSWERING.

SECTION A

PERSONAL DETAILS

Respond to the following questions by putting the relevant number in a square in the right hand column that suits your personal particulars .

1. QUALIFICATIONS

STD (Technical)	1
ND : Technical education	2
National Technical Diploma	3
NHD : Technic	4
B Tech: Educati	5
First degree	6
Postgraduate qualification	7
Other (specify)	8

2. YEARS TEACHING EXPERIENCE

0-3 years	1
4-7 years	2
8-11 years	3
12-15 years	4
16-19 years	5
20 years and more	6

3. AGE

Less than 20 years	1
21-25 yrs	2
26-30 yrs	3
31-35 yrs	4
36-40 yrs	5
41-45 yrs	6
46-50 yrs	7
51-56 yrs	8
57 yrs and above	9

SECTION B

1. ATTITUDES TOWARDS TECHNOLOGY

1.1 Please indicate the extent to which you agree with the following statements

Provide your choice to each statement truthfully by writing a relevant number in a square in the right hand column.

The numbers have the following meaning:

- 5 = Strongly Agree
- 4 = Agree
- 3 = Do not agree
- 2 = Disagree
- 1 = Strongly Disagree

1.1.1 When something new is discovered, I want to know more about it immediately

1.1.2 I would enjoy teaching technology education

1.1.3 There should be education about technology

1.1.4 Technology causes large unemployment

1.1.5 Technology as a subject should be taken by all learners

5 = Strongly Agree 4 = Agree 3 = Do not know 2= Disagree 1 = Strongly Disagree

1.1.6 Technology is good for the future of this country

1.1.7 Technology makes everything work much better

1.1.8 You have to be intelligent to study technology

1.1.9 Technology is very important in life

1.1.10 Everyone needs technology

1.1.11 Technology has brought more good things than bad things

1.1.12 The world would be a better place without technology

1.1.13 Boys are more capable of doing technological jobs than girls

1.1.14 Learn technology only when you are good at both mathematics and science

1.1.15 Technology does not need a lot of mathematics

1.1.16 Because technology causes pollution, we should use less of it

1.1.17 Technology is a subject of the future

COMMENTS:

2. RATIONALE FOR TECHNOLOGY EDUCATION

2.1 Please indicate the extent to which you agree with the following statements

Provide your choice to each statement truthfully by writing a relevant number in a square in the right hand column.

The numbers have the following meaning:

5 = Strongly Agree

4 = Agree

3 = Do not know

2 = Disagree

1 = Strongly Disagree

2.1.1 The abilities to solve problems through design and use of technologies improves the quality of human life

2.1.2 Quality of life is directly related to an ability to creatively develop new technologies

2.1.3 Science and technology play a big role in the economic and social development in today's world

2.1.4 Science and technological literacy must be given priority as an essential component of education

2.1.5 Technology is an important part of our daily life

2.1.6 Technology education at high schools (FET: grade 10- 12) should be distinct specialized field of study

2.1.7 Design and make should be the methodology of teaching technology education

2.1.8 Technology education at FET schools should focus on acquisition of specific technical skills

2.1.9 To survive in a technological world, technological literacy is needed

2.1.10 Technology education can help learners to make informed choices in their further education

2.1.11 Technology education develop problem solving skills which may be used in all aspects of life

2.1.12 Technology education train learners to design and develop technological products to trade on international markets

2.1.13 Technology education equip learners with thinking, problem-solving and decision-making skills to enable them to address community needs

2.1.14 Technology education should be integrated with technical/vocational subjects at FET schools

COMMENTS

3. PURPOSE OF TECHNOLOGY EDUCATION

3.1 Please indicate the extent to which you agree with the following statements

Provide your choice to each statement truthfully by writing a relevant number in a square in the right hand column.

The numbers have the following meaning:

5 = Strongly Agree

4 = Agree

3 = Do not know

2 = Disagree

1 = Strongly Disagree

3.3.1 To develop and apply specific skills to solve technological problems

- 3.1.2 To understand the concepts and knowledge used in Technology
-
- 3.1.3 To develop creativity thinking and inventiveness in design and production of practical projects
-
- 3.1.4 To produce, maintain, and repair products, and systems in technological fields of interest
-
- 3.1.5 To use correct terminology and language in identifying machine parts and describing process
-
- 3.1.6 To provide employment, with marketable technical skills and knowledge
-
- 3.1.7 To service technical occupation, through exploration of various technological fields and concentration in a field of learner's choice
-
- 3.1.8 To provide learnership and trades, through mastery of a specific technology
-
- 3.1.9 To prepare for entering the workplace or post-secondary education
-
- 3.1.10 To promote a well-organised teamwork for complex industry-oriented projects
-
- 3.1.11 To enable learners to cope with the challenges of a technological society
-
- 3.1.12 To enable learners to explore both the positive and negative impacts of technology on their political, social, economical and biophysical environment.
-

4. KNOWLEDGE OF TECHNOLOGY EDUCATION

5 = Strongly Agree 4 = Agree 3 = Do not know 2= Disagree 1 = Strongly Disagree

- 4.1 The following knowledge should be covered in the study of technology
-

- 4.1.1 Structures which involve making products that are stiff, stable and strong when forces are applied to them
-
- 4.1.2 Resistant materials and processing which involve practical ways in which materials may be processed or manufactured
-
- 4.1.3 Control and systems which is divided into mechanical systems (hydraulic and pneumatic systems) and electrical system
-
- 4.1.4 Understanding of the interrelationships between science, technology, society and the environment
-
- 4.1.5 Understanding of the various technological process used in the designing of products, artifacts and prototypes as a solution to human needs
-
- 4.1.6 Understand energy types and use the concepts of energy transfer, conservation and efficiency
-
- 4.1.7 Understand the current rationale for Technology education within the national curriculum
-
- 4.1.8 Understand the historical development of technology education through curriculum projects such as HEDCOM Technology 2005 and other key influences
-
- 4.1.9 Understand the nature of technology education within GET and FET bands at schools.
-

4.2 Teachers of Technology education at FET schools is should specialize in the following **technological areas**:

	YES	NO	DO NOT KNOW
▪ Materials technology			
▪ Information technology			
▪ Electronics and control technology			
▪ Biotechnology			
▪ Structures and mechanisms			
▪ Process and production technology			
▪ Food technology			
▪ Hydraulics and pneumatics			

4.3 Learners at FET schools should specialize as an elective course in one of the following **specific field** of technology:

	YES	NO	DO NOT KNOW
a) Agriculture			
b) Aeronautical			
c) Automotive			
d) Civil and building			
e) Electrical			
f) Electronics			
g) Metallurgical			
h) Mechanical			
i) Mining			

4.4 Learners at FET schools should do practicals on **manufacturing and assembly** simulating industrial practice on the following areas:

	YES	NO	DO NOT KNOW
a) Wood products			
b) Textile products			
c) Packaging & paper products			
d) Metal products			
e) Graphic arts and printing			

f) Glass, crockery and pottery products			
g) Automotive components			
h) Biotechnological systems			
i) Electrical & electronic products			
j) Plastic products			

5. TECHNOLOGICAL PROCESS AND SKILLS IN TECHNOLOGY EDUCATION

5.1 Learners should develop some core **design skills through projects that are need driven**. Indicate the extent to which you agree with the following skills associated with the design process:

Please indicate the extent to which you agree with the following statements by writing a relevant number in a square in the right hand column.

Provide your choice to each statement truthfully by writing a relevant number in a square in the right hand column. The number has the following meanings

5 = Strongly Agree 4 = Agree 3 = Do not know 2 = Disagree 1 = Strongly Disagree

5.1.1 Identify and clarify design problems

5.1.2 Produce design briefs and specifications to model and generate solutions

5.1.3 Investigate a situation to gain information during design process

5.1.4 Making using tools, equipment and materials to develop a solution to the identified problem

5.1.5 Evaluate actions, decisions and results throughout the design process

5.1.6 Communicate using graphic strategies and techniques including sketching, scaled and annotated drawings and electronic form according to written or oral instructions

COMMENTS:

6. PEDAGOGIC KNOWLEDGE

Please indicate the extent to which you agree with the following statements

Provide your choice to each statement truthfully by writing a relevant number in a square in the right hand column.

The numbers have the following meaning:

5 = Strongly Agree 4 = Agree 3 = Do not know 2= Disagree 1 = Strongly Disagree

- | | | |
|-------|--|--------------------------|
| 6.1.1 | Teaching technical knowledge and understanding, design strategies, and practical techniques and skills | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.2 | Develop learners' conceptual understanding | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.3 | Questioning strategies, instruction and demonstration, facilitating to meet learner's needs | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.4 | Plan and implement technology activities that motivate both boys and girls, avoid unjustified assumptions about gender differences. | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.5 | Plan and implement technology activities in a manner that recognizes and values the different cultural origins of learners | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.6 | Involve local industry and the community, and the materials produced by local and national industry to enhance the relevance of the national curriculum in Technology. | <input type="checkbox"/> |
| <hr/> | | |
| 6.1.7 | Select, use and produce a range of appropriate resource to support teaching and learning | <input type="checkbox"/> |
| <hr/> | | |

6.2 The following types of assessment are important to enhance individual growth, development and monitor the process of learners:

6.2.1 Baseline assessment of prior learning which establish what learners already know

6.2.2 Diagnostic assessment which is used to determine the nature and cause of barriers to learning experienced by specific learners

6.2.3 Formative assessment which monitors and supports the process of learning and teaching

6.2.4 Summative assessment which provide an overall picture of learners' process at a given time e.g. end of term of year .

Thank you for your cooperation