THE INTEGRATION OF TECHNICAL SUBJECTS IN CIVIL TECHNOLOGY CURRICULUM WITH SPECIAL REFERENCE TO FET TECHNICAL SCHOOLS

By

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DECLARATION

I KHOJANE GEOFFREY MOKHOTHU [redacted]), declare that this dissertation titled: "**The Integration of Technical Subjects in Civil Technology Curriculum with Special Reference to FET Technical Schools";** which I submit for the Degree of Master of Education at the Central University of Technology, Free State is my own work and has never been submitted by me for a degree at this or any other tertiary institution. I also declare that, all references used in this dissertation have been cited and acknowledged.

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KHOJANE GEOFFREY MOKHOTHU Date

DEDICATION

This study is dedicated to my mother, Mashibe and my children, Kganya, Keketso, Keletso and Kutloano for their support, patience and understanding during my study. Also dedicated to my late beloved grandparents, Fine and Cecilia Matsekane for their efforts and encouragement they gave me to achieve best education.

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ABSTRACT

The main aim of the study was to investigate the integration of technical subjects in Civil Technology curriculum with special reference to FET Technical Schools in the Free State, South Africa. The research had used mixed method approach comprised of qualitative as well as quantitative methodology to collect data. The method of investigation included a literature review, empirical study by using qualitative and quantitative method in the form of questionnaires and purposive sampling and semi-structured interview.

The sample in the research was twenty one (21) teachers responsible for teaching Civil Technology in grades 10-12 from schools in the five districts of Free State province: Fezile Dabi, Motheo, Lejweleputswa, Thabo Mofutsanyana and Xhariep. The study revealed that majority of teachers did not receive formal training on the new Civil Technology Curriculum, therefore, majority of teachers highlighted that they took initiatives of self-training and development on the subject which had made challenges of the subject more interesting.

The quantitative responses were analysed by the employed statistician using SPSS computer software and interpreted by the researcher and reported. Qualitative data; semi-structured interviews were recoded, transcribed and analysed by the researcher. The study found that teachers define Civil Technology as a subject that gives the general background of Civil engineering or building environment. The teachers suggested that the Department of Basic Education should provide them with full course training on applied mechanics of the subject and to keep the current curriculum of Civil Technology for Mathematics and Science stream and to implement new Civil Technology specialisation for the new stream of Technical Mathematics and Technical Science.

LIST OF ACRONYMS

AS	Assessment Standard
C2005	Curriculum 2005
CAPS	Curriculum Assessment Policy Statement
CK	Content Knowledge
CT	Civil Technology
DBE	Department of Basic Education
DoE	Department of Education
DST	Department of Science and Technology
EMIS	Education Management Information Systems
FET	Further Education and Training
FETC	Further Education and Training Certificate
FSDoE	Free State Department of Education
GET	General Education and Training
HET	Higher Education and Training
HOD	Head of Department
ITEA	Internal Technology Education Association
LPG	Learning Programme Guideline
MET	Manufacturing Engineering and Technology
MSE	Micro and Small Enterprises
NATED	National Technical Education
NCS	National Curriculum Statement

NCV	National Certificate Vocational
NCVQ	National Council for Vocational Qualifications
NDE	National Department of Education
NQF	National Qualification Framework
OBE	Outcome Based Education
PAT	Practical Assessment Task
RNC	Revised National Curriculum Statement
SAG	Subject Assessment Guideline
SETA	Sector Education and Training Authorities
TVET	Technical Vocational Education Training
UNESCO	United Nations Education, Scientific and Cultural Organisation
VTE	Vocational Training Education

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CHAPTER 1

ORIENTATION

1.1 Introduction

Twenty years is a long time in the relatively short global history of technology education and it is an even longer time in the educational history of a democratic South Africa. Before 1994, education in South Africa was organised along racial lines with separate schools, universities, teacher colleges and administration systems for each of the four main groups as was defined by the apartheid state: namely black, white, coloured and Indian (Steven, 2006:1-2). Although it is regarded as offensive to use these racial labels, it is difficult to describe or understand the South African education system without almost continual reference to them. To complicate matters further, there were four so-called ‘independent homelands’ within the borders of the country for the four main black population groups, each having its own educational ministry and administration (Steven, 2006:1). Although the curricula in each of these systems were theoretically the same, the huge differences in state funding made a mockery of the apartheid state’s claim of ‘separate but equal’ treatment for all races. In terms of resources; very little provisioning was made in the black schools for subjects such as Physical Science, Home Economics, Woodwork and the other ‘practical’ subjects (which many see as the forerunners of technology education). This was particularly true in the rural schools where large proportions of black children were (and still are) educated. The result was that few schools in South Africa offered subjects with a ‘practical’ orientation: those that did were largely to be found in urban areas and were, to a large extent, reserved for white children only (Steven, 2006:1).

The South African education system changed rapidly since 1998, when curriculum 2005(C2005), founded on the outcomes-based education (OBE) to teaching was phased in. This curriculum was then revised in 2002 Revised National Curriculum Statement (RNCS) and the National Curriculum Statement was introduced in 2006 (Teis, 2010:1; National Department of Education, 2003) and the Curriculum and Assessment Policy Statement (CAPS) introduced in 2011 (DBE, 2011:3). The names of the subjects also changed, and the number of subjects were reduced by combining Civil Technika, Plumbing, Building and Plastering, Woodwork and

Woodworking, to form the subject Civil Technology as a part of the subjects in the Manufacturing, Engineering and Technology (MET) field, which has been produced out of the NATED 550 subjects known as Civil Technika, Plumbing, Building and Plastering, Woodwork and Woodworking , with regard to knowledge, skills, values development (DBE,2011:3).

Teachers were concerned about the way the subject Civil Technology had been structured in the National Curriculum Statement (Karlin, 2010). The subject was more theory orientated than practical, and it put less emphasis on practice than on theory. This resulted in a negative attitude towards the NCS policy and the subject in particular (Beute & Karlin, 2010). The formation and interpretation of the curriculum in South African schools needed more attention, because Civil Technology has its own terminology or means of communication all over the world (Van der Walt, 2010:212). The traditional teacher needed to enhance their pedagogic content knowledge of Civil Technology to enhance effectiveness and to promote the implementation of the subject curriculum.

1.2. Significance of the Study

The significance of the study was to contribute to the body of literature available and to advocate for the integration of theory, practice and reflection with regards to the NATED 550 subjects in Civil Technology.

1.3. Statement of the Problem

The implementation of technical and vocational programmes was problematic prior to the “democratically elected government”. Teachers are confused about the new curriculum change that suggests the integration of the technical subjects into Civil Technology. This has resulted in a passive attitude and ineffective participation of teachers in the implementation of the new curriculum.

According to Beute and Karlin (2010), South African teachers regarded Engineering as a good subject to teach, but their knowledge of Maths, Physical Science and Technology was very limited. Beute (2010) argues that many of the Civil Technology teachers were not trained in Physical Science. Many of Civil Technology educators were former woodworking teachers and metal shop whose subjects were being phased out. Since the implementation of Civil Technology, educators in South Africa did not have adequate training in the Technology Learning Area (Mosoabi, 2008:34) and Civil Technology, but they did have primary subject content knowledge which contributed to their technological understanding and conceptualisation. Primary knowledge developed from the subjects such as Woodwork, Craft, Science, Needlework and Home Economics (Reddy, 1995:130; Teis, 2010:5).

The question to be asked is: "Are Civil Technology educators competent and confident to teach this subject which has shifted focus from specialized technical subjects to the civil engineering content in general?"

According to Van Wyk (2007), teachers, particularly Civil Technology teachers, have been confronted with extensive curriculum changes within the South African education system over the past years since the implementation of the National Curriculum Statement (NCS). The role of the teacher was vital in the successful implementation of the new curriculum, specifically with regard to Civil Technology in grades 10-12 in the FET phase. Civil Technology educators in South Africa were introduced to the new National Senior Certificate curriculum in 2006 (NDE, 2008:12; Teis, 2010:3).

1.4. Aim and Objectives of the study

Aim

The aim of the study was to investigate the integration of technical subjects in Civil Technology curriculum with special reference to FET Technical Schools.

Objectives

The objectives of the study are to:

- describe the meaning and integration of the subjects in the Civil Technology Curriculum,
- examine the roles of the educators in the integrated curriculum and suggest recommendations for the implementation of the Civil Technology Curriculum.

1.5. Research Questions

1.5.1 What was the purpose of integrating the technical subjects into Civil Technology?

1.5.2 What was the role of teachers in the integrated Civil Technology Curriculum?

1.5.3 What were teachers' attitudes towards the integrated curriculum?

1.6. Hypotheses

1.6.1 Integrating technical subjects into Civil Technology is to shift low-level technical skills to high levels of technology skills.

1.6.2 The role of teachers in the integrated Civil Technology curriculum is to integrate principles of Mathematics and Physical Science into Civil Technology in order to impart skills to learners.

1.6.3 Teachers seem to have a negative attitude towards the integration of technical subjects into Civil Technology.

1.7. Literature Review

Integration of academic and vocational subjects was a strategy for educational reform conceptualised by educators, supported by business, and articulated by policy makers in the Perkins Amendments in America (Lankard, 1992). Integration is perceived as effective in improving opportunities for youth who had faced technologies that demanded high-level skills. According to Erickson (1995), an integrated curriculum takes thinking to levels of analysis, synthesis, and evaluation and should be used to help students understand concepts, problems or issues from multiple perspectives, applying what they learned to real-world problem solving.

Technology as such is evident in many of the new subjects which had been introduced in the new FET Phase, namely Design, Computer Applications Technology, Mechanical Technology, Electrical Technology, Civil Technology and Engineering Graphics and Design. All these new subjects were reformulations or aggregations of previous computer and technical subjects which appeared to have retained a rather narrow (specialised) focus. The argument by Stevens (2004) was that the holistic nature of the general technology subject with its emphasis on creative, flexible thinking, its combination of conceptual and procedural knowledge and its unique practical focus, seemed to have fallen on deaf ears. However, an informal group of educators based at a number of South African universities worked on a curriculum for a general technology subject whom the group had hoped will convince the Department of Education authorities (Stevens, 2004:4).

As Civil Technology is a relatively new subject in the education field, a comparative literature study has been undertaken to clarify and explain what the curriculum constitutes.

According to the Curriculum and Assessment Policy Statement (CAPS), Civil Technology focuses on concepts and principles in the built environment and on the technological process (DoE, 2011:9). It embraces practical skills and the application of scientific principles. The subject aims to create and improve the built environment to enhance the quality of life of the individual and society and to ensure the sustainable use of the natural environment. The subject focuses on three main areas, namely: Services, Construction and Woodworking (NDE, 2005a; DoE 2011:9).

Stevens (2006) explains that the rebuttal by Minister Asmal in (personal communication, 28 January 2003) and the Department of Education indicated a commitment to a narrow view of specialisation: they believed that aspects of GET Technology could be found in various MET fields (cf.1.1 page 1), namely Design, Computer Applications Technology, Mechanical Technology, Electrical Technology, Civil Technology, Engineering Graphics and Design (Stevens, 2006:4).

Enthusiasm by teachers and their dedication to technology was one of the most consistent and impressive findings from Stevens' (2006) evaluation. The positive attitude of teachers was fed, in part, by the enthusiasm of their learners. Most teachers indicated that they would like to continue teaching Technology. More than that, many seemed pleased to be able to break out of the old modes of teaching and reconceptualise their notions of what it meant to be a teacher/ facilitator (Stevens, 2004:6). Technology was introduced during OBE to prepare teachers to be aware of the technical subject's curriculum and most teachers, who found that approach to be a positive experience and one that often gained the attention and recognition of their peers. Most teachers thus commented that they had benefited both professionally and personally from their participation in the project (Mouton, Tapp, Luthuli and Rogan, 1999:157-8).

1.8. Research Methodology

1.8.1. Research Design

This research employs a mixed method approach, comprising qualitative as well as quantitative methodology to collect relevant data. The method of investigation includes a literature review and an empirical study by using qualitative and quantitative data in the form of questionnaires and a purposive sampling interview.

Mixed methods research is defined as a procedure for collecting, analysing and mixing both quantitative and qualitative data at some stage of the research process within a single study to understand a research problem more completely (Creswell, 2005). In a mixed methods study, both numerical and text data are collected and analysed to address different aspects of the same general research problem and provide its more complete understanding (Ivankova, Cresswell& Clark, in Maree, 2009: 263).

1.8.2. Participant's Sample

Burns (2000:464) is of the opinion that the sample chosen must serve the real purpose and objectives of the research, gaining understanding with regard to the particular phenomenon chosen. The population of the study was forty nine (49) teachers and the sample in the research had been twenty- one (21) teachers responsible for teaching Civil Technology in all grades at schools in five districts of the Free State Province: Fezile Dabi, Motheo, Lejweleputswa, Thabo Mofutsanyana and Xhariep.

According to the social research glossary Changing Minds (2002-2012), purposive sampling starts with a purpose in mind and the sample is thus selected to include people of interest and to exclude those who do not suit the purpose. Makgatho (2003) states that in purposive sampling the researcher identifies respondents who have expertise and an interest in the field under study. seven teachers were selected, the first four are teachers with three or more years' experience of teaching

Civil Technology and the second three are teachers who have less than three years' experience of teaching Civil Technology.

1.8.3. Data Collection

1.8.3.1. Literature Study

The literature study describes theoretical perspectives and previous research findings related to the research problem undertaken. This study looked at what other researchers have done in areas that are similar to Civil Technology, but not necessarily identical to the researcher's investigation (Leedy and Ormrod, 2001:70). The literature study focussed on aspects related to the integration of Civil Technology related subjects to form one new subject.

1.8.3.2. Questionnaire

A quantitative research method was used to test the theories about reality, to also look for cause and effect used to gather data to test the questions (Inankova, Creswell, and Clark, 2007:255). Questionnaires had been distributed to twenty one Civil Technology teachers in the Free State. The group consisted of teachers with woodwork, plumbing, bricklaying and plastering, civil technika and civil technology training. The group was based on teachers with teaching experience, but who did not have any formal training in Civil Technology but who teach the learning area in the FET phase of the Free State schools, as well as teachers with formal tertiary training in the Civil Technology learning area. The questionnaire focused on the teachers' degree of competency and attitudes towards the new integrated subject Civil Technology**.**

De Vos et al. (2004:179) claim that the use of questionnaires enables the researcher to explore the variables better and to obtain an idea of the spectrum of possible responses. Selesho (2010:6) explains that questionnaires allow respondents more time and they can be completed whenever it suits the respondents.

1.8.3.3. Interviews

The researcher conducted interviews with seven teachers within twenty one Civil Technology teachers from five schooling districts in the Free State to obtain data on the research questions. One-on-one interviews were conducted with four (4) experienced and three (3) less experienced teachers on their experiences regarding the integration of technical subjects in secondary schools and to answer a set of predetermined questions that would allow for probing and clarification of answers. Interviews were audio- recorded and notes taken during the interviews with the permission of the participants**.**

According to Kvale (1996: 11), the use of an interview in research marked a move away from seeing human subjects as simply manipulatable and data as somehow external to individuals, and towards regarding knowledge as generated between humans, often through conversations. Cohen, Manion and Morrison (2004: 267) mentioned that an interview enabled participants-be they interviewers or interviewees to discuss their interpretations of the world in which they lived, and to express how they regarded situations from their own point of view.

1.8.4. Data Analysis

Descriptive and inferential analysis had been used to analyse data from the questionnaires. Rijuan (2009) cites Burns (2000: 43), as having stated that descriptive and inferential statistics used in analysing the data from the questionnaire is preferred, as it allows the researcher to use numerical techniques to summarise the data. Coding had been used to analyse qualitative data from the interviews. Coding has been defined by Kerlinger (1970) as the translation of question responses and respondent information to specific categories for the purpose of analysis. Many questions were pre-coded, that is, each response had been immediately and directly converted into a score in an objective way (Cohen, Manion and Morrison, 2004: 284).

1.9. Limitations of the Study

- The study had been limited to twenty one (21) teachers of Civil Technology in the Free State Province.

- The study had been conducted in five districts of Free State province: Xhariep, Motheo, Lejweleputswa, Thabo Mofutsanyana and Fezile Dabi. (FSDoE-EMIS,2009)

- The research had looked at the practical and theoretical activities that are used in Civil Technology as a new integrated subject.

1.10. Definition of Terms

This section explains or defines the following concepts: Integrated curriculum, Technical trade subjects, Secondary schools curriculum, Teacher perspectives:

Integrated Curriculum

According to Erickson (1995), an integrated curriculum takes thinking to levels of analysis, synthesis, and evaluation and should be used to help students understand concepts, problems, or issues from multiple perspectives, applying what they learn to real world problem solving. Integration activities were defined as those involving joint use of facilities, team teaching, guest lecturing and curriculum alignment**.**

Technical Trade Subjects

This term refers to subjects that have evolved from the NATED550 subjects known as Plumbing, Civil Technika, Woodwork, Woodworking, Welding, Motor Mechanics, Electricity, Electronics, etc. with regard to knowledge, skills, value development (DBE, 2011:3). A technical education subject is that aspect of education that gives its recipients an opportunity to acquire practical skills as well as some basic scientific knowledge (Nigerian Policy on Education, 1981).

Secondary School Curriculum

Badenhost & Lemmer, (1997:260) explain a Secondary School Curriculum as a list of broad aims and content for a technical school subject which will be taught over a period of one year's schooling. A programme specifies lesson planning on a weekly or even a daily basis.

Teachers' Perspectives

A perspective on teaching is an inter-related set of beliefs and intentions that gives direction on and justification to teachers' actions. It is a lens through which teachers view teaching and learning (Pratt, 2012: 1).

1.11. Ethical Considerations

Leedy & Ormrod (2001: 13) note that the researcher should ensure that participants are not exposed to any undue physical or psychological harm. During the study the researcher strived to be honest and respectful towards all the participants. Before an interview commenced, the researcher presented the participants with a copy of the letter of request to do research from the Department of Education Free State, and one asking their consent. For the sake of anonymity and confidentiality the names of the participants were not included or any other way associated with the data collected in the study. Furthermore, because the interest of the study was in the average responses of the participants, individual participants were not identified in any way in any written reports of the research. The research process was described, and the consent form was also signed as proof of their willingness to participate in the research.

1.12. Chapter Outline

The study has been divided into the following chapters:

Chapter One: Introduction to the study. The chapter briefly discusses the background to the research problem, research methodology, and significance of the study, limitations, and the aims and objectives of the study.

Chapter Two: Literature review. The chapter provides a historical background on the integration of the technical subjects curricula and the new technology subjects.

Chapter Three: Research design and methodology. This chapter discusses in detail the research design and methodology used in this study.

Chapter Four: Results of the study. This chapter focuses on the findings and the analysis of data and interpretations of the study.

Chapter Five: Conclusion and recommendations: This chapter presents the conclusion and recommendations and guidelines on the integration of technical trade subjects in secondary schools based on the participating teachers' perspectives.

CHAPTER 2

THE CONCEPTS OF CURRICULUM CHANGE BY INTEGRATING TECHNICAL SUBJECTS TO DEVELOP THE SUBJECT CIVIL TECHNOLOGY

2.1 Introduction

The rapid changes of curriculum in the South African school system produce challenges that contribute to confusion or misunderstanding of the new integrated curriculum to the teachers of technical/technology subjects. This chapter provides an overview of the relevant literature regarding the historical background and the aims of the technical/ technology subjects.

Firstly the study gives the historical background of the subject Civil Technology from the time of Bantu education; through C2005, (NCS) to the current curriculum (CAPS and specialisation) in South African technical schools. The chapter then focus on an international background of related technical subjects, and to determine teachers' content knowledge, understanding and qualifications needed to teach Civil Technology effectively. The chapter analyses the integration of Woodwork, Woodworking, Plumbing, Bricklaying & Plastering and Civil Technika development as a basis in the Civil Technology, which is divided into three interrelated categories: Construction, Woodwork and Civil services.

In reviewing the literature, this research looked at the aims and objectives of developing the curriculum of Civil Technology from technical subjects. Chen[1], Chen[2], Cheng. (nd:2) observed Bobbitt's objective model of curriculum planning as evident below :

Objective Model: Curriculum Planning Model in America

Bobbitt's Contribution

Bobbitt was one of those researchers who addressed the concept of object mode. As early as 1918, Bobbitt addressed the concept of developing curricula based on objectives. He believed that a human being's life constitutes the implementation of very specific activities. For example, we wash our hands before eating, because we would like to keep healthy. In addition, if the objective of education is to prepare individuals for future careers, then the specific activities and curriculum plan should help develop skills and knowledge that will enable students to successfully enter the job market (Chen[1], Chen[2], Cheng; n. d: 2).

Curriculum, therefore, as far as this research is concerned, should promulgate explicit practical and theoretical aspects of civil technology, based on the following:

- Content
- Teacher placement
- Proper facilities
- Time allocation
- Assessment
- Job opportunities

2.2 **Definition of terms**

2.2.1 Defining **'Integration'/ curriculum integration.**

The term **integration is** used as one of the main words in this study and this term may be defined as the amalgamation or re- organising of items to produce specific upshots. The Oxford English Dictionary (1971) traces the English word integration back to the Latin word integrare, meaning "to make whole." Over the centuries, the idea of integration has been associated with holism, unity, and synthesis. The foundation, though, differed over time (Klein, 2008:284).

In the United States of America, integrating disciplines and developing the "whole" person at the post-secondary level were core values in the general education movement, although proponents differed on whether the whole was located in the content of texts within a prescribed curriculum or in a process of knowing and understanding contemporary problems. At the primary and secondary school levels, integration was associated with the Progressivists' social democratic vision of education centred on students' personal and social concerns, and the term 'integrated curriculum' was also linked with the project approach during the 1920s. During the 1930s, it appeared in conjunction with the core curriculum movement. In the 1940s and 1950s, it was aligned with problem-centred cores, as well as a broad-fields approach; skills across subjects; child-centred, activity-based, and experience-based curricula (Beane, 1997: 2–3, 28–29; Ciccorico, 1970: 62; Klein, 2002: 5–6; Klein, 2011:284-285).

Even with differences in individual approaches, a major shift in meaning occurred during the 1930s and 1940s that lies at the heart of Repko's (2008) emphasis on integration as a process. Repko (2008) explains that it does not derive from a predetermined pattern. It is something we must create. It also, he cautions, does not supply a universal template that is necessarily applicable beyond the specific problem, issue, or question being addressed in a particular course. The shift in meaning emphasised process over content and pre-existing formulas for integration (Klein, 2011:285).

Relan and Kimpston (1993:32-33) discuss curriculum integration in terms of integrated knowledge, referring to the knowledge and higher-order thinking skills needed by citizens to understand a complex, interrelated world. *Recognizing rapid changes in the amount of knowledge that can be learned, the need for students to understand both global and local concerns, and the importance of ensuring that students are able to apply knowledge learned in the classroom to the realities of life*; Relan and Kimpston(1993:32-33) describe curriculum integration as its own way of knowing and understanding the world that moves beyond traditional, discipline-specific knowledge and skills (in: Macmath, 2011:15). Bintz et al. (2006) also use the term 'integrated thinking'. Venville, Wallace, Rennie, and Malone (2000), use the term 'bridging' (instead of connecting); and they discuss curriculum integration as the learning of bridges between the different discipline areas so that students are better able to apply their knowledge in different situations. In addition, Johnson (2002) supports the value of teaching integrated thinking skills by arguing that numerous, traditionally identified skills (e.g. graphing, critical thinking, problem-solving) are actually integrated skills meant to be used across different subject areas (in: Macmath, 2011:16-17).

2.2.2 **Technical education/ subject**

Technical and vocational education and Training (TVET) is broadly defined as "Education which is mainly to lead participants to acquire the practical skills, know-how and understanding, and necessary for employment in a particular occupation, trade or group of occupations" (Atchoarena, D & Delluc, A 2001). Such practical skills or know-how can be provided in a wide range of settings by multiple providers, both in the public and private sector. The role of TVET in furnishing skills required to improve productivity, raise income levels and improve access to employment opportunities has been widely recognized (Bennell, P 1999). Developments in the last three decades have made the role of TVET more decisive: the globalization process, technological change, and increased competition due to trade liberalization necessitate requirements of higher skills and productivity among workers in both modern sector firms and Micro and Small Enterprises (MSE). Skills development encompasses a broad range of core skills (entrepreneurial, communication, financial and leadership) so that individuals are equipped for productive activities and employment opportunities (wage employment, self-employment and income generation activities) (Nyerere, 2009:4).

It is important that technical knowledge be accompanied with social skills in order to build harmonious societies (Wals, 2009). He further said that Education for Sustainable Development (ESD) within TVET is seen as a means to ensure sustainable lifestyles and occupations through the development of knowledge and skills that can meet the needs for a specific position in the labour market and result in an overall improvement of the quality of life of people. That is why the role of TVET is to provide young people and adults with the life-skills necessary for the labour market and also to provide support to keep up with the fast changing market by expanding necessary skills and competencies (Brizuela, Gomes, Gu. 2011:7).

Some reports mention that technical/vocational education has been seen as less dignifying, only suitable for dropouts from school and children of low-income groups over the years. There is a widely held wrong perception of technical and vocational education; Technical training is used when referring to boys and vocational training when referring to girls. The trend has been that any boy whose parents are poor or who fails to gain admission to traditional secondary schools because of poor grades gets enrolled in a technical school; such a girl, however, gets enrolled in a "vocational" school (Hoffmann-Barthes, et al., 2000:15). According to Gardner and Hill (1999:104), technical education emphasises using tools and making artifacts, with little attention to problem-solving, creativity, design skills and social and environmental concerns (Makgato, 2003:17). From the above-mentioned information, it is clear that the curriculum was designed to produce hard labour market learners. It also raises a question: what is the difference between technical high schools and technical (FET) colleges?

2.2.2.1 **Subject Bricklaying and Plastering**

The aims of teaching bricklaying and plastering in Standard 10 were to:

1. Correlate different aspects of the pupil's school experiences and manual dexterity; give the pupil a better understanding of industrial processes and development in order that he may adapt himself better socially, and acquire a broader outlook in the world of technology; provide the pupil with opportunities that stimulate his interest, help him to discover and develop his aptitudes, and serve as medium for self-expression
2. give the pupil the opportunity of personally building and finishing off something, and thereby experiencing the satisfaction of creative activity;
3. develop the pupil's manual dexterity to ensure his command of tools to increase his knowledge of the use of materials and to acquaint him with industrial methods, processes and products;
4. to inculcate habits of orderliness, neatness and accuracy in the pupil;
5. to train the pupil to be observant, industrious and persevering;
6. inculcate in the pupil a sense of quality which will develop his critical appreciation DoE (1989: 44-45).

2.2.3 **Technology Education/ Subjects**

Technology subjects refer to new integrated subjects from old name "Technical subjects". Technology therefore; is defined as the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, while at the same time taking social and environmental factors into consideration (Department of Education, 2002b). It is therefore, a learning area/ subject which in implementation, is integrated easily across other learning areas. It cannot be separated into content and process, or theory and practice (Williams, 2000: 1, cited by Heymans, 2007; Ntshaba, 2012). Smith (2007) views Technology as part of our daily lives and is getting more entwined in what people do every day.

Technology education may be applied in a very technicist way to maintain the status quo of a capitalist economy. It, however, can be transformative if the technological process based on an appropriate ideology is followed. This should lead to empowerment of the learner; the hallmark of quality education (Ankiewicz, 1995:253). Ntshaba (2012:23) cited in Pudi (2012). Technology education can be seen as a comprehensive-based educational programme that allows learners to investigate and experience the means by which people meet their needs and wants, solve problems and extend their capabilities (Pudi, 2002).

2.2.3.1 **Subject Civil Technology**

Civil Engineering and the related professions such as architecture, building and quantity surveying, collectively known as the Built Environment, are the basis on which the modern world was founded. It is through these professions that essential services such as roads, bridges, purified water, water-borne sewage, railway lines, high rise buildings, factories and housing are provided. The subject Civil Technology aims to create an awareness of these services in learners and society. Civil Technology focuses on concepts and principles of the Built Environment, as well as on the technological process. It embraces practical skills and the application of scientific principles. This subject creates and improves the Building Environment in a way that enhances the quality of life of an individual and society and ensures sustainable use of the natural environment. Civil Technology falls in the Engineering and Technology learning field and gives learners the opportunity to solve problems by practically carrying out simulations and doing real-life projects, using a variety of processes and skills (DoE, 2008:7-8).

The new subject Civil Technology is based on the following NATED 550 subjects: Building Construction, Bricklaying and Plastering, Woodwork, Woodworking, Technika Civil, Plumbing and Sheet Metalwork. Civil Technology is a vibrant new subject. While it has its roots in the above-mentioned NATED 550 subjects, the emphasis is on the technological process, which builds on the technological literacy achieved in the Grades R-9. The focus has shifted from gaining knowledge and practical skills to the integration of **high knowledge** and **high skills**, concentrating on the principles and concepts embedded in Civil Technology. The technological process is the rationale and driving force behind this subject. Creativity, innovation and ingenuity play a major role in developing the learners' full potential in this field

(LPG) (DoE, 2008:7-8). Teis (2010:14) cites Gagne (1993) who uses the term problem- solving to describe a high-order intellectual ability and a way of learning. According to Makgato (2003:59), Mathematics; Physical Science and Technology have a common component, namely problem solving. ORT-STEP (1995:7) explains the interrelationship between Mathematics, Physical Science and Technology by means of a Venn diagram:

The Interrelation Between: MATHEMATICS, PHYSICAL SCIENCE AND TECHNOLOGY

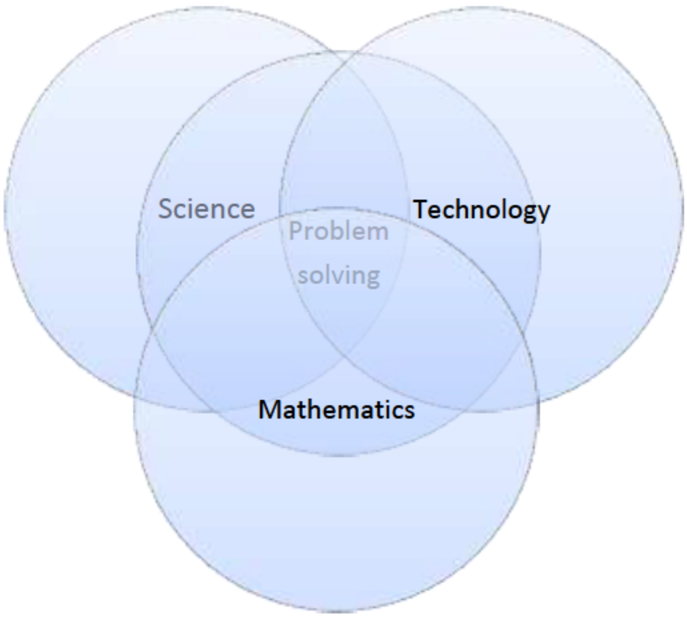

Figure 1: The Interrelation between Mathematics, Science and Technology

Source: ORT-STEP (1995:7); Makgato, (2003:60)

From figure1 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 Physical Science and Mathematics, it should not be considered 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

(Makgato, 2003:60). The other ways in which technology is different from Physical Science are indicated in table 1.

TABLE 1: Relationship between Technology and Physical Science

Emphasis in Physical Science	Emphasis in Technology
1. Exploring existing phenomena to reach new knowledge	· Designing new products that did not exist before
2. Curiosity as a driving factor	· Needs/wants as main driving factor
3. Working with an ideal and simplified world	· Working in the real complex world
4. Research	· Design for application
5. General problem statements	· Specific problem solution
6. Reliance on assumptions	· Reliance on facts
7. Truth, accuracy, the ideal	· Solutions should be effective, efficient, within acceptable tolerances
8. Abstract/theoretical	· Concrete/practical
9. Looks for uniform knowledge, that applies everywhere in the same way, i.e. ideal	· Looks for solutions that are optimal for specific situations

Source: ORT-STEP (1995:8); Makgato (2003:61)

According to Pucel (1995:38) in: Makgato (2003:61)., 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

2.3 International and South African curriculum perspective

Curriculum has been designed to serve the interests of each and every country. This section of the chapter will discuss the implementation of technical or technology education internationally and in South Africa.

2.3.1 International perspective of design and implementation

2.3.1.1 AUSTRALIA

Middleton and Stevenson, (20011:161) explain that the Technical and Further Education sector in Australia has traditionally been responsible for the training of apprentices within a range of trade areas such as welding, fitting and machining, dressmaking, carpentry in other skilled areas such as office work, as well as for some middle level paraprofessional occupations. The major emphasis of these courses has been on developing technical competency in the activities associated with each skilled occupation. Therefore, the recent move to develop creative thinking in post-compulsory education students is not unique to Australia with the desire being mirrored in overseas initiatives.

The Department of Education, Science and Training Australia indicates that the reasons for offering VTE in secondary schools are to:

• Make school more attractive for the 70% of students who will not go on immediately to university; have a strong commitment to general education in schools and balance this with a more employment related curriculum. Support disengaged young people and those at risk of leaving early. There is a need for alternative pathways between school and employment. Meet specific industry needs in key locations (Department of Education, Science and Training Australia 2005:15).

In the United Kingdom, the National Council for Vocational Qualifications (NCVQ) has defined problem solving (including creative thinking) as one of the core skills. In the United States the US Department of Labour's Commission on achieving Necessary Skills (SCANS) has described creative thinking as a component of problem solving, as one of the foundation and basic skills that are part of what the department describes as workplace know-how. Furthermore, in New Zealand, problem-solving is defined in the National Curriculum as problem-solving and decision-making skills which are regarded as part of the Essential Skills (Middleton and Stevenson, 20011:161).

2.3.1.2 NIGERIA

Technology education stimulates growth and empowers the citizenry to achieve victory over ignorance, poverty, unemployment and other indices of under-development. For Nigeria as a nation to achieve substantial success in exploiting the potentials of its citizens to facilitate development and on a sustainable basis, it must equip its citizens with skills to dominate and manoeuvre the resources for better living. The instructional facilities in consonance with industrial development in Nigeria are grossly inadequate (Momoh 2009; Langa & Wafunda 2014).

The most significant aspect of the National Policy on Education, as noted by Dike (2009), is the new focus it gives to the Nigerian educational system; the need for the industrialization of the nation in which technical and vocational education play crucial roles and the realisation to change from a white collar job oriented educational system to a science, vocational and technical oriented educational system which prepares individuals to be self-reliant and useful to the society (Ofaha, Dorothy 2011:78).

2.3.1.3 ZIMBABWE (overview of technical education in Zimbabwe)

Zimbabwe follows a 7-4-2-3 system of education, (7 years of primary, 4 years of secondary, 2 years of advanced high school, and 3 years of college or university). Technical education is available from the last two grades in primary school through to university. In primary and secondary schools, the technical subjects on offer include: Building studies, Fashion and fabrics, Food and nutrition, Metal work, Technical graphics, and Woodwork (Mopinga, Burnett and Redmann 2005:76). The Minister of Education and Culture (n.d.) listed and explained Zimbabwe Junior Certificate syllabuses for Building, Metalwork, Woodwork, and Technical Graphics. The list of objectives for Building Studies and Woodwork are as follows:

- Building studies

Develop a variety of manual skills; become aware of trades and professions in the building industry; become aware of construction technology available and appropriate to community development (Minister of Education and Culture, n.d., 3).

- Woodwork

“Promote the acquisition of knowledge and technical skills leading to self-reliance; and make simple wooden articles that are useful in the home and community” (Minister of Education and Culture, n.d., 22); (Mopinga, Burnett and Redmann 2005:76).

2.3.2 South African Civil Technology curriculum perspective (historical background)

The South African Civil Technology curriculum changed rapidly from Bantu, OBE, NCS, CAPS to CAPS on specialisation; therefore this section of the research gives an overview of the historical background and the new development in Civil Technology in South Africa.

2.3.2.1 Bantu Education (historical background)

Curriculum for Secondary Education

The senior secondary education phase could further be divided vertically into a number of courses, namely the humanities, commercial and technical, as well as natural science courses. By and large commercial and technical subjects are offered in the same schools. In comprehensive schools all courses are made available to pupils (Behr, 1984:210; Keikabile, 1991:67).

Pupils were supposed to take at least six subjects in Std. 10, two of which must be official languages of South Africa: one being language of instruction and the other language, can be chosen on a second language basis. The remaining subjects may be selected from the groups of subjects listed in the following fields of study (DET, 1989:101-103; Keikabile, 1991:68):

• Technical Subjects

The technical field of study in the senior secondary phase comprises the following:

- The official language
- Mathematics
- Physical Science
- Technical Drawing and
- One subject from the Technika range, i.e. civil, electrical or mechanical subject (Behr, 1988:109)

Apart from Technical Drawing (reflected above), which is compulsory for this field of study, pupils may choose one of the following subjects at technical secondary schools and at some comprehensive schools:

- Motor Mechanics
- Electrician's Work
- Electronics
- Woodworking
- Fitting and Turning
- Plumbing and Sheet Metalwork
- Motor Body Repairing
- Bricklaying and Plastering
- Welding and Metalwork

The syllabi of all subjects are based on core syllabi used by the Department of Education in South Africa (DET, 1989:1 03). The examination subjects may be offered at two grades, namely Higher and Standard Grades (DET, 1989:101; Keikabile, 1991:69).

When planning a curriculum for a specific school, local employment opportunities, the general labour-market, and the wishes of the local community are taken into account because the Department recognizes the importance of scientific curriculum design, this receives continuous and intensive attention. The aim is to design curricula in a more effective manner, based on the findings of intensified research, to meet the specific needs of pupils. Aspects such as education relevant to the exploration of the world of work and the opportunities it offers, receive special attention in curriculum research and planning (DET, 1989:1 03; Keikabile, 1991:69).

2.3.2.2 National Curriculum Statement

What is the relationship between civil technology and the national curriculum statement principles?

The Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa.

The NCS Grades 10-12 (General) are based on the following principles:

- **Social transformation**

The imperative to transform South African society through various transformative tools stems from a need to address the legacy of injustice in all areas of human activity, including the built environment and 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. The participation of learners in decision making about the built environment ensures that they are active participants in the economy of the country.

- **Outcomes-Based Education**

Civil Technology makes use of learning outcomes and assessment standards to describe what a learner should know and be able to demonstrate, i.e. the skills, knowledge, and values that are the results of learning. Civil Technology encourages learners to develop inquiring and problem solving skills which support the practical application of knowledge in technology and involves active and high level teaching, learning and assessment.

- **High knowledge and high skills**

Civil Technology aims at developing a high level of knowledge and skills in learners. It sets high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by a lack of knowledge and skills. Civil Technology specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all fields. The emphasis on use and application of new technology ensures that high knowledge and high skill are not compromised in this subject.

- **Integration and applied competence**

Civil Technology seeks to integrate theory, practice and reflection. The following are some of the subjects that can be integrated with Civil Technology:

 Language – communication is key in Civil Technology

 Mathematics – there will always be a need for calculations and use of formulae in this subject

 Physical and Life Sciences – many concepts used in Civil Technology have their roots in
the Physical and Life Sciences

 History – practices of years gone by hold value and lessons for Civil Technology

 Geography – climate and natural environments should inform the built environment.

- **Progression**

Progression refers to the process of developing more advanced and complex knowledge and skills. The subject statement for Civil Technology shows progression from one grade to another. Each Learning Outcome is followed by an explicit statement of what level of performance is expected for the outcome per grade. The content and context of each grade will show progression from simple to complex.

- **Articulation and Portability**

Articulation refers to the Further Education and Training (FET) Band that links to the exit levels of the General Education and Training (GET) Band and the entrance levels of careers in the Built Environment in Higher Education and Training (HET). Portability refers to the extent to which parts of the qualification (subjects or unit standards) are transferable to other qualifications in different learning pathways of the same NQF band.

- **Human Rights, Inclusivity, Environmental and Social Justice**

Civil Technology seeks to promote human rights, social and environmental justice. It is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors. Civil Technology acknowledges that all learners should be able to develop to their full potential, provided they receive the necessary support. The intellectual, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate Learning Programmes and through the use of appropriate assessment instruments.

- **Valuing Indigenous Knowledge Systems (IKS)**

In the 1960s, the theory of multi-intelligences forced educationists to recognize that there were many ways of processing information to make sense of the world, and that, if one were to define intelligence anew, one would have to take these different approaches into account. Up until then; the Western world had only valued logical, mathematical and specific linguistic abilities, and rated people as 'intelligent' only if they were adept in these aspects. Now people recognize the wide diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. The NCS Grades 10-12 (General) has infused IKS into the subject statements. It acknowledges the rich history of Civil Technology and heritage of this country as important contributors to the curriculum.

- **Credibility, quality and efficiency**

Civil Technology aims to achieve credibility, quality and efficiency through pursuing a transformational agenda and providing an education that is comparable with other progressive countries. The curriculum, developed in consultation with local and international specialists, encapsulates the essence of progressive international thinking, adapted to South African conditions DoE (2008:8-9).

2.3.2.3 Curriculum Assessment Policy Statement (CAPS) and CAPS on Specialisation

The curriculums indicated in 2.3.2.3 indicate two curriculums of Civil Technology which are CAPS and CAPS on specialisation with the same name, aim and definition but different focus. Table 2 and table 3 below present the content topics of each curriculum.

What is Civil Technology?

DoE (2011:8) Civil Technology focuses on concepts and principles in the built environment and on the technological process. It embraces practical skills and the application of scientific principles. This subject aims to create and improve the built environment to enhance the quality of life of the individual and society and to ensure the sustainable use of the natural environment. The subject focuses on three main areas, namely:

- civil services;
- construction; and
- woodworking.

In the following section, the respective areas of specialisation are described and placed within the intended context.

- Civil Services

Civil services can be construed as plumbing which focuses on the supply of cold and hot water supplies to a building and the installation of a sewerage system enabling soiled, waste water and storm water removal from a site. It focuses on materials and the way it is used to provide water and sanitation on a site, taking into account environmentally friendly technology (green energy).

- Construction

Construction focuses on the development of concrete and brick structures in the built environment. It focuses on materials and the way they are used to provide infrastructures in the development of sites, taking into account environmentally friendly technology (green energy).

- Woodworking

Woodworking works hand in hand with construction. It focuses on structures such as roof trusses, windows, doors and any part of a building that is made of timber. It also focuses on providing temporary supporting structures to obtain permanent structures such as concrete floors, stairs, roofs and arches DoE (2013:9).

Specific Aims

The aim of the subject Civil Technology is to develop the skills levels of learners from Grade 10-12 to such an extent that they will be able to enter a career pathway at a Further Education and Training College or a university immediately after obtaining the National Senior Certificate. Learners will be ready to enter into learnerships or apprenticeships that will prepare them for a trade test DoE (2011:8).

Table 2 below indicates the main topics in Civil Technology CAPS.

Table 2: Main topics in Civil Technology

Safety
Equipment
Materials
Graphics and communications Terminology
Applied mechanics
Construction
Civil services
Quantities
Joining

Source (DoE 2011:9)

Table 3 below indicates the main topics in Civil Technology CAPS on specialisation (DoE 2013:9 CAPS specialisation draft).

Table 3: Main topics in Civil Technology according to the area of Specialisation

CIVIL SERVICES	CONSTRUCTION	WOODWORKING
Safety	Safety	Safety
Materials	Materials	Materials
Equipment	Equipment	Equipment
Graphics and communications	Graphics and communications	Graphics and communications
Terminology	Terminology	Terminology
Quantities	Quantities	Quantities
Joining	Joining	Joining
Construction	Foundations	Casement
Cold water supply	Concrete	Doors
Storm water	Formwork	Wall panelling
Hot water supply	Reinforcements	Centering
Roof work	Cavity walls	Formwork
Drainage (Sewerage)	Lintels	Shoring
Sanitary fitments	Waterproofing	Ironmongery
	Concrete staircases	Suspended timber floors
	Roof coverings	Ceiling
	Brickwork	Staircases
	Piling	Roofs
	Rib and block floors	Cupboards
	Arches	
	Scaffolding	
	Plaster and screed	

(DoE 2013:9 CAPS specialisation draft).

Table 3 above shows three curricula of Civil Technology specialisation and has been outlined vividly to appearances that, level of skills shifts from high to low and also omitting applied mechanics; which emphasises the application principles of Mathematics and Physical Science in a specific subject; as these subjects differ per in terms of application. It poses a question of as to why should Civil Technika content be left out when shifting backwards?

2.4 IMPLEMENTATION OF CIVIL TECHNOLOGY CURRICULUM

2.4.1 **Teachers' role and attitude**

Classroom (theory)

The teacher's role is to guide students towards a set of shared norms that include: cooperation to produce mutually acceptable solutions, methods and interpretations, to "persist" and consider alternatives, to have "courage" to propose ideas, to ask for explanations and evidence and for mathematical solutions to be explainable and justifiable, and to operate as a community of "consensual validators" (Cobb, Wood & Yackel, 1991; Ntshaba 2012:41).

Cross (2008:908) concurs that in the Technology Education classroom "the teacher's role is crucial, not as the repository of knowledge, but as the one who initiates and guides the students in 'community' practices… maximizing the effectiveness of these classrooms requires the teacher to take on the role of 'facilitator' and not 'transmitter of knowledge'. Similarly, Capel, Leasky & Turner (1995:.214) and Ntshaba (2012:31) adds that "effective teaching and learning depend on the ability of the teacher to create learning experiences that bring desired educational outcomes".

Freiberg (2002:.56) in Hackett (2010) mentions that, in the case of beginning teachers, professional development is focused on ensuring effective instruction and classroom management. These teachers begin with a "limited repertoire of instructional strategies". However, given time, a positive teaching culture and support by more experienced teachers (Feiman-Nemser 2003), beginning teachers turn their attention to the needs of their students and quality of their teaching. The experience of teaching plays a significant part in the professional formation of the teacher (Littleton & Littleton 2005). The day-to-day experience of teaching is a challenging one and if teachers approach the challenges in the right perspective, it can lead to professional growth. On the other hand, experience may lead to frustration and resentment, causing stress and disenchantment in the teacher. Prolonged disenchantment may cause a teacher to leave the profession or become bitter or cynical about teaching. Flores (2003) found that most teachers experienced a loss of idealism within two years of teaching. However, she also found that while these teachers had become compliant and negative, other teachers were dedicated and keen. These differences seemed to be focused upon personal dispositions towards teaching, the support the teachers received both personally and professionally and the nature of the teaching experience (Hackett 2010:3-4).

Recent studies indicate that the success of outcomes-based education is dependent on teachers' attitudes towards the programme. Forlin (2004) includes attitudes and beliefs of the school staff, students, parents and local community. She regards attitude as one of the variables that impact on the school's effectiveness in implementing outcomes-based education practices. While the attitudes of the teachers, parents and learners are emphasised as critical in most research, it is argued that the attitudes and beliefs of principals towards a new programme is the key factor to successful implementation at school level (Hipp & Huffman 2000; Praisner 2003; Mhizha 2012:33).

Mhizha (2012:33) asks how one can determine whether the role players' attitudes are positive or not. It is generally accepted that the concept 'attitude' is a very complex phenomenon. It is complex in the sense that it is difficult to observe directly. One can only infer people's attitudes from their expressed view and from what they do (Stofile, 2008). Attitudes are generally divided into three components: effective, cognitive and conative components. An attitude is therefore a combination of three conceptually distinguishable reactions to a certain object (Avramidis, Bayliss & Burden 2000).

PRACTICAL ASSESSMENT TASK (PAT)

- **Administration of the PAT**

The PAT should be based on real-life situations and completed under controlled conditions. Teachers must set dates for the different phases of the PAT. In this manner learners can assess their progress. It is the responsibility of the teacher to administer assessment of the tasks in instances where formal assessment tasks take place. After studying the guidelines, teachers must explain in full what the requirements of the different stages of the PAT, as well as the criteria as indicated in the rubrics and mark schedules are. This will ensure that learners and teachers have a common understanding of the assessment tools and what is expected of the learners (DBE 2014:4).

Maeko (2013:42) mentions that the role of teachers in any subject matter cannot be questioned. Teachers are the people who have to ensure that teaching and learning takes place under all circumstances; sadly though, not all teachers may be good quality teachers. Aliyu (1995:56) suggests the following competencies that the practical technology teacher must possess for the effective transfer of practical skills to learners:

(i) Adequate, up- to- date knowledge of the science subject under focus.

(ii) Educational knowledge relating to the psychological characteristics of the students;

(iii) Knowledge of processes (and methodologies) involved in learning and how to promote them;

(iv) Motivation or new enforcement of learning to keep enthusiasm of the students;

(v) Skills for effective planning and presentation;

(vi) Above all, the teacher must possess technical and scientific skills for proper performance of the task at hand;

- **Assessment and moderation of the PAT**

The PAT for Grade 12 is externally set and moderated, but internally assessed by the teacher and moderated by the internal moderator/HOD.

Assessment

Frequent developmental feedback by the teacher is needed to guide and give support to the learner to ensure that the learner is on the right track. Both formal and informal assessment should be conducted on the different tasks that constitute the PAT. An informal assessment can be conducted by the learner himself or herself, by a peer group, or by the teacher. Formal assessment should always be conducted by the teacher and recorded. The teacher must take into account the requirements of the assessment of all the components of the PAT and therefore plan the assessment programme for the PAT accordingly (DBE 4:2014).

2.4.2 **CONTENT KNOWLEDGE**

Harris, Koehler and Mishra (2007:5-6) state that content knowledge is knowledge about the actual subject matter that is to be learned or taught, including, for example, middle school science, high school history, undergraduate art history, or graduate level astrophysics. Knowledge and the nature of inquiry differ greatly among content-areas and it is critically important that teachers understand this about the subject matter that they teach. As Shulman (1986) notes, this includes knowledge of concepts, theories, ideas, organizational frameworks, knowledge of evidence and proof, as well as established practices and approaches toward developing such knowledge. The cost of not having a comprehensive base of content knowledge can be quite prohibitive as students can receive incorrect information and easily develop misconceptions about the content area (National Research Council 2000; Pfundt & Duit 2000).

Golafshani (2002) states that a great deal of educators' conceptions about content influence their instructional practice. Golafshani further explains that educators who perceive learning as the accumulation of information are likely to view teaching as a transfer of information (Moila 2006:15).

Conceptual misunderstanding arises when students are taught scientific information in a manner that does not encourage them to settle any cognitive disequilibrium. In order to deal with their confusion, students construct a weak understanding and consequently are very insecure about constructed concepts (Rankhumise, 2008:12).

Technology has its own distinctive characteristics which make it essentially different from other things (Ankiewicz, 1995: 250; ITEA, 1997: ii). Although there is a distinction between conceptual knowledge ("knowing that") and procedural knowledge ("knowing how") in technology (McCormick, 1997: 143; Ryle, 1949: 28-32; Ropohl, 1997: 69); these two types of knowledge cannot be separated (McCormick, 1997:145). Conceptual or descriptive knowledge relates to the links between knowledge items, to such an extent that when learners can identify these links, we can say that they have conceptual understanding. Conceptual knowledge relevant to technology includes "knowledge that drawn from other subjects, such as science, that are unique to technology" (McCormick, 1997: 153; Ankiewicz; Engelbrecht and Swardt, 2006:2).

McCormick (1997: 153,) in Ankiewicz; Engelbrecht and Swardt (2006:2) state that procedural knowledge is frequently referred to as tacit, personal or implicit knowledge. "Design, modelling, problem solving, systems approaches, project planning, quality assurance and optimisation are all candidates for technological procedural knowledge …" (McCormick, 1997: 144). In contrast with conceptual knowledge, procedural knowledge cannot be taught: "Technical know-how can be gained by thorough practice only" (Ropohl, 1997: 69).

2.4.3 TRANFER OF KNOWLEDGE USING DIFFERENT METHODS AND STRATEGIES

It is very important that an integrated approach should be used to teach technology education, because it will enable learners to apply the relevant technological knowledge they gain in all aspects of their lives, as well as to understand the interrelationship between technology, society and the environment (Smit, 2007:32). The current methods of teaching technology education encourage certain aspects of learning, but often leave large gaps that are not complete (Wicklein, 1997:77 cited in Smit, 2007; Ntshaba, 2012:39).

Teis (2010) states that a teaching approach that emphasises open-ended problem-solving is the best way to prepare students for the challenges they will meet in the world outside the school. In the problem-solving workplace, projects may not always be clearly defined and traditional methods and procedures may need to be modified to meet the unique project requirements. Learners' engagement to challenge in open-ended problem-solving will involve practice in responding to challenges they may face in real life. Civil Technology educators must ensure that their teaching and learning environment stimulates circumstances that would help learners deal with authentic situations (Teis, 2010:18).

According to Van der Walt (2006), the technological process is central to all technology learning areas. Van der Walt (2010) indicates that technology is the interaction between hand and brain and also about thinking and doing. The balance should be reflected in the technological process itself and in the results of the process (Van der Walt, 2010:39). The Civil Technology process has six steps, consisting of:

- Identify : identify the problem
- Investigate: research or design brief; design specifications and requirement lists
- Design : formal drawings; formal material list and formal working programme
- Making: Making of the project or model
- Evaluation : evaluation checklist
- Communicate: presentation of work.

Maeko (2013:33) deviates from the approach of teaching the technology practical component side by side with theory, while Layton (1984:9) recommends the reinterpretation approach or a move from practice to theory and back to practice, as reflected in the figure below:

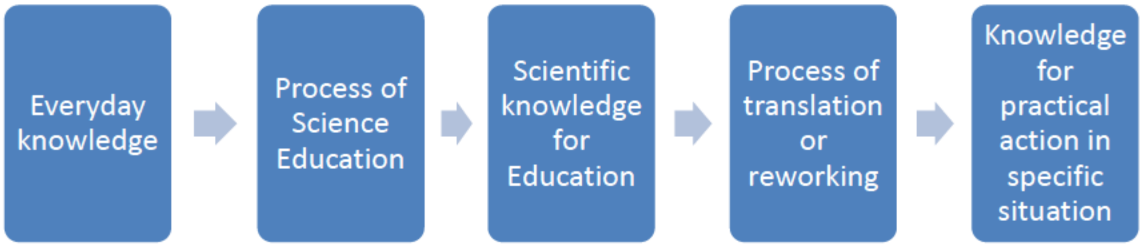

Figure 2: Layton's relationship between practical knowledge and scientific knowledge

Teis(2010) and Van der Walt (2010) concurs with figure 2 above that problem solving prepares leaners for reality challenges by applying knowledge they acquired from theory. Therefore; the figures two illustrate how to use scientific knowledge to solve the problem in technology or technical situation (practicals).

2.4.4 **INFRASTRUCTURE AND RESOURCES**

Textbooks, while essential to teaching Civil Technology, should not be considered as the only source of content. Other relevant resources such as newspapers, user manuals, magazines, journal articles, radio and television, other electronic media and Internet sites need to be incorporated into the content. Learners must be encouraged to use their own initiative; and project-based learning, collaborative learning and group work need to be encouraged. Content needs to be selected in such a way that it encourages the development of creativity, critical thinking, research skills, reading proficiency and interpretation skills (DoE 2008:14).

Safety in technology education is a major concern because of the use of dangerous tools and equipment. Technology educators, as the sole responsible persons for the safety of the learners, experience the added pressure of having to equip themselves and their teaching environment with the knowledge and infrastructure pertaining to the basic safety of learners (Arends 2010:36).

Every Technology and Civil Technology laboratory/classroom should, as a basic requirement, have access to adequate electrical points, water services and drainage with chemical traps if required. This would avoid waste water contaminated with chemicals entering the community sewerage system. Provision should also be made for adequate ventilation for the fumes and dust being emitted because of the nature of the activities taking place in that environment. An important safety aspect that needs careful consideration is room layout, which must allow for the safe location of machinery and tools. Areas for mounted machines should be clearly marked in relation to the walkways, work areas and other portable machines, as stipulated by safety requirements (Arends 2010:36).

Fundamental to the success of any educational programme, is the availability of appropriate teaching and learning facilities and materials. The need for these facilities and materials becomes more pronounced particularly in the area of technical education, where skill acquisition and development is the focal point (Olaitan 2003; Werner 2002). Ogunlade (2006) discloses that in technical colleges, not only are facilities and materials needed for infrastructure but also in the proportion of students' environment in order to provide for the kind of intensive practicals which go along with training in technical education.

Aina (2006) states that while facilities and materials may only facilitate classroom learning under general education, they are the very core of learning itself in technical institutions. This becomes the case in view of the fact that these institutions are specifically established for the purpose of imparting and developing skills. This underscores the relevance of facilities and materials in technical colleges, as it is not possible to acquire and develop skills without practice, just as it is not possible to carry out practicals without facilities and materials. Musa (2004) asserts that educational facilities, therefore, are the material things that facilitate the teaching and learning process in the school. He opines that facilities include school buildings (i.e. classroom, assembly halls, laboratories, workshops and libraries), teaching aids and devices such as modern hardware and their software in the form of magnetic tapes, films and transparencies. Educational facilities enable a skilful teacher to achieve a level of instructional effectiveness that far exceeds what is possible when they are not provided (Langa and Wafudu 2014:4).

Fundamental to the success of any educational programme, is the availability of appropriate teaching and learning facilities and materials. The need for these facilities and materials becomes more pronounced particularly in the area of technical education, where skill acquisition and development is the focal point (Olaitan, 2003; Werner, 2002; Langa and Wafudu 2014:4).

Two plans below show the layout of a woodwork workshop floor plan with resources:

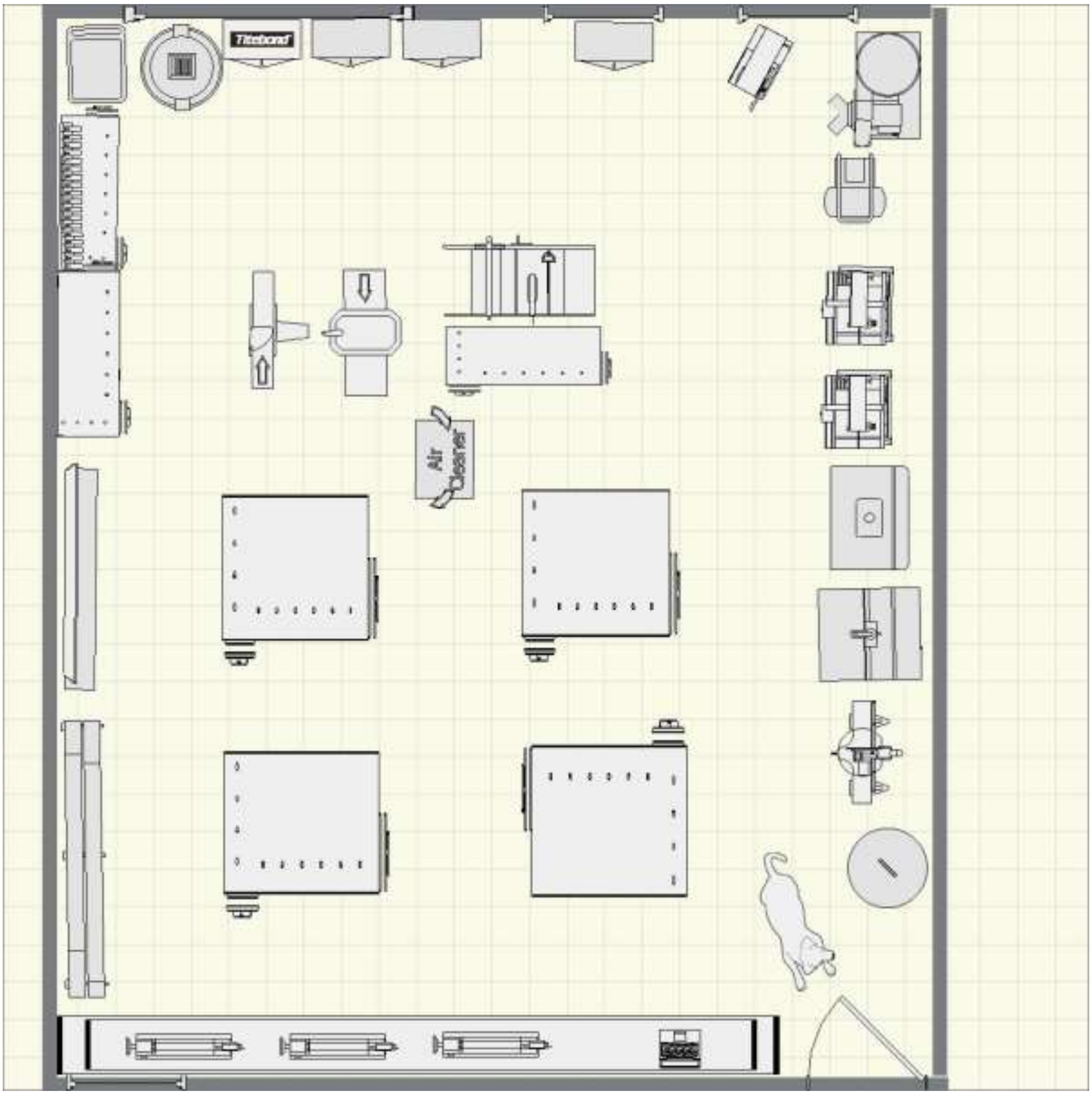

Figure 3: Fine Woodworking workshop floor plan

Source: http://www.finewoodworking.com

The floor plan figure 3 shows the layout of a fully equipped workshop with the following requirement: the dog symbolise the security, working table in the middle to allow freedom of movement, machines and working tool next to the wall for good housekeeping and free cross ventilation.

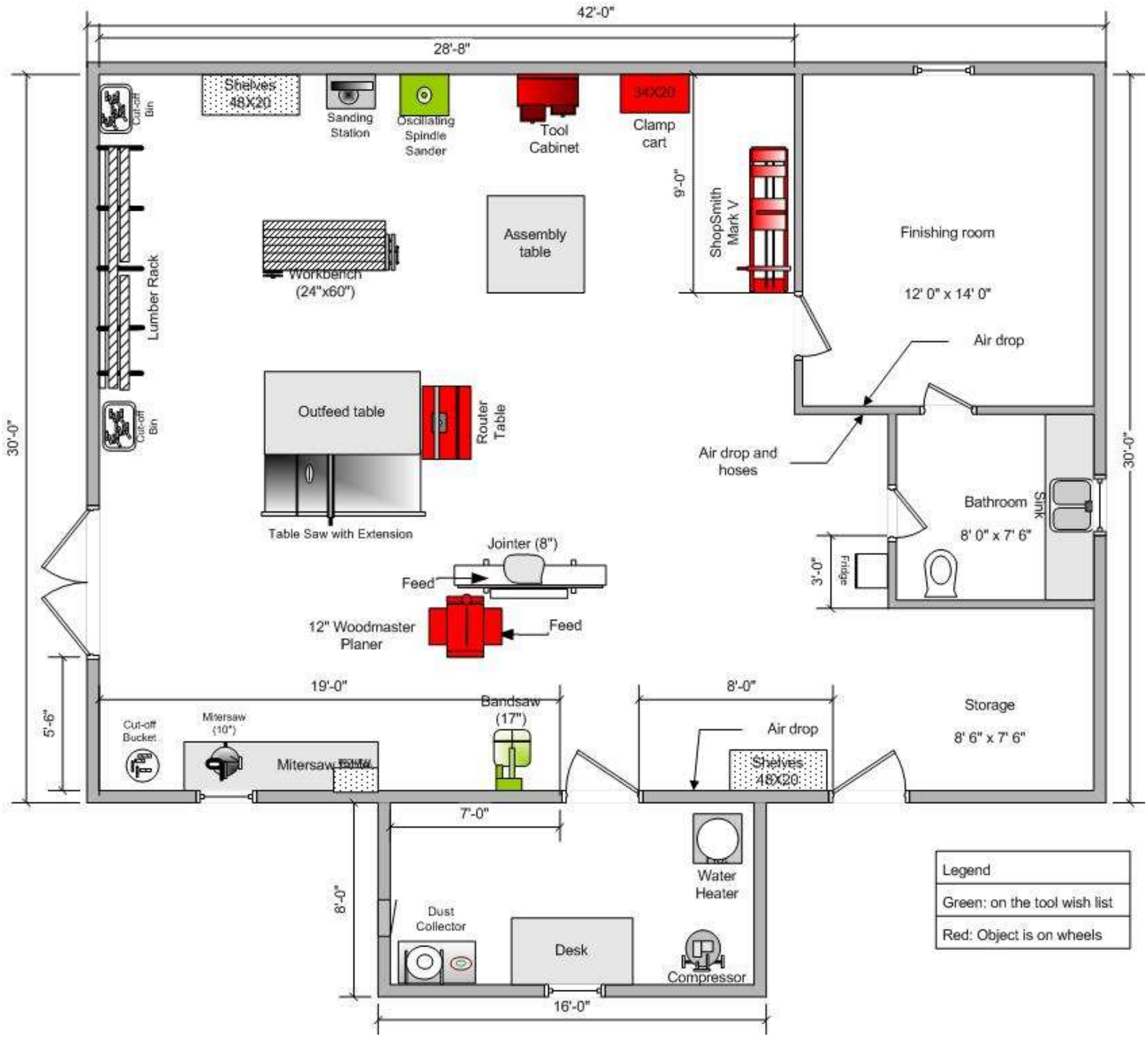

Figure 4: Woodworking workshop floor plan

Source: http://woodworkingblueprints.com

According to Maeko (2013), a workshop is a primary requirement for Civil Technology to be offered as a subject in schools. It is evident from that background that the practical workshop for the subject is of paramount importance. This means that all schools offering the subject should have workshops and material for practical training. Students' practical projects are an important part of the curriculum in technology education and a supportive school environment is a fundamental requirement for the successful implementation of the curriculum (Bybee & Loucks-Horsely, 2000:18; Maeko, 2013:36). This aspect of the curriculum can only be implemented where facilities in the workshop are adequate and relevant (Maeko 2013:36).

Practical work, according to Lunetta, Hofstein and Clough (2007:400) can be described as those learning experiences in which students interact with the materials or with secondary sources of data to observe and understand the natural world. Millar (2004:16) emphasizes the important role of practical work in helping students to make links between the domain of objects and observable properties and events, and the domain of ideas (Maeko, 2013:36).

Since Civil Technology is a practical subject, applying skill to everyday life requires both theory and a hands-on workshop (Rosa & Feisel, 2005:56). While the former lends itself to classroom learning, the latter can only be learned and practised in the workshop. Gardner and Gauld (2009 :23) assert that "merely being in the workshop and doing lab work there does not translate into fostering technical attitudes as it is the quality of the experiences that students have there that is critical" (Maeko 2013:36).

It is contended that working with materials and tools should lead to the development of manual skills, cognitive reasoning and the transfer of these abilities to what has been designed in reality (Seiter, 2009:422; Maeko, 2013:36). Seiter concludes that pupils do not often prepare materials for practicals and more often rely on their teachers or outside help. Hence, Seiter recommends that learners should be given access to workshops, which allow all possible methods of working with and the processing of materials (Maeko, 2013:36).

2.4.5 TIME ALLOCATION IN CIVIL TECHNOLOGY

The DoE (2008:17) LPG indicates the stages of time allocation into three stages which are:

Table 4: Stages of time allocation in to three stages

STAGE 1 Subject Framework	4 hours per week is allocated to Civil Technology in the NCS. This is approximately 160 hours per year. The teachers of the subject should plan how this time will be used for the teaching of Civil Technology in the three grades.
STAGE 2 Work Schedule	The groupings of ASs as arrived at in the integration process should be paced across the 40 weeks of the school year to ensure coverage of the curriculum.
STAGE 3 Lesson Plan	The amount of time to be spent on activities should be indicated in the Lesson Plans.

CAPS (DoE 2011), clearly states that four hours of contact time is prescribed per week. Two and a half hours is intended for theory and one and a half hours for practical work and completion of the PAT. (One double period per week is required for practical work).

According to Makgato (2003) 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 teaching 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 (Makgato, 2003:48).

2.4.6 Context of implementation

According to Mhizha (2012), researchers are in general agreement that policy implementation is affected by the context in which policies are implemented (Brynard and De Coning, 2006; Berman, 1978; Maharaj, 2005; O'Toole, 1986; Van Meter and Van Horn, 1975; Warwick, 1982). Policies that work in one context may fail in another. Gornitzka et al. (2005) also state that the socio-cultural, socio-economic and socio-political conditions of the implementing agency shape the outcomes of policy implementation.

Socio-economic factors affect policy initiatives in various ways. Communities in lesser developed countries are often characterised by poverty and development constraints. According to Cloete (2006), the development constraints influence public policy making negatively. A widespread lack of infrastructure and funds for development impedes the capacity of the system to achieve policy objectives. With regard to socio-political factors, Cloete (2006; 90) argues that many of these policies are complex, requiring considerable changes in attitudes and behaviour. They are also aimed at depriving powerful interest groups of their privileges. As a result, they are normally fiercely resisted by various vested interests and cannot be effectively implemented (Mhizha, 2012:33-34).

2.5 CONCLUSION

Civil Technology is a new subject which is integrated with other building environment related subjects. It is a subject which requires high levels of skills and high levels of critical thinking by the teachers teaching Civil Technology. In this chapter, the definitions of the main key words were discussed in order to indicate a clear distinction between technical education and technology education. International curricula, as well as the South African curriculum of technical and technology education were discussed to specify the curriculum shift globally. South African Civil Technology curricula, which are changing rapidly, may cause teacher stress in terms of subject approach, because of a lack of subject content knowledge. It may lead to uncertainty regarding the role of the teacher; therefore different approaches of implementation of the curriculum were addressed. To assist schools to produce quality results and work time, infrastructure and resources play a major role; therefore time allocation, infrastructure and resources were also addressed in this chapter.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The previous chapter looked at the concept of curriculum change by integrating technical subjects to develop the subject Civil Technology. The literature study was done to clarify the integration of technical subjects and Civil Technology as a new subject and its aims and objectives of implementation of the curriculum.

This chapter focuses on the research design and methodology process used. It provide the details regarding the collection of data and analysis. The chapter also explains the population and sampling used in the study in detail.

3.2 RESEARCH DESIGN

The research design is a mixed method approach, comprising qualitative as well as quantitative methodology to collect data. The method of investigation includes a literature review, as well as the empirical study, using qualitative and quantitative methods in the form of questionnaires and a purposive sampling interview.

Mixed method research is defined as a procedure for collecting, analysing and mixing both quantitative and qualitative data at some stage of the research process within a single study to understand a research problem more completely (Creswell, 2005). In a mixed method study both numerical and text data are collected and analysed to address different aspects of the same general research problem and provide a more complete understanding (Ivankova, Cresswell & Clark, in Maree, 2009: 263).

The researcher used semi-structured interviews and questionnaires to collect the data as discussed further in 3.4.1 to 3.5.3. Questionnaires were delivered at schools where teachers had one day to complete the questionnaires and two days were devoted to the teachers who were sampled for the interview.

3.3 POPULATION AND SAMPLING

Goddard and Melville (2001: 34), as well as Maeko (2013:51), define population as any group that is the subject of research interest. A research population is categorised into targeted accessible population and looked at in terms of those elements in the target population within the reach of the researcher (Pole & Lampard, 2002; Mhizha, 2013:38). Burns (2000:464) is of the opinion that the sample chosen must serve the real purpose and objectives of the research, gaining understanding with regard to a particular phenomenon chosen. Due to lack of accessibility in terms of distance and the limited number of schools offering Civil Technology in the Free State Province, the population in this research was forty nine and the sampling was twenty- one teachers responsible for teaching Civil Technology in all grades from schools in the five districts of the Free State Province: Fezile Dabi, Motheo, Lejweleputswa, Thabo Mofutsanyana and Xhariep. In the schools where more than one teacher is responsible for the subject, a maximum of two teachers participated. Table 5 below specifies the number of teachers and schools per district that participated in this study:

Table 5: Number of schools and Number of Teachers

Districts	Number of schools = 18	Number of Teachers = 21
Thabo Mofutsanyana	3	3
Xhariep	1	1
Fezile Dabi	3	3
Motheo	8	11
Lejweleputswa	3	3

3.4 DATA COLLECTION INSTRUMENTS

3.4.1 INTERVIEWS

Munonde (2007) cites Schulze (2000:82) as saying that there are four kinds of interviews in qualitative research: unstructured interviews; non-directive interviews; structured interviews and focus group interviews. According to Babbie & Mouton (2006:290 and Munonde(2007:80) a qualitative interview is an interaction between an interviewer and a respondent in which the interviewer has a general plan of inquiry, but not a specific set of questions that must be asked in particular words and in a particular order. In addition, Babbie and Mouton (2006:288) assert that a qualitative interview is essentially a conversation in which the interviewer establishes a general direction and pursues specific topics raised by the respondent.

Neumann (1997:373) in Munonde (2007:81); maintains that there are three types of questions in an interview, i.e. descriptive, structural and contrast questions. he (1997:251) further asserts that questions are usually in one of the following forms: structured, semi- structured or unstructured. She indicates that in semi- structured questions, the question is phrased to allow for individual responses in that it is an open-ended question but fairly specific in its intent

According to Leedy and Ormrod (2001: 196), a survey research employs mostly a face-to-face interview or a telephone interview. They regard the structured face-to-face interview as yielding the highest response rates in survey research, because of its distinct advantage of enabling the researcher to establish rapport with respondents and therefore gain their cooperation. According to De Wet et al. (1981: 163), the interview can be used to identify variables, formulate hypotheses and provide guidance to other phases in the research. It can be used either as the major medium through which data is compiled or in support of other research methods (Brunnette, 2006:241). Cohen, Manion and Morrison (2004: 267) state that an interview enables participants- be they interviewers or interviewees- to discuss their interpretations of the world in which they live, and to express how they regard situations from their own point of view.

The researcher conducted qualitative research to understand the research phenomena from the Civil Technology teachers of five districts in Free State. One-on-one interviews were conducted with four experienced and three inexperienced teachers on the integration of technical subjects in secondary schools. They had to answer a set of predetermined questions that allowed for further probing and clarification of answers. Interviews were audio- recorded and notes were taken with the permission of the participants.

According to Schumacher and McMillan (1993:432), audio - recording the interviews ensures completeness of verbal interaction and provides material for reliability checks. In addition, Neuman (1997:368) maintains that tape recordings can supplement the research by providing a close approximation to what occurred and by providing a permanent record that the researcher can listen to more than once. Nieswiadomy (1987:48) points out that through tape recordings, the total interview process can be captured and the interviewer is free to observe the participants (Munonde 2007:91).

Teachers were selected according to teaching experience in Civil Technology and other subjects integrated in developing the subject Civil Technology. Table 6 and table 7 below explain the selection criteria that were used when selecting participants for the interview:

Table 6: Experienced teachers with long service without formal training of CT

Experienced teachers with long service without formal training of Civil Technology		
Teachers	**Specialisation**	**Experience**
Teacher A	Woodwork or Woodworking	3 years or more
Teacher B	Bricklaying and Plastering	3 years or more
Teacher C	Plumbing	3 years or more
Teacher D	Civil Technika	3 years or more

Table 7: Inexperienced teachers with formal training of CT

Unexperienced teachers with formal training of Civil Technology		
Teachers	**Specialisation**	**Experience**
Teacher E	Civil Technology	Less than 3 years
Teacher F	Civil Technology	Less than 3 years
Teacher G	Civil Technology	Less than 3 years

Schumacher and McMillan (1993:427) maintain that question content asked in the interview varies because of different research purposes and problems, theoretical frameworks and the selection of participants. They further suggest that interview questions can focus on experience or behaviour, opinions, values, feelings, knowledge, sensory perceptions and the individual's background or demographic information. The researcher in this study used an interview guide to direct the interview. However, some questions were not used as they appeared in the interview guide, but were reformulated to suit the setting (Munonde, 2007:81).

The following questions were asked during the one-on-one semi- structured interviews with teachers:

1. What is the difference between Civil Technology and your subject specialisation in Technical Education?

2. Did you attend any formal training in the Civil Technology curriculum conducted by the Department of Education?

3. Which challenges did you experience in teaching which aspects did you find difficult to teach in Civil Technology curriculum?

4. Did you find the mathematical and scientific principles applied in Civil Technology beneficial to the integrated curriculum?

5. What is your opinion about the practical part of the Civil Technology Curriculum?

6. Do you have a proper or fully equipped workshop and laboratory?

7. Explain how you access information about new technology in your field.

8. Explain your understanding of the purpose of a Technical high school and Technical (FET) colleges or Technical Vocational Educational Training.

The semi structured interview questions were used to obtain in depth information, as all above questions emanated from research questions of the study. Therefore; they were used to measure the objectives of the study.

3.4.2 Questionnaire

De Vos et al. (2004:179) claim that the use of questionnaires enables the researcher to explore the variables better and to obtain an idea of the spectrum of possible responses. Selesho (2010:6) asserts that the questionnaire allows respondents more time and it can be completed whenever it suits them.

A quantitative research method is used to test the theories about reality, and to look for cause and effect used to gather data to test the questions (Inankova, Creswell and Clark, 2007:255). Questionnaires were distributed to the Civil Technology teachers in the Free State. This group consisted of teachers with Woodwork, Plumbing, Bricklaying and Plastering training, and teaching experience, but who do not have any formal training in Civil Technology and who facilitate the learning area in FET schools, as well as teachers with formal tertiary training in the Civil Technology learning area. The questionnaire focused on the teachers' level of competence and attitudes to the new integrated subject Civil Technology.

The questionnaires were delivered by hand or posted to Civil Technology teachers with a letter attached asking participants to fill in the questionnaire and also explaining instructions to them. Participants had four days to complete and return the questionnaire. All twenty- one teachers that participated in the survey teach at schools in five districts of the Free State Province in South Africa. Table 8 below illustrates the placement of teachers in their districts and the names of schools as Pseudonym for confidentiality and numbers of the schools:

Table 8: Districts, Names of Schools, Number of Teachers and Number of schools

Districts	Names of Schools	Number of Teachers = 21	Number of schools = 18
Thabo Mofutsanyana	School A	1	3
	School B	1	
	School C	1	
Xhariep	School D	1	1
Fezile Dabi	School E	1	3
	School F	1	
	School G	1	
Motheo	School H	2	8
	School I	1	
	School J	1	
	School K	1	
	School L	2	
	School M	2	
	School N	1	
	School O	1	
Lejweleputswa	School P	1	3
	School Q	1	
	School R	1	

Figure 5: Free State district municipality map

Source: http://www.oecd.org/edu/imhe/46661089.pdf

The above map shows all five districts of the Free State and also provides the route the researcher travelled to conduct the research.

Proper administration of the questionnaires is crucial and also to be informed which districts participated in the survey. The table 9 below was used to control the flow of the questionnaires. The first column indicates school districts, second number of schools, third number of teachers per district, fourth and fifth were used as the checklist of handing out questionnaires and handing in of the questionnaires for reliable administering audit.

Table 9: Control list for questionnaire

CONTROL LIST FOR QUESTIONNAIRES				
Districts	Number of schools = 18	Number of Teachers = 21	Out	In
Thabo Mofutsanyana	3	3		
Xhariep	1	1		
Fezile Dabi	3	3		
Motheo	8	11		
Lejweleputswa	3	3		

3.5 DATA ANALYSIS

The study uses a procedural method to analyse the data collected by means of qualitative method from the questionnaire and qualitative method the in the quantitative data from the questionnaire and the interviews and this section will explain the procedure followed.

3.5.1 INTERVIEWS

The researcher collected data by means of the interviews and categorised the data according to themes. The main task in the data analysis stage was to identify common themes from the participants' description of their experiences (Leedy & Ormrod 2005; Ntshaba 2012:78).

Coding was used to analyse qualitative data from the interviews. Coding has been defined by Kerlinger (1970) as the translation of question responses and respondent information to specific categories for the purpose of analysis. Many questions are pre-coded, that is, each response can immediately and directly be converted into a score in an objective way (Cohen, Manion and Morrison 2004: 284). The interview records were analysed by transcribing them. Each transcription is considered with the aim of identifying key issues (Maeko, 2013:55).

Mollo (2006) cites Miles and Huberman (1984:231-243) who explain the steps to follow:

Step 1. Identification of themes

Step 2. Coding

Step 3. Drawing a table

Step 4. Grouping data according to themes; and the writing of the report (Mollo 2006:54).

This method was applied in the interpretation of data gathered from the interviews.

Teachers were coded as:

Experienced teachers with long service without formal training of Civil Technology (3 years or more)		
Teachers Code	**Specialisation**	**Experience**
Teacher A	Woodwork or Woodworking	
Teacher B	Bricklaying and Plastering	
Teacher C	Plumbing	
Teacher D	Civil Technika	

Table 10: Experienced teachers with long service without formal training of CT

Unexperienced teachers with formal training of Civil Technology (Less than 3 years)		
Teachers Code	**Specialisation**	**Experience**
Teacher E	Civil Technology	
Teacher F	Civil Technology	
Teacher G	Civil Technology	

Table 11: None experienced teachers with formal training of CT

Tables 10 & 11 therefore enable the researcher to identify respondents, with the knowledge that teachers A, B, C and D are experienced while teachers are E, F and G are inexperienced.

The information gathered from the respondents was translated or transcribed and analysed by means of coding. The same questions were posed to all the participants and were analysed as follows:

Teacher A and Teacher D provided similar responses and these were converted into a score that built a clear picture of data gathered.

3.5.2 Questionnaire

Descriptive and inferential analysis was used to analyse data from the questionnaires. Rijuan (2009) cites Burns (2000: 43) as stating that; descriptive and inferential statistics used in analysing the data from the questionnaire allows the researcher to use numerical techniques to summarize the data.

- The researcher employed a professional **statistician** to assist in the accurate analysis of data. The data gathered from respondents was organised and analysed by the researcher and the qualified statistician. The data was analysed into the following categories:
- **Section A**
  A. Personal information
- **Section B**
  A. Purpose of integrating technical subjects into the Civil Technology curriculum
  B. Role of the teacher in the Civil Technology integrated curriculum
  C. Teachers' attitudes towards integrated curriculum

Table or diagram method was used be to expound data, which is further explained in words to provide clear information.

The last question of section B was analysed by the statistician and the researcher, in which teachers were tested on the application of scientific and mathematical aspects in Civil Technology. The researcher tried to determine the attitude of the teachers towards Applied Mechanics, which is assumed to be the difficult part of the curriculum in Civil Technology.

3.6. Conclusion

In this chapter, the research design and method was discussed. The chapter presented the procedure involved in the collection of data by means of the instruments, namely interviews and questionnaires. The list of participants and their location of was presented. The instruments used for the data analysis and procedure were also clearly explained.

CHAPTER 4

DATA PRESENTATION, INTERPRETATION AND DISCUSSIONS OF THE RESULTS

4.1 INTRODUCTION

The previous chapter explained how the methods of collecting data were employed and how data was analysed. This chapter presents the findings of the research study and it also discusses the results as derived from the questionnaires and interviews that were conducted.

The aim of the study was to investigate the integration of technical subjects in Civil Technology curriculum with special reference to FET Technical Schools.

The research study was projected to achieve the following objectives:

- Describe the meaning and integration of the subjects in the Civil Technology curriculum.
- Examine the role of educators in the integrated curriculum.
- Give recommendations for the implementation of the Civil Technology curriculum.

4.2 PRESENTATION OF DATA

The research population was 49 teachers in the Free State Province and the sampling was N =21 teachers from all five districts of the Free State. The instruments used were questionnaires and face- to- face interviews.

4.2.1 Presentation of data from the questionnaires

Twenty- one (21) Questionnaires were distributed to all 21 participants, based on purposeful sampling and they were all returned. Questionnaires were divided into two sections: Section A which concentrated on biographical information of participants and Section B was divided into three categories:

A. Purpose of integrating technical subjects into the Civil Technology curriculum

B. Role of the teacher in the Civil Technology integrated curriculum

C. Teachers' attitudes towards integrated curriculum

Section B was aimed at determining the positive and negative experiences and attitudes of teachers towards implementation of the integrated curriculum of Civil Technology.

4.2.1.1 Teacher biographical detail

Table 12 Teacher biographical detail

Frequency Table			
		Frequency	**Percent %**
Q1 Gender			
Valid	Male	18	85.7
	Female	3	14.3
	Total	21	100.0
Q2 Age			
Valid	Under- 25	3	14.3
	25-35	8	38.1
	36-45	4	19.0
	46-55	5	23.8
	Over 55	1	4.8
	Total	21	100.0
Q3 Years of experience			
Valid	Under-3	6	28.6
	3-6	3	14.3
	7-10	3	14.3
	Over 10	9	42.9
	Total	21	100.0
Q4 [**MAJOR SUBJECTS]**		**Q4a Woodwork & woodworking**	
Valid	Yes	8	38.1
	No	13	61.9
	Total	21	100.0
Q4b Bricklaying and Plastering			
Valid	Yes	2	9.5
	No	19	90.5
	Total	21	100.0
Q4c Plumbing			
Valid	Yes	1	4.8
	No	20	95.2
	Total	21	100.0
Q4d Civil Technika/Technical			
Valid	Yes	2	9.5
	No	19	90.5
	Total	21	100.0
Q4e Civil Technology			
Valid	Yes	8	38.1
	No	13	61.9
	Total	21	100.0

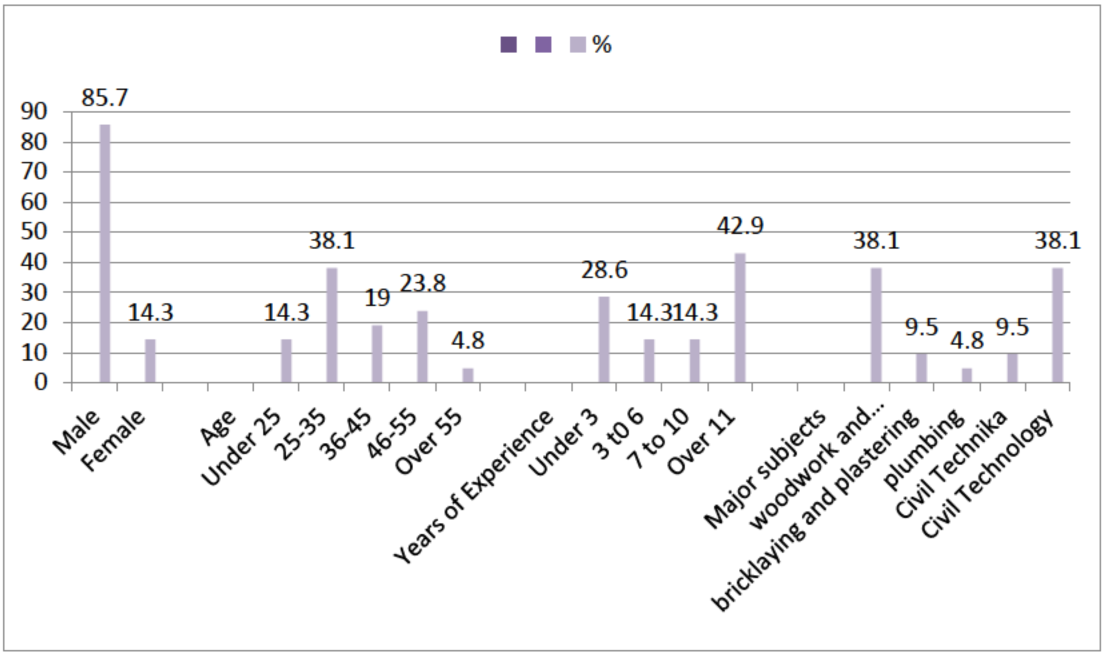

Figure 6: Teachers' biographical detail

- GENDER

The results above in terms of gender show that males are in the majority (n=18) (85.7%) when females are in minority (n=3) (14, 3%). It means that the majority of teachers of Civil Technology in the Free State are still males.

- AGE

In terms of age, the highest (n=8) (38,1%) number of respondents fall within the age group 25-35 years, followed by the group aged between 46-55 years with (n=5) (23,8%) and the smallest age group derived from the data was the age of over 55 years with (n=1) (4,8%). The group aged between 36-45years constitutes 19, 0% (n=4) and 14, 3% are under 25 years (n=3).

- YEARS OF EXPERIENCE

With regard to years of experience in Civil Technology and specialised technical subjects from the participants, table 11 above indicates that teachers with more than 11 years' experience are the largest group with (n=9) (42,9%), followed by those with less than 3 years' experience (n=6) (28,6%) and the last two groups have between 3-6 years' (3) (14,3%), and 7-10 years' (3) (14,3%) experience.

- MAJOR SUBJECTS IN TEACHING QUALIFICATION

Results above showed that the highest number (n=8) (38, 1%) of teachers majored in Civil Technology (4e), followed by the teachers (*on the same score*) who majored in Woodwork and Woodworking (4a) with (n=8) (38, 1%). Teachers who majored in Civil Technika; Bricklaying and Plastering (4b) are both (n=2) (9, 5%), with the smallest number who majored in Plumbing (4c) with (n=1) (4, 8%).

Table 13: Items 1 towards more to strongly agree

Q5. Civil Technology develop high level of knowledge and skill					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	13	61.9	1.476	.7496
	Agree	7	33.3		
	Strongly disagree	1	4.8		
	Total	21	100.0		
Q6. All technical subjects in building related environment are integrated in civil technology curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	11	52.4	1.476	.5118
	Agree	10	47.6		
	Total	21	100.0		
Q9. Civil Technology curriculum establish general background of civil engineering					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	13	61.9	1.381	.4976
	Agree	8	38.1		
	Total	21	100.0		
Q11. Integration of mathematics and science principle applications shows the important of Civil Technology curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	15	71.4	1.286	.4629
	Agree	6	28.6		
	Total	21	100.0		
Q13. I develop myself by reading and research					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	12	57.1	1.429	.5071
	Agree	9	42.9		
	Total	21	100.0		
Q17. Site visit with learners stimulate understanding of integrated Civil Technology curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	16	76.2	1.238	.4364
	Agree	5	23.8		
	Total	21	100.0		
Q18. It is my responsibility to assess learners as prescribed in the policy Curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	14	66.7	1.333	.4830
	Agree	7	33.3		
	Total	21	100.0		
Q19. It is my responsibility to order material in time for practical work					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	11	52.4	1.476	.5118
	Agree	10	47.6		
	Total	21	100.0		
Q20. I always call for help if I don't understand other disciplines in Civil Technology					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	15	71.4	1.286	.4629
	Agree	6	28.6		
	Total	21	100.0		
Q29. I can teach my specialised trade with confidence					

		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	16	76.2	1.238	.4364
	Agree	5	23.8		
	Total	21	100.0		

(Source: Analysis of survey data collected for this study)

Table 13 above shows frequency, percentage, mean and standard deviation of the 11 items analysed from the questionnaire (Appendix A). The two lowest scores are Q17 "Site visit with learners stimulate understanding of the integrated Civil Technology curriculum", and Q29 "I can teach my specialized trade with confidence," with a mean of (1.238). The second low score was Q13 "I develop myself by reading and research," with a mean of (1.429); and Q9 "Civil Technology curriculum establishes general background of civil engineering," (1.381). Q18 "It is my responsibility to assess learners as prescribed in the Curriculum Policy Statement" (1.333); and Q11 "Integration of mathematics and science principle applications shows the importance of the Civil Technology curriculum", (1.286); and Q20 "I always call for help if I don't understand other disciplines in Civil Technology", (1.286). Q5 "Civil Technology develops high levels of knowledge and skill", (1.476); and Q6 "All technical subjects in the building related environment are integrated into the Civil Technology curriculum", (1.476); "It is my responsibility to order material in time for practical work", (1.476) are the three items with high scores. The results imply that most of the teachers have confidence in teaching the subjects they specialised in and they also agreed very strongly that site visits with learners promote a better understanding of the integrated Civil Technology curriculum (1.238).

Table 14 Items towards (2) more to agree

Q7. Civil Technology curriculum provide industrial knowledge needs which create job opportunity to learners					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	6	28.6	1.857	.6547
	Agree	12	57.1		
	Disagree	3	14.3		
	Total	21	100.0		
Q8. Civil Technology curriculum promote self-employment					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	3	14.3	2.429	.8106
	Agree	7	33.3		
	Disagree	10	47.6		
	Strongly disagree	1	4.8		
	Total	21	100.0		
Q10. Civil Technology use problem solving (technological process) as a main strategy or method					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	11	52.4	1.571	.6761

	Agree	8	38.1		
	Disagree	2	9.5		
	Total	21	100.0		
Q12. I will like to have more formal training in civil technology Curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	12	57.1	1.667	.8563
	Agree	4	19.0		
	Disagree	5	23.8		
	Total	21	100.0		
Q14. I regularly attend departmental workshop and training					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	13	61.9	1.571	.9258
	Agree	6	28.6		
	Strongly disagree	2	9.5		
	Total	21	100.0		
Q16. I use multimedia (TV and Video) to enhance my teaching					
		Frequency	Percent	**Mean**	**SD.**
Valid	Strongly agree	10	47.6	1.571	.5976
	Agree	10	47.6		
	Disagree	1	4.8		
	Total	21	100.0		
Q21. Do you use problem solving as the main method in the curriculum					
		Frequency	Percent	**Mean**	**SD.**
Valid	Strongly agree	10	47.6	1.571	.5976
	Agree	10	47.6		
	Disagree	1	4.8		
	Total	21	100.0		
Q22. Civil Technology is for intelligent peoples only					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	7	33.3	2.238	1.0911
	Agree	5	23.8		
	Disagree	6	28.6		
	Strongly disagree	3	14.3		
	Total	21	100.0		
Q27. I recommend full training course in applied mechanics					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	13	61.9	1.571	.8106
	Agree	4	19.0		
	Disagree	4	19.0		
	Total	21	100.0		
Q28. Time allocation for the subject is not sufficient					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	3	14.3	2.190	.8136
	Agree	13	61.9		
	Disagree	3	14.3		
	Strongly disagree	2	9.5		
	Total	21	100.0		

(Source: Analysis of survey data collected for this study)

Table 14 explains the frequency, percentage, mean and standard deviation. The five lowest score items are Q10 “Civil Technology uses problem solving (technological process) as a main strategy or method”, (1.571); Q14 “I regularly attend departmental workshops and training”, (1.571); Q16 “I use multimedia (TV and

Video) to enhance my teaching", (1.571); Q 21 "Do you use problem solving as the main method in the curriculum", (1.571); and Q27 "I recommend a full training course in Applied Mechanics", (1.57).The second highest score items are Q12 "I would like to have more formal training in the Civil Technology Curriculum", (1.667); Q7 " The Civil Technology Curriculum provides industrial knowledge needs which create job opportunities for learners", (1.857); Q28 " The time allocation for the subject is not sufficient", (2.190); and Q22 "Civil Technology is for intelligent peoples only", (2.238). The highest score item is Q8 "The Civil Technology Curriculum promotes self-employment", (2.429). The results imply that teachers use problem solving as the main strategy or method and regularly attend departmental workshops and training; they also use multimedia (TV and Video) to enhance their teaching and teachers recommend full course training in Applied Mechanics; which indicates that the mean is more around 2 which is "Agree".

Table 15 Items towards disagree (3)

Q15. I am a full registered member of cluster group					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	4	19.0	2.952	1.2032
	Agree	3	14.3		
	Disagree	4	19.0		
	Strongly disagree	10	47.6		
	Total	21	100.0		
Q23. Mathematics and scientific principles make Civil Technology less interesting subject					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	3	14.3	3.238	1.0911
	Agree	1	4.8		
	Disagree	5	23.8		
	Strongly disagree	12	57.1		
	Total	21	100.0		
Q24. I was forced by the changing of system to teach Civil Technology					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	1	4.8	2.714	.9562
	Agree	10	47.6		
	Disagree	4	19.0		
	Strongly disagree	6	28.6		
	Total	21	100.0		
Q25. Civil Technology produce poor practical work					
		Frequency	Percent	**Mean**	**SD**
Valid	Strongly agree	1	4.8	2.571	.8701
	Agree	11	52.4		
	Disagree	5	23.8		
	Strongly disagree	4	19.0		
	Total	21	100.0		
Q26. I lack confidence in teaching applied mechanics in Civil Technology curriculum					
		Frequency	Percent	**Mean**	**SD**
Valid	Agree	6	28.6	3.143	.8536
	Disagree	6	28.6		

	Strongly disagree	9	42.9		
	Total	21	100.0		

(Source: Analysis of survey data collected for this study)

Table 15 reflects the items on which the teachers tended to disagree, as table 15 above presents frequency, percentage, mean and standard deviation. The lowest score item is Q25 “Civil Technology produces poor practical work”, (2.571), followed by Q24 “I was forced by the changing of the system to teach Civil Technology”, (2.714); and Q15 “I am a full registered member of a cluster group”, (2.952). The highest score item is Q26 “I lack confidence in teaching Applied Mechanics in the Civil Technology Curriculum”, (3.143). The results imply that Civil Technology produces poor practical work; as the mean shows the lowest score of (2.571) is more toward “Disagree” (3); therefore it implies that teachers **disagree**.

Table 16 More towards strongly disagree (4)

Q30. I don’t like to teach technology subjects because technology change fast					
		Frequency	Percent	**Mean**	**SD**
Valid	Agree	1	4.8	3.619	.5896
	Disagree	6	28.6		
	Strongly disagree	14	66.7		
	Total	21	100.0		

(Source: Analysis of survey data collected for this study)

Table 16 above indicates data presented on Frequency, Percent, Mean and Standard deviation. Table 16 shows only one item, i.e. Q30 “I don’t like to teach technology subjects because technology changes fast” (3.619), which implies that teachers strongly disagree that they do not like to teach technology subjects because technology changes fast.

RELIABILITY OF STATISTICS

The reliability of statistics on Cronbach’s Alpha reports the positive items only. Therefore table 17 reports the on hypothesis one, table 18 reports on hypothesis two while table 19 reports the on hypothesis three.

Table 17 Hypothesis one

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.766	**.756**	**11**

The reliability of the statistics revealed that hypothesis 1 “Integrating technical subjects into Civil Technology or the technology shift from a low level of technical skills to a high level of technology skills”; which was tested with 11 items (Q5,Q7,Q8,Q9,Q10,Q11,Q13,Q16,Q17,Q20,Q21) (table 13) has a high Cronbach’s Alpha (0.766) score which indicates that there is an **internal consistency** between the questions or items.

Table 18 Hypothesis two

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.147	**.171**	**3**

The reliability statistics in the above table indicate that the alpha coefficient for three items (Q12, Q15, Q29) obtained a Cronbach’s Alpha score of 0.147, which is less than the reliability coefficient of 0.70, therefore hypothesis 2 “Teachers’ roles in Civil Technology are to integrate principles of mathematics and science to impart skills to learners” reveals that there is **no internal consistency (inconsistency)** between the questions**.**

Table 19 Hypothesis three

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.864	**.880**	**9**

Table 19 indicates the reliability of statistics for 9 items (Q15, Q22, Q23, Q24, Q25, Q26, Q27, Q28, and Q30). The Cronbach’s Alpha is 0.864, which is higher than the alpha coefficient of 0.70, therefore hypothesis 3 “Teachers seem to have negative attitude towards the integration of technical subjects into Civil Technology” because of high Cronbach’s Alpha indicates that there **is internal consistency** between the questions.

4.2.2 PRESENTATION OF DATA FROM INTERVIEWS

Interview questions with Teachers

Theme 1: Definition of Civil Technology.

1. What is the difference between Civil Technology and your subject specialisation in Technical Education?

Table 20: Teachers' responses on Civil Technology versus Subject (trade) specialisation

Teacher	ANSWER
A	Civil Technology comprises of other subjects which are in the building environment such as: Woodwork, Bricklaying & Plastering and Plating.
B	It gives general knowledge in the general building environment because of combination of all these three subjects Plumbing, Woodwork and Construction. Actually is a top subject.
C	Civil Technology covers the whole built environment, specialisation subjects concentrated only on specialisation.
D	I specialised with Civil Technika , Civil Technology is too easy and indeed gives all building environment information and makes you the master of none, while the specialisation channels you to a specific trade and be a master in that trade
E	Civil Technology is the general background of building environment and specialisation focuses on vocational training.
F	I specialised with Civil Technology from high school to university, Civil Technology prepares learners to have a general background of building environment and specialisation channels learners into hard labour.
G	I did Civil Technology but the difference is that Civil Technology covers the general background of building environment; Technical Vocational Education Training covers only special discipline in building environment.

(Source: Analysis of survey data collected for this study)

Civil Technology

All teachers defined Civil Technology as a subject which comprises the entire building environment, because of the integration of all subjects such as Woodwork, Bricklaying (construction) and Plumbing.

Subjects (trade) specialisation.

Teacher D and G explained that specialisation in the subject channels you to a specific trade and you will master that trade only. Teacher E said specialisation focuses on vocational training, and Teacher F specified that subject (trade) specialisation channels learners into hard labour.

The above responses implied that teachers share the same understanding of what Civil Technology is, but they differ in terms of the aim of the subject's (trade) specialisation. Therefore teachers concur with DoE (2008) when it stated that new subject Civil Technology is based on the following NATED 550 subjects: Building Construction, Bricklaying and Plastering, Woodwork, Woodworking, Technika Civil, Plumbing and Sheet Metalwork (DoE, 2008:7).

Theme 2: Lack of training in Civil Technology

2. Did you attend any formal training in the Civil Technology curriculum conducted by Department of Education?

Table 21: Teachers' responses on formal training of Civil Technology curriculum

Teacher	ANSWER
A	Only workshops and practical skills, no formal training on curriculum for me.
B	Workshop for CAPS grades 10, 11 & 12 during the holidays.
C	I was invited by DBE to join the CAPS developers for two weeks. No training course or cluster provided to clarify Curriculum.
D	I was lucky to receive formal training that was conducted by a subject specialist from Mpumalanga who trained us so we could be able to give training to other teachers.
E	Some kind of formal skills training for five days.
F	Only five day's skills training.
G	No, only skills training

(Source: Analysis of survey data collected for this study)

Formal Training

All interviewees except D agree that the Department of Education did not conduct any formal training on the Civil Technology Curriculum. Teacher D was fortunate to receive formal training that was conducted by the subject specialist from Mpumalanga. All teachers mentioned that they received only five days formal skills training conducted by a mining company.

Workshop

All the teachers indicated that they only received a five days' workshop once a year as implementation per grade.

The information above therefore implies that teachers lack knowledge of the curriculum, because the Department of Education does not provide adequate formal training on the Civil Technology Curriculum. Ntshaba (2012:31) highlights that "effective teaching and learning depend on the ability of the teacher to create learning experiences that bring desired educational outcomes".

Theme 3: Content

3. What was difficult about the Civil Technology curriculum?

Table 22: Teachers' responses on challenging disciplines in the Civil Technology curriculum

Teacher	ANSWER
A	Applied Mechanics (moments, centroids, frames) and Quantity Surveying, but through the help of Mr Mokhothu teaching me and my learners, I can try on my own.
B	Applied Mechanics, but through the help of my teacher at my school Mr Mokhothu he helped me to have a fair understanding.
C	Applied Mechanics, more especially considering learners' background, also the drawing part gives problems.
D	Theory
E	Graphics and communication
F	I don't have problems at all as a result of my background from high school and university

G	I don't have problems at all, I did Civil Technology from high school to university.

Challenging areas

Teachers A, B and C all mentioned that they experience challenges with the Applied Mechanics area in Civil Technology. Teacher D mentioned that the only challenge is the theory; whereas Teacher E indicated that the challenge is Graphics and communication, while Teacher F and G indicated that they have no problem at all.

The information above implies that most experienced teachers have a problem or challenges in some area, while other teachers experience one challenge, except Teacher F and G (see table 22). Therefore that concurs with Hackett (2010) when states that day-to-day experience of teaching is a challenging one and if teachers approach the challenges in the right perspective, it can lead to professional growth. On the other hand, experience may lead to frustration and resentment, causing stress and disenchantment in the teacher (Hackett, 2010:3).

Theme 4: Role of Mathematics and Physical Science in Civil Technology

4. Did you find mathematics and scientific principles applied in Civil Technology beneficial to the integrated curriculum?

Table 23: Teachers' responses on the importance of Mathematics and Physical Science principles

Teacher	ANSWER
A	More beneficial for Mathematical Literacy, and very important for Mathematics and Physical Science learners to understand the application of principles.
B	More beneficial because you can't do anything in engineering without Mathematics and Physical Science, e.g. Shear forces, Concrete test, roof trusses for special building.
C	Plays positive role in Civil Technology curriculum: it shows a clear application of those subjects in Civil Technology.
D	Yes, Mathematics and Physical Science are really part of Civil Technology, as they give a clear application of science principles.

E	Yes, because it helps learners to see what they have learned in Mathematics and Physical Science being applied.
F	Yes, more beneficial, because we have lots of problems that we need to solve which require a Mathematics and Physical Science background
G	Yes more beneficial, because you cannot separate them, e.g. mixing of concrete is chemical reaction which is science.

(Source: Analysis of survey data collected for this study)

Mathematics and Physical Science principles

All teachers responded more positively, because they all agree that Mathematics and Physical Science play an important role in the Civil Technology curriculum. Teacher B supplied a clear example "More beneficial because you can't do anything in engineering without Mathematics and Physical Science, e.g. Shear forces, Concrete test, roof truss for special building" and also teacher G "Yes more beneficial because you cannot separate them e.g. mixing of concrete is a chemical reaction which is science". Teacher A also stated one of the major roles of Mathematics and Physical Science in the Civil Technology class situation "More beneficial for Mathematical Literacy, and very important for Mathematics and Physical Science learners to understand the application of principles", which brings more attention to the implementation of the curriculum by both teacher A and teacher B.

The responses above reveal that teachers do understand the importance of Mathematics and Physical Science in the Civil Technology curriculum, and also imply that the implementation of the curriculum at school needs to be closely monitored. The responses of teacher A and teacher B clearly indicate that school streams of subjects need to be taken into consideration as they hamper the effective implementation of the subject curriculum. According to Makgato (2003:59), Mathematics; Physical Science and Technology have a common component, namely problem solving. ORT-STEP (1995:7) explains the interrelationship between Mathematics, Physical Science and Technology by means of a Venn diagram (see page 18)

Theme 5: Lack of skills and time

5. What is your opinion on the practical part of the Civil Technology curriculum?

Table 24: Teachers' responses on Civil Technology practicals

Teacher	ANSWER
A	No skills for practical because of time.
B	I really don't agree with this part of practicals, because it doesn't give learners skills because of time allocated.
C	We need a better practical perspective e.g. we must take learners to sites for a week.
D	Practical Assessment Task is very poor because they do models only, not the real structures.
E	Poor, practical need to give more real work practice and we need time.
F	Poor, we need to do real projects and we need time.
G	Poor practicals, using box models rather than using bricks. The problem is time and materials.

(Source: Analysis of survey data collected for this study)

Practical Assessment Task

All teachers expressed their opinion that Civil Technology practicals do not impart excellent or good practical skills, as compared to the technical (trade) subjects. All the interviewed teachers complained about the models instead of the real practical work, but some mentioned the challenge that may cause demotion of real practical work to models and simulation. Teachers highlighted the problems as follows: teacher A stated "No skills for practical because of time"; teacher B said "I really don't agree with this part of practical because it doesn't give learners skills because of time allocated", while teacher E said the following: "Poor, practical needs to give more real work practice and we need time". Teacher F had the following to say, "Poor, we need to do real projects and we need time", and teacher G mentioned two factors "Poor practicals, we use box models rather than using bricks. The problem is time and materials".

The above responses imply that teachers do have a problem with the type of practical work that the Civil Technology curriculum promotes, but the majority of teachers mentioned the factors that compelled curriculum designers to design that kind of practical, as the majority mentioned that time allocation and material are the major constraints regarding real practical work. Teacher C's suggestion "We need a better practical perspective, e.g. we must take learners to site for a week" may solve the problem of lack of materials at school. Teachers agree with DBE (2014) when indicates that, PAT should be based on real-life situations and completed under controlled conditions. Teachers must set dates for the different phases of the PAT (DBE, 2014:4).

Theme 6: Infrastructure

6. Do you have a proper or fully equipped workshop and laboratory?

Teacher	ANSWER
A	Only workshop equipped for Woodwork and Construction, but no workshop at all for Civil Technology.
B	No laboratory, but we have fully equipped workshops.
C	Yes, well- equipped workshop but only for Woodwork.
D	Yes, both laboratory and workshop.
E	Yes, fully equipped workshop, no laboratory.
F	No, it just a standard workshop without laboratory.
G	We have a good workshop, but no laboratory.

Table 25: Teachers' responses on fully equipped workshops and laboratories
(Source: Analysis of survey data collected for this study)

<u>Workshops and Laboratory</u>

All teachers except D mentioned that they have well-equipped workshops for specific trades and Civil Technology, but they do not have a laboratory for Civil Technology. Teacher D mentioned that a fully equipped workshop and laboratory are available. The above responses imply that teachers are failing to implement the curriculum effectively, because of lack of proper infrastructure such as a laboratory in order to perform some tests like the cube test for concrete work, etc.

Teachers agree with Aina (2006) who mentions that facilities and materials may only facilitate classroom learning under general education, but they are the very core of learning in technical institutions. This becomes the case in view of the fact that these institutions are specifically established for the purpose of developing skills and lifelong learning. This underscores the relevance of facilities and materials in technical colleges, as it is not possible to acquire and develop skills without practice, just as it is not possible to carry out practicals without facilities and materials. Musa (2004) asserts that educational facilities, therefore, are the material things that facilitate the teaching and learning process in the school. He opines that facilities include school buildings (i.e. classrooms, assembly halls, laboratories, workshops and libraries), teaching aids and devices such as modern hardware and their software in the form of magnetic tapes, films and transparencies. Educational facilities enable a skilful teacher to achieve a level of instructional effectiveness that far exceeds what is possible when they are not provided (Langa & Wafudu 2014:4).

Towards this end, effective laboratory experiences are highly interactive and make explicit learners' relevant prior knowledge, engender active mental struggling with that prior knowledge and new experiences, as well as encourage metacognition. Without this, learners will rarely create meaning similar to that of the scientific community (Driver, 1989). That is why typical cookbook laboratory activities do not promote, and often actually hinder, deep conceptual understanding; they do an extremely poor job of making apparent and playing off learners' prior ideas, engendering deep reflection, and promoting understanding of complex content. Such activities mask learners' underlying beliefs and make desired learning outcomes difficult to achieve (Driver, 1989; Rankhumise, 2012:103).

Theme 7: Research

7. Explain how do you access information about new technology in your field?

Teacher	ANSWER
A	Reading building magazines and watching TV programmes.

B	Research, internet and field work.
C	Internet, magazines, site visits and subject cluster meetings.
D	Workshops, site visits and internet.
E	Internet, research and videos.
F	Internet, site visits.
G	Visiting construction sites, research and internet.

Table 26: Teachers' responses on access to new technology development
(Source: Analysis of survey data collected for this study)

Access to information

Teacher A said, "I read building magazines and watch TV programmes". Teachers B, C, D, E, F, and G all certified that the sources actively available to access information are "internet, research, videos and site visits" and the most common source is the internet which implies that they are more actively integrating their teaching and learning with Information and Communications Technology (ICT). This may imply technology plays a very important role in our education system.

Moila (2006) agrees that teachers that are using ICT in teaching and learning are doing so because they see the use of ICT resources in teaching and learning, helping them to be better teachers; or the use of ICT tools will help them in improving their classroom practice (Higgins & Moseley 2001; Moila 2006:20).

Teachers emphasised the application of site visits and videos as part of auditory, visual and kinaesthetic learning styles in order to stimulate their understanding and improve their knowledge or the information they acquired through research.

Ahmadi & Gilakjani (2011:469) confirm that in order to achieve the ultimate goal of student learning it is important to use a combination of teaching methods and to make the classroom environment as stimulating and interactive as possible. Students learn in many different ways. Some students are visual learners, while others are auditory or kinaesthetic learners. Visual learners learn visually by means of charts, graphs, and pictures. Auditory learners learn by listening to lectures and reading. Kinaesthetic learners learn by doing. Students may prefer one, two, or three learning styles, as a result of these different learning styles, it is important for teachers to incorporate in their curriculum, activities related to each of these learning styles, so that all students are able to succeed in their studies. While we use all of our senses to take in information, we each seem to have preferences in how we learn best. In order to help all students learn, we need to incorporate as many of the different aspects as possible (Cuaresma, 2008; Ahmadi & Gilakjani, 2011:469).

Theme 8: Specialisation of institutions

8. Can you explain the purpose of a Technical High School and Technical (FET) colleges or Technical Vocational Educational and Training college?

Teacher	ANSWER
A	A Technical High School gives learners more opportunities to know which stream to follow in a civil engineering environment. Technical Vocational Education Training enthuses practical and specialised skills
B	A Technical High School gives general civil technology and all other technology subjects. Technical Vocational Educational Training gives more practical and deeper content.
C	A Technical High School gives general background in technical world theory and Technical Vocational Educational Training must give high skills in industrial practices in order to create more skilled workers.
D	They go hand in hand, but Technical Vocational Education Training must only advance skills of learners from a Technical High School as they acquired basic technical skills.
E	Technical Vocational Education Training must give students advanced and relevant skills, and a Technical High School high knowledge and skills.
F	They have a relationship because Technical Vocational Education Training provides advanced skills on specialisation but a Technical High School provides basic general information.
G	A Technical High School prepares learners for Technical Vocational Education and Training (TVET), so that learners cannot struggle at TVET as it gives advanced skills.

Table 27: Teachers' responses on THS versus TVET/FET
(Source: Analysis of survey data collected for this study)

Technical High School and Technical Vocational Education Training/ FET Colleges

Teachers A, B, C, D, E, F and G all expressed the same views that a Technical High School gives the general basic background of Civil Engineering from Civil Technology, which means preparation to various streams of construction or the built environment. The DoE (2008) attests that the subject Civil Technology aims to create an awareness of Technology in learners and society. Civil Technology focuses on concepts and principles in the Built Environment, as well as on the technological process. It embraces practical skills and the application of scientific principles. This subject creates and improves the Built Environment in a way that enhances the quality of life of the individual and society; and it ensures sustainable use of the natural environment. Civil Technology falls in the Engineering and Technology learning field and gives learners the opportunity to solve problems by practically carrying out simulations and doing real-life projects using a variety of processes and skills (DoE, 2008:7).

All teachers believe that the purpose of Technical Vocational Education Training or FET Colleges is to emphasise practical and relevant specialised skills. Therefore the above responses indicate that there must be a scaffolding path between THS and TVET which should comprise of general background skills and specialised skills. Nyerere (2009:4) cites Atchoarena & Delluc (2001) who state that Technical and Vocational Education (TVET) is broadly defined as “Education which is mainly to lead participants to acquire the practical skills, know -how and understanding, and necessary for employment in a particular occupation, trade or group of occupations” (Atchoarena, D & Delluc, A 2001). Developments in the last three decades have made the role of TVET more decisive; the globalization process, technological change, and increased competition due to trade liberalization necessitates requirements of higher skills and productivity among workers in both modern sector firms and Micro and Small Enterprises (MSE). Skills development encompasses a broad range of core skills (entrepreneurial, communication, financial and leadership) so that individuals are equipped for productive activities and employment opportunities (wage employment, self-employment and income generation activities) (Nyerere 2009:4).

4.3 DISCUSSION OF FINDINGS

The above section (4.2) was about the presentation and interpretation of data, while in this section the findings from the above, based on the biographical details of the teachers in section A will be discussed. The aims and objectives based on the research questions of the study will also be evaluated.

4.3.1 Teacher biographical detail (Section A)

- Gender

Table 12 revealed that the subject Civil Technology in the Free State Province is dominated by 85, 7% male teachers with the. This implies that females in the Free State do not have much interest in technical education and they regard it as hard labour which is meant for males only. This assumption concurs with a statement by Hoffmann-Barthes, et al. (2000) that there is a wrong perception of technical and vocational education. Technical training is used when referring to boys and vocational training when referring to girls. The trend has been that any boy whose parents are poor or who fails to gain admission to traditional secondary schools because of poor grades gets enrolled in a technical school. Such a girl, however, gets enrolled in a "vocational" school (Hoffmann-Barthes, et al. 2000:15). Even recently; some parents still maintained the view that a technical school was developed only for boys; this explains the number few female teachers in the system in the Free State, because of lack of understanding of the aims and objectives of this field of study.

- Age, Years of Experience and Major Subjects

Data presented in Table 12 (Q2) indicates that most teachers fall in the age group between 25-35 years (38, 1%), followed by the age group 46-55 years (23, 8%). The high percentage of young teachers is promising for the future need for teachers with particular skills needed in the country, but the second high group is not promising at all, as they are working towards retirement and pension which may mean the country may be in trouble if these teachers decide to take early retirement, as they are regarded as teachers with scarce skills and knowledge. Table 12 further reflects information obtained in Q3 and Q4a, Q4b, Q4c, Q4d and Q4e which indicates that the majority (42, 9 %) of teachers have more than 10 years' experience. The majority of teachers (38, 1 %) majored in Woodwork while others (38.1%) majored in Civil Technology as indicated by Table 12 (Q4e- the years of experience). This indicates that most of the teachers who were trained to teach technical subjects were mostly trained to teach woodwork. It also shows that the majority of teachers who have less experience are trained to teach Civil Technology as a new subject. Other major subjects such as Plumbing, Bricklaying and Plastering and Civil Technika were not emphasised before. It means that there is still a need for people with skills and knowledge to teach or transfer to the Free State Province. It also shows that in Civil Technology environment we still maintain a positive percentage of teachers with recent relevant high knowledge and skills. The statement concurs with Freiberg who believes that teachers begin with a "limited repertoire of instructional strategies" (Freiberg 2002:56). However, given time, a positive teaching culture and support by more experienced teachers (Feiman-Nemser 2003), mention that beginning teachers turn their attention to the needs of their students and quality of their teaching. The experience of teaching plays a significant part in the professional formation of the teacher (Littleton and Littleton, 2005). The day-to-day experience of teaching is a challenging one and if teachers approach the challenges in the right perspective, it can lead to professional growth. On the other hand, experience may lead to frustration and resentment, causing stress and disenchantment in the teacher. Prolonged disenchantment may cause teachers to leave the profession or become bitter or cynical about teaching. Flores (2003) found that most teachers experienced a loss of idealism within two years of teaching. However, she also found that while these teachers had become complacent and negative, other teachers were dedicated and keen. These differences seemed to be focused upon personal dispositions towards teaching, the support the teachers received both personally and professionally and the nature of the teaching experience (Flores 2003: 23-24; Hackett 2010:3-4).

4.3.2 Section B

This section discusses the findings from the questionnaires based on the following themes or question statements:

- Purpose of integrating technical subjects into Civil Technology.
- Role of teachers in the integrated Civil Technology curriculum.
- Teachers' attitudes towards the integrated curriculum.

4.3.2.1 Purpose of integrating technical subjects into Civil Technology.

- The statement was posed to teachers with a view of soliciting their opinions. Q5 was: "Civil Technology develops high level of knowledge and skills". The score for item Q5 is 61.9 % with the mean of 1.476, which means that teachers strongly agree that Civil Technology develops high level of knowledge and skills.

However, these results show that teachers are in strong agreement with the statement captured in the Learning Programme Guidelines (LPG) of Civil Technology by the DoE (2008); which state that Civil Technology aims at developing a high level of knowledge and skills in learners. It sets high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by a lack of knowledge and skills. Civil Technology specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all fields. The emphasis on use and application of new technology ensures that high knowledge and high skill are not compromised in this subject (DoE 2008:9).

- In order to find the real purpose of integrating technical subjects into Civil Technology the following questions were asked:

Q6 "All technical subjects in the building related environment are integrated into the Civil Technology curriculum".

Q9 "Civil Technology curriculum establishes the general background of Civil Engineering".

Q7 “The Civil Technology curriculum provides industrial knowledge needs which create job opportunities for learners”.

Q8 “The Civil Technology curriculum promotes self-employment”.

The results of Q6 indicate that teachers strongly agree (52.4%), with a mean of 1.476. They were also in strong agreement in Q9 at a percentage of 61.9% with a mean of 1.381; therefore teachers are in strong agreement with the LPG statement of Civil Technology by the DoE (2008); which states that the new subject Civil Technology is based on the following NATED 550 subjects: Building Construction, Bricklaying and Plastering, Woodwork, Woodworking, Technika Civil, Plumbing and Sheet Metalwork. It further continues by highlighting that, Civil Engineering and the related professions such as architecture, building and quantity surveying, collectively known as the Built Environment, are the basis on which the modern world was founded. It is through these professions that essential services such as roads, bridges, purified water, water-borne sewage, railway lines, high rise buildings, factories and housing are provided. The subject Civil Technology aims to create an awareness of these in learners and society (DoE 2008:7).

The Curriculum Assessment Policy Statement 2011 (CAPS) states that the subject aims to create and improve the built environment to enhance the quality of life of the individual and society and to ensure the sustainable use of the natural environment. The subject focuses on three main areas, namely: civil services; construction; and woodworking (DoE 2011:8).

The aim of Q7 and Q8 was to determine the extent to which the Civil Technology curriculum capacitated and benefited learners in terms of work environment. The results of Q6 indicate that 57.1% of teachers with a mean of 1.857 agree with the statement. In Q8 the results expose that teachers disagree with the statement at a high percentage of 47.6%, while the mean is 2.429. The results from both Q7 and Q8 brought forward the argument that the Civil Technology curriculum provides industrial knowledge needs which may create job opportunities for learners, but not self-employment.

CAPS (2011:9) states that; “the aim of the subject Civil Technology is to develop the skills levels of learners from Grade 10-12 to such an extent that they will be able to enter a career pathway at a Further Education and Training College or a university immediately after obtaining the National Senior Certificate. Learners will be ready to enter into learnerships or apprenticeships that will prepare them for a trade test".

DoE (2011) further explains that "through the integrated completion of theoretical work and the practical assessment tasks (PAT), skills in respect of the following will be developed: safe working practices; good housekeeping; first aid practices; interpretation of working drawings; erection of structures; working with accurate measurements; and workshop practice. Knowledge of subject principles, combined with applied skills, equips the Civil Technology learner with a unique set of skills, placing her or him apart from other learners and in a category much desired by industry, tertiary institutions and entrepreneurs. Learners with Civil Technology as a subject fare markedly better during the first two years at tertiary level when studying engineering than learners without this background, giving them an advantage when studying engineering" (DoE 2011:9).The above policy is in line with the international perspective in technology as indicated by Dike (2009); who states that the most significant aspect of the National Policy on Education is the new focus in the Nigerian educational system. The need for the industrialization of the nation in which technical and vocational education play crucial roles and the realization to change from a white collar job oriented educational system to a science, vocational and technical oriented educational system which prepares individuals to be self-reliant and useful to the society is paramount (Ofaha and Dorothy 2011:78).

Langa and Wafunda (2014) cites Momoh (2009) as stating that technology education stimulates growth and empowers the citizenry to achieve victory over ignorance, poverty, unemployment and other indices of under development. For Nigeria as a nation to achieve substantial success in exploiting the potentials of its citizens to facilitate development and on a sustainable basis, it must equip them with skills to dominate and manoeuvre the resources for better living. The instructional facilities in consonance with industrial development in Nigeria are grossly inadequate.

The results of Q10 show that 52.4% teachers with a mean of 1.571; strongly agree; therefore the results of Q10 certify that teachers strongly agree with Teis (2010:8) when he mentions that a teaching approach that emphasises open-ended problem-solving is the best way to prepare students for the challenges they will meet in the world outside the school. In the problem-solving workplace, projects may not always be clearly defined and traditional methods and procedures may need to be modified to meet the unique project requirements. Learners' engagement to challenge in open-ended problem-solving will give them practice in responding to challenges they may face in real life. Civil technology educators must ensure that their teaching and learning environment stimulates circumstances that would help learners deal with authentic situations.

- Van der Walt (2010:39) argues that the technological process is central to all technology learning areas. S/He further indicates that technology is the interaction between hand and brain and also about thinking and doing. The balance should be reflected in the technological process itself and in the results of the process. He further postulates that Civil Technology technological process has six steps:

- Identify: identify the problem
- Investigate: research or design brief; design specifications and requirement list
- Design : formal drawings; formal material list and formal working programme
- Making: Making of the project or model
- Evaluation : evaluation checklist
- Communicate: presentation of work.

Q11 "Integration of Mathematics and Physical Science principles application shows the importance of the Civil Technology curriculum". The results reveal that 71.4%, teachers with a mean of 1.286 are in strong agreement. This result corroborates the views of Makgato (2003:59) who states that there is a relation between technology and Physical Science, because Physical Science provides knowledge of natural phenomena that are used in technology. On the other hand, technology provides Physical 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, Physical Science and Technology, which are the foundations of the wealth generating economies (MST Strategy Report, 2003). Mathematics, Physical Science and Technology have common components in problem solving.

Piaget (1972) and Iozzi (1978) theorize that individuals tend to reason at more sophisticated levels in areas that they have more knowledge. If the nature of science is related to decision making on Physical Science and technology based issues, as is commonly assumed, then it follows that those who understand the nature of science should reason differently on these issues than those who do not (Bell and Lederman 2003:354). Figure 1 also illustrates the relationship between Mathematics, Physical Science and Technology (MST). Table 1 tabulates the emphasis on Physical Science and emphasis on Technology (see page 16).

4.3.2.2 Role of teachers in the integrated Civil Technology curriculum.

Questions were probed to assess the understanding of teachers' roles, to evaluate the teachers' content knowledge of the new Civil Technology curriculum and also to find out how effectively the curriculum was implemented.

Q12 "I would like to have more formal training in the Civil Technology curriculum". The results articulate that teachers strongly agree, at a percentage of 57.1% with the mean at 1.667. Teachers concur with Sparks and Horsley (1989:14) when they highlight that it is the trainer's role (DBE) to select activities (e.g. lecture, demonstration, role-playing, simulation, and micro-teaching) that will aid teachers in achieving the desired outcomes.

Sparks and Horsley (1989:15) cite Showers, Joyce, and Bennett (1987: 85-86) when arguing that the purpose of providing training in any practice is not simply to generate the external visible teaching "moves" that bring that practice to bear in the instructional setting, but to generate the conditions that enable the practice to be selected and used appropriately and integratively; a major, perhaps the major, dimension of teaching skill is cognitive in nature. Sparks and Horsley (1989:14) further state that training sessions that are spaced one or more weeks apart so that content can be "chunked" for improved comprehension and so that teachers have opportunities for classroom practice and peer coaching, are shown to be more effective than "one-shot" training.

Kuiper and Wilkinson (1998:208) see professional development as a broad concept which includes more than changing teaching approaches. To support this, Onwu (2000:46) suggests that professional development programmes should enable educators to build knowledge, skills and attitudes necessary to engage in life-long learning. Fishman, Marx, Best and Revital (2003:645) maintain that professional development should be about educator learning: changes in knowledge, beliefs, and attitudes of educators that lead to the acquisition of new skills, new concepts and new processes related to the work of teaching (Mononde 2007:26-27).

To get a clear understanding of how teachers develop themselves to stimulate the understanding and how they improvise to effectively implement the Civil Technology curriculum, the following question statements were asked:

- Q13 “I develop myself by reading and research.”
- Q14 “I regularly attend departmental workshops and training.”
- Q15 “I am a full registered member of a cluster group.”
- Q16 “I use multimedia (TV and Video) to enhance my teaching.”
- Q17 “Site visits with learners stimulate understanding of the integrated Civil Technology curriculum”

The results indicate that in Q13 57.1% teachers with a mean of 1.429 strongly agree. 61.9% teachers with a mean of 1.571strongly agree with Q14. For Q16; 47, 6% of teachers with a mean of 1.571 confirm that they use multimedia in class, and that emphasises the statement highlighted in the Learning Programme Guidelines of the DoE (2008) which states that textbooks, while essential to teaching Civil Technology, should not be considered as the only source of content. Other relevant resources such as newspapers, user manuals, magazines, journal articles, radio and television, other electronic media and internet sites need to be incorporated into the content. Learners must be encouraged to use their own initiative. Project-based learning, collaborative learning and group work need to be encouraged. Content needs to be selected in such a way that it encourages the development of creativity, critical thinking, research skills, reading proficiency and interpretation skills (DoE 2008:14).

In Q17 teachers strongly agree at a percentage of 76.2%, with a mean of 1.238, which means that teachers agree with the views of Fourie and Fourie (2015) that teachers should focus on improving their own knowledge and skills, should impart pre-determined knowledge to their learners and should also spend significant time and energy on nurturing and sustaining each of their learners (Fourie & Fourie, 2015:53). Teachers strongly disagree (47, 6%) with Q15, with a mean of 2.952, which implies that teachers are not interested in joining a cluster group because of the lack of knowledge they have found in these cluster groups.

According to Smith and Desimone (2003:127), novice and veteran educators have different professional development needs and different forces in the policy system create incentives for educators, depending on their experience. To support this, Grisham and Peck (2002:14) suggest that the brutal conflict between the complexity of the challenges faced by educators attempting to implement deep and pervasive changes in their teaching practice and the impoverished motivational and professional support for this change process, suggests that policy makers have failed to imagine the reality of implementing education reform. In addition, Vally and Spreen (1998:16) indicate that the research done on educators and INSET during the implementation of C2005 in South Africa reveals that many educator training institutions, district officials and educator unions have long warned about potential problems in the implementation at provincial and local level (Munonde, 2007:37-38).

Munonde (2007:75) mentions that the professional development of educators forms the heart of maintaining and sustaining the quality of education. By having a plan and policy for professional development, the various education institutions responsible for the professional development of educators maintain and sustain the future of such institutions.

The following questions were probed to measure the responsibility of the teachers to effectively implement the Civil Technology Curriculum according to the policy:

- Q18 “It is my responsibility to assess learners as prescribed in the policy document.”

- Q19 “It is my responsibility to order material in time for practical work.”
- Q20 “I always call for help if I don’t understand other disciplines in Civil Technology”

The results reveal that in Q18, teachers strongly agree at a percentage of 66.7% with the mean at 1.333; therefore teachers concur with DBE 2014 PAT which highlights that it is the responsibility of the teacher to administer the formal assessment of tasks. After studying the guidelines, teachers must explain in full detail the requirements of the different stages of the PAT, as well as the criteria as indicated in the rubrics and mark schedules. This will ensure that learners and teachers have a common understanding of the assessment tools and what is expected of the learners (Practical Assessment Task, DBE 2014:4). The document further mentions that frequent developmental feedback by the teacher is needed to guide and give support to the learner in ensuring that the learner is on the right track. Both formal and informal assessment should be conducted on the different tasks that constitute the PAT. Informal assessments can be conducted by the learner himself or herself, by a peer group, or by the teacher. Formal assessment should always be conducted by the teacher and will be recorded. The teacher must take into account the requirements of the assessment of all the components of the PAT and therefore plan the assessment programme for the PAT accordingly (DBE 4:2014).

In Q19 52.4% teachers with a mean of 1.476 strongly agree with Arends (2010:36) when he mentions that fundamental to the success of any educational programme is the availability of appropriate teaching and learning facilities and materials. The need for these facilities and materials becomes more pronounced, particularly in the area of technical education, where skill acquisition and development is the focal point (Olaitan, 2003; Werner, 2002). Ogunlade (2006) discloses that not only are facilities and materials needed in technical colleges, they are also needed in the proportion of students’ environment in order to provide for the kind of intensive practical practice which goes along with training in technical education (Arends, 2010:36).

In Q20 teachers show a strong agreement at a percentage of 71.4 with a mean of 1.286. Teachers concur with the conviction of the DBE (2015) which states that it is not only physical resources that drive the quality of teaching and learning, but the human resources in each and every classroom and this is the reason for the success of some of the African countries with limited resources. Teacher development centres have been revived to ensure that they become resource hubs for capacitating teachers on a continuous basis. Teachers and subject advisors are trained on aspects of the curriculum and assessment and it is hoped this protracted programme of supporting teachers will bear fruits (DBE Newsroom, 2/1/2015).

Question Q21 “Do you use problem solving as the main method in the curriculum?” was modelled to test and certify responses in Q10, namely “whether teachers understand the role of problem solving as the main method or strategy of teaching and learning in Civil Technology?” The results reveal that teachers at a percentage of 47.6 strongly agree while the same percentage with a mean of 1.571 agrees that they understand the role of problem solving as the main method of teaching and learning in Civil Technology. The results certify that teachers are in agreement with Teis (2010), who believes that a teaching approach that emphasises open-ended problem-solving is the best way to prepare students for the challenges they will meet in the world outside the school. In the problem-solving workplace, projects may not always be clearly defined and traditional methods and procedures may need to be modified to meet the unique project requirements. Learners’ engagement in challenges in open-ended problem-solving will give them practice in responding to challenges they may face in real life. The Civil Technology educator must ensure that their teaching and learning environment stimulates circumstances that would help learners deal with authentic situation (Teis, 2010:18).

Wicklein (1997:77) cited in Smit (2007:32) and Ntshaba (2012:39) argues that it is very important that an integrated approach be used to teach the technology subjects, because it will enable learners to apply the relevant technological knowledge they gain in all aspects of their lives, as well as to understand the interrelationship between technology, society and the environment The current methods of teaching technology encourages certain aspects of learning, but often leaves large gaps that should be filled.

Teachers are responsible for equipping students with the knowledge that will enable them to perform these roles and competences effectively (Fourie & Fourie 2015:53).

4.3.2.3 Teachers’ attitudes towards the integrated curriculum.

The question (Q22) was aimed at investigating the attitude of the teachers towards the Civil Technology curriculum, and also to investigate the understanding of aims and objectives of the subject.

Q22 “Civil Technology is for intelligent people only”. Teachers strongly agree at a percentage of 33.3% with the mean at 2.238, therefore teachers strongly agree with De Boer (2000) when he states that there are things the public might rightly learn about science that will enable them to live more intelligent lives in a world where science and technology have such importance. There are many reasons for teaching these things that are consistent with our democratic and intellectual values, but the range of this knowledge is enormous and artificially narrowing as it has more negative effects than positive (De Boer ,2000:593).

Neisser et al., (1996:80) state that for the developmental perspectives on intelligence, two researchers deserve to be mentioned. One is the Swiss psychologist Jean Piaget and the other is the Russian psychologist Lev Vygotsky. They were interested in how intelligence develops in the first place. Piaget thought that intelligence develops in all children through "the assimilation of new information into existing cognitive structures and the accommodation of those structures themselves to the new information”; he devised a method to assess children's understanding of conservation, and specifically the principle that material quantity is not changed by changes of shape. In his method, a child watched water being poured from a small container to a large one and was asked if the large container had less water in it. The answer indicated the development of that child's intelligence. Whereas Piaget thought that intelligence naturally develops fully in all children, Vygotsky believed that intelligence is social in origin and has potential to develop throughout life. He thought that "language and thought first appear in early interactions with parents, and continue to develop through contact with teachers and others".

Piaget viewed the entire purpose of intellectual growth as one of coming to know reality more objectively through developing increasingly decentenxi-and hence more objective-perceptions of reality (1992:793).

The following interview questions were posed to investigate the attitude of teachers in applying Mathematics and Physical Science principles as the main part of Applied Mechanics in the Civil Technology curriculum:

- Q23 “Mathematics and scientific principles make Civil Technology a less interesting subject”.
- Q26 “I lack confidence in teaching Applied Mechanics in the Civil Technology curriculum”.
- Q27 “I recommend a full training course in Applied Mechanics”.

The results mentioned for Q23 indicate that 57.1% of teachers strongly disagree at and Q26 results show that teachers strongly disagree at a percentage of 42.9% with a mean of 3.143. In Q27; the results reveal 61.9% of teachers strongly agree at a with a mean of 1.571. This signifies that teachers are in agreement with De Boer (2000) who pronounces that Technology is a legitimate part of the science curriculum, because the subject matter deals with the physical world. Technological design depends on scientific principles and parallels the methods of scientific inquiry, and the study of technology has the potential to be more immediately interesting and motivating to students, since it deals with concrete objects from their everyday experience. Technology has been closely linked with Physical Science teaching throughout our educational history, but its role in the Physical Science curriculum has been somewhat uncertain. Through the first half of the 20th century, Physical Science teaching often focused on technological applications. In the late 1950s there was a concerted effort to move away from teaching about technology and toward teaching the principles of Physical Science. Only in the last few decades has the explicit integration of Physical Science with Technology taken on such importance among science educators (DeBoer 2000:593).

The DBE (2013) draft CAPS for Technical Mathematics certifies that **Mathematics** is a universal science language that makes use of symbols and notations for describing numerical, geometric and graphical relationships. It is a human activity that involves observing, representing and investigating patterns and qualitative relationships in physical and social phenomena and between mathematical objects themselves. It helps to develop mental processes that enhance logical and critical thinking, accuracy and problem solving that will contribute in decision-making. Mathematical problem solving enables us to understand the world (physical, social and economic) around us, and, most of all, to teach us to think creatively. The aim of **Technical Mathematics** is to apply the Science of Mathematics to the Technical field where the emphasis' is on APPLICATION and not on abstract ideas (DBE 2013:53).

DeBoer (2000:590) continues to state that learning outcomes that were suggested by Project 2061 included "being familiar with the natural world and respecting its unity; being aware of some of the important ways in which mathematics, technology, and the sciences depend upon one another; understanding some of the key concepts and principles of science; having a capacity for scientific ways of thinking; knowing that science, mathematics, and technology are human enterprises, and knowing what that implies about their strengths and limitations; and being able to use scientific knowledge and ways of thinking for personal and social purposes" (DeBoer 2000:590).

The questions were analysed to assess the attitude of the teachers in terms of their confidence to cope with the new subject or changes:

- Q24 "I was forced by the changing of the system to teach Civil Technology".
- Q29 "I can teach my specialised trade with confidence".
- Q30 "I don't like to teach technology subjects because technology changes fast".

The results reveal that, in Q24; 47.6% teachers with the mean of 2.714 agree. The results of Q29 show that teachers strongly agree at a percentage of 76.2 with a mean of 1.238. Teachers strongly disagree with Q30, as the results are at a percentage of 66.7% with a mean of 3.619. These teachers seem to agree with Beute and Matlala (2007) when they attest that the new curriculum for Engineering and Technology Subjects in Grades 10-12 poses a challenge to some of our teachers. It is no doubt difficult for teachers at the pre- university level to give students technical training and to bring engineering principles into the classroom. There is no doubt that engineers can help teachers to make this learning field as well as Mathematics and Science more meaningful with engineering applications (Beute and Matlala, 2007:4).

According to Beute and Karlin (2010), South African teachers do think engineering is a good subject to teach, but their knowledge of Mathematics, Physical Science and Technology is very limited. According to Beute (2010), many of the teachers are not Physical Science educators, but former Woodworking and metal shop instructors whose subjects were being phased out (Karlin 2010).

Munonde (2007:140) states that restructuring of the education system has introduced drastic changes to many education institutions. The curriculum was changed to fit the new education system. The new curriculum required a shift in emphasis in the approaches to teaching and learning. This in turn meant a shift in emphasis in the professional development of educators. The implementation of the new curriculum requires that those who are responsible should follow the correct procedures and the involvement of all stakeholders responsible in planning the whole process is of vital importance (Munonde, 2007:140).

Stevens (2006:2) confirms the response in Q30, highlighting that teachers' enthusiasm for and dedication to technology is one of the most consistent and impressive findings from this evaluation. The positive attitude of teachers was fed, in part, by the enthusiasm of their learners. Most teachers indicated that they would like to continue teaching Technology. More than that, many seemed pleased to be able to break out of the old modes of teaching and reconceptualise their notions of what it means to be a teacher/facilitator.

The following interview questions were posed to investigate the attitudes of teachers in structuring and designing of a practical component in the Civil Technology curriculum:

- Q25 "Civil Technology produces poor practical work".
- Q28 "The time allocation for the subject is not sufficient".

In Q25 the results indicate that teachers agree at a percentage of 52.4% with the mean at 2.571. Results for Q28 results show that teachers are leaning more towards agreeing at 61.9% with a mean of 2.190 This implies that teachers are in agreement with Maeko (2013:3) who cites Letsie (2003:11), pointing out that although technology subjects offer an array of vocationally focused subjects with a practical orientation, most South African schools depend on theoretical studies with little access to technological facilities linked to apprenticeship. He also mentions that the Civil Technology subject is allocated 4 hours in schools, of which 2½ hours are for teaching theory and 1½ hours meant for the practical lessons on a weekly basis (DBE, 2011:45). These practical lessons cannot happen haphazardly, as they require fully equipped workshops and material. According to Ike (2004:19), schools in the United States and Germany allocate more than 70% of the time to the training of technology learners in the practical component to ensure that learners perform well on the job (Maeko, 2013:3). Therefore the above statements imply that the main problem of poor Civil Technology teaching results is caused by insufficient time allocation.

DBE (2014:4), in the Practical Assessment Task document, argues that PAT should be based on real-life situations and completed under controlled conditions. Teachers must set dates for the different phases of the PAT. In this manner learners can assess their progress. Instances where formal assessment tasks take place is the responsibility of the teacher. After studying the guidelines teachers must explain in full detail the requirements of the different stages of the PAT, as well as the criteria as indicated in the rubrics and mark schedules. This will ensure that learners and teachers have a common understanding of the assessment tools and what is expected of the learners (DBE 2014:4).

Maeko (2013:42) opines that the role of teachers in any subject matter cannot be questioned. It is the teachers who ensure that teaching and learning takes place under all circumstances. Sadly though, not all teachers may be good and efficient teachers. Aliyu (1995:56) suggests the following as competencies the practical technology teacher must possess for the effective transfer of practical skills to learners:

(vii) Adequate up-to-date knowledge of the science subject under focus.

(viii) Educational knowledge relating to the psychological characteristics of the students.

(ix) Knowledge of processes (and methodologies) involved in learning and how to promote them.

(x) Motivation or new enforcement of learning to keep enthusiasm of the students.

(xi) Skills for effective planning and presentation.

(xii) Above all, the teacher must possess technical and scientific skills for proper performance of the task at hand (Maeko, 2013:42).

4.4 Conclusion

The aim of the study was to investigate the extent to which Civil Technology teachers understand and implement the Civil Technology curriculum in the Free schools; South Africa. Since the implementation and evolvement of the subject from the National Curriculum Statement (NCS) to the Curriculum Assessment Policy Statement (CAPS); the researcher employed a statistician to analyse data that was collected through questionnaires. The other data which was collected by means of interviews was transcribed and analysed.

In conclusion: both sets of data revealed that teachers in the Free State, at the beginning of the implementation of the subject Civil Technology experienced problems in some areas of the curriculum such as Applied Mechanics, because of inadequate training on the new subject curriculum, but the majority of teachers managed to equip themselves through self-study and are currently comfortable with the theoretical part of the subject, but experience problems with the practical component.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the summary of the findings based on the responses of the interviews and questionnaires completed by the teachers as the participants in the study. The main aim of the study was to investigate the extent to which Civil Technology teachers understand and implement the Civil Technology Curriculum (CT) in Free State schools, since the first implementation of the subject from the National Curriculum Statement (NCS) to the Curriculum Assessment Policy Statement (CAPS) and CAPS specialisation is on the process of implementation.

The problem statement of the study was: To identify and evaluate the implementation and effectiveness processes related to the NCS and CAPS of Civil Technology as an integrated subject. The question was: 'Are Civil Technology teachers competent and confident enough to teach the subject which has shifted focus from specialized technical subjects to the real civil engineering content in general?' The research explored the degree of responsiveness of the technical subject teachers in the Free State schools to the adaptation and implementation of the new integrated curriculum in the form of "technology subjects".

The summary presents the measurements of the research objectives of the study which are stated as follows:

- Describe the meaning and integration of the subjects in the Civil Technology Curriculum.
- Examine the role of the educators and the learners in the integrated curriculum
- Give recommendations on the implementation of the Civil Technology Curriculum.

This chapter will furthermore discuss the recommendations made by the respondents during data collection. The researcher added recommendations based on his experience of teaching Civil Technology and what he learnt during the conduct of this study.

5.2 SUMMARY OF THE FINDINGS

5.2.1 Responses of the teachers in the Questionnaire

5.2.1.1 Purpose of integrating technical subjects into Civil Technology (CT).

The research revealed that teachers understand the purpose of integrating the technical subjects to develop the Civil Technology (CT) curriculum. The results provided clear evidence when participants strongly agreed with Q5 (see Table 13) which was posed to explore the understanding of the rationale for the introduction of the new subject Civil Technology. It was furthermore revealed that teachers understand the actual purpose of CT by providing results that indicated strongly agree on Q6, Q9 and Q11(see table 13) and they further agree on Q7,Q8 and Q10 (see table 14), that was aimed to investigate the general meaning and purpose of CT.

5.2.1.2 Role of the teacher in the Civil Technology (CT) integrated curriculum.

The study revealed that teachers are trying to fulfil their roles in order to implement the Civil Technology (CT) curriculum effectively. The results indicated that teachers agreed with Q12 (see table 14) that they would like to have more formal training in the CT curriculum. They further strongly agreed with Q13, Q14, Q15, Q16 and Q17 (see table 13) that for self-development, they have to improvise to stimulate their mind in order to understand and implement the CT curriculum effectively. In terms of responsibility teachers strongly agreed with Q18, Q19 and Q20 that it is their responsibility to implement and utilize the official policies of the DoE. Teachers further continue to reveal that they agreed on Q21 that they use problem solving as the main method in CT curriculum.

5.2.1.3 Teachers' attitudes towards integrated curriculum

The interview questions were analysed to investigate the attitude of the teachers towards the Civil Technology (CT) curriculum. The results revealed that in Q22 (see table 14) teachers agreed that Civil Technology is for intelligent people only, based on the amount of higher order content. Teachers disagreed with Q23 and Q26 (see table 15) and strongly agreed with Q27 (see table 14), indicating that teachers have a positive attitude towards the CT curriculum as they showed interest and willingness to be trained in challenging areas of the CT curriculum. They strongly disagreed with Q30 (see table 16) to emphasise the positive attitude of teachers teaching the CT curriculum. It is also evident that teachers are confident and eager to teach the integrated CT curriculum, and accepted the curriculum shift as they disagreed with Q24 and Q25 (see table 15), and they agreed with Q29 (see table 13), which indicate a positive attitude.

5.2.2 Responses from the Interview with the Teachers

The interview was transcribed and analysed and the following themes emerged:

Theme 1: Definition of Civil Technology

Teachers defined Civil Technology as a subject which comprises all building environment related subjects and more technological and defined technical subject (trade) specialisation, as a subject which specialises or focuses on a specific trade (bricklaying and others) and promote hard labour only.

Theme 2: Lack of Training

The majority of the teachers indicated that they did not attend any formal training in the Civil Technology curriculum, but they attended a five days' workshop on the CT curriculum, and five days' formal training of practical work. Only one teacher indicated that he was formally trained by a subject specialist from Mpumalanga Province.

Theme 3: Content

Experienced teachers mentioned that Applied Mechanics was a serious challenge, but they are managing with the assistance of another teacher who was helping them to understand the context, while inexperienced teachers indicated that they do not have a problem at all, as they were trained at university and their high school background gives them an advantage.

Theme 4: Role of Mathematics and Physical Science in Civil Technology

All teachers indicated that Mathematics and Physical Science principles are beneficial, because they show the application of Mathematics and Physical science in practice, for example concrete mixing (chemical reaction) and roof development (force).

Theme 5: Lack of skills and time

All teachers indicated that Civil Technology delivers poor practical work because the time allocated for the subject is not sufficient to perform productive practicals. They also raised concern about the types of practical tasks assigned to learners, as leaners are making models instead of real practical work. Proper skills are therefore not acquired.

Theme 6: Infrastructure

All teachers mentioned that they have well equipped CT workshops, but they do not have CT laboratories at all. Teacher D however indicated that they have both a well-equipped CT workshop and CT laboratory at their school. Therefore it underscores the fact that teachers are unable to perform some practical tests (wood test, concrete test, soil test, steel test and others); which affect the effective implementation of the integrated Civil Technology curriculum.

Theme 7: Research

All teachers mentioned that they use internet, magazines, visiting construction sites and videos to learn about new technology developments and to gain new knowledge of how to use and how to teach or apply the new knowledge. Some teachers indicated that they use television programmes to learn about new technology developments and its benefits in the integrated Civil Technology curriculum. Teachers emphasised that videos and site visits facilitate better understanding of new technology development.

5.3 CONCLUSION

The research aim and objectives, questions and hypotheses, were tested and measured through the research study that was conducted by the researcher in order to obtain the results. That reliably suggests to research questions and hypothesis, also present vibrant measurement of objectives of the study.

In conclusion, teachers answered the questionnaire and substantiated their opinions by responding to interview questions. The study revealed that teachers have strong confidence to teach or implement the Civil Technology integrated curriculum if the Department of Basic Education would provide them with the adequate formal training in some challenging areas of this subject and also restructure the practical aspects of Civil Technology to provide real basic skills.

5.4 RECOMMENDATIONS OF THE STUDY

Teachers recommended that:

- The Department of Basic Education (DBE) must provide full formal training of applied mechanics as one of important areas of Civil Technology.
- The Department of Basic Education (DBE) must restructure the types of Practical Assessment Tasks they provide to schools. They must involve real practical work, not models, only as Civil Technology covers the general building environment.
- The curriculum designers must not change the current Civil Technology curriculum. When they implement the new Civil Technology specialisation, it must serve concurrently with the integrated curriculum.
- Civil Technology specialisation should be for learners who are interested to become artisans only.
- The current Civil Technology curriculum must be able to open different careers that learners will be interested in pursuing.
- The Department of Basic Education must increase the time allocated for technical subjects in order to perform productive practical skills, by allocating days for site and industrial visits.
- Controlled internet access should be available in class.

- Civil Technology laboratories should be erected in order to perform practical tests and experiments.

- <u>Researcher's recommendations</u>

The main aim of the integrated Civil Technology Curriculum is to promote high levels of knowledge and skills, also to provide a general background of the building environment such as civil engineering and others. Therefore, re-establishing specialisation of the subject meant promotion of high skill only and the marginalisation of high technological knowledge and skill through the promotion of high skills in a form of hard labour.

The researcher recommends that the DBE:

- Should take cognisance of the challenges and provide full training in Applied Mechanics.
- Should introduce a new CAPS specialisation with specialised streams and must consider the current curriculum as the fourth stream of Civil Technology, as it entails crucial content of high order skills like calculation on a specific purpose of Civil Technology.
- Should monitor the teacher-learner ratio in the classroom.
- Should engage with all relevant university lecturers without compromising the quality of education

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APPENDIX A

Questionnaires for Teachers

SECTION A

Please make a cross**(x)** at appropriate block.

1	**GENDER**	Male	Female	**RACE**	Black	Coloured	White	Other
2	**AGE**	Under 25	25-35	36-45	46-55	Over 56		
3	**YEARS OF EXPERIECE**	Under 3	3-6	7-10	Over 11			
4	(Fill in): **TEACHING QUALIFICATIONS**							
5	(Fill in): **MAJOR SUBJECTS ON TEACHING QUALIFICATION**							

SECTION B

Indicate the degree to which you agree or disagree with the statement. Respond by making a cross **(x)** over the number that match your answer.

Strongly agree	**1**
Agree	**2**
Disagree	**3**
Strongly disagree	**4**

A	**Purpose of integrating technical subjects in civil technology curriculum**				
1	Civil Technology develop high level of knowledge and skill	**1**	**2**	**3**	**4**
2	All technical subjects in building related environment are integrated in civil technology curriculum	**1**	**2**	**3**	**4**
3	Civil Technology curriculum provide industrial knowledge needs which create job opportunity to learners	**1**	**2**	**3**	**4**
4	Civil Technology curriculum promote self-employment	**1**	**2**	**3**	**4**
5	Civil Technology curriculum establish general background of civil engineering	**1**	**2**	**3**	**4**
6	Civil Technology use problem solving (technological process) as a main strategy or method	**1**	**2**	**3**	**4**
7	Integration of mathematics and science principle applications shows the important of Civil Technology curriculum	**1**	**2**	**3**	**4**

B	**Role of the teacher in civil technology integrated curriculum**				
8	I will like to have more formal training in civil technology curriculum	**1**	**2**	**3**	**4**
9	I develop myself by reading and research	**1**	**2**	**3**	**4**
10	I regularly attend departmental workshop and training	**1**	**2**	**3**	**4**
11	I am a full registered member of cluster group	**1**	**2**	**3**	**4**
12	I use multimedia (TV and Video) to enhance my teaching	**1**	**2**	**3**	**4**
13	Site visit with learners stimulate understanding of integrated Civil Technology curriculum	**1**	**2**	**3**	**4**
14	It is my responsibility to assess learners as prescribed in the policy	**1**	**2**	**3**	**4**
15	It is my responsibility to order material in time for practical work	**1**	**2**	**3**	**4**
16	I always call for help if I don't other disciplines in Civil Technology curriculum	**1**	**2**	**3**	**4**
17	Do you use problem solving as the main method in the curriculum	**1**	**2**	**3**	**4**
C	**Teachers attitudes towards integrated curriculum**				
18	Civil Technology is for intelligent peoples only	**1**	**2**	**3**	**4**
19	Mathematics and scientific principles make Civil Technology less interesting subject	**1**	**2**	**3**	**4**
20	I was forced by the changing of system to teach Civil Technology	**1**	**2**	**3**	**4**
21	Civil Technology produce poor practical work	**1**	**2**	**3**	**4**
22	I lack confidence in teaching applied mechanics in Civil Technology curriculum	**1**	**2**	**3**	**4**
23	I recommend full training course in applied mechanics	**1**	**2**	**3**	**4**
24	Time allocation for the subject is not sufficient	**1**	**2**	**3**	**4**
25	I can teach my specialised trade with confidence	**1**	**2**	**3**	**4**
26	I don't like to teach technology subjects because technology changes fast	**1**	**2**	**3**	**4**

APPENDIX B

Interview question with Teachers

1. What is the difference between Civil Technology and your subject specialisation in technical education?
2. Did you attend any formal training in Civil Technology curriculum conducted by Department of Education?
3. What did you find more difficult to solve in Civil Technology curriculum?
4. Did you find mathematical and scientific principles applied in Civil Technology beneficial to curriculum integrated?
5. What is your opinion about practical part of Civil Technology curriculum?
6. Do you have a proper or fully equipped workshop and laboratory?
7. Explain how you access information about new technology in your field.
8. Can you explain in your understanding the purpose of technical high school and Technical (FET) colleges or Technical Vocational Educational Training?

APPENDIX C

Central University of Technology, Free State

Private Bag X20539

BLOEMFONTEIN

9300

10 *March2015*

Dear Sir/Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am writing to request permission to conduct research on you around March 2015. I am Mr MOKHOTHU KHOJANE GEOFFREY former Civil Technology Teacher at Hodisa Technical School in Bloemfontein and provincial Marker for Civil Technology, former Marking Examiner and Chief Marker for Civil Technology grade 12, and currently employed by Central University of Technology Free State as Civil Technology lecturer and registered in the Masters of Education programme with Central University of Technology Free State student number: 2080866225.

Title of my study is: **The Integration of Technical Subjects in Civil Curriculum with special reference to FET Technical schools.**

My request is to be allowed to conduct research survey through interview and completing of questionnaire by the teachers who are teaching Civil Technology at their respective schools. The results of the survey will be used for research study and they will be presented strictly confidential and anonymous.

I am looking forward to you granting permission for the research study to be conducted. Please don't hesitate to contact me directly for more information and clarity on: 051 577 4046/078 185 9952 or email address kmokhothu@cut.ac.za or geoffrey82@hotmail.co.za.

Should permission be granted to conduct research survey on your schools, kindly forward me a signed Letter of Permission on your institutions' letterhead, acknowledging your consent for the study to be conducted at your schools?

Sincerely

MOKHOTHU KHOJANE GEOFFREY

APPENDIX D

Approval to Conduct Research

APPENDIX E

Editor's Confirmation Letter

Central University of Technology, Free State

DECLARATION

I, Maria Petronella Roodt, hereby declare that I have proofread and edited the dissertation ***The Integration of Technical Subjects in Civil Technology Curriculum with special reference to FET** Technical Schools* by Mr KHOJANE GEOFFREY MOKHOTHU(St no 208066225).

My qualifications are as follows: BA with major in English, BA Hons (English) and MA in English (Applied Linguistics) and an MA (Higher Education Studies).

I have extensive experience in proofreading and editing and can be contacted at the following address: mroodt@cut.ac.za . My telephone number is 051 507 3866/ 0822025167.

MP Roodt.

Central University of Technology, Free State

TO WHOM IT MAY CONCERN

This is to confirm that I; Siphiwe Nzelwane, a Language Practitioner, with a B. Tech degree in Language Practice, have verified, edited and confirmed the dissertation of KG Mokhothu, a student at Central University of Technology, Free State, with student number 208066225. The dissertation is titled "*The Integration of Technical Subjects in Civil Technology Curriculum with Special Reference to FET Technical Schools*".

S. Nzelwane (Mr.)

LANGUAGE PRACTITIONER

Enquiries: Dr MC Liphapang
Reference: Research Approval
Tel: 051 404-9290
Fax: 0866929092
E-mail: maphokal@edu.fs.gov.za

Central University of Technology, Free State

education
Department of Education
FREE STATE PROVINCE

Mr Mokhothu

RE: APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION:

This letter serves as an acknowledgement of receipt of your request to conduct research in the Free State Department of Education.

1. **Research topic:** The Integration of Technical Subjects in Civil Technology Curriculum with special reference to FET Technical Schools.

2. Approval is granted for you to conduct research in the Free State Department of Education for the period **March 2015 to April 2015.**

3. Should you fall behind your schedule by three months to complete your research project in the requested period, you will need to apply for an extension.

4. This approval is subject to the following conditions:-

   4.1 The collection of data should not interfere with the normal tuition time or teaching process.

   4.2 A bound copy of the research document should be submitted to the Free State Department of Education (Old CNA Building, Room 301, Charlotte Maxeke Street, Bloemfontein).

   4.3 You will be expected, on completion of your research study, to make a presentation to the relevant stakeholders in the Department.

   4.4 The attached ethics document must be adhered to in the discourse of your study in our department.

5. Please note that the costs relating to all the conditions mentioned above are your own responsibility.

6. This letter should be shown to all participants.

Thank you for choosing to research with us. We wish you every success with your study.

Yours faithfully,

RS Malope
HOD: FS Department of Education.

25/03/2015
Date