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Investigating the use of Essential Features within technology pre-service programmes: a case of University of Pretoria

by

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Declaration

I declare that: **Investigating the use of Essential Features within technology pre-service programmes: a case of University of Pretoria** is my own work and that all sources that I used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE DATE

(Mampiane Johanna Maphutha)

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BEd	Baccalaureus Educationis
CHE	Council on Higher Education
D&T	Design and Technology
DoE	Department of Education
FET	Further Education and Training
GET	General Education and Training
IHL	Institutions of Higher Learning
NCS	National Curriculum Statement
OBE	Outcomes-Based Education
PBL	Problem-Based Learning
PDA	Project-Driven Approach
RNCS	Revised National Curriculum Statement
RPL	Recognition of Prior Learning
SAQA	South African Qualification Authority
SBD	Standard-Based Design
UP	University of Pretoria
UP-D&T	University of Pretoria Design and Technology

Executive summary

Establishing proficient practices for technology teaching and learning is an immense challenge, especially since technology is a new subject that was added as one of the new learning areas within the South African education curriculum. This happened when the South African education system was reviewed after the 1994 democratic elections and OBE was chosen as not only the hub, but the underpinning philosophy of education. As part of the challenges that followed implementing a new subject, when technology was first implemented, there were no qualified teachers to teach it, and there were no official academic programmes to train those who were inevitably selected to teach it. After a while, the government found out that all was not well with the national curriculum technology and that in many schools, it was not as well taught as other subjects.

From ever since, institutions of higher learning and service providers across the country made efforts to develop programmes and offer formal training in technology education. This study intended to carefully examine how technology academic programmes are conceptualised, planned, and implemented; and how that contributes to efficient training and development of student-teachers in technology education. This it did by purposefully sampling the University of Pretoria (UP) and performing a case study on its technology education pre-service programme. The investigation necessitated the concept: "the essential features of an effective and comprehensive technology education programme", which the researcher believes are inescapable because they forms the core, effect and success of technology programmes' design features; and they have a propensity to guide educational practice to enhanced performances and yield. From literature, the essential features are centred on programme

design, content, teaching methods, programme coordination, staffing, student assessment policies and practices and the context of study.

The investigation at UP started with programme conceptualisation and planning, which the researcher performed by interviewing the developers, designers and the lecturing staff. She then performed document analysis on the study guides and university general programme to investigate programme content; and she did lecture observations to explore teaching methods. The results of the study indicated that UP technology education pre-service programme is conceptualised and planned based on problem-based learning, project-driven approach and standard-based design. The lecturing staff applies learner-centred, activity-based, and outcome-based approaches that provide student teachers with opportunities to engage in authentic, real-life problems. The programme content consists of modules that are made up of study units that engage various technology concepts and knowledge base. They have good resources and specialised venues for technology teaching and learning. UP-D&T is balanced and auspicious; students and lecturers are enthusiastic and positive about the activities of this programme. However there exist a few hiccups, which are resembled in the level at which certain essential features are engaged within UP-D&T. The designers and lecturing staff might want to conduct some impact studies of this programme, as well as evaluations of practice on student-teachers presently training and those who were trained under this programme in the past.

The study reflected in-depth descriptions of how technology education programmes can be comprehensively designed; by providing a window, patterns, essential features and rubrics for enhanced planning, practice and implementation. Discussions thereof might serve to mobilise, critique and further the discourse on effective pre-service teacher education.

Chapter 1

General introduction, statement of the problem and overview of the study

1.1 Introduction

The history of education in South African emerges from a background of apartheid, engrossing inequalities and injustices amongst particular races and certain ethnic groups. However "after the first 1994 national democratic elections, the Government of National Unity issued several curriculum-related reform policies, amongst whose Outcomes-Based Education (OBE) was selected to underpin Curriculum 2005 as it was perceived the most appropriate, relevant and comprehensive" (Jansen, 1998). OBE is an education philosophy that focuses on what learners can actually do after they are taught, where "all curriculum and teaching decisions are made based on how best to facilitate the desired outcomes" (Lorenzen, 2004). It is organised around the basic principle that all learners can learn and succeed; therefore it leaves up to institutions to control the conditions of success through which they will supply quality and authentic learning experiences for their learners.

Complementary to the new South African education system, eight learning areas within the schooling curriculum replaced the subjects of the previous system. The new learning areas were: language, literacy and communication; mathematical literacy; mathematics and mathematical sciences; natural sciences; technology; human and social sciences; economic and management sciences; arts and culture; and life orientation. These learning areas according to the Department of Education (DoE, 1997) were selected based on the fact that they highlighted the need for a degree of specialisation, which prepares learners in the General Education and Training (GET) band to enter the Further Education and Training (FET) band. Some of these learning areas existed and resembled the former subjects within the traditional education system, but some such as technology, arts and culture and life orientation were completely new in the school curriculum.

This study is interested in the developments of technology as a new learning area, and therefore is secondarily concerned with the effective practices towards technology teaching and learning. It focuses primarily on the nature of technology education programmes, as to whether how they are conceptualised, developed and implemented enhances efficient teacher education training that might lead to competent classroom practices. It acknowledges the role of all forms of training necessary for technology development such as in-service training (Potgieter, 2004:210), but its main focus is on pre-service training as a form of meticulous and extensive training inevitably necessary in technology.

1.2 Background of technology

The rationale for the DoE to introduce technology as a school subject was to give learners an opportunity to learn by solving problems and to encourage a critical understanding of the interrelationship between technology, society, economy and the environment, nationally and globally. Another reason is that "learners should develop intellectual and practical skills to investigate, design, develop and evaluate products, processes and systems" (DoE, 2002:5). According to Ter-Morshuizen, Thatcher, and Thomson (1997:5), learners are supposed to link knowing with doing so as to be people who are capable of doing things, not simply repeating what other generations have done. They say learners need to be creative, show initiative, discover, and have minds that are critical and can verify; not just accepting everything offered.

The effect thereof is that we live in a highly modernised and technological world which requires our children to cope with its challenges by being open-minded; therefore the role of technology is to assist them in developing such competencies. "If the purpose of technology education in South Africa is to supply young people, as future citizens, with the necessary resources to live effectively and meaningfully in an increasingly complex technological world, then the new technology learning area does in fact have the potential to make education more relevant to the South African society" (Potgieter, 2004:209).

Noteworthy, there were a number of problems that existed when technology was first implemented. One such problem was lack of qualified teachers in the field; worse of all, no formal or academic pre-, in-, and post-service programmes to train teachers who were inevitably selected to teach technology. According to the South African Yearbook (2001/2002:188), teachers would just go for a few workshops and training sessions offered by the DoE. "As a result of such trainings, a few practicing teachers in South Africa were getting familiar with some of the concepts, processes, content and methods associated with technology education, however the vast majority had no formal training in this regard at all" (Potgieter, 2004:210). Teachers in the public schools for the first time had to teach technology as an integral part of an outcome-based, cross-curricular and interdisciplinary approach. Onwu and Mogari (2004:162) corroborate that most teachers in schools were not adequately trained in the use of outcome-based teaching approaches and subjects (in this case technology) and therefore there existed a need for supplementary and even other severe forms of teacher training. "Obviously the education authorities did not provide all the training that was needed regarding technology and technology education; except for that which left teachers with anecdotal experiences" (Potgieter, 2004:207). Jansen (1998) expounds the frustration of inconsistent and non existent training for teachers during OBE implementation as: “in a cruel twist of history, teachers continue to be defined as 'implementers' in marginal roles of uneven, fragmented and for many, simply non-existent official support”.

Consequentially, according to Eggleston (1998:3), the government found out that all was not well with the national curriculum of technology and that in many schools, particularly secondary schools, it was not as well taught as other subjects. He held a view that due to lack of skill and training, technology lessons have turned into a "mickey mouse circus"; the fall out is of spectacular and of royal proportions and events were beginning to take a downward turn. He therefore asked: “why act surprised, with limited training of a few workshop sessions instead of years of knowledge and skill development?”

1.3 Rationale of the study

Ultimately, Institutions of Higher Learning (IHL) such as universities and training colleges; as well as service providers nationally and internationally such as non-governmental organisations, sectors of education and training, provincial and national government departments, started making efforts to develop and implement academic programmes in the training of technology and technology education. These training providers aim to offer qualifications and formal training in technology for professional development and teaching practice so as to improve technology’s present state and "to gain its respect as a discipline and a body of knowledge just like other subjects that have been in curricula for ages" (Spoerk, 2005:31).

This study therefore intended to investigate and carefully examine available programmes offered by the above-mentioned IHL and service providers, by purposefully sampling one case of IHL which is University of Pretoria (UP) and conducting a case study on its technology education pre-service programme to investigate the bases for its conceptualisation, planning and implementation. This was so as to critically evaluate if what the programme entails, as well as how it is conceptualised, planned and delivered enhance proficiency, capability, efficiency and effectiveness in the teaching and learning of technology. The researcher acknowledges that this case "is a unique and specific example used to illustrate a general principle of real people in a real situation" (Cohen, Manion and Morrison, 2002:181); however the findings of this case will not be used to generalise the present conditions of other IHL and service providers.

The investigation conducted within the UP technology education pre-service programme was done by employing a concept: the essential features of a comprehensive technology education programme, which necessitates that for a programme to be effective, it requires to have certain fundamental design features that are key and non-negotiable to form the core of its intended impact and success on student-teachers. According to Reddy, Ankiewics, de Swart and Gross (2003:28), the concept "essential features" is a South African and technology education practitioner term (similarly referred to world wide) that is used to clarify the nature of technology and technology education so that it is better understood by curriculum developers and educators.

1.3.1 The essential features of a comprehensive technology education programme

An array of scholars refer to them comparably as: "principle dimensions" (Eisenberg, 1996:36), "inescapable features" (Glover 1996:12); "fundamental (core) characteristics" (Reddy et al, 2003:28); "major planning elements" (Van den Akker, 2004:4); "key aspects" Lee (2003:110); "basic inherent tenets" (Potgieter, 2004:211) or "key traits" (Spoerk, 2005:29). The above titles demonstrate the exigency of the essential features, that a programme identified as a technology education entity cannot do without.

Essential features are selected based upon the sole function of technology according to the DoE (2002:4), which is to equip learners with knowledge, skills, and values of developing practical solutions to problems, considering social and environmental factors. Essential features incorporate "that technology caters for different levels and individual characteristics of students by accommodating each individual in terms of their point of departure, existing frame of reference, cultural, environmental, and socio-economic needs" (Eisenberg, 1996:36).

Glover (1996) identified essential features as content knowledge or facts, theory and technical knowledge; Eisenberg (1996) identified them as content, methodology and context; Lee (2003) identified them as what was taught, how it was taught and how it prepared the learners for the future; Potgieter (2004:207) identified them as: technology education lesson planning, design principles, problem-solving approach, group work, and practical activities; and Spoerk (2005; 29-31) identified them as standard-based, focused conceptual understandings, laboratory-oriented, problem-solving, system-thinking, and academically challenging. In an encompassing pitch, these features engulf all processes necessary in an academic programme such as conceptualisation, planning, implementation and impact. These incorporates programme design, selection of programme activities, practical work, assessment strategies, delivery methods, programme infrastructure, study materials, programme coordination and all other processes necessary for effective programme delivery that will be discussed in detail throughout this study.

1.3.2 Quality pre-service for effective teaching practice

"One of the core functions of professional education is to ensure that knowledge and skills acquired during training are transformed into the ability to apply them when and where it matters- in the workplace" (Hattingh and Killen, 2003:39). According to Mosaica (1997) pre-service refers to any structured activity that is purposed to develop or reinforce knowledge and skills before a professional enters public or private practice or service. A new employee's first impressions about service expectations are often formed during pre-service training.

An electronic oxford dictionary (2006) define pre-service training as: the process of giving, acquiring, changing or strengthening knowledge and skills, as well as developing attitudes and values, especially at a school or university, aiming at improving the level of a trainee's competence in a specific area. They are in fact activities and courses for graduates and undergraduates which take place before a person takes up a job whose services requires specific training and competences. Solid pre-service training produces members who are more effective and happy because they have the knowledge and skills needed to excel in their service obligations. Hence an effective pre-service orientation lays the groundwork and allows for further, effective in-service training because the member will able to use the training to build upon past experience and skills. However, if pre-service does not entail essential key features to qualify it for the above role, it terminates the confidence of trainees and other stakeholders. "Stakeholders at all times wants to know on what basis of quality and effectiveness programmes offered will enhance professional preparation, as well as provide good education and training for trainees" (Singh, 2004).

In education, according to the Committee on Science and Mathematics Teacher Education (2000:4), teaching effectiveness is the ability to produce desired changes within the classroom, and has been found to relate assertively to the quality of pre-service training a teacher has undergone, as well as their grades as student-teachers and teaching practice. "A well trained teacher, with essential competencies, trained in a good pre-service programme, prepared in effective pedagogical practice, is a command of subject, and is likely to show high overall academic performance" (American Council on Education, 1999:5). A well designed pre-service training experience can communicate service expectations and provide a level of knowledge suitable for further training, yet a counter state of affairs is also true, ineffective pre-service training may cause problems that might interrupt future training.

1.4 Methodology

1.4.1 Approaches and strategies

This study was conducted using a qualitative research approach; where the researcher sampled and performed a case study on the UP's pre-service technology programme. She went through investigative processes based on criteria derived from literature that necessitates essential features as fundamentals for an effective and comprehensive technology programme. As part of the investigation, she used semi-structured interviews on programme designers, lecturers, and advisors for the conceptualisation, planning and infrastructure of the programme. She performed document analysis on the study guides and the university's general programme so as to evaluate the programme content and assessment policies and procedures. Then the researcher attended technology lectures and used lecture observation schedules to evaluate teaching methods used thereof.

1.4.2 Data Analysis

Data was analysed using qualitative analysis method. All aspects investigated were based on the criteria as set out by Table 2 in Appendix 1, where the researcher designed a ranking scale notched 1- inadequacy, 2 - fairly adequate and 3 - entirely adequate. Each criterion had its relevant aspects and levels, with summarising descriptions. This ranking scale resembles a quantitative aspect of data analysis, however in this study it was just used to separate the ranks into adequate, fairly adequate and entirely adequate categories, based on the criteria within these ranks and had no intentions to utilise the ranking for quantitative data analysis. The interview schedules (Appendix 2) has a rubric (Appendix 3) that the researcher used to rate and explain responses from interviewees. The observation schedules had compartments or relevant aspects that allowed for comments at each category that was investigated. These were divided into the topic, introduction, lecture activities, teaching methods, assessment strategies and conclusion (see Appendix 7).

1.4.3 Research Design

The following figure summarises the research design of this study:

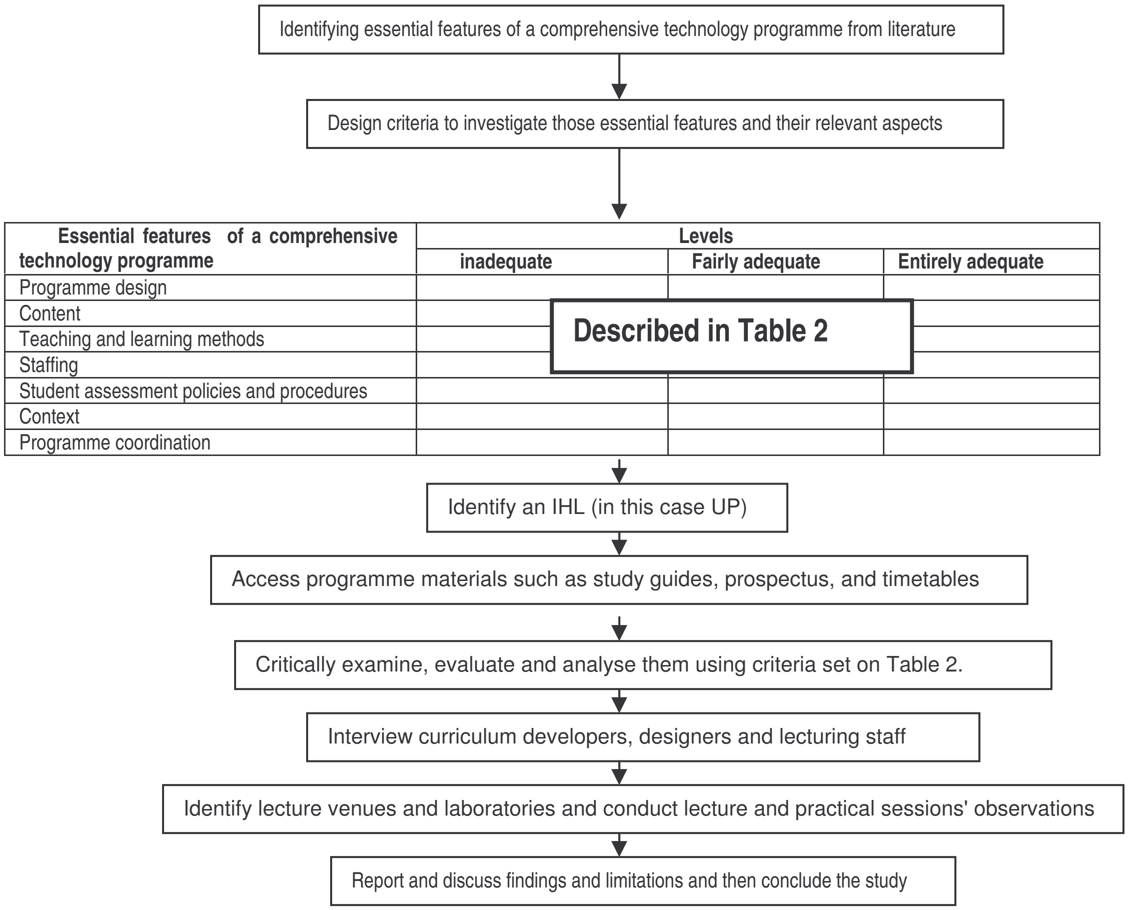

Figure 1. Research design

1.5 Problem formulation and research questions

1.5.1 Significance of the study

"As a profession, technology education stands at the crossroads, where one path, the one we have been on for decades, will ensure we remain in a limbo, lack the respect we desire from peers, and never realize the goal of evolving into a required general education program. The other, harder to travel path, holds the potential for respect as a discipline, the possibility of realising the goal of

becoming a required program for all students, and a prosperity we have only dreamed of. If we are to head down the more desirable path, we must demonstrate that our programmes are relevant, standard-based, and truly beneficial to all students" (Spoerk, 2005:31).

The above is a statement that depicts an ambivalent state of technology as a school subject, as well as suggestions for a potential enhanced future especially since technology in South Africa comes from a place of no deference and lack of training and skill development. According to Potgieter (2004:212), South Africa does not have the privilege of having a recorded best practice experience and a history of technology education, which teachers can draw on to develop learning programmes. That, Ankiewicz et al (2006:118) equate with lack of philosophical framework that accounts for technological issues such as knowledge base and technical skill development, because there exist no equivalent academic disciplines which serves as basis for curriculum development for technology teaching and learning. "By including relevant aspects from other disciplines in a cross-curricular and interdisciplinary way, the technology learning area could serve as an integrator to form a relevant whole which will empower learners to function effectively in a technological environment to the benefit of the individual, society and the natural environment" (Ankiewicz, 1995:253 and Eisenberg, 1994:5 as quoted by Potgieter, 2004:209).

The above are pertinent demands that polls for substantial development and practice of technology education; that technology programmes should entail substance necessary to provide technology teachers with good training that will enhance their classroom practice. The researcher believes that advancement in practice start with technology training; if technology programmes are planned and implemented on essential features that promotes efficacy within their programme design, content, methods, assessment, staffing, coordination, and context.

As a former lecturer and a programme coordinator of technology education at one IHL in South Africa, the researcher was once entasked to conceptualise, develop and design a technology education pre-service programme for first entering to fourth year students. That was apposite because the norms and standards for educators (DoE, 1997) identifies one of the roles of an educator as developers of learning programmes. Just at that time it was two years after technology was implemented in schools and only one IHL and a few service providers in the country were offering technology pre- and in-service programmes. Though the researcher was trained within a four year pre-service technology education programme, she was weary to develop a technology programme because of all the challenges and problems that followed technology's introduction and implementation; which were problems ranging from unqualified teachers, to lack of support materials and academic programmes to draw programme activities from (refer to 1.2).

This study therefore intends to go back to the derivation of the quandary, which is a basis that if programmes of technology are well conceptualised, planned and implemented during teaching practice and are made relevant according to particular essential features, implying also the order of the national curriculum and the sole role of technology, then the teaching and learning of technology at schools will advance. It is also to create a pedestal, upon which technology programme providers can consider when structuring their programmes, and to contribute knowledge and practice support for efficient training in technology education.

1.5.2 Statement of purpose

The purpose of this study is to investigate how an institution of higher learning, in this case University of Pretoria engage essential features in the conceptualisation, planning and implementation of a technology education pre-service programme for effective practices and learning.

1.5.3 Research questions

- Main question

How does an institution of higher learning, in this case University of Pretoria, engage essential features in the conceptualisation, planning and implementation of a technology education pre-service programme for effective practices and learning?

- Sub-questions
    - What forms the basis in terms of conceptualisation, planning, and implementation within the University of Pretoria technology education pre-service programme?
    - How are essential features of a comprehensive technology education programme engaged within the activities of the University of Pretoria technology education pre-service programme?

1.6 Reliability and validity

Reliability and validity were done to evaluate the consistency and the degree in estimation of the interview schedules, programme documents and observation schedules used in this study, as well as to strengthen the researcher's conclusions, inferences or propositions. These varying data collection instruments were used for triangulation, which according to Colossi (1997), is the application and combination of several research methodologies in the study of the same phenomenon so as to find credibility in qualitative analysis.

Reliability and validity were also done to show transparency and to encourage confidence in the research processes that occurred in this study. Though the researcher was a full-time student at the faculty of education at UP within the department of curriculum studies, she was studying for a different programme from technology pre-service programme; was at a different level (postgraduate: MEd-science and technology); and was lectured and supervised by different lecturers from those involved in the pre-service. So, ethical issues of bias and disposition because of propinquity and exposure between lecturers and students are not of concern for this research.

- The researcher carefully designed semi-structured interview schedules, with direct and focused questions and language and reading levels appropriate to respondents so as to ensure the eradication of wording biases.

- She used purposive sampling method to conveniently select respondents from an appropriate institution with relevant experiences to study.

- For validation and member checks, the researcher requested permission from subjects and subjects in authority to record interviews and analyse programme documents. Attached (see Appendix 6) is a copy of a letter sent to all respondents by the researcher that each could sign for consent of participation. However some respondents did not sign the letter but provided verbal consent to participate in this study.

- She analysed and reviewed documents relevant to the context of the research; copyrights issues as well as a mindful check of accuracy and authenticity of data sources were considered during the access of all documents.

- Rubrics to interpret and readily report findings as per data to be analysed were developed.

1.7 Overview of research

This study is divided into five chapters:

- The first chapter orientates the reader on the general introduction and background information of the present education system in South Africa. Then it provides the context and the present situation of technology as a school subject in our country as well as its impact in society. Later it presents the research problem, research questions, significance of the study, the design of the study and it closes by outlining the limitations of the study thereof.

- The second chapter explains the literature review and conceptual framework of the study. Through literature review, it builds on the definition of essential features and their role in a relevant, comprehensive and effective technology programme. It concludes by discussing the gaps found in technology education literature.

- The third chapter focuses on the research methodology and data collection methods engaged during the investigation. It outlines in depth the research design and methodology used to investigate the use of essential features within a technology education programme. It therefore describes the respondents, and data collection sources, and it closes by describing data analysis procedures, as well as validity and reliability.

- The fourth chapter presents research findings and data analysis of the study. The presentation is structured through the use of themes which emerge from data answering research questions as well as those designed in the research process.

- The fifth chapter is the final chapter of this study. It discusses findings presented in chapter 4; it also argues concluding comments, recommendations and implications of the whole study. In fact it is an examination, a description and an exploration of major findings and or emerging themes of the investigation conducted in this study. Then it examines the limitations, implications and suggestions for further research, and close off with the major conclusions of the study.

Chapter 2

A review of literature on the present state, development and impact of technology, as well as essential features of comprehensive technology programmes

2.1 Introduction

The dominant role of technology in societies today is indubitable; "the capacity and potential of technology to establish and nurture a culture of lifelong learning because of the phenomenal increase in information and knowledge, the accelerated pace of change, and the far greater diversity that was foreseen for the society of the future during the latter half of the previous century can today be accepted as inevitable" (Streichler 1994:9 and Toffler 1981:360 as quoted by Potgieter, 2004:207). From eternity, according to Murray (1990:6), technology's impact on humanity has been so significant that it is a practical method through which we can raise ourselves above the animals. We create not only habitats, food supplies, comfort and means of health, travel, and communication; but also our arts-painting, sculpture, music and literature, which basically are human capability for action.

The above role of technology in the society is part of the rationale why the national curriculum of technology in South Africa found it important to include technology as one of the learning areas. South Africa has a policy document that guides all technology classroom practices called the revised national curriculum statement of technology (RNCS-Technology: R-9). This document envisages "to produce learners who are technology literate, who are practically developed, who have capabilities of solving problems, and who can cope with the challenges of a technological society so as to become useful citizens in the technological world in which they live" (DoE, 2002:3). However, is it enough to support technology as a school subject to effectively create technological awareness, maintaining the love and appreciation of technology in learners, and developing an understanding of technology's impact for them in our modern society?

2.2 The present state of technology at schools

"Technology education at school level is still a developing learning area worldwide" (Ankiewicz et al, 2006:117), hence there exist challenges convoying the processes thereof. Below are two statements that demonstrate the indecision of the past and present state of technology classroom practice and learning programmes ever since technology was implemented in school curricula:

Technology in schools seem so elusive that it embodies the aspirations of a number of different interest groups which have been kept together only by pitching its objectives and content at such a high level of generality that it can include almost anything. If it is to be given shape and substance as a subject, then agreement will have to be reached at the much more difficult level of detail" (Smithers & Robinson, 1992).

Approximately fourteen years after:

"In contrast to the other learning areas where a well founded subject philosophy (accounts for technological issues such as what is technological knowledge, what is a technical artifacts, etcetera) exists at least for particular components, there is as yet no established subject

*philosophy for the technology learning area – in fact, the dynamic nature of technology as such leaves its own philosophy in a tentative or flexible state" (*Ankiewicz et al, 2006:118).

The fact is, it has been approximately seven years now since technology has been implemented as a school subject within the South African school curriculum, so we cannot afford to continue to label it as "tentative" (Ankiewicz et al, 2006:117), or "tenuous" (Spoerk, 2005:29) or "uncertain" (Loveland, 2004:1), or "anecdotal" (Potgieter, 2004:207), or "lacking quality" (Lee, 2003), or generally "elusive and a mess" (Smithers and Robinson, 1992) or even "a mickey mouse circus" as Eggleston (1998:3) describes it. Tracing the years of these quoted publications (1992 to 2006), there still are some problems surrounding proper introduction, implementation and sustenance of technology worldwide, ranging from common curriculum development related issues (Van den Akker, 2004:1) up to specific lack of qualified technology teachers and appropriate professional training.

At least as an attempt to address the issue of lack of teachers when technology was first implemented in South Africa, 'the cabinet agreed to the need for intensive in-service teacher development programs which focused on technology so as to address the immediate lack of capacity in this area (SA Yearbook 2001/2002:188). Potgieter (2004:206) explains the aim of these workshops as to expose teachers who have had no formal training in technology education to what the new technology learning area is about. He says that these workshops also served to educate teachers on how the design process can be applied to practical projects using available tools and materials, as well as how teachers can design learning programmes based on such projects.

However, that did not begin to eradicate yet a part of the actual problems related to this issue, because the nature of the in-service programmes themselves hemmed in inconsistency and were delivered on infrequent to once-off bases ["short, some two and a half days" (Potgieter, 2004:206)]. That reflected a number of problems whereby Hurst (1994:74) (speaking in terms educational technology in-service training programmes) wrote: "over the years I have talked with hundreds of teachers and principals about technology and the training they have received. Teachers reported that their in-service training in technology had been positive, but too short and infrequent. So they suggested the need for ongoing, flexible training, not just a one-shot programme".

The researcher acknowledges the impact of in-service as a relevant form of training (drawing from the work of authors such as Potgieter (2004:205-218). However, she impresses that it should be coupled with other forms of longer-term and "rigorous training" (Onwu and Mogari, 2004:162) such as pre-service and even post-service programmes. Besides, the kind of teacher envisaged by the national curriculum statement (DoE, 2002:3), who is qualified and competent, with abilities to fulfil various roles outlined in the norms and standards of educators such as designer of learning programmes, scholar, researcher, learning area specialist, etc, "cannot be cooked from limited training of a few workshop sessions, but from years of knowledge and skills development" (Eggleston, 1998:1).

Effective and comprehensive programmes are not only needed for educators, but also for the sake of learners. According to Spoerk (2005:29), if technology education programmes cannot demonstrate a tangible relevance for today’s students, then they will quite simply cease to exist because now more than ever, technological development is growing at an astonishing rate, and it is critical that the best possible technology education be provided for students. "Every school should have a true technology education programme if we can reasonably expect to prepare students to be technologically literate in today's society" (Hendricks, 2003). According to Eisenberg (1996:36), technology should not just be another subject to be learnt at school; rather it should be a lifestyle which equips students with necessary fundamentals such as knowledge, skills (problem-solving, entrepreneurship and decision-making) and ways of thinking.

2.3 Effective practices towards proficient development of technology teaching and learning

The primary concentration of this study is that feasible and properly conceptualised, planned and implemented pre-service programmes, designed around essential features, can contribute to teachers' successful delivery of effective technology lessons. Secondarily, it is concerned with effective practices towards proficient development of technology and technology education. According to King and Lawrence (2004), careful planning and design are key to providing efficient career technology development education amenities.

A technology educator's role is crucial in delivering proficient and relevant technology lessons. According to Seeman (2002), a competent technology teacher is the one who is able to holistically integrate the doing of technology (designing, making and evaluating technology products) and effectively teaching it (deciding on useful outcomes, relevant classroom activities and proper assessment strategies for their lessons). Reddy et al (2003:42) declares that the inability of teachers to see the interrelationship between components of the content dimension (i.e. technological content knowledge, skills, attitudes and values and technological capability) could lead to technological tasks becoming isolated experiences leading to lack of progression in learners knowledge and understanding in technology education. Therefore it is the role of the teacher "to have capabilities of making more accurate curriculum decisions about content and its presentation, resulting in observable differences in the conduct of technology education" (Zuga, 1998:1).

Nonetheless, the above only explains what teachers are supposed to do, but do not offer methods of how to engage or improve on the above practices. Onwu and Mogari (2004:162) call this type of descriptions "blueprint for change", and they support that for teachers to successfully implement these blueprint in classrooms, it is essential that they are knowledgeable in content and confident in ability and skills. "Teachers should also be able to establish a balance between methods that give learners the freedom to think and make decisions" (Deluca, 1992:28 as quoted by Reddy et al, 2003:29). It is of consequence as mentioned earlier that most technology teachers did not receive proper training prior to being allocated technology to teach (SA Yearbook 2001/2002:188), however, current offered technology programmes should be able to usher teachers to enhanced and above described capabilities.

Below are examples of pre-service and in- service training, as well as their effect on teachers' classroom practice enhancement:

- *Pre-service training*

Reddy, Ankiewicz, de Swart, and Gross, (2003:28) hold that programme development in technology education seem to emerge from an atheoretical perspective. Therefore a conceptual framework for a clearer understanding of how learning and instruction in technology education can be enhanced may be sought in the essential features of technology and technology education. As a basis for that conceptual framework, they adopted Moreland and Jones' (2000:288) three dimensions of knowledge (knowledge in technology, knowledge about technology and general technological pedagogical knowledge) which they believe teachers need to develop so as to be effective in technology education. For them, to be able to highlight the importance of these conceptual frameworks, they explored the role of the essential features (especially the content dimension) in OBE related to the instructional programme they developed.

Over a period of six weeks they did a descriptive, contextual case study at a college of education on a group of 20 students doing their second year technology education course, by implementing the OBE related instructional programme. The programme was based on criteria derived form essential features of technology and technology education, which also served as a data gathering instrument for the researchers. The programme engaged the students with specific technological tasks (2 case studies, 6 resource tasks, and 1 capability task). To validate their data collection, they also used questionnaires, classroom observation and focus group interviews.

The results of their study showed how the instructional programme empowered the students. They find that the programme increased learners' appreciation of technology; because it had a pervasive influence and it provided them with opportunities outside the classroom such as entrepreneurship and others to support their socio-economic background. As far as content is concerned, learners displayed some knowledge of understanding familiar materials such as wood, metal, waste materials, etc. however they showed some difficulties in choosing appropriate materials for the right projects and showed some weak conceptualisation of two and three dimensional drawings. As for acquisition of motor skills, learners reflected some difficulties with taking accurate measurements and thermometer readings. Design ideas also seem to emanate only from a few members of each group. Difficulties were experienced, especially with female learners, with regard to hand tools.

The above results reflect important issues in most educational programmes, ranging from the extend of how learners grasp content to gender related issues. These could not have been identified if the instructional programme employed did not have a conceptual framework. The authors gathered that "failure to take cognisance of the principal dimensions constituting the essential features of technology and technology education leads to a neglect of the holistic nature of technology and technology education" (Reddy et al, 2003:42).

- *In-service training*

In the training of OBE learning areas, Onwu and Mogari (2004:162) suggested that in-service or professional development models be developed that empower teachers, so that reform-based teaching and learning strategies be implemented in classrooms. They believe that the answer lies in building an ongoing capacity (in-service training) for teacher development and change within the school context, where that capacity acknowledges the pre-eminent role of teachers in curriculum implementation and the importance of the teacher's own professional development as an ongoing feature for teacher change.

Onwu and Mogari (2004: 161-177) modelled professional development by conducting an empirical research engaging a case study of a project called UNIVEMALASHI. This was a systematic reform initiative for teacher development that these authors conducted so as to improve teachers' content knowledge, skills, and attitudes at the Malamulele region of the Limpopo Province in South Africa.

The study was based on the assumption that is derived by Loucks-Horsley (1998) that "successful implementation of school reform for professional development for teachers is greatly enhanced by a systematic approach, which involves partnering with strong support structures at the provincial, district and school levels, real support for classroom teachers, and support and engagement from community". Therefore the activities of the project involved orientation training sessions, district early childhood development specialist visits, cluster meetings, school-based workshops, and parent involvement interactions. The study tentatively resulted in them discovering that:

- An appropriate teacher development programme results in teacher classroom practice and behaviour positively changing.

- Teachers are encouraged because during the project activities, they saw and experienced what they are expected to do with learners in their OBE classrooms, and their confidence in their ability to cope with the demands of the Curriculum 2005 may have increased because of the supporting role of the project in equipping them with necessary content, skills, and attitudes on an ongoing bases.

- They had an opportunity to analyse their real classroom experiences during their follow-up cluster meetings.

- There was a fair construct of understanding on teachers on the learning areas they are expected to facilitate.

- Teacher and support was being maintained by the schools' yearly follow-up workshops, provisional materials, cluster meetings and classroom visits by the early childhood development specialist.

In technology education, according to Potgieter (2004:210), there exist needs for in-service training for teachers who have to teach technology as an integral part of an outcomes-based, cross-curricular and interdisciplinary approach. "The challenge that lies before providers of in-service teacher training regarding technology education is not only to be able to train so many teachers from both rural and urban backgrounds but also to include the relevant technological content and teaching practice aspects that are involved. The in-service training should obviously also be presented in a way that takes into account that the teachers are novices regarding technology education" (Potgieter, 2004:217). Potgieter (2004:206) also identified the role of technology, which he said is to promote a culture of lifelong learning in an increasingly technological world we live in, as well as to effectively elevate the technological awareness and literacy to scale in societies.

2.4 Essential features of a comprehensive technology education programme

Potgieter (2004:206, 210 and 217) and Onwu and Mogari (2004: 161-177) contend that the above characteristics are essential elements in professional development or in-service programmes. However there exist other essential features which virtually form the basis or are core in technology programmes. The above literature has already singled out some of these features; below the researcher examined, analysed and evaluated other authors' outlook on them:

- *Eisenberg (1996:36-38) - Essential features of technology education programmes*

Essential features of an effective technology programme are similar with most authors, but the researcher used this article as a yardstick to outline those relevant, feasible and effective in technology programmes. This is because Eisenberg (1996:36-38) presented the essential features explicitly and simply, and as those that determines the basics of any successful programme. The basis of Eisenburg's conception of essential features is on the identification that: "one of the problems the technology education community may encounter is how or when can a lesson, programme or course be identified as a technology education entity" (Eisenberg, 1996:36). It is only when it entails these clearly identifiable, yet inter-related essential features or non-negotiable characteristics of a technology education curriculum.

Eisenberg identified essential features and their principle dimensions as described in the text box below:

Content	- Knowledge- technological concepts and principles - skills- problem solving, decision making, entrepreneurial, management, innovative and creative thinking, etc - Attitudes- comprise the thought processes of the brain, use of hands for making, etc.
Methodology	- Technological / design process- design, make and evaluate - The system' approach- input, function, output and the compatibility and interfaces between systems - The integrated approach- emphasise the interdisciplinary characteristic of technology education with many other disciplines
Context	- Its about making any technology education programme relevant to students' lives. - in all technology projects designed and developed, environmental issues, social and cultural considerations and economic constraints should be considered.

Text Box 1. Eisenberg's essential features

The author concludes that the development of a technology education curriculum is a multi-faceted task, therefore when developing it, each topic it comprises should be evaluated according to these features because that will create an overall balance between them.

- *Spoerk (2005:29-31) – key traits: how to keep your programme relevant and standard based*

Spoerk (2005:29-31) refers to essential features as "key traits" and he explains their significance based on how crucial is the demonstration of their tangibility and relevancy to technology programmes. He stresses that they should be pertinent, standard-based, and truly beneficial to all students. He identifies the key traits as:

- Standards based: where 70-90% of course contents connects to state or national standards for technology education
- Focused on conceptual understandings, higher order thinking skills and "big ideas."
- Lab oriented but not skill development oriented.
- Problem-solving and system-thinking focused.
- Intended to serve the entire school population.
-Integrates and reinforces content from other academic disciplines.
- Academically challenging.
- Content is rapidly changing but clarity is retained through conceptual models.
- Content is being absorbed into other disciplines.
-Growing movement from within and outside the profession to establish as a general ***education*** discipline (Hendricks, 2003).

Text Box 2. Mark Spoerk' key traits

It should be noted that technology as a school subject is not a specialist skill development subject (such as in FET), but it is meant for "knowledge application, designing, problems solving and system thinking capabilities development" (DoE, 2002:4-5). So the key trait quoted above cohere with the South African purpose for technology as a school subject, because they promote standards-based, lab-oriented but not skill development oriented, problem-solving and system-thinking focused, intended to serve the entire school population.

Spoerk (2005:29-31) further stresses the relevance of project-based learning, and he acknowledges that though projects are an integral part of virtually every technology classroom, precious few are engaging in project-based learning in a meaningful way. He therefore identifies the traits of meaningful hands-on activities as: learner-centred, authentic, content and purpose-based, should be challenging, include a product, presentation and performance, and should have strong elements of collaboration. He says there should be a continuous improvement from start to finish; the teacher should facilitate, have educational goals, and they should be rooted in constructivism.

He also wrote of programme formats that drives instruction towards the project-based learning and mentions its key components as: educational standards driven, knowledge driven, assessment driven and community driven. There exist an overlap between the key traits of technology programmes and the traits of project-based learning as reviewed by Spoerk (2005:30). He holds that key traits are identical for all types of technology programmes, be it technology education, or industrial arts, or technology as a school subject in the South African context, or career and technical education.

Figure 2 summarises how Spoerk outlines the key traits of technology education programmes:

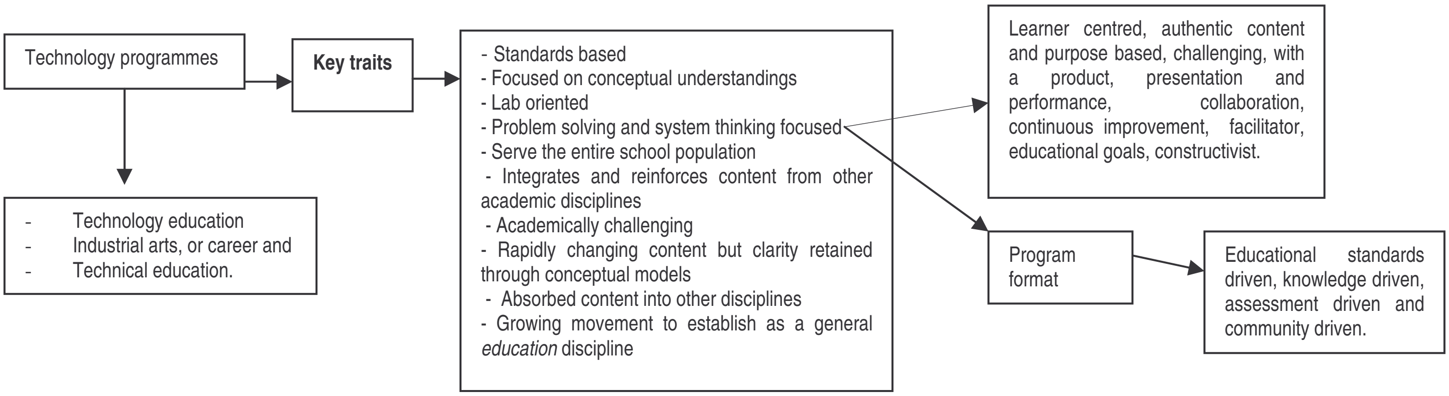

Figure 2. Spoerk's outline of key traits

What seems a challenge is that Spoerk (2005:29-31), have identified and provided the key traits, but just like most of the authors and as in most books and curriculum policy statements, they are non-figurative. Methods to demonstrate understanding and eventually carry them out in lessons are not provided. He identified the importance, the traits and the programme format of project-based learning, he also noticed how teachers do not carry it out effectively, but he did not suggest practical methods to implement change. Also, his concerns for technology being on the crossroads and the importance for it to develop and grow into a respectable discipline are superlative.

- *Glover (1996:14-17) - inescapable features of technology education and what they tell us about the development of an effective curriculum*

Glover (1996:14) begins by explaining the importance of merging the inescapable features of technology education programmes with the definition of a curriculum, and curriculum standards because he deems that the disconnectedness thereof is a problem. He defines a curriculum as all activities within the school that includes: aims and objectives of an education system, what is taught (values, content, etc.), strategies and methodologies of teaching and learning, assessment and evaluation used, and how learning opportunities are serviced and resourced. So, whatever features that are fundamental within a subject programme, should be connected to what is needed within a curriculum.

He therefore identifies the basics of technology as processes of designing, making and evaluating the means of solving problems. He holds that problems that are designed, made and evaluated by technology are value laden, in terms of their roles (political, economical, etc.) in human cultures and environments. Therefore, the inescapable features of technology programmes should consider the roles of technology in societies. In the same breath, he motivates that for technology education to have an impact on learners; it should have abilities of training them into awareness of theses roles, especially problem identification and solving, clarifying and articulating them properly. These he refers to as technological literacy, which according to him is the absolute aim of technology education.

- *Potgieter (2004:205-218) - The impact of the implementation of technology education on in-service teacher education in South Africa (impact of technology education in the RSA)*

The aim of the study was to evaluate the impact of in-service training that was provided to South African educators when technology was first implemented as a separate learning area. Potgieter (2004:205-218) conducted studies at a time when short introductory in-service workshops were conducted by the national DoE in three provinces in South Africa between 1999 and 2002 involving 36 schools and 87 teachers to pilot the process of implementing technology. This was during the same period when curriculum 2005, a new national curriculum (DoE, 1997), was developed for South Africa and introduced in 1997 after extensive world wide consultation.

Potgieter (2004:210) wrote that the effect of introducing technology was the need for in-service training for teachers who, for the first time, had to teach technology as an integral part of an outcomes-based, cross-curricular and interdisciplinary approach. Therefore there existed a need for intense and good in-service programmes in technology education that the author suggested that they should entail the following topics: the design process; technological content (energy, systems, structures, processing, etc); materials and tools; managing the technological environment (including supplying tools, raw materials and workshop environments); safety issues regarding technology education and teaching or learning methods for technology education. He also said that in order to be able to teach technology education effectively, in-service teachers will also have to be exposed to teaching practice sessions and internships.

He identified essential features which he called "technology education aspects" or "basic inherent tenets" as, "lesson planning, design principles, problem-solving approach, group work, and practical activities" (Potgieter, 2004:207). He said that the development of these aspects should be based on the critical and developmental outcomes of the new South African national curriculum statement. These critical outcomes are: "learners should be able to communicate effectively, solve problems, organise and manage themselves, work effectively with others, process information, use science and technology effectively and understand the relatedness of society and the environment" (DoE 2002:11). Potgieter (2004:211) recognised the basic technology activities as portfolios, problem-solving, design and continuous assessment. He therefore said these features and activities are inseparable to general outcome-based activities because he deems that technology is a vehicle by which the implementation of outcome-based education can be enhanced.

After conducting studies on both the rural and urban, contact sessions and distance learning technology teachers, the author found out that teachers had positive attitudes and were enthusiastic about training for technology education. They also embraced the notion of improvisation when designing technology artifacts. He also found that the hands-on nature of technology does not imply that technology education cannot take place over distance education. Just that students within distance education should do "in-depth and extensive curriculum design and development and will have to be prepared to accept a very heavy work load with regard to the assessment of assignments, projects, workbooks, portfolios, and so on (Potgieter, 2004:213). The studies the author conducted also reflected familiar challenges in any curriculum implementation such as: "a lack of appropriate resources, insufficiently stocked libraries and media centers, overcrowded classrooms, inappropriate and insufficient furniture, no room to store materials, tools and projects in progress, classes where a number of different grades are combined, and insufficient time allocation for technology education in time tables" (Potgieter, 2004:215).

- *Van den Akker (2004:3-7) - major planning components*

Van den Akker's (2004:3-7) approach is not specific to technology but general to all programmes and curricula of any learning area implemented. His aim is not necessarily to highlight on blueprints for learning, but to "summarise sets of concepts and perspectives that from experience has helped to increase the transparency and balance of curriculum or programme analysis, development and discourse" (Van den Akker, 2004:4). He approached curricular activities from hierarchical levels starting from the macro (system, national), to meso (school, institution), to micro (classroom), to nano-level (individual, personal). He appreciates that at all these levels, curricular content is accepted differently: it can either be intended (vision, rationale and basic philosophy), implemented (perceived and operational), and attained (experiential and learned).

Therefore he emphasises the need for planning for learning, where he employs Walker's (1990) planning elements (content, purpose and organization of learning) for student learning. He says that these elements are crucial as major orientation points, and they vary across the above mentioned curriculum levels. Therefore they need to be ideally linked and consistent with each other (he represents them in a form of a spider web, whereby each strong link is as equally important as the weaker link).

Table

1 is a description of his essential elements for learning:

Major elements	**Description**
Rationale	Why are they learning
Aims and objectives	Towards which goal are they learning
Content	What are they learning
Learning activities	How are they learning
Teacher's role	How is the teacher facilitating learning
Material and resources	With what are they learning
Grouping	With whom are they learning
Location	Where are they learning
Time	When are they learning
Assessment	How far are they progressed?

Table 1. Van den Akker's major components

In balance of the above components, the Van den Akker (2004:5) emphasises that to decide on what is to be included in a curriculum, the orientations in Text Box 3 are a priority for selection and setting:

- Knowledge- what is the academic and cultural heritage that seems essential for learning and future development
- Society- which problems and issues seem relevant for inclusion form the perspective of societal trends and needs
- Learner- which elements seem of vital importance for learning from the personal and educational needs and interests of the learners themselves?

Text Box 3. Orientations of curriculum implementation

2.5 General synthesis of literature on essential features

A number of noteworthy issues arose throughout the above literature, one of which being that essential features as identified by authors are comparable; all of them revolve around subject content, methods of delivery and context or learning environment. This is helpful because "if curricula and programmes are overloaded, fragmented and incoherent this leads to all sorts of problems such as teacher and student frustrations and failure to implement, therefore an agreement juncture should be reached whereby a reduced and simple structure of particular subjects domain is reached, consisting of sharper priorities in aims for learning and focusing on basic concepts and skills" (Van den Akker, 2004:7).

Furthermore, some authors refer to essential features as crucial and inescapable, giving them a standing of blueprints, others refer to them as just guiding features to help focus learning. Some institutions explicitly outlines them in their study materials and policy documents and implement them as is, while for others these features surfaces while the programmes are busy being implemented. It should be noted that some students and some staff members comes to institutions already equipped with inherent knowledge of some of these features, especially those with developmental outcomes such as qualifications, determination, etc., hence each institution implement and focus on them differently. In fact "there is not a single perspective or an overarching rationale of higher authority that can resolve all dilemmas in programme development" (Van den Akker, 2004:8). Hence when these features are identified, they should be explicitly specified as to which level of training they belong to: pre-, post-, or in-service teacher training programmes, or even which should be more stressed and focused on at different levels of training.

Anyway this study maintains the recognition of all features that are basic, and it eventually in its theoretical framework sums up an all inclusive structure that will implicate most if not all features. This it will use to investigate as to how they are conceptualised, planned and implemented, focusing also on their brunt for enhancing classroom practice.

2.6 Theoretical Framework

This study is based on the concept "essential features of a comprehensive technology education programme", which is a product of a common description espoused mainly by authors in the above literature such as Potgieter (2004:205-218), Spoerk (2005:29-31), Van den Akker (2004:3-7), Reddy et al (2003:27-45), Eisenberg (1996:36-38) and Glover (1996:14-17). These authors have concurrently outlined the essential features as "foundational basic principles" and used them as a yard stick to outline what is important and to be found within an effective technology education programme. The philosophy thereof holds that essential features are inescapable, comprehensive, relevant and key to effective technology education programmes.

The authors' comparable analysis espoused the rationalistic approach, which is "a method typically involving the use of observational data, logical inference, reason" (Lacey, 1996:286). It also engages other epistemologically well-grounded procedures of inquiry which according to Audi (1999:771) are a basis on which to generalize collective presumptions and philosophical standpoints. For the grounds that the investigation in this study reports on how the UP-D&T staff experience and engages essential features in their own programme, the epistemological stance (how knowledge is acquired, based on its nature and forms and how it is communicated to other humans) is that of an antipositivist, because "the knowledge acquired thereof is of a softer, more subjective form, based on experience and insight of the participants" (Cohen, Manion and Morrison, 2000:23-24). The ontological assumption of this study is that engagement of essential features within a study programme is a result of human consciousness and individual's cognition (created by authors' own minds).

In all descriptions, the above authors delineated essential features as:

- Programme content , which includes knowledge of subject matter

- The methodologies used to deliver the programme

- Educational contexts and educational ends, which is the environment in which this 'body of knowledge' should be taught

- Programme design, which evaluates if a programme is consonant with the national curriculum's requirements and it is coherent and properly planned with resource allocation, meets the needs of student and other stakeholders, and is intellectually credible.

- Student assessment policies and practices, which necessitates different modes of delivery of the programme have appropriate policies and procedures for internal assessment, internal and external moderation; monitoring of student progress, explicitness, validity and reliability of assessment practices, recording of assessment results, settling of disputes, the rigour and security of the assessment system.

- Programme coordination, which evaluates if the programme is effectively coordinated in order to facilitate the attainment of its intended purposes and outcomes.

- Staffing, which appraises if the academic staff responsible for the programme is suitably qualified, has sufficient and relevant experience and teaching competence, their assessment competence and research profiles are adequate for the nature and level of programme.

However, teaching begins with an understanding of what is to be learnt as well as how and what is to be taught. The basis for effectiveness of the above depiction is provided by three dimensions of knowledge: knowledge about technology, knowledge in technology and general technological pedagogical knowledge adopted (Morelands and Jones, 2000:229).

While using the essential features as a concept of focus, the researcher has also adopted the model from the Council on Higher Education (CHE) and used it to explore each essential feature within its dimensions and distinctive components. This model was a framework of criteria for programme accreditation which was used in 2004 when the CHE did the national review of professional and academic programmes in education. The CHE used the systems' approach engaging the input (candidacy phase), process (accreditation phase), and output (paired with the impact phase), which according to Eisenburg (1996:37) is an ideal approach because it is an inherent feature of the technology discipline, especially since it complies with the cognitive development of the learner.

Each essential feature had a criterion that is separated into levels to measure programme areas, as well as relevant aspects to outline its contents (see Table 2 below). However, it should be noted that the investigation in this study does not explore the impact or output of the UP pre-service programme.

Essential Features	Relevant aspect	Criteria	
		No.	Nature
Programme design	*Relation to national curriculum standards and requirements *Cater for the needs of students and other stakeholders *Coherent *Good learning materials development *Provides rationale *Aims, objectives and towards which they are learning available *Time defining	1	It is consonant with the national curriculum's requirements, where 70-90% of course contents connects to state or national standards for technology education. It is coherent and properly planned with resource allocation, meets the needs of student and other stakeholders, and is intellectually credible.
Content	*Interrelatedness of distinctive components constituting knowledge of technological concepts (facts)and principles, skills, capabilities and competencies *Ability to engage confidently with the technological / design process *Provides an important support base for problem solving activities *Integrates and reinforces content from other academic disciplines. *Is rapidly changing but clarity is retained through conceptual models.	2	Content forms the core of any educational programme in technology as it increases learners' ability to engage confidently with the technological process. It should consist of distinctive but interrelated components which constitute knowledge, skills (problem solving, decision making, entrepreneurial, management, innovative and creative thinking), values, attitudes (comprise the thought processes of the brain, use of hands for making), and technological capabilities. These components should reflect an affective aspect unto learner's behaviour, principles, values and norms. Theories involved should consist of sets of hypotheses which connect known facts into logical and coherent patterns to base predictions.
Teaching methods	*Promote student learning *Emphasise the interdisciplinary characteristic of technology education with many other disciplines *Upgrade teaching methods *Targets, implementation plans and ways to monitor, evaluate impact and effect improvement *Problem solving and system thinking focused. *Lab oriented but not skill development oriented. *Its about making any technology education programme relevant to students' lives.	3	Promote student learning by employing a variety of appropriate of teaching and learning methods. e.g. the system' approach, the compatibility and interfaces between systems and the integrated approach. Methods are appropriate for the programme type as reflected in its design and all other programme areas. They also set targets, plans implementation, as well as mechanisms to monitor progress, evaluate impacts and effect improvement. They are activity based, defining how students are learning, teacher's role, and material and resources.
Context	*Infrastructure such as venues, library, resources, well structured and equipped technology laboratory *How to establish as a general education discipline. *Environmental, social, economic constraints and cultural issues and issues	4	Defines location or where they are learning. There should be growing movement from within and outside the profession to establish a general education discipline. In all technology projects designed and developed, environmental issues, social and cultural considerations and economic constraints should be considered.
Student assessment policies and procedures	*Internal assessment *Internal and external moderation *Recognition of prior learning (RPL)	5	The different modes of delivery of the programme have appropriate policies and procedures for internal and external moderation; monitoring of student progress, explicitness, validity and reliability of assessment practices, recording of assessment results, settling of disputes, the rigour and security of the assessment system.
Staffing	*Qualified *Teaching experience *Assessment competence *Research profile *Frequently attend professional development programmes	6	Academic staff responsible for the programme is suitably qualified, has sufficient and relevant experience and teaching competence, their assessment competence and research profiles are adequate for the nature and level of programme.
Programme coordination	*Mandate and responsibilities of the programme coordinators outlined *Student input and participation	7	Should be effective in order to facilitate the attainment of its intended purposes and outcomes. There should be academic development initiatives that promote student, staff and curriculum development and offer academic support for students where necessary.

Table2. Relevant aspects and criteria to measure the dimensions of the essential features.

2.7 Conclusion

This chapter has reviewed the literature that the researcher has used to build on the essential features of a comprehensive technology education pre-service programme. It has dealt with and explored issues of when technology was first implemented, pre- and in-service teacher training programmes, as well as the present stage of technology as a school subject. The researcher has carefully selected various authors who built on the literature focusing on essential features to be engaged in this study, and explored how each showcased the roles thereof. She therefore concluded with the theoretical framework upon which this study is built on, as well as Table 2, which is a basis upon which essential features to be investigated in this study will be explored.

Chapter 3

Research design and methodology

3.1 Introduction

The theoretical framework in Chapter 2 (refer to 2.2) explains the basis of the research strategy engaged in this study, that it approaches research from a qualitative system of inquiry. That is "research involving detailed, verbal descriptions of characteristics, cases, and settings; typically using observation, interviewing, and document review to collect data" (BJA Centre for Program Evaluation, 2005). Just as the engagements of the researcher within the UP technology education pre-service programme, qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings, such as "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (Patton, 2001:39).

Essentially, this study is a case of an IHL, which was purposed to evaluate opportunities for technology teacher learning and growth in South Africa. It involved performing a case study, investigating a specific and unique technology education programme (UP pre-service programme); how it is conceptualised, planned, and implemented based on the essential features of an effective, relevant and comprehensive technology programme. In particular, the researcher chose UP as "a single, specific instance of a bounded system that is frequently designed to illustrate a more general principle, providing a unique example of real people in a real situation" (Nisbet and Watt, 1984:72 as quoted by Cohen et al, 2000:181).

3.2 Why the case of the UP technology education pre-service programme

The UP technology education pre-service programme was selected using purposive sampling method. The researcher opportunely chose this case because UP has been offering pre-service technology education for approximately seven years now, therefore it probably has more experience in development and practice of implementation, as well as structured programme activities, support materials and resources in place.

Besides the researcher was a student of technology education at UP at a time this study was conducted (see 1.6), so she applied the convenient selection method, which provided the researcher with uncomplicated access to subjects, documents and lectures as the main components to facilitate activities of this study. This, according to Cohen et al (2002:92) is a solemn factor to consider when choosing a case or sample for study.

3.3 Sample

The sample in this study was the developers, designers and lecturing staff of the UP technology education pre-service programme, and was purposefully selected using the non-probability method. This technique was used because according to Cohen and Holliday (1996), the chances of members of the wider population, such as developers and designers of other service providers and IHL to be selected to engage in this study are unknown. These members of the wider population will definitely be excluded and will not have an equal chance as the students and staff of UP technology education pre-service programme.

3.4 Data collection

3.4.1 Interviews

Data for this study was collected using semi-structured interview schedules, where the researcher (as summarised by Bennett, 2005:51) planned a general configuration of open-ended questions by deciding before hand what key areas or questions will be covered in those interviews. The open-ended nature of the questions allowed the participants to respond based on their own experiences rather than on pre-arranged responses. These questions were also used to guarantee useful data because they comprised probing measures for experiences, opinions, values, and knowledge from the participants. The probing was also used to follow-up on comments and to get more details; to encourage the interviewee to disclose more information and to acquire clarifications on certain or all responses. The interview schedules are attached as Appendix 2.

The interviews were conducted with the lecturers, programme developers and designers of the UP technology education pre-service programme and were used to investigate how the programme is conceptualised, planned, and implemented. All participants were interviewed using the same interview schedules and were asked more or less the same questions. The schedule had questions that focused on how curriculum developers justified the structures and natures of their programme, how they demonstrated an understanding of technology as a school subject and an academic area of learning, and how best it should be taught.

The first interview question inquired about who the developers, designers, coordinators and implementers of the UP technology education pre-service programme were, as well as what are their qualifications and present studies in technology education. It further probed on what professional development programmes they usually engage in to keep them afloat with technology education developments. The second interview question inquired about the basis for conceptualisation, planning and design of the programme. The third interview question probed the opinions of the programme designers, as to what the important characteristics of a successful technology education programme are. It also inquired on how the programme designers understand the above mentioned characteristics should be engaged to enhance effective practices of technology teaching and learning. The fourth interview question explored the perceptions of the staff, if they suppose that their programme is good and has potentials to provide student teachers with enhanced understanding of technology and technology education. To validate the data from the fourth interview question, the researcher has interviewed two student-teachers on their perceptions and reflections, as to whether the programme activities within the programmes they are enrolled for provide them with enhanced understanding of technology and technology education.

3.4.2 Document analysis

Document analysis is "the practice of examining a set of documents that are used to support specific goals and objectives" (Flatirons Solutions, 2001), which in this case are all documents used in the planning and implementation of the technology education programme, such as study manuals, guides, and general programmes. This was done so as to explore the programme content, assessment policies and procedures, as well as plans for implementations of the UP technology education pre-service programme.

The general programmes are university prospectuses that explain all degrees, courses and module contents offered within a particular faculty, which in this study is the faculty of education at UP. The researcher analysed and evaluated them to demonstrate the design of the programme and to narrate on how technology education is structured by the university to be chosen as an academic learning area of specialises for student-teachers. They were also reviewed to explore the areas of need, based on the phase a student-teacher should be trained for, whether to be selected as a fundamental, a core or an elective course; what all those entails, why, and how that will prepare student-teachers for a more adroit teacher training of technology and technology education.

The researcher also investigated the study guides, so as explore how each lecturer engages content and instruction through the integration of educational technologies and media, and also on how practical work is outlined throughout each module. The guides were also analysed to evaluate how assessment strategies, assessment criteria and student feedbacks are catered for. On assessment strategies such as assignments, tasks, case studies, and practical work, the researcher evaluated if the lecturers assess students according to the scope of technology education within the national curriculum policy documents, that assessment should evaluate the use of design processes; if students can design, make and evaluate technological products.

3.4.3 Observation schedules

Observation schedules were developed for lecture visits to evaluate some modes of delivery, as to how lecturers apply a variety of methods to impart technological knowledge, as well as the perceptivity of students towards activities, methods and assessment strategies. The observation schedules used here were designed by the researcher specially to inspect issues pertaining to lecturer presentation. They evaluated the topic of the lesson, the introduction, and the lecture activities utilised to meet lecture outcomes, assessment strategies and the conclusions of the lecture.

The researcher has collected data on the observation schedules for approximately three weeks; she had selected a sample of six of them; three from first year, two from second year and one from third year that she attached as Appendix 6. Her observations were inconsecutive but they targeted particular lectures such as lectures on introductions to particular concepts, theory lectures, and particular days when student-teachers were making presentations of group-work discussions or practical work. Each lecture is an hour but full sessions are made of two hours on selected week days; student-teachers were approximately thirty in each class.

3.5 Data analysis

A qualitative analysis will be done on data collected using the above discussed data collection instruments (interview schedules, documentation analysis and observation schedules). For all instruments, the researcher have designed criteria (see section 2.6, Table 2), which consist of the essential features and their relevant aspects, where each feature has a criterion split into levels determining inadequacy, fair adequacy and entire adequacy at different levels, rating availability, depth, breadth, and relevancy. Similarly, the researcher designed a rubric (see Appendix 3) that analysed the responses of participants according to the interview questions they were asked on Appendix 2.

The observation schedules (see Appendix 6) have key points to be observed: topic, introduction, activities, methods, assessment strategies and conclusions of the lecture. Further they are divided into two compartments: expected competencies, and the researcher's comments. The expected competencies consist of general pedagogical features expected for any well prepared and structured lesson. The researcher's comments compartment is a blank space where the researcher can freely narrate experiences and happenings in her own words and to qualitatively analyse each key point based on criteria as provided by the expected competencies. Table 3 is an example of an observation schedule:

Topic: Unique characters of the design process Module: JOT 152 Date: 27/03/06 Duration: 120 minutes

Important aspects of the lecture	**Expected competencies**	***Researcher' s comments***
Topic	- Derived from which learning outcome within the technology RNCS?	LO 1
	- Addresses which aspects of technology?	Design processes
Researcher's comments		
Introduction	- Gathers students' attention	Yes, short and guiding.
	- Clearly explains the mission of the 'day', outlines the objectives	Yes
	- Reviews relevant prior knowledge	Not discussed
Researcher's comments		
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Yes
	- Explorative, promotes inquiry	Yes
	- Targets basic knowledge, skills and values required in technology	Yes
	- Poses challenge, educative, help learners construct knowledge	Yes, possibly
Researcher's comments		
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes
	Clear explanations of concepts and ideas given	Yes
	Make good use of visual aids	Yes, the lecturer used PowerPoint™ slides
	Student participation encouraged through range of questioning techniques	Yes
	Relates theory to current industry practice	Yes, because they related concepts to daily used products
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were cooperative
Researcher's comments		
Assessment strategies	Strategies available? Particular project given for future sessions?	None
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Researcher's comments		
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Researcher's comments		

Table 3. An example of an observation schedule

Similarly, the document analysis of the general programme and the study guides will be done qualitatively based on the descriptions of the role of these documents in this research as explained above.

3.6 Reliability and validity

For a qualitative study, according to Cohen et al (2000:119), reliability addresses issues of honesty, depth and scope of data achieved and the participants approached. Validity addresses issues of stability of observations, parallelism and "interaterness"; where if another researcher with the same methods and framework can work on this research will attain similar results. For this study, reliability is "the degree of accuracy and comprehensiveness of coverage, regarded as a fit between what the researcher record as data and what actually occurred in the natural setting being researched" (Bogdan and Biklen, 1992:48). Validity however according to Davies and Dodd (2002) addresses issues of quality, rigor and trustworthiness. So, reliability and validity in this study were conducted to evaluate the consistency and the degree in estimation of the research instruments (interview schedules, document analysis and observation schedules), as well as the strength of the conclusions, inferences or propositions made by the researcher.

Internal validity was conducted; there exist a demonstration that the explanations of all sets of data this study collected using the above mentioned research instruments is sustained by the data presented in Chapter 4. The findings acutely describes the phenomenon being researched (Cohen et al, 2000:107), which in this case is the engagement and application of essential features of a comprehensive technology programme. The interview schedules and the documents analysed evaluates how the UP-D&T programme is conceptualised, developed and planned, whereas the observation schedules evaluates the implementation of this programme. For the same reasons content reliability, which checks if the instruments show a fair and comprehensive covering of the domain or items that it purports to cover in this study was conducted.

As described in Chapter 1 (refer to 1.7), the semi-structured interview schedules were carefully designed, with direct and focused questions and language, appropriate to respondents so as to ensure the eradication of wording biases. The measures of these interviews were compared to those of data gathered during lecture visits to validate if from the implementation of the programme, the researcher got similar results as those from the conceptualisation, planning and development of the programme. Purposive sampling method was used to conveniently select respondents from an appropriate institution with relevant experiences to study. Documents chosen for review were relevant to the context of the research and copyrights issues as well as careful checks of accuracy and authenticity of data sources were considered during the access of all documents.

Conduct of external validity is challenging because according to Cohen et al (2000:109), it refers to the degree to which the results can be generalised to the wider population, cases or institutions. Nevertheless conducting a case study justifies that the researcher wanted to focus on a specific instance to exemplify a more general principle, so as to grant a distinctive example of the real technology education population, service providers and institutions. This however do not imply that the results of the study conducted within the UP pre-service can be used to generalise on activities of all technology education programmes offered by other providers. This is a unique example, where the UP technology education programme engages their own essential features, with its own plans and implementation processes.

3.7 Ethical Issues

Although the researcher was a fulltime student within the science and technology division at UP and was familiarity to the environment thereof, prior to data collection, she has requested the coordinator of the technology education pre-service programme, as well as all participants permission to conduct research on the division. This involved obtaining permission and verbal consent from the department thereof to:

- Interview the students and staff within the technology education pre-service programme.

- Access and use documents used within the delivery of the UP the technology education pre-service programme.

- Assuring the respondents of the confidentiality of their responses, in the presentation of findings and the discussions of the data, the researcher had not identified verbatim comments with names of respondents.

3.8 Conclusion

This chapter provided details of the design of this study as well as the methodology utilised throughout the data collection and analysis of this research. It justified why the case study was conducted specifically on UP as an IHL, provided full details of the sample, and explained all processes throughout data collection. Details of how data would be analysed, issues pertaining to reliability and validity, and ethical issues were also addressed.

Chapter 4

Data presentation and analysis

4.1 Introduction

This chapter presents and analyses data from data collection instruments (document analysis, interviews and observation schedules) used in this study. Presentation of data will be structured in two sections, necessitating the research questions as well as themes that emerged from the data analysed. The research questions reads as follows:

- What forms the basis in terms of conceptualisation, planning, and implementation within the University of Pretoria technology education pre-service programme?

- How are essential features of a comprehensive technology education programme engaged within the activities of the University of Pretoria technology education pre-service programme?

The first section explores the basis for conceptualisation and planning and the second section explores the implementation of the UP technology education pre-service programme. Each of these sections inherently necessitates engagements of essential features within this programme. The conceptualisation and the planning address the essential features: programme design, teaching methods, assessment policies and procedures, programme coordination as well as staffing issues. These were extracted by the responses from the interviews as well as document analysis on the study guides and the university programme.

The second section investigates the implementation of the UP technology education pre-service programme, which was explored during lecture visits using observation schedules; some were discussed during the interviews with the lecturing staff. The aspect of planning for implementation was explored in the study guides. These concentrated on the essential features: teaching methods, programme content, assessment procedures, as well as the context of study. Figure 3 clarifies the above discussed processes:

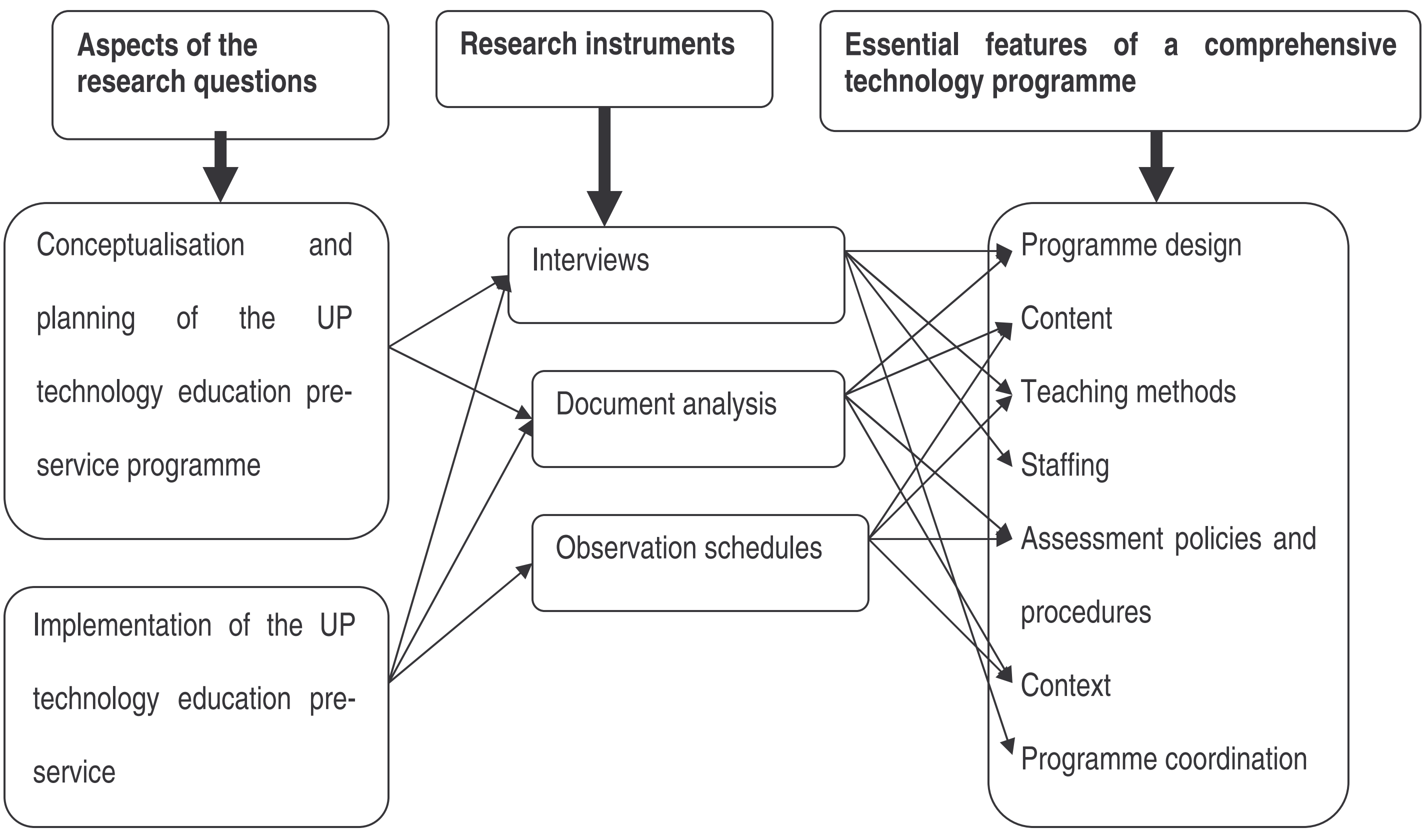

Figure 3. Data collection, presentation and analysis

4.2 The basis for conceptualisation and planning

This section begins by presenting the background information of who the designing, developing and lecturing staff are, together with their qualifications, expertise and experiences in technology education. That will be followed by explorations of the programme design according to the UP general programme and programme content according to the study guides. Then, it will present further discussions on the design, perceptions of the lecturing staff on essential features, and their reflections of the UP technology pre-service programme. It will therefore close by explorations of assessment policies and procedures from the study guides.

4.2.1 The UP-D&T staff

Data for this section was extorted from the first interview question, which explored who the developers, designers, coordinators and implementers of the UP technology education pre-service programme are, as well as their qualifications and present studies. It further probed for what professional development programmes they usually engage in to keep them afloat with technology education developments.

The lecturing staff of the UP technology education pre-service programme consists of three members: two males and one female. All of them are well qualified in technology education ranging from masters to post-doctoral studies. Table 4 below indicate their responses of their qualifications, experiences and professional development:

Interviewee	Responses	
	Qualifications and present studies in technology education	***Professional development programmes they attend to keep them buoyant with technology education developments***
Interviewee 1	I have a PHd in technology education from University of Johannesburg. I am presently engaged in a lot of technology education research projects, for which I write papers and make publications. I originally trained for technology education from Ort-Step, which I furthered by a masters degree with the former VISTA university that has now merged with UP. I have ever since joined the Groenkloof campus as a full-time lecturer in D&T.	The provincial department of education keeps us informed of professional development courses they offer to technology educators. I therefore attend some of these to keep me informed of educational changes in technology.
Interviewee 2	I come from a background of languages, but when technology was introduced, I became interested and trained for it with Ort-Step. I therefore furthered my studies in technology and now I am busy with a master's degree with the University of Pretoria.	I attend seminars and conferences of technology education nationally and internationally. I usually fly abroad to network and get in touch with what other nations are doing to keep afloat with developments in technology education.
Interviewee 3	I am busy working on a PHd with the University of Pretoria. I come from a background in engineering, but I decided to branch in education, so technology became a learning area I found interesting and could relate to.	I usually attend conferences of technology education; in fact I am a member of a discourse group, where technology educators all around South Africa engage in discussions of how to improve the present state of technology teaching and learning, which we do via e-mails, seminars and conferences.

Table 4. Staff qualifications and professional development

All the interviewees compatibly indicated that the UP technology education pre-service programme is designed, developed and implemented by the lecturing staff of the programme. At the beginning of the year, the members of the lecturing staff assemble as a unit and make decisions about the content, the modes of delivery, venues and laboratories, as well as assessment processes of each module to be delivered. "*We do not have a specialist or consultant from outside to advise us on how the programme should be, but we sit down together as a unit and discuss how best our programme can be" (interviewee 2).* They therefore share the working load equally amongst themselves according to their expertise, competencies and experiences. *"Our expertise in technology differs, which is why we have split our workload into three parts according to the three learning outcomes of the RNCS. The first part focuses on the design process, which is done by* *one of us as she has more experience in that. The second part consists of knowledge themes such as structures, food technology and materials, which is done by me; and the last part focuses on processing, systems and control, which is done by the other member as he is more experienced, with a background in engineering" (interviewee 1).*

The UP technology education pre-service programme has a programme coordinator, who is one of the staff members. Her duties are to direct the activities of the programme; *"I evaluate study contents to ensure that they suit the requirements of each module, I oversee students' evaluations processes, I chair our meetings, I arrange for venues, I inform staff of professional developmental programmes, and I attend to any queries students and staff have about the programme" (interviewee 2).*

4.2.2 Programme design

The technology education pre-service programme at UP is offered as an elective course (student-teachers' fields of specialisation for particular phases and grades of training) within packages in the BEd programme that train student-teachers for Early Childhood Development and Foundation, Intermediate, and Senior Phases. It is called Design and Technology (D&T) and it consists of ten modules named JOT that runs as 151, 152, 153 and 154 in the first year, 251, 252, 253 and 254 in the second year, and 351, 352, 353 and 354 in the third year. In the fourth year students do self studies which mostly consist of teaching-practice sessions.

There also exist a methodology module called Methodology for Design and Technology (JMC 300) that is offered concurrently for student-teachers of all phases. This module serve to prepare and provide student-teachers with teaching strategies and effective methods for teaching practice in their areas of specialisation. There is also a module compulsory for student-teachers training for Early Childhood Development and Foundation Phase which is called Learning Area Technology (JLT 320). The same module is offered for student-teachers training for intermediate and senior phases but it is called Technology (JLT 254, 451).

During the interviews with UP-D&T developers, the decision about why there are two types of modules (theory and method) offered within UP-D&T was hinted and clarified: "w*hen students get to the third year of training, they register for JMC 300 and JLT 451 which are method courses, designed to prepare them for actual teaching out there. Throughout these courses, students do not necessarily as a group have contact sessions, but they do individual consultations, where they make their own appointments to meet with their instructors. They are in fact given a long assignment, requiring them to create their own resource manuals as technology teachers which they will possess even when they complete JLT451 (end of completion of their BEd training). This is because we lecturers only see them in the first quarter and in the second quarter they are out to schools, whereby if they are in third year they do observations and if they are in fourth year they are allowed to teach, but under the supervision of their mentor teachers (teachers at public schools teaching the same subjects and are in the same phases as student-teachers)" (interviewee 1)*.

4.2.3 Programme content

As evidence for this analysis, the researcher has attached an electronic sample of three study guides on a CD-ROM which will be part of this thesis. These study guides ranges from year 1 to year 3 of study; they are: Design Process (JOT 152), Food Technology (JOT 252) and Structures (JOT 354).

Modules at each level of study entail distinctive units to constitute content base that is covered throughout the programme. These units extract technology concepts which are core and act as a vehicle that drives student-teachers to increased abilities to engage confidently with technological processes. The first three years of the D&T training defines technology content (see page 9 of JOT 152, 8 of JOT 252 and 6 of JOT 354), which starts with the design process, then followed by project management and entrepreneurship, food technology, soft materials and then textile technology. The third year deals with electrical, mechanical systems and controls, and structures. Each of these consist of interrelated units to support its delivery, for example, food technology have: food production issues, food processing and preservation, as well as marketing and distribution of food; soft materials has moulding and casting, resin, plaster of Paris, paper mache, cement and pertile objects.

Figure 4 outlines and summarises what content component is offered within each module:

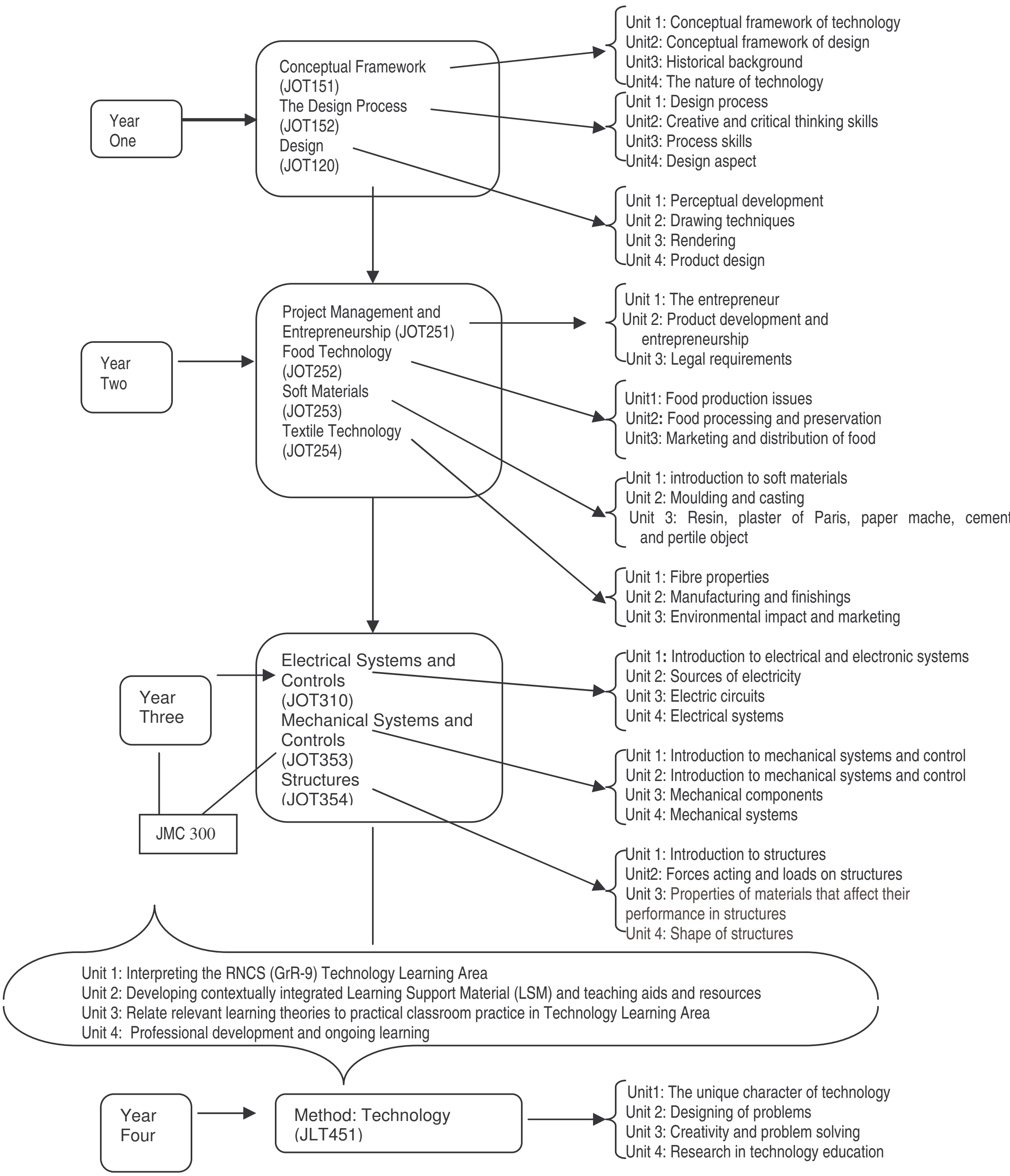

Figure 4. Courses, modules and units outlining content components

Each module is catered for by study guides which registered students access online using the university library software facility called WebCT™. The guide serves as support material for individual modules; however a module is completed when a student has met all requirements as presented by the demands of the course which include assessment tasks, classroom engagements and attendance registers, which are evidence of full participation.

Study guides are separated into two components, the organisational (refer to pages 4 to 9 of JOT 152, 3 to 7 of JOT 252 and 3 to 5 of JOT 354 study guides) and the study component (the rest of the study guides). The organisational component delineates the general premise and educational approach of the course, the significance of that particular module, instructions for using the study guides and educational approaches. It also provides logistical information such as lecture rooms, laboratories and venues.

Furthermore, the organisational component outlines study materials, which constitute learning units as well as access to content information, readings and learning activities. It also provides assessment strategies and procedures, which outlines assessment policies and approaches explaining how formative and summative assessment is conducted throughout the module. Then there is general information, which outlines motivation, code of conduct and expectations of the lecturers from student-teachers registered in the course; as well as information on progress to further studies, which outlines the requirements of what a student needs in order to progress to the next year modules.

The study component of the study guides outlines the module specifications**,** which entails purpose statements, learning presumed to be in place, articulation with other modules in the programme and the critical cross-field outcomes. It comprises the module structure which outlines information on the study themes (each providing specific outcomes, interpretation of learning outcomes, assessment criteria, embedded knowledge, self-study activities, tasks and assignments) and study units, method of instruction, tabulated notional hours, and contact sessions or day-by-day lectures.

4.2.4 Further discussions on the programme design, perceptions and reflections of the lecturing staff

Data from this section was extorted from the second, third and fourth interview questions (see Appendix 2), which inquired about the programme design, perceptions of the lecturing staff on essential features, and their reflection of UP-D&T. Data will be presented as per these interview questions, followed by a rubric that will rate interviewees' responses according to the inadequacy, adequacy and entire adequacy descriptions of the rubric (see Appendix 3).

- Interview question 2

The responses from the interviewees on the second interview question indicated that UP-D&T is conceptualised, planned and designed based on the national curriculum policy document of technology called the RNCS-Technology: R-9 (DoE, 2002:1-66). They said that this document guide them on how to align their programme activities with the national standards. Also because the school curriculum uses these documents as reference to technology classroom practice and conduct, which is a context at which student-teachers are going to work in the future. *"We have to make sure that what we design is perfectly in line with what the department of education and technology policy documents requires" (interviewee 1).* The coherency thereof they said is that the education system in South Africa is incessantly in the processes of reform and there are recurrent changes to accommodate the present political, economic and educational state nationally and globally. *"These changes are entailed and highlighted in the national standards policy documents, which is why we need to remain in touch with the contents of these documents" (interviewee 2).*

Another important aspect of the programme design of UP-D&T is that activities are structured following problem-based and project driven approaches. "*Nevertheless all activities included are based on a problem, not only making and design challenges, but a conceptual problem that will require students to think critically and creatively right about it. Then they will design and make a central project as a solution to the identified problem" (interviewee 3).* By this the respondents mean that they train their student-teachers to advance technological situations by firstly identifying a problem, then devising a system of how to solve it, and then critically assessing the way that problem plays out itself out in reality. *"Our programme is divided into two sections: first the practical implementation of a design and technology programme, which includes the design process and knowledge areas; and secondly teaching methodology section which is a platform where we implement a problem-based learning series so as to develop critical thinking skills. The above should support one another, where working and thinking should integrate with the education content and be streamlined with a sense of direction" (interviewee 2).*

They believe that the design process is a core component of how to teach student-teachers to solve problems and think critically. *"The design process are the backbone of technology, they train students to be problem solvers and critical thinkers. Students should be able to put in practice what they preach, which is demonstrated when they put an idea on paper and then model or make it through the design process" (interviewee 2).* This justify why the design process are the first module in D&T because student-teachers learn how to design, make and evaluate technological projects, which is knowledge they will use throughout all the modules. "*During the design module, students learn how to investigate the existing problem and eventually come up with possible solutions to that problem, and then they will go to the making stage starting first with diagrams and sketches" (interviewee 2*). This they said happen in authentic contexts, where student-teachers will go out and identify problems in real life. "*In that process we involve the other two learning outcomes called knowledge and the relationship between technology, science, society and the environment; which is the context we actually refers to when we talk about relating technology content with real life situations" (interviewee 1).*

From the above descriptions, it might seem like UP-D&T is predetermined, preset and fixed, but it is in fact flexible and therefore ad infinitum reviewed and adjusted to accommodate the demands of the DoE and the input of the management of the faculty of education at UP. Presently UP-D&T is in the process of review because the designers want to adjust and balance their programme content and time with what is done at public schools. *"The reason why we want to review the program is because we realised that in terms of notional hours, it seems we are giving a lot of time to food technology, whereas in schools it is not actually given that much time but it covers just a percentage. In terms of weighting according to the RNCS, the learning outcome that weighs much is the design process, which is the very first learning outcome and remember, we are guided by the curriculum. This also came through the faculty at management level, who has the responsibility to make sure that we have a convincing argument why we want to structure or restructure the programme this way or that way. So we have submitted a proposal, it is awaiting the next faculty board meeting, and if it gets approved, it is then that we would be able to adjust our programme.*

Again, all is supposed to be done according to South African Qualification Association (*SAQA*) *requirements because in the end these modules are supposed to be registered" (interviewee 1).*

- Interview question 3

The third interview question probed the opinions of the programme designers as to what the important characteristics of a successful technology programme are. It also inquired as to how those characteristics should be engaged to enhance effective practices of technology teaching and learning. The researcher asked this question to investigate the knowledge of the lecturing staff as programme designers of the essential features of a comprehensive technology education programme. The interviewees provided different opinions, which the researcher outlined in the following table:

Interviewee	**Responses**	
	Interview question 3 What in your opinion are the important characteristics of a successful technology programme?	***Probe:*** How do you suppose the above mentioned characteristics should be engaged to enhance effective practices of technology teaching and learning?
Interviewee 1	The technological process or design process, knowledge and methodology, and context of studies.	He referred to E. Eisenberg and his contributions of 1996 (October 16) as the father of the basic characteristics of a successful technology education programme. He explained that technology characteristics and activities do not happen in isolation, but all should be integrated as one complements another.
Interviewee 2	Problem-solving and solution-based learning	Students and learners of technology will only be able to engage in important aspects of technology education such as design processes if they are problem solvers and critical thinkers. These they can do if they firstly identify technology problems and then model and construct products or solutions through design processes.
Interviewee 3	*Project-driven approaches*	Students cannot only identify problems and not design and make projects to solve or simulate solutions to those problems. They need to 'get their hands dirty' by practically working in technology workshops to design and make projects.

Table 5. Interviewees' responses on question 3

- Interview question 4

The fourth interview question explored the perceptions of the UP-D&T staff, if they suppose it is a programme that has the potential to provide student-teachers with enhanced understanding of technology and technology education. All respondents are of the opinion that they provide a fairly good and effective technology education programme. They are confident that the way they deliver their modules help student-teachers and equip them with the relevant content, knowledge and methods so that they can have confidence when they deliver their own technology lessons at schools after completion of training. *"We do our best at UP, we are proud and confident of our programme, and though according to university strategy we do not observe our technology students during teaching practices, they have mentor teachers at schools who are curriculum implementers to help students not to derail, so they do give us feedback that our students cope well with teaching technology" (interviewee 1).* This indicate that the UP education faculty standard procedure for teaching practice sessions does not allow lecturers to observe student-teachers trained in their own fields of specialisation, which is why the D&T staff do not observe their own students during teaching practices. However as they mentioned above, all student-teachers are allocated mentor teachers at schools for individual subjects, who afterwards provide feedback to lecturers.

Towards the end of every semester, the staff of UP-D&T engages in processes of reflection and evaluation. *"It is expected of every lecturer in every module that at the end of that module they give out the "pink forms" where the students enrolled in that module conduct student evaluations of that module based on three things: the conduct of lecturer, teaching referring to methodology and* *strategies used, and the module itself referring to what goes into the content of the module and how it is structured" (interviewee 1)*.

- Student-teachers' perceptions of UP-D&T

To validate the above data, the researcher has interviewed two student-teachers enrolled for UP-D&T. This was done so as to heed student-teachers' perceptions, reflections and experiences; as to whether UP-D&T activities provide them with enhanced understanding of technology and technology education. The researcher chose these student-teachers randomly within the first and the second years of study, but intentionally in terms of gender where one was a male and one a female. Also, because these student-teachers are in different years of training, so the first year student-teacher might provide initial and basic information on experiences from a beginner point of view, whereas the second year student-teacher has more exposure and familiarity. Moreover, it was because of their availability for participation, especially since the interviews were conducted towards the end of the third trimester, where the third and fourth year student-teachers were at teaching practical sessions at schools.

Their responses were positive in terms of their experiences throughout the activities within the programme. As most students, they seemed to be keen on the practical part of learning technology, they said they liked investigating ideas, working with their peers on projects and presenting in front of their classmates. *"Our lectures are interesting because we do not learn theory and calculations only, we also do practical projects, which is fun because we also get a chance to present them in class in front of our classmates" (student-teacher 2).* They also commented on how the programme is well organised and on how it avails necessary resources for them: *"our lecturers* *are always there when we need them, we are always informed of what to do as all study materials are always available on WebCT" (student-teacher 1).*

The researcher also asked the student-teachers if what they are learning in lectures D&T assist them with understanding technology and its impact in the society. The response I got from one interviewee was: *"I never learned science, mathematics or technology before I enrolled for this course because I always perceived them to be difficult. However I was compelled to register for technology as an elective module because of the nature of the learning programme I am enrolled for. Despite my fear of learning something I never did before, I find my lecturers supportive, approachable and educative. The support and extra reading materials they provide us helped me a lot to cope with learning technology. Now I know how important technology is in today's life and the basic skills I have learnt during lectures helps me cope with technology in every day life" (student-teacher 1).*

The other interviewee indicated that though they learned technology at school within the General Education and Training (GET) band, they never actually had a chance to design and make actual projects because of financial constraints at their school: *"we could not make actual projects at school because there was no budget for technology and no money at home. However here we are privileged to actually design and make because the university has equipped technology labs, and parents and guardians assist us with some money for our projects because we need to pass our courses" (student-teacher 2).*

However there seem to exist some language use controversy within UP-D&T, which seemed to be a sensitive issue to these student-teachers, because they indicated that their lectures are offered in English and Afrikaans, depending on the lecturers offering the course: *"some of us do not speak or understand Afrikaans, some lecturers insist on offering courses in this language, depending on the majority of students in the lecture" (student-teacher 1)*. This the researcher have also observed during lecture visits where in one class of eighteen students, only two were Africans and the lecture was offered in Afrikaans. Student-teachers have indicated that though they usually take it up with the programme coordinator, it still remains a problem. The researcher then followed it up with the programme coordinator and the response she got was: *"English is supposed to be the medium of instruction in lectures, and or unless only Afrikaans speaking students are there in that particular lecture" (programme coordinator).* This is a programme coordination problem because how well a programme is coordinated is also distinguished when the needs (content and logistical) of the students are taken care of seriously (refer to section 2.6, table 2).

- A rubric rating responses from interview questions

Rubric1 below follows up on the responses of the interviewees on all the interview questions indicated in Appendix 2. The researcher has designed this rubric based on the relevant aspects of the essential features (see section 2.6, table 2) investigated by the interview questions. It is used to rate responses according to inadequacy, adequacy and entire adequacy descriptions of Appendix 3. At the end of each question, the researcher has slotted a row for her comments to validate the individual ratings. For an example, if the researcher rates the response of the first interview question as inadequate (see column 2, row 2 of Rubric 1), that implies that UP-D&T has no developers, designers or advisors; lecturers are poorly developed, there is no proper design of the programme, and there exist no input from educational authorities and other stakeholders on the activities of this programme.

Interview questions	Inadequate	Adequate	Entirely adequate
Who are the developers, designers and advisors of UP-D&T? What are their qualifications and present studies in technology education? What professional development programmes do they usually engage in to keep them afloat with technology education developments?	No developers, designers or advisors within UP-D&T. Lectures are poorly developed, there is no proper design to the programme and they receive no input from educational authorities or other stakeholders. The academic staff responsible for the programme is unduly qualified. They have inadequate and unrelated experience. Their teaching and assessment are incompetent. Their research profiles are inadequate for the nature and level of programme. They rarely attend professional development programmes.	Developers, designers and advisors are available for UP-D&T. The programme is properly structured, lecturers follow the course outlines and other sources made available and they use that for the delivery of lectures. They receive input from educational authorities, network with colleagues and other stakeholders. The academic staff responsible for the programme is justifiably qualified. They have fairly adequate and fairly related experience. Their teaching and assessment are reasonably competent. Their research profiles are fairly adequate for the nature and level of programme. They at times attend professional development programmes.	The academic staff responsible for the programme is credibly qualified. They have adequate and satisfactorily related experience. Their teaching and assessment are entirely competent. Their research profiles are adequate for the nature and level of programme. They at all times attend professional development programmes.
***Researcher's comments:* Adequate -** the UP-D&T lecturing staff are the developers and designers of their own programme. The programme is properly structured, one of the staff members is coordinating the programme, they do have appropriate venues and they follow contact sessions and self study (for third and fourth years) timetables. They receive input from educational authorities, for an example at the moment their programme is under review, where they intend to include modules that cover other relevant learning outcomes. They also network with colleagues and other members of the technology education communities nationally and internationally. The UP-D&T staff is credibly qualified; their qualifications range from post doctoral studies to Masters studies in technology education. They do attend professional development courses and conferences to nourish their professional practice. The related experiences, teaching and assessment competencies, as well as research profiles of the lecturing staff were not discussed during the interviews.			
What forms the basis in terms of conceptualisation, planning, and implementation within UP-D&T?	Their programme has no basis, it is poorly conceptualised, and no planning took place prior to the implementation of the programme. It is not properly structured programme, lecturers just take what is available from textbooks and no other sources and they use that for delivery of lectures. Lecturers derisorily justified the structures and natures of the programmes.	The programme is based upon some of the essential features of a comprehensive technology programme. Developers could identify and justify the use of these features thereof; they also could reasonably justify the structures and natures of the programmes.	The programme is based upon all essential features of a comprehensive technology programme and the relevant aspects of each feature thereof. Developers could utterly identify and justify the use of these features and they also could outstandingly justify the structures and natures of the programme.
***Researcher's comments:* Entirely adequate -** UP-D&T is conceptualised, planned and designed based on the national curriculum policy document of technology, the RNCS. They also structure their activities following problem-based and project-driven approaches. They believe that the design processes are a core component of how to teach students to solve problems and think critically. To all extends the essential features of a comprehensive technology programme as discussed in Table 2 of this study are incorporated within UP-D&T.			
What in your opinion are the important characteristics of a successful technology education programme?	They derisorily identify the most important characteristics of technology in their programmes. There are no identified Essential Features of a comprehensive technology programme forming a foundation for this programme and those identified shabbily are engaged in a traditional or not convincingly effective way.	They reasonably identified the most important characteristics of technology in their programmes. They could identify some of the Essential Features of a comprehensive technology programme. They also confirmed that some of them are integrated and engaged within their programme.	They utterly could identify the most important characteristics of technology in their programmes. They could confirm that all those Essential Features of a comprehensive technology programme are engaged within their programme, and they

			could explain well how that is done thereof.
Researcher's comments: the respondents could **adequately** identify the important characteristics of a successful technology programme; their responses gave the essential features: the technological process or design process, project-driven approaches, problem-solving and solution-based learning, which is an important aspect of the teaching methods in technology education. They also identified knowledge, which is content and the context of studies. They however did not mention programme coordination and staffing issues, which are also quite essential for effective teaching and learning of technology.			
What are your perceptions and reflections on the UP-D&T? Do you suppose that it is a good programme, with potentials to provide student teachers with enhanced understanding of technology and technology education?	They are not sure if their programme is good or not, they can not confirm the effect it has on student teachers understanding of technology and technology education.	They suppose their programme is good, they believe it plausibly assist teachers in the understanding of technology and technology education. They also assume that how they train student teachers prepares them for enhanced teaching practices when they complete their training.	They are completely confident that their programme is good and it plausibly assist teachers in the understanding of technology and technology education. They are also confident that how they train student teachers prepares them for enhanced teaching practices when they complete their training.
Researcher's comments: **Adequate** - the UP-D&T staff are confident that the way they deliver their programme and modules help the students and equip them with the relevant content, knowledge and methods so that they can have confidence when they deliver their own technology lessons in class after completion of training.			

Rubric 1. Rating of the interviewees' responses of the interview questions

4.2.5 Assessment policies and procedures

According to the study guides (see page 6 of JOT 152, 6 and 7 of JOT 252, and 5 of JOT 354), the student-teachers are assessed using five types of assessment activities (some of these are demonstrated in Appendix 6):

- Focus or resource tasks, which are short tasks focussing on a particular aspect of a learned concept. They provide the student-teachers with opportunities to gather knowledge and practise particular skills that can be used with understanding in various situations (see lecture 1 on Appendix 6).

- Case studies, which are tasks describing real examples of technology in the world. They help student-teachers to find out about the way individuals and businesses solve technological problems through the design and manufacture of goods, as well as how the goods are marketed and sold. They also help to reflect on the impact and appropriateness of the products of technology (an example is field trips which were not observed in this study).

- Capability tasks, which are projects that involve designing and making of products that work. These require the successful completion of the design process. The outcome is tangible in forms of completed products and reports of the designing and making processes in portfolios (see lecture 4 and 5 on Appendix 6).

- Research, which encompasses collecting, processing and reporting information on a specific topic or problem (see lecture 4 on Appendix 6).

- Tests and examinations, which student-teachers formally write as indicated in the official examination time table (see lecture 6 on Appendix 6).

Some of the above tasks are given in forms of assignments, theoretical and oral presentations, and practical work. Tasks, assignments and projects are assessed according to standards and criteria set by the module instructor. Below are examples of general guidelines and criteria for oral presentations and displays (e.g. see page 14 of JOT 152).

- The oral presentation must demonstrate the following:

    - clarity and logic
    - good communication skills (eye contact, loud and clear speech, etc)
    - an ability to design and effectively use quality media (slides, Microsoft PowerPoint™, etc)
    - good questioning skills
    - *a thorough understanding of principles.*

Evidence of individual rigor and responsibility in individual and group work play a major role in all assessment because continuous assessment applies as an assessment policy for this programme. The pass requirement for each module is an average of 50%, formed by 50% of different tasks, 20% of the tests, and 30% of the examination. The study guides do not have rubrics or tables for each of the above assessment tasks, however the researcher observed during lecture visits that lecturers design evaluation rubrics to assess projects and presentations that they bring to class all through (see section 4.3.2 lecture 5).

4.3 The implementation of the UP technology education programme

This is the second section of data presentation where the researcher explored the implementation of UP-D&T. She has divided the section into two parts constituting: planning for implementation and the implementation (actual happenings and experiences during lectures). Some aspects of planning for implementation were addressed during the interviews, however some aspects which explore how the day-to-day lectures should run are extracted from the study guides [refer to the attached disk forming part of this thesis; there is a sample of three study guides namely: Design Process (JOT 152)**,** Food Technology (JOT 252) and Structures (JOT 354)].

4.3.1 Planning for implementation

There are two types of lectures within UP-D&T (see page 5 of JOT 152, 4 of JOT 252 and 4 of JOT 354), which are lectures at the beginning of a learning period (term or semester) referred to as orientation lectures (see lecture 6 on Appendix 6); and day-by-day lectures or contact sessions.

- Orientation lectures

Aspects of the orientation lectures are covered within the organisational components of the study guides (refer to pages 4 to 9 of JOT 152, 3 to 7 of JOT 252 and 3 to 5 of JOT 354). These lectures take place at the beginning of a term or semester, where the lecturer will introduce the module, mention the outcomes thereof and explain procedures and the approaches a module is going to take so as to be feasible for student-teachers. Then they will explain the roles of the student-teachers within that module, assessment opportunities, the importance of participation and all processes to guarantee completion. Part of the student-teachers' roles described here are a few logistical activities (see for example page 3 of JOT 252) such as engagement in self study in order to establish a broad knowledge base in the area of study and doing projects individually as well as in groups. Student-teachers are orientated on how to demonstrate understanding and apply knowledge in solving problems when participating in lectures and on assessment tasks. Textbox 4 is an example from the study guides of what the lecturer will give student-teachers so as to explain the importance of participation during lectures and practical sessions (see page 16 of JOT 152, 9 and 10 of JOT 252 and 7 of JOT 354):

As evidence of full participation during lectures and practical sessions, students need to:

- Ask questions that contribute to the discussion agreeing or disagreeing with a point that's been made (can you justify it?)
- Disagreeing with what's been said (can you justify it?)
- Answering questions asked by the instructor or group
- Questions or comments that prompt a new direction in the discussion
- Contributing a relevant resource (book/ paper reference; news item; internet link; visual/print/other artifact)
- Telling a relevant story
- Sharing an experience related to the discussion
- Requesting a "Quaker Moment" - i.e. a minute or two of silence to reflect on or digest what has been said

Text box 4. Important aspects of student participation during lectures

- Contact sessions

Aspects of day-by-day lecturers are catered for by the study component of the study guides (from pages 5 of JOT 152, 8 of JOT 252 and 6 of JOT 354 to the end of the study guides). These lectures take three different formats: theory lectures, practical sessions and presentations of projects. The guides clearly outline the theory topics or content knowledge to be covered within a module, the practical aspects and the project-driven approach goals. These allows student-teachers to make use of resources to design, make and evaluate technological projects, and to do presentations of projects, as well as portfolios, posters, models of projects, and actual projects to present to their lecturer and peers.

As an example of a theory lecture, the researcher will use JOT 252 study guide, which is about food technology. There are class-notes provided within each guide (see page 3 of JOT 252), such as: "*the learning area technology is concerned with the use of knowledge, skills and resources to* *meet people's needs and wants by developing practical solutions to problems. Food technology in particular concerns itself with the application of the physical, chemical and biological sciences on the processing and preservation of foods and the development of new and improved foods"*. The kind of theory topics to be discussed within lectures will be: "*orientation to food technology in context, food preservation, food production issues such as genetically modified foods, micro organisms, food processing, food additives, food packaging materials, food labels, marketing and advertising, and careers in the food industry".* To extend student-teachers' knowledge on these topics, the study guide caters for prescribed textbooks and readings. For an example, for food production issues and genetically modified foods, students can access more information on: "*South Africa: Draft Policy for Genetically Modified Foods at www.gene.ch/genet/2001 and food and environmental safety at www.whybiotech.com"* (see page 4 and 5 of JOT 252).

Practical sessions take place in technology laboratories and specialised or equipped venues for practical activities. During practical sessions, student-teachers work as individuals or in groups to design and make technology products, which are accompanied by portfolios and observation posters (see page 12 of JOT 152, 10 JOT 252, and 3 and 8 of JOT 354). The observation posters (storyboards) should be made such that they narrate the story of the project in an attractive and interesting way to the viewer. Its permissible size and shape should exhibit space allowing for a maximum of 122 cm wide, 76 cm deep, and 274 cm high (including the tables they stand on). The title and other headings should be neat and large enough to be read at a distance of about 3 feet (1 m).

Figure 5 is a display of an observation poster, model of project, and portfolio or journal that D&T student-teachers make for presentations:

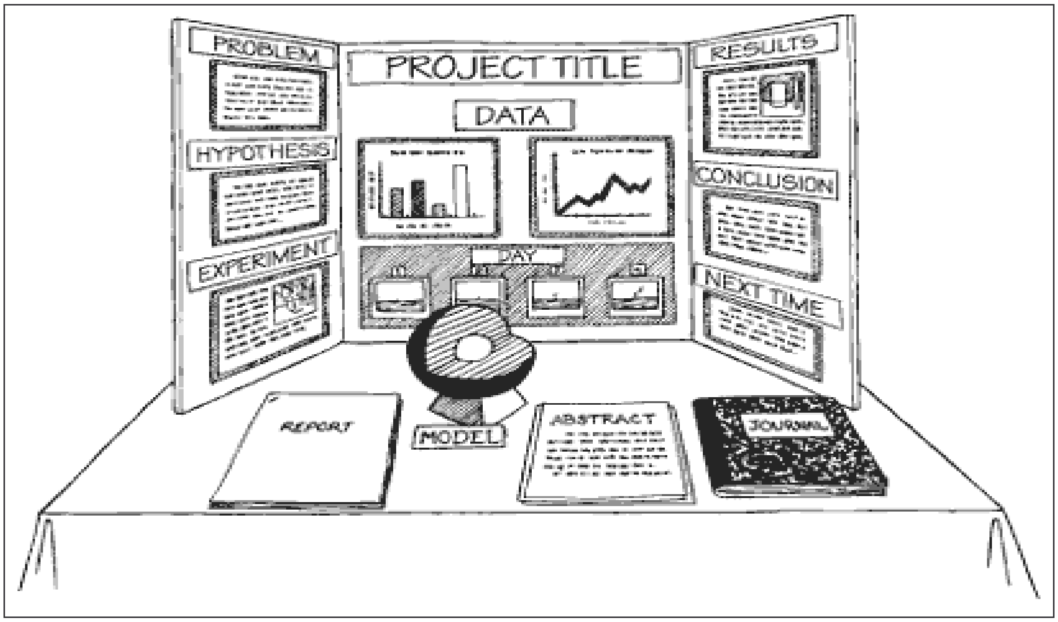

Figure 5. Observation poster, model of project and portfolio

4.3.2 Observation schedules

To explore classroom experiences within UP-D&T, the researcher has made observations in various lectures for three weeks. This she did not do consecutively every day, but she targeted lectures on an introduction to a particular concept, followed by a series of theory lectures, and particular days when student-teachers were making presentations of group-work discussions or practical work. The researcher's report of the observation schedules is made of a sample of six observation schedules, three in design process (JOT 152), two in food technology (JOT 252), and one orientation and introduction to soft materials (JOT 354) (see Appendix 6).

JOT 152 was a seven weeks module, which started on the 27th of March and ended on the 24th of May 2006. There were four contact sessions per week: two on Mondays and two on Wednesdays. So the researcher observed four sessions in the first two weeks, targeting lectures on the introduction to the design process. JOT 252 was a seven weeks module as well; it started on the 24th of March and ended on the 25th of May 2006. The researcher attended this for three weeks but targeted the introduction lecture, the follow-up and group discussion sessions, and the presentation of products sessions. JOT 354 started at the beginning of the fourth quarter towards the end of September and the researcher attended only one orientation lecture that she reported as in observation schedule 6 (see Appendix 6).

The criteria of the observation schedules were based on the essential features of a comprehensive lecture such as: the topic, introduction, learning activities, teaching methods, assessment strategies and the conclusion. Lecture one to six on Appendix 6 are a summary of the selected lectures the researcher sampled and they report on what actually happened during those particular lectures.

- Lecture 1

This was a JOT 152 lecture, held on the 27th March 2006; it was a theory and introductory lecture which went on for two hours. The topic of this lecture was: the unique features of the design process, and the focus were on the nature and the purpose thereof. This topic correlated with the first learning outcome of the RNCS (DoE, 2002:6), which is technological processes and skills. The introduction was direct; the lecturer told student-teachers that they were going to discuss the nature and the purposes of the design process. The learning activity was a class presentation, where the lecturer used PowerPoint slides to showcase and explain the different stages of the design process. She also used questions to engage student-teachers in thought processes of how familiar products such as televisions and computers were designed and made based on the design process.

Then she divided them into groups and gave them fifteen minutes to discuss a specific technology product of their choice, as to how the design process was applied to design and make it. She then gave each group five minutes to report back to the class on their discussions. This was an introductory design lecture and some student-teachers were not used to presentations, so though some were audible, they clearly lacked presentation skills (refer to page 14 of JOT 152): others were shy, non-conversant, non-coherent and some exceeded the time allocated to present, hence they were cut while still presenting. The lecturer commented that these presentations gave her an idea to dedicate the next lectures on evaluation tools to familiarise the student-teachers on presentation skills and criteria used to assess technology products. She requested them to read page 14 of their study guides, which has guidelines and criteria for oral presentations.

She also informed them to read point 3 of their study guides and access all reading materials recommended for this module, especially the RNCS and the two design and technology books by Garratt and Caborn (see page 9 of JOT 152). Towards the end of the lecture, the lecturer consolidated by informing the student-teachers that in the next classes they were going to work in groups to design and make a technology product of their choice, engaging all stages of the design process.

- Lecture 2

This was a JOT 152 lecture as well, which took place two days after lecture 1 because days before student-teachers were trained on evaluation tools and presentation skills. The topic for this lecture was: planning for models and presentations exhibiting the unique characters of the design process. During this lecture, student-teachers were instructed to work in groups to use what they have learnt two days before about the nature and the purpose of the design process to identify a common technology product that they will design, make and evaluate.

They were to start by discussing the importance of each stage of the design process and plan how they were going to apply all those stages on a particular product. During the discussions, the researcher walked around the class to observe how the students were carrying out the task. The student-teachers were keen throughout; they exchanged turns in sharing ideas and planning for their projects. One group decided that they will share different stages of the design process amongst themselves to compile the portfolio; one group decided that each member would work on all the processes and they will meet later in the day to combine their compilations and come up with one portfolio; two other groups spent a lot of time discussing that they did not move to other tasks by the end of the lecture.

The lecturer consolidated by telling the student-teachers that they should use the rest of the day and the following lecture to work together on the model of the product they have selected, as well as their plan of action on how they will actually design and make that model. She mentioned that a lecture of the day after tomorrow will be used for group presentations.

- Lecture 3

Lecture 3 was also a JOT 152 lecture, which was a follow up of a lecture that took place two days after the lecture on planning for models and presentations exhibiting the unique characters of the design process (lecture 2). For a day and a half student-teachers were working in groups to plan how they were going to apply the design process to design and make a model of a technology project of their choice. So, during this period student-teachers were given a task to present to the class the models which they have designed and made, as well as portfolios of evidence that they have engaged the design processes throughout.

Various groups presented their models and portfolios; some groups had posters to discuss their presentations and others only presented their portfolios and models. This was for the first time the student-teachers have designed and made a technology product, and they all showed hard work and interest. However the levels at which some groups had researched and investigated for their models lacked profundity and quintessence, considering that according to Yarwood and Heywood (1990:4), these stages of the design process stipulates that students should go all out to investigate existing materials and products, and then report on how theirs is going to be different, add more value or be authentic. Also because according to Ter-Morshuizen (1997:12), the design process is like a hairpin, which follows complex, conservative and progressive steps, which involves looping back now and then to revisit previous stages so as to add substance, alterations or more value, until the process is complete.

Besides, the student-teachers did not ask the presenting groups questions to follow up on their presentations, which is an essential part of product evaluation; they mostly just applauded after every presentation. However, they cooperated well with each other during group work, they were enthusiastic about the task and they listened to each other during presentations. All groups managed to present during this period, though some groups exceeded the five minutes given to them for presentation. After, the lecturer made a few comments based on the presentations and the models, and then she consolidated the session by indicating that the following lecture would be about the roles of the design process in the educational curriculum.

- Lecture 4

This was a JOT 252 lecture that took place on the 24th March 2006, for two hours. Just like the lectures presented above, it was a planning and preparations lecture for exhibitions of various food technology products that the students had to design and make. Student-teachers were instructed to work in groups to design and make real food technology products of their choices, engaging production, processing, packaging and preservation processes. They also had to compile portfolios of evidence and observation boards entailing all the stages of the design process, and to come up with plans to advertise and market their products.

The lecturer gave students a chance to plan for their projects, they formed four groups of six members each and they shared ideas and responsibilities of how they were going to carry out this task. Then the lecturer gave each group an evaluation tool that had criteria and ratings, which would be used during presentations to assess and rate all products; this evaluation tool assesses various stages of the design process, the actual making processes of the products and the presentation thereof. After ten minutes of group discussions, the lecturer asked the student-teachers to report back on which product they have decided to design and make. The first group chose marmalade jam, the second yogurt, the third biltong, and the last group chose fruit punch. The lecture gave each group twenty minutes to work on their plans of action which he collected afterwards. Then he gave the students the rest of the time (±60 minutes), as well as the lectures of the coming two days (120 minutes) to work on their projects. The lecturer walked around during discussions to monitor and facilitate all processes.

- Lecture 5

Lecture 5 was also a JOT 252 lecture; it took place on the 29th March 2006 and it went on for two hours. It was a follow-up lecture for lecture 4, where individual groups were going to present the products they were working on in the previous one and half contact sessions. Each group was instructed to include as part of the presentation explanations of all stages of the design process, their portfolios of evidence, observation boards and give the whole class food samples of their final products. They were allocated twenty minutes, where the whole group would take turns to share on their projects and experiences. The lecturer gave the whole class evaluation tools (rubrics presented below) that were used to assess oral presentations and objects:

Criteria for assessing oral presentations	**Advanced (4)**	**Good(3)**	**Basic (2)**	**Unsatisfactory (1)**
Clarity and logic				
Good communication skills: eye contact, loud and clear speech, etc				
Use quality media (slides, Microsoft PowerPoint™,				
Good question-answering skills				
Thorough understanding of principles				

Rubric 2. An example of assessment tool for presentations

The following rubric was used to assess product displays:

Criteria for assessing project displays	**Advanced (4)**	**Good(3)**	**Basic (2)**	**Unsatisfactory (1)**
Representative of all the work done				
Tells the story of the project such that it attracts and holds the interest of the viewer				
Thorough, not too crowded, simple				
Display has a : backboard, project report, models, photographs, surveys				
Authentic designs				

Rubric 3. An example of assessment tool for projects

All the groups made remarkable food products; the first group to present has made marmalade jam, the second yogurt, the third biltong, and the last group made fruit punch. They all demonstrated how they engaged processing, packaging and preservation during the making of their products. They also shared the marketing and advertising strategies for their products; each group had a catchphrase for their products. They worked hard because all these products resembled real productions; they all had well designed observation posters and prestigious portfolios. Their advertising slogans showed creativity and their marketing plans showed potential. They all showcased how their products showed authenticity, they indicated what they "added" to make their products original and different from other products in the market; aestheticism because they showcased how their packaging was attractive; and ergonomics because their packaging was user-friendly, with nutritional information indicating daily dietary allowances. Their food products were edible without exposing the consumer to harm (they shared their foods with the rest of the class and the researcher also had a taste).

The presentations lasted for the whole period, the presenters shared turns amongst their groups to give explanations of various processes to showcase their products. Three groups used PowerPoint slides to present their projects, while one group did a verbal presentation. Student-teachers and the lecturer asked them follow-up questions engaging issues of authenticity, ergonomics and aesthetics. Throughout the presentations, the rest of the class and the lecturer were using evaluation tools to assess the presenting groups, which the lecturers afterwards collected to calculate average marks for the presenting groups. The lecturer concluded the lesson by commenting on the good work of the presenters; he thanked the rest of the class for their participation and promised the presenters of their product marks in the next period.

- Lecture 6

Lecture 6 was for JOT 354 and it took place towards the end of the fourth quarter. It was a short orientation lecture that was about the final examination student-teachers were going to write towards the end of the year. The lecturer indicated his portion of the examination, as to what the paper was going to cover and he allowed student-teachers to ask him questions based on their expectations, frustrations, and experiences for preparations. He later discussed with them a forthcoming module that he was going to offer; that it requires dedication and responsibility as they were going to learn skills of how to handle different machinery to process various materials. He therefore took the whole class to a technology laboratory, where he showed student-teachers the kind of equipment they were going to use for practical sessions within that module. He also showed them a few projects that were designed and made by student-teachers who previously studied that module. He consolidated the lecture by encouraging student-teachers to work hard for the exams because they could only work in that laboratory next term if they passed.

4.4 Conclusion

This chapter presented raw data as collected from the interviews with lecturers and student-teachers, study guides, university general programme and observation schedules. It further catered for the research questions of this study, which inquired of the conceptualisation, planning and implementation as well as the engagement of the essential features within UP-D&T.

All the essential features as outlined in Table 2 of Chapter 2 are extracted, analysed and discussed within the data collected. Below is a rubric following Appendix 1, which displays the analysis of the application of the essential features as engaged within UP-D&T. As in rubric 1, the ratings of inadequacy, adequacy and entire adequacy consist of criteria that clearly explain how each essential feature was engaged within the programme. At the end of each row, are the researcher's comments, which summarise or add on the ratings of the essential features as provided by the rubric. For an example, if the rating of the researcher on the content of UP-D&T is entirely adequate, according to the rubric means that:

- There is sufficient content satisfactorily incorporates important concepts to be learned in technology
- There exist well organised practical work that intergrades proper problem-based learning, design, making and evaluation of products
- Content utterly outlines the core of the educational programme and it sufficiently increases learners' ability to engage confidently with the technological process
- It completely provides an imperative support base for problem-solving activities
- It entirely consist of distinctive but interrelated components which constitute knowledge, skills, values and attitudes, and technological capabilities, that completely reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.

Rubric 4 below provides the ratings of the essential features as engaged within the UP-D&T programme.

Essential features	Levels		
	Inadequate	**Fairly adequate**	**Entirely adequate**
Programme design	- It is not consonant with the national curriculum's requirements and the nature of the programme is not entirely based on standards. - It is inadequately planned with no availability of suitable learning materials. If available, materials do not and or are not adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is not coherent, clear and properly planned and there is no careful selection and clear instruction of activities for learners in programmes - The design of the curriculum do not meet the needs of students and other stakeholders, or even reflects future technology career opportunities for learners - It is not clear as to whether the programme is full-time or part-time and on how do they keep lecturers working on tasks as required by SAQA to cover the amounts of credits required for a particular qualification	- It is fairly in consonance with the national curriculum's requirements and the nature of the programme is somewhat based on standards. - There is a good plan for design of; or availability of suitable learning materials which are adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is adequately coherent, clear and properly planned. there is careful selection and instruction of activities for learners in programmes - The design of the curriculum somehow meet the needs of students and other stakeholders and to some extend it reflects future technology career opportunities for learners - It is adequately clear as to whether the programmes are full-time or part-time and there are measures to keep lecturers working on tasks as required by SAQA to cover the amounts of credits required for a particular qualification	- It is entirely consonant with the national curriculum's requirements and the nature of the programme is totally based on standards - There is an entirely feasible plan for the design thereof; and suitable learning materials are available which are adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is sufficiently and completely coherent, clear and properly planned. there are thorough and rigour selection and instruction of activities for learners in programmes - The design of the curriculum wholly meet the needs of students and other stakeholders and it totally reflects future technology career opportunities for learners - It is entirely clear as to whether the programmes are full-time or part-time and there are exclusively adequate measures to keep lecturers working on tasks as required by SAQWA to cover the amounts of credits required for a particular qualification
Researcher's comments: the UP-D&T programme design is **entirely adequate.** However issues of credibility and exposure of students to career opportunities were not discussed in this study.			
Content	-Inadequate content that does not clearly incorporates important concepts to be learned in technology. - Insufficient practical work that does not integrate PBL, design, making and evaluation of product. - Content does not form the core of this educational programme in technology, therefore it inadequately increases learners' ability to engage confidently with the technological process. -It inadequately provides a support base for problem solving activities. -It insufficiently consists of distinctive components which are supposed to constitute knowledge, skills, values and attitudes, and technological capabilities; and reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.	- Fairly adequate content that clearly incorporates important concepts to be learned in technology. - Fairly adequate practical work that integrates PBL, design, making and evaluation of product. - Content forms the core of this educational programme in technology and it adequately increases learners' ability to engage confidently with the technological process. - It adequately provides an important support base for problem solving activities. - It sufficiently consist of distinctive but interrelated components which constitute knowledge, skills, values and attitudes, and technological capabilities, that reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.	- Sufficient content that satisfactorily incorporates important concepts to be learned in technology. -Well organised practical work that intergrades proper PBL, design, making and evaluation of product. - Content utterly outline the core of this educational programme in technology and it sufficiently increases learners' ability to engage confidently with the technological process. - It completely provides an imperative support base for problem solving activities. - It entirely consist of distinctive but interrelated components which constitute knowledge, skills, values and attitudes, and technological capabilities, that completely reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.
Researcher's comments: the content of the UP-D&T programme is **entirely adequate**			
Teaching and learning methods	- Limited variety and ineffective of methods used to deliver lectures. - Methods do not give recognition to the importance of the promotion of student learning. -Methods are inappropriate for the programme type as reflected in its design and all other programme areas. - Methods shabbily set targets, heedlessly plans implementation and mechanisms to monitor progress, and they inadequately evaluate impacts and effect of improvement - Methods do not assist teachers in developing confidence in applying various methods other than group work.	- Quite a variety and adequate methods used to deliver lectures - Methods moderately give recognition to the importance of the promotion of student learning. - Methods are appropriate for the programme type as reflected in its design and all other programme areas. - Methods reasonably set targets, sensibly plans implementation and mechanisms to monitor progress, and they adequately evaluate impacts and effect of improvement - Methods moderately assist teachers in developing confidence in applying various methods other than group work	- Total variety of methods that are effective used to deliver lectures. - Methods completely bestow recognition to the importance of the promotion of student learning. - Methods are entirely appropriate for the programme type as reflected in its design and all other programme areas. - Methods clearly set targets, rigorously plans implementation and mechanisms to monitor progress, and they effectively evaluate impacts and effect of improvement - Methods exclusively assist teachers in developing confidence in applying various methods other than group work?
Researcher's comments: the methods used in the delivery of UP-D&T programme are **entirely adequate**			
Staffing	-Academic staff responsible for the programme are unduly qualified - Staff has inadequate and unrelated experience - Their teaching and assessment are incompetent	- Academic staff responsible for the programme are justifiably qualified - Staff has fairly adequate and fairly related experience	- Academic staff responsible for the programme is credibly qualified - Staff has adequate and satisfactorily related experience

	- Their research profiles are inadequate for the nature and level of programme - They rarely attend professional development programmes	- Their teaching and assessment are reasonably competent - Their research profiles are fairly adequate for the nature and level of programme - They at times attend professional development programmes	- Their teaching and assessment are entirely competent - Their research profiles are adequate for the nature and level of programme - They at all times attend professional development programmes
Researcher's comments: the UP-D&T programme staffing issues are **entirely adequate**			
Student assessment practices, policies and procedures	- The modes of delivery of the programme have inappropriate assessment practices, policies and procedures for internal assessment, and internal and external moderation; -There exist no monitoring of student progress; therefore, they do not offer helpful and obliging feedback to learners. -There exist ambiguous and or lack of rigour, validity and reliability of assessment practices, - There is no recording of assessment results and settling of disputes, - the is poor or no recognition of prior learning (RPL) -There is poor and insufficient security of the assessment system - there is no form of development for staff competence in assessment	- The different modes of delivery of the programme have appropriate policies and procedures for internal assessment, internal and external moderation; -There is fair monitoring of student progress, and they offer helpful and obliging feedback for learners. -There are adequate measures for rigour, validity and reliability of assessment practices, - There is recording of assessment results and settling of disputes are done, - There is reasonable RPL. -There is adequate security of the assessment system - There are forms of development for staff competence in assessment	- The different modes of delivery of the programme have entirely appropriate policies and procedures for internal assessment, internal and external moderation; - monitoring of student progress is thoroughly and appropriately done, -there exist explicit and a variety measures for validity and reliability of assessment practices, - there are sufficient and systematic recording of assessment results and records of settling of disputes - RPL imperatively an integral part of teaching and learning -there sufficient and tight security of the assessment system - there sufficient and adequate development for staff competence in assessment
Researcher's comments: the application of the UP-D&T programme **is adequate.** There are no discussions within the planning of implementation or student assessment practices, policies and procedures where external moderations are discussed. Also there are no attached assessment tools in the study guides, except for a petite description of how assessment is done (e.g. see page 14 of JOT 152). However the researcher has observed during lecture visits that individual lecturers design their own evaluation tools to assess projects and presentations.			
Context	-Inappropriate and inadequate venues, IT infrastructure and library - Available resources are not sufficient for students and staff in programme, - Resources are also poorly managed and maintained - Do not offer academic support for students, and staff where necessary	-Resources are fairly available and adequate for students and staff in programme. - Resources are appropriate available and sufficient for students and staff in programme, -Resources are also moderately managed and maintained - Sometimes they do offer academic support for students, and staff	-Suitable and sufficient venues, IT infrastructure and library -Resources are appropriate available and sufficient for students and staff in programme, -Resources are also properly managed and maintained - Constantly they do offer academic support for students, and staff where necessary
Researcher's comments: conditions and environment of studies at the UP-D&T is **entirely adequate**			
Programme coordination	-The programme is poorly coordinated and there are no means to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are poorly outlined - There is no student and staff input and participation within the coordination of the programme - Insufficient academic development initiatives to promote student, staff and curriculum development	-The programme is adequately coordinated in order to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are fairly outlined - There exist a fair student and staff input and participation within the coordination of the programme - frequently available academic development initiatives to promote student, staff and curriculum development	-The programme is effectively coordinated in order to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are clearly outlined - There exist interactive and integrative student and staff input and participation within the coordination of the programme -constantly available and sufficient academic development initiatives to promote student, staff and curriculum development
Researcher's comments: the UP-D&T programme is **adequately** moderated, where the needs of both the students and the lecturing staff are cared for.			

Rubric 4. The rating of the essential features as engaged within UP-D&T

Chapter 5

A discussion of research findings, limitations of research design, implications, recommendations for future research, and conclusions

5.1 Introduction

In this chapter the researcher discusses major findings extracted from the data presented in Chapter 4. The discussions follow up on the review of literature as well as the themes that emerged from the data presented. This chapter also discusses concluding comments, recommendations and implications, reflections on the significance of the study, limitations and suggestions for further research, and it closes off with the major conclusions of the study. The findings regard each of the research questions signified in this study, which inhere within them essential features of a comprehensive technology education programme.

5.2 Discussions of major findings and implications

Findings will be presented following on the two research questions which are:

- What forms the basis in terms of conceptualisation, planning, and implementation within the University of Pretoria technology education pre-service programme?

- How are essential features of a comprehensive technology education programme engaged within the activities of the University of Pretoria technology education pre-service programme?

The first research question addresses engagements of essential features: programme design, teaching methods, assessment policies and procedures, programme coordination as well as staffing issues. The second research question concentrate on the essential features: teaching methods, programme content, assessment procedures, as well as the context of study. The researcher will discuss findings beginning with an outline of the summary of essential features as engaged within UP-D&T in Table 6 and after discuss them one by one, demonstrating how they answer the two research questions.

Essential features from literature ***(refer to section 2.5, table 2)***	**Essential features engaged within** ***UP- D&T (refer to sections 4.2 and 4.3)***
Programme design	Problem-based learning, project-driven approach, standard-based design
Content	Conceptual framework, the design process, design, project management and entrepreneurship, food technology, soft materials, electrical systems and controls, mechanical systems and controls, structures, and methods.
Teaching methods	They use the application of the design processes, as well as learner-centred, activity-based, problem-based and project driven outcome based approaches. Group discussions, lecturing method, inquiry, presentations, and demonstrations, and other approaches that provide opportunities to engage in authentic, real-life problems are also used. Students are moreover expected to do a lot of self-study and independent work.
Context	They have good resources for technology teaching and learning such as technology laboratories and a computer centre where D&T students can access WebCT™. Just that there exist a huge language (English and Afrikaans) controversy, whereby in some lectures they use English and in some Afrikaans conduct, even when some students does not speak or understand the latter.
Student assessment policies and procedures	Every module consists of assessment strategies such as resource tasks, capability tasks and case studies. There are also portfolios, projects, assignments and tests. The pass requirement for modules is an average of 50%, made from an average 50% of examinations and 50% year mark.
Staffing	The UP-D&T staff is all qualified; they are of a fair spread on a moderate, high and above rating in terms of technology qualifications; they are all enrolled for postgraduate degrees in technology. They frequently attend professional development programmes and they consult with other IHL as well as other service providers to enrich their knowledge of technology. They also keep in touch with the DoE for updates on curriculum standards' development. Their knowledge base in technology is quite satisfactory with adequate related experience; they were all able to identify the most necessary characteristics of a comprehensive technology programme. They are designers, developers as well as implementers of their own programme.
Programme coordination	The coordinator of the programme oversees development of guides, setting up of venues, handles student's queries and leads the D&T unit. She makes follow-ups of results and assessment processes, as well as checks on students' attendances and performance.

Table 6. Summary of essential features as engaged within UP-D&T

5.2.1 Programme design

The UP-D&T staff have indicated during interviews (refer to section 4.2) that their programme is conceptualised and planned upon standard-based design (SBD), problem-based learning (PBL) and project-driven approaches (PDA). Below is the synthesis and interpretation of these approaches as engaged throughout the programme.

- Standard-Based Design

According to the lecturing staff, UP-D&T is based entirely upon the national standards specific to technology stated within the technology RNCS (refer to section 4.2.4). They also indicated that they base their programme on PBL and PDA, which bears evidence that their programme is standard-based because PBL and PDA are the major components of the features and scope of the RNCS (DoE, 2002:5). In fact, the first critical outcome thereof states a major principle of PBL which is: "learners are supposed to be able to identify, solve problems and make decisions using critical and creative thinking" (DoE, 2002:1). In addition, the significance of technology within the RNCS (DoE, 2002:4) is declared as "learners should apply the design process, whose use is for learners to identify everyday problems, needs or wants by selecting and applying appropriate resources, knowledge, skills and values to develop practical solutions". This implies that solutions to problems should comprise students using skills and resources, which are aspects of PDA, to actually design, make and evaluate actual products.

To evaluate the precision of SBD within UP-D&T, the researcher has examined the module contents of UP-D&T (refer to section 4.2.3). This she did by streamlining the module contents with the national standards of technology as outlined by the learning outcomes and the assessment standards of the RNCS (DoE, 2002:11-51) using the table below:

Programme modules	Technology educational standards according to the RNCS of technology (DoE, 2002)	
	Learning Outcomes	Assessment Standards
Conceptual framework	LO1: Technological process and skills	Designs, makes and evaluates
The design process	LO1: Technological process and skills	Investigates, design, makes, evaluates and communicates
Design	LO1: Technological process and skills	Designs, makes and evaluates
Project management and entrepreneurship	LO3: Technology, society and the environment	Impact of technology
Food technology	LO2: Technological knowledge and understanding	Processing
Soft materials	LO2: Technological knowledge and understanding	Processing
Electrical systems and controls	LO2: Technological knowledge and understanding	Systems and control
Mechanical systems and controls	LO2: Technological knowledge and understanding	Systems and control
Structures	LO2: Technological knowledge and understanding	Structures

Table 7. Modules based on South African national standards for technology

Column 2 of Table 7 shows that LO1 and LO2 dominate UP-D&T. This implies that UP-D&T focuses more on technological processes and skills, and technological knowledge and understanding. It is reasonable because according to the discussions of the present state of technology in South African schools (refer to section 2.2), technological processes and skills, and technological knowledge and understanding are still sparse and therefore there exists a need for vigorous effort on these concepts.

Yet, LO3 (technology, society and the environment) is featured once in column 2 of table 5; which might have the implication that it does not take much prominence within UP-D&T. From experience and observation, educators have a tendency of dwelling more on content that they are comfortable with and usually neglect certain parts of syllabi that they doubt or lack confidence with. Therefore, if during training, a particular component of study is not dealt with intently and precisely, teachers might ignore it or not be comfortable teaching it after completion of training. For a new subject like technology, with all challenges that accompanied implementing it (refer to section 1.2), trainers might want to avoid this problem by treating programme content equally and proportionally.

Moreover, the only place where LO3 is featured within UP-D&T is in the modules: project management and entrepreneurship, which only addresses the aspect of the impact of technology in the society. Entrepreneurship is important in technology because "all technological developments take place in economic, political, social and environmental contexts" (DoE, 2002:9). However, LO3 does not focus only on the economic impact of technology; instead to measure the achievement of this LO, "learners should be aware of issues pertaining to indigenous technology and culture, as well as the bias in technology" (DoE, 2002:9).

At the moment indigenous knowledge and indigenous knowledge systems are national burning issues because of the adoption by the South African ministry of science and technology of the verdict reached by the World Conference that scientific and traditional knowledge should be integrated. According to Odora Hoppers (2002:16) these disciplines represent national recourses because the local contextual expertise and technologies that indigenous knowledge frames offer can complement some of the mechanical and technical precision capabilities to generate forms of creativity that benefit and empower everyone.

The same deliberation goes for environmental issues where according to Table 7, they are not sufficiently addressed within UP-D&T. Principally, LO3 aims at learners being able to demonstrate an understanding of the interrelationships between science, technology and the environment, so UP-D&T designers and developers may consider introducing a module that deals with these issues, especially environmental matters.

It is understandable that a university has academic freedom and may make their own decision as to what should go into their own programme. However the UP-D&T staff has indicated that their programme is completely based on national standards. SBD is a relevant aspect of programme design (refer to section 2.6, table 2) and according to criteria 1 of Table 2, SBD requires that a balanced programme should at least address 70 to 90% of national curriculum component of technology. Nevertheless, the UP-D&T staff has indicated that their programme is in processes of review and they intend to involve a component that deals with indigenous knowledge and indigenous knowledge systems (refer to 4.2.3) and expectantly they might include a module that addresses aspects of science, technology, the environment and the society as well.

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- Problem-Based Learning (PBL)

UP-D&T developers and implementers obstinate on PBL because they consider that when all teaching and learning activities are centred on a problem, they train or develop students' critical thinking and creative skills (refer to 4.2 and 4.3). The reason thereof is that the unique features and scope of the technology learning area within the RNCS (DoE, 2002:5) undertake to give learners an opportunity to learn by solving problems using open-ended and problem-solving approaches. This is to develop intellectual and practical skills, where learners should link knowing with doing by applying and integrating knowledge and skills to real life situations. The effect thereof is that "students involved in PBL acquire knowledge and become proficient in solving problems, engage effectively in self-directed learning, and team participation" (Maricopa Centre for Learning and Instruction, 2001).

UP-D&T developers and implementers refer to PBL as a process of centring programme activities around a particular problem that will engage student-teachers in creative and critical thinking processes so as to result in a meticulous solution (refer to 4.2.3, under interview question 2). According to them, PBL occurs when during the design process, student-teachers learn how to investigate the existing problem and eventually come up with possible solutions. Afterwards they should design and make an optimal solution, bearing in mind issues of authenticity, investigation and research, where they will go out and explore the problem in real life contexts. They follow what

Van Loggerenberg-Hattingh (2003:52) refers to as putting learners at the centre of activity and making them accountable for their learning, where the teacher still sets the agenda but has much less control over what and how learners learn. In figure 7 below, the researcher illustrates PBL as described by the UP-D&T staff:

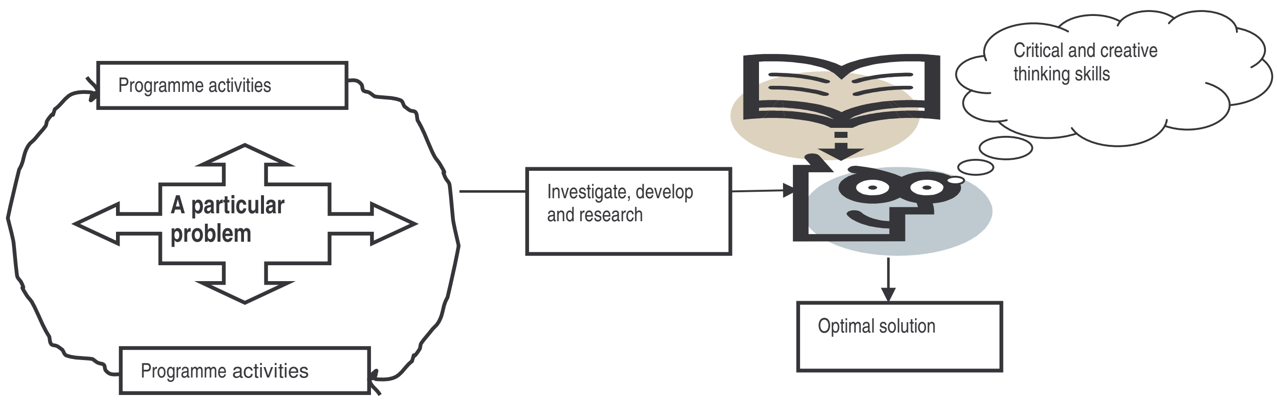

Figure 6. PBL according to UP-D&T developers and implementers

Noteworthy, in any way PBL is used, it has proven that it is an effective approach for facilitating technology education. Evidence of this within the South African education curriculum is that: "the fact that technology as a school subject concerns technological knowledge and skills, as well as technological processes, which are triggered by a problem or a need, contend that PBL is an appropriate strategy for facilitating in technology education" (Williams and Williams, 1997 as quoted by Hattingh and Killen, 2003:40).

- Project-Driven Approach (PDA)

PDA is a major component of UP-D&T because according to the UP-D&T staff, it allows students to put theory into practice, where they take their solutions of PBL and engage in processes of designing, making and evaluating actual technological products (refer to 4.2.3 and 4.3). The significance thereof is the role of PDA in education declared by the Qualifications and Curriculum

Authority (1999) that "students use knowledge and understanding from across the curriculum and apply and consolidate it in practical activities; hence designing and making real products can give them a sense of achievement and improve their self-esteem".

The researcher observed student-teachers within UP-D&T engage in design processes for a food technology project (see 4.3, lecture 4 and 5) which required them to work as a team to investigate a food related issue and identify and design a workable solution for that problem. They were required to describe food manufacturing technologies, as well as describe the principles underlying the preservation of food, investigating current developments in packaging materials and technologies and marketing of a food product. Eventually they were expected as a group to present their product in the form of a portfolio or a journal, an observation poster (storyboard) and food samples of the actual product which meets all requirements set about in the journal. They were given about three days to work on their product and one contact session to present their work in class.

The quality of work done by these student-teachers was remarkable; based on the fact that the RNCS stipulates that "technology should be encountered through projects structured around technological skills, where creative and critical thought are encouraged as artefacts are designed and made; engaging fine motor coordination and dexterity" (DoE, 2002:11). Student-teachers did not only provide the above, but they made actual products such as yogurts, biltong, jams, etc that resemble authenticity, aesthetics and ergonomics (refer to 4.3, lecture 5). Authentic because they indicated what they "added" to make their products original and different from other known products in the market; aesthetic because their packaging were attractive with pictures and other decorations; and ergonomic because their packaging were user-friendly, had nutritional information indicating daily dietary allowances, and their food products were edible (they shared their foods with the rest of the class and the researcher also had a taste). Evidently, their products were also not only about "recipes" but were about important aspects in food technology such as processing, production, nutritional information, packaging, food preservation, etc.

These activities provide some evidence that when all is done well, as according to Wright (1993:11), students and teachers of technology can in fact be able to make artefacts, systems and environments, through preparing and working to a plan, managing and using appropriate resources including knowledge and processes. The RNCS clarifies that the sole reason of technology as a school subject is to "offer authentic, real life opportunities, where learners should use knowledge, skills, and resources to meet human needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration" (DoE, 2002:5). Therefore it is expected that technology lessons should not be about cutting and pasting useless products, but should be about designing and making actual products, useful enough to meet human needs.

5.2.2 Programme content

Content within UP-D&T is divided into knowledge, skills, values and attitudes (see 4.3 and 4.4, as well as lecture 4 and 5). It is outlined as themes that are divided into study units (see Figure 4) and method of instruction; each providing specific outcomes, interpretation of learning outcomes, assessment criteria, embedded knowledge, self-study activities, tasks and assignments. Names of study units are engulfed in themes that outline the substance that accompanies a specific module component. These are based on learning outcomes of the RNCS which are further deepened and directed by the assessment standards thereof (DoE, 2002:6-9). Table 6 below demonstrates how each learning outcome and assessment standards amalgamate the content components of UP-D&T:

Learning Outcomes (LO)	Assessment Standards	Modules	Content
LO1: Technological processes and skills	Design, investigate, make, evaluate and communicates	JOT151	Conceptual framework Design
		JOT152	The design process
		JOT120	Design
LO 2: Technological knowledge and understanding	Structures, processing, systems & control	JOT252	Food technology
		JOT253	Soft materials
		JOT254	Textile technology
		JOT310	Electrical systems and controls
		JOT353	Mechanical systems and controls
		JOT354	Structure
LO 3: Technological Society and the Environment	Indigenous technology and culture, impact of technology and bias in technology	JOT251	Project management and entrepreneurship

Table 8. Modules aligned with national standards

UP-D&T content is arranged according to the learning outcomes and the assessment standards of the RNCS because UP-D&T is standard-based. According to the RNCS (DoE, 2002:8), technology content should consist of distinctive but interrelated components which constitute knowledge (structures, processing, systems and control, indigenous knowledge and knowledge systems, technological impact on societies, and bias of using technology); skills (problem solving, decision making, entrepreneurial, management, innovative and creative thinking), values, and attitudes (comprise the thought processes of the brain, use of hands for making), and technological capabilities.

On table 6 below, the researcher took an example of a content module (food technology) and demonstrated how the UP-D&T staff organises knowledge, skills, values and attitudes within their modules' aims and themes:

Content	Aim	Themes
Knowledge	Describe food manufacturing technologies and their impact on the individual, society and environment.	Food preservation
	Classify the main causes of food spoilage and depict the relationship amongst foods, food spoilage and principles of preservation in a diagram.	Food production issues
	Describe the principles underlying the preservation of food	Microorganisms
	Identify additives and the reasons for using them in processed foods	Food processing
	Investigate current developments in packaging materials and technologies	Food additives
	Identify and interpret the information on food labels	Food packaging materials
	Describe the role of packaging in the marketing of a food product	Food labels
	Work as a team to investigate a food related issue, identify and design a workable solution for the problem taking into account its impact on society and/or the environment.	Marketing and advertising
Skills	Researching and analysing information	Themes for skills, values and attitudes are embedded in the developmental and critical outcomes of the RNCS (DoE, 2002:1-2)
	Designing solutions for identified food problems	
	Documenting research, experiments and design activities	
	Managing resources	
Values and Attitudes	An appreciation for the contribution of food technology to the quality of life	
	Sensitivity to the effects of food technology on the environment	
	A sense of responsibility for decisions about food	

Table 9. Knowledge, skills, values and attitudes

5.2.3. Teaching methods

The UP-D&T lecturing staff uses mostly learner-centred, activity-based, problem-based and project-driven approaches (refer to section 4.2 and 4.3). In their view, they train student-teachers in methods that promote creativity, critical thinking, authenticity and insight (refer to 4.2.4). During lectures, they engage student-teachers in group discussions, they have both group and individual presentations, they do practical assignments and they also encourage students to do some self study. The adequacy of these practices is that it is expected in the teaching and learning of technology (refer to section 2.5) that a variety of methods should be used to deliver lectures; methods that completely bestow recognition to the importance of the promotion of student learning in technology. According to Eggleston (1998:24), methods should clearly set targets, with rigorous implementation plans and mechanisms to monitor progress; effectively evaluating impacts and effect of improvement.

Application of the design process is integrated within activities and is also used as a mode of delivery within UP-D&T (refer to 4.3, lecture 2, lecture 3 and lecture 5). This supports their SBD feature because the RNCS (refer to DoE, 2002:4) stipulates that the design process should be followed to identify everyday problems, needs or people's wants (which in this case is food production). Also that the above should be done using the selection and application of appropriate resources, knowledge, skills and values to develop practical solutions (in this case being manufacturing, processing, packaging and preservation processes).

The design process follows technological processes and are based on the development of technological knowledge and skills, which is why the assessment standards of the design process measures the investigation, design, making, evaluation and communication of technology products designed and made by students (DoE, 2002:6-7). During lecture 4 (refer to 4.3), UP-D&T student-teachers planned, investigated and designed food technology products. During lecture 5, they used their portfolios, observation boards and presentations to communicate technological processes, their solutions and the final products. So the application of the learning outcomes and the integration of the assessment standards supporting the use of the design process in teaching and learning technology are applied within UP-D&T.

5.2.4 Staffing and coordination

It is outside the scope of this study to discuss lengthily and explicitly the qualifications and expertise of the lecturing staff within UP-D&T, as issues pertaining to people's qualifications are moral and susceptible. However, the three lecturing staff within UP-D&T are fully qualified (refer to 4.2.1), with postgraduate credentials ranging from the masters in education level to post doctoral studies. Their independency within the design and development of this programme is credible because as revealed earlier, they design, develop and implement their own programme, as well as study materials and guides. They monitor their own progress and set out the activities of the programme themselves.

The affirmative point thereof is that the way the RNCS is set basically leaves it up to the teacher to decide on what and how they would teach. The learning outcomes and the assessment standards do not enforce formulation of how teaching should be done, but just a plan of knowledge, skills, attitudes and values (DoE, 2002:6), and leave it up to the teacher to put more flesh and to decide on what is needed for their own lessons. Therefore "it is essential that teachers be curriculum developers than just mere implementers of syllabi designed elsewhere" (Carl, 1995:250).

The UP-D&T staff indicated that they are at the moment, at the advice of the university faculty authorities, reviewing their programme (refer to section 4.2.4) because there exists a need to adjust and balance programme content and time with what is done in public schools. Part of this undertaking is that "teachers as implementers of the syllabus, should identify deficiencies and defects, such as relevancy of contents, practical feasibility, degrees of difficulties, realization of objectives, unclear formulation and realism of relevant syllabus content" (Carl, May 1987:112 as quoted by Carl, 1995:250). They should be able to decide what is satisfactory or dissatisfactory within their lessons and they should be able to use various sources to add value and substance to their own lessons.

5.2.5 Assessment policies and procedures

Student assessment at UP-D&T is done using continuous assessment approaches, based on tasks (resource, capability and case studies), assignment, projects, theoretical and practical class work (refer to 4.2.5). In technology, assessment is done in different ways and for many different reasons, for an example, when a learner demonstrates a skill, or presents a final product or writes a test about specified section of work. According to Potgieter (2004:214), aassessment strategies envisaged for the technology learning area and the outcomes approach have a significant impact on the day-to-day activities of teachers. "There exist types of assessments: assessment of a process, assessment of a product and assessment of knowledge and concepts" (Barker et al, 2001: v). Which is why in UP-D&T, they have designed evaluation tools to evaluate projects and practical work that assesses: problem description, description of what will solve the problem and why, full colour presentation drawings, development of ideas, working drawings, lists of materials, equipment and tools and procedure in diagram format, results of experiments, visual research, research information visual research, presentation of final solution, evaluation of solution and conclusion on success of the design (an example is on 4.3.2, lecture 5). Assessment strategies envisaged for the technology learning area and the outcomes approach have a significant impact on the day-to-day activities of teachers.

The UP-D&T staff assess stringently as they explicitly demand honouring of due dates and time for assignments or projects, and in cases of absence from tests without a proper medical certificate, a student does not get the opportunity to write a supplementary test. Plagiarism is also penalized in the strongest way possible as the UP itself places a high premium on its academic standards and it subscribes to a value system that requires strong action against plagiarism. Assessment needs to be coupled with responsibility; in a form of accountability, because "assessment for accountability is essentially a regular process, designed to assure institutional conformity to specified norms, where assessment is a set of initiatives we take to monitor the results of our actions and improve ourselves and accountability is a set of initiatives others take to monitor our actions, based on the outcomes" (Frye, 1999).

5.3 Reflection on the significance of the study

The ambivalent present state of technology as a school subject (refer to section 2.2) pertinently demands that substantial development and practice of technology education be instituted. The researcher worked from the assumption that advancement in practice starts with technology training; if technology programmes are conceptualised, planned and implemented on essential features that promote efficacy within their programme design, content, methods, assessment, staffing, coordination, and context. She believes that programmes of technology education should be made relevant, entailing substance necessary to provide technology teachers with good training to enhance classroom practice. Discussions of this particular case (UP-D&T) can serve to mobilise critique and further the discourse on effective pre-service teacher education.

This study has also provided a window into the design of technology pre-service teacher education and contributed knowledge and practice support for efficient training which developers can consider when structuring technology programmes. It is one case of how essential features can be planned for programme conceptualisation, planning and implementation, which are issues raised by research question 1 and 2 of this study. This study therefore has added to the practice and implementation of pre-service technology education programmes.

In the same way, the study engaged rubric 4 (see section 4.4) to extract, analyse, rate and discuss the application of the essential features as engaged within UP-D&T. The ratings of inadequacy, fair adequacy and entire adequacy consisted of criteria that clearly explained how each essential feature was engaged within the programme. At the end of each row, the researcher commented by summarising or adding on the ratings of the essential features as provided by the rubric. The rubric is significant in that it may serve as a tool for planning or for formative assessment in curriculum design and implementation.

5.4 Limitations of the study design

This section reflects on occurrences that might have had limiting implications on the design and methodological issues of this study or caused the design to interference with the data and the findings thereof.

- Part of the criteria for analysing the design of comprehensive programme requires that the curriculum wholly meets the needs of students and other stakeholders (refer to section 2.5, table 2). It also evaluates the ability of a technology education programme to totally reflect future technology career opportunities for student-teachers; as well as issues of programme credibility as required by quality assuring bodies such as CHE/SAQA. This study did not explore these aspects, therefore it took a narrow exploration of the design and the implementation of the investigated programme.

- Apart from study guides' presentations and evaluation schedules during class presentations, student-teachers' assessment tasks (assignments, tests, etc) were not evaluated and assessments procedures were not explored during this study. This is because this study is of limited scope and evaluation of tasks might prompt a fervour to explore the impact of UP-D&T on student-teachers' performance, which is by no means within the scope of this study. For the same reasons, only two student-teachers were involved to inquire their perceptions of the programme, with an aim of validating if UP-D&T provide student-teachers with enhanced understanding and experiences of technology and technology education.

- The academic staff qualifications are an essential feature, however due to the fact that people's qualifications and experiences are ethical and moral issues, the researcher could reveal the qualifications but not explicitly discuss the related experiences, teaching and assessment competencies, as well as research profiles of the lecturing staff as data or findings in this study.

- The limitation about validity of observations is that only the researcher observed the lectures of D&T; no other observers were involved which may have eliminated possible researcher biases.

5.5 Recommendations for further research

In this section the researcher presents areas of investigation that might poll for further research and study. These are based particularly on the investigations within UP-D&T, which is centred on the design of the programme, the implementation processes, broader literature review, research design and programme review.

- The programme developers of UP-D&T might want to conduct a longitudinal research to evaluate the delivery of this pre-service programme so as to document its impact and effect on its stakeholders, which will also assist them to evaluate their own programme progress and input on student teachers. They might also conduct impact studies to follow up on students who graduated from UP-D&T in the past to evaluate whether what these student-teachers practice in real teaching situations reflects and demonstrate the outcomes of D&T.

- Table 6 (see section 5.2) shows that learning outcome 3 of the RNCS is not represented to scale as learning outcome 1 and 2. The UP-D&T developers might conduct research to investigate as to why the aspect of technology, society and the environment is not preceding in their programme. Can it be that maybe they lack relevant expertise and therefore no confidence to handle this learning outcome? Will it be possible that during the reviews of their programme they consider introducing a module or other approach for dealing with the aspects of this learning outcome?

- During the investigation of this study, the researcher drew together that the DoE (2002:5) and some authors such as Ter-Morshuizen et al (1997:5) and Potgieter (2004:209-210) present the role of technology as what the researcher refers to as "blueprints of proficiency". For example, the DoE (1997:85) identify the role of technology as:

"*the technology learning area seeks to develop in pupils: an ability to solve technological problems by investigating, designing, developing, evaluating as well as communicating effectively in their own and other languages and by using different modes of communication; a fundamental understanding of and an ability to apply technological knowledge, skills and values by working as individuals and as group members, in a range of technological contexts; and a critical understanding of the interrelationship between technology, society, the economy and the environment*" .

Can the above mentioned plans be exercised and met? How can day-to-day teaching of technology meet the above standards? Does the national department execute somewhat activities to ensure that the nature of technology learning area as implemented within classrooms augment the above standards?

- Throughout the review of literature, the researcher established that most technology education authors has identified essential features, however approaches to review their impact once planned, merged and implemented into programmes is faintly researched upon. Similarly, most scholars have identified how technology programmes and teaching practices are not courtier, but have not provided programmes or alternative elucidations of how to improve the present and future state of technology education.

5.6 Conclusion

This chapter has presented findings based on the research questions and literature espoused within this study. The research questions focused on the basis for conceptualisation, planning and implementation of UP-D&T as well as how essential features of a comprehensive technology education programme are engaged. The findings showed that UP-D&T is conceptualised on problem-based, project-driven and standards-based approaches. Content is planned according to the learning outcomes and the assessment standards of the national policy document guiding technology in South Africa. The programme is coordinated by one of the lecturing staff who also guides and monitors all activities within the programme. There are relevant and well resourced technology venues (refer to section 4.3) consisting of lecture halls and laboratories where they can access computer facilities and practical sessions are done. The study guides show that assessment policies and procedures are in place and the UP-D&T staff is capable and well qualified.

It is evident from the study that at different levels the UP-D&T staff applied essential features of a comprehensive technology programme during the conceptualisation, development and implementation of their programme. The advances of UP-D&T to provide teaching practice in technology education that is courtier are encouraging considering the ambivalent state of technology in South African schools (refer to section 2.2). Teachers and teachers in training need to be developed by providers that offer programmes that are centred around effective and efficient practices towards teaching and learning of technology. These expertise will be reflected in their educational practice and technology as a discipline will advance in academic reverence and impact.

Just like the studies conducted by Reddy et al (2003:27-45) and that by Potgieter (2004:205-218), this study shows that technology learners (including practicing educators) find technology studies exciting, empowering and they get positive, with increased appreciation of technology during tuition. They are given a chance to display some knowledge of understanding familiar concepts and materials. Though there exist some difficulties in choosing appropriate materials for the right projects and a display of weak conceptualisation of skills such as dimensional drawings, investigations, research and motor skills, they always seem to be keyed up during learning. However that will not be achieved if technology programmes are disorganised, lack robustness and are not well structured. “Failure to take cognisance of the principal dimensions constituting the essential features of technology and technology education leads to a neglect of the holistic nature of technology and technology education” (Reddy et al, 2003:42). Essential features therefore, are a vehicle to shape up technology programmes, without which technology programmes will lack the substance necessary to make them effectual and relevant.

6. Reference list

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7. Appendices

Appendix 1. A rubric summarising criteria outlined in Table 2.

Essential features	Criteria	Levels		
		Inadequate	**Fairly adequate**	**Entirely adequate**
Programme design		- It is not consonant with the national curriculum's requirements and the nature of the programme is not entirely based on standards. - It is inadequately planned with no availability of suitable learning materials. If available, materials do not and or are not adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is not coherent, clear and properly planned and there is no careful selection and clear instruction of activities for learners in programmes - The design of the curriculum do not meet the needs of students and other stakeholders, or even reflects future technology career opportunities for learners - It is not clear as to whether the programme is full-time or part-time and on how do they keep lecturers working on tasks as required by SAQA to cover the amounts of credits required for a particular qualification	- It is fairly in consonance with the national curriculum's requirements and the nature of the programme is somewhat based on standards. - There is a good plan for design of; or availability of suitable learning materials which are adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is adequately coherent, clear and properly planned. there is careful selection and instruction of activities for learners in programmes - The design of the curriculum somehow meet the needs of students and other stakeholders and to some extend it reflects future technology career opportunities for learners - It is adequately clear as to whether the programmes are full-time or part-time and there are measures to keep lecturers working on tasks as required by SAQA to cover the amounts of credits required for a particular qualification	- It is entirely consonant with the national curriculum's requirements and the nature of the programme is totally based on standards - There is an entirely feasible plan for the design thereof; and suitable learning materials are available which are adjustable to suit student needs, content, activities, methods, assessment strategies and environment. - What needs to be taught is sufficiently and completely coherent, clear and properly planned. there are thorough and rigour selection and instruction of activities for learners in programmes - The design of the curriculum wholly meet the needs of students and other stakeholders and it totally reflects future technology career opportunities for learners - It is entirely clear as to whether the programmes are full-time or part-time and there are exclusively adequate measures to keep lecturers working on tasks as required by SAQWA to cover the amounts of credits required for a particular qualification
Content	2	-Inadequate content that does not clearly incorporates important concepts to be learned in technology. - Insufficient practical work that does not integrate PBL, design, making and evaluation of product. - Content does not form the core of this educational programme in technology, therefore it inadequately increases learners' ability to engage confidently with the technological process. -It inadequately provides a support base for problem solving activities. -It insufficiently consists of distinctive components which are supposed to constitute knowledge, skills, values and attitudes, and technological capabilities; and reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.	- Fairly adequate content that clearly incorporates important concepts to be learned in technology. - Fairly adequate practical work that integrates PBL, design, making and evaluation of product. - Content forms the core of this educational programme in technology and it adequately increases learners' ability to engage confidently with the technological process. - It adequately provides an important support base for problem solving activities. - It sufficiently consist of distinctive but interrelated components which constitute knowledge, skills, values and attitudes, and technological capabilities, that reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.	- Sufficient content that sufficiently incorporates important concepts to be learned in technology. -Well organised practical work that intergrades proper PBL, design, making and evaluation of product. - Content utterly outline the core of this educational programme in technology and it sufficiently increases learners' ability to engage confidently with the technological process. - It completely provides an imperative support base for problem solving activities. - It entirely consist of distinctive but interrelated components which constitute knowledge, skills, values and attitudes, and technological capabilities, that completely reflect an affective aspect unto learner's behaviour, attitude, principles, values and norms.
Teaching and learning methods	3	- Limited variety and ineffective of methods used to deliver lectures. - Methods do not give recognition to the importance of the promotion of student learning. -Methods are inappropriate for the programme type as reflected in its design and all other programme areas. - Methods shabbily set targets, heedlessly plans implementation and mechanisms to monitor progress, and they inadequately evaluate impacts and effect of improvement - Methods do not assist teachers in developing confidence in applying	- Quite a variety and adequate methods used to deliver lectures - Methods moderately give recognition to the importance of the promotion of student learning. - Methods are appropriate for the programme type as reflected in its design and all other programme areas. - Methods reasonably set targets, sensibly plans implementation and mechanisms to monitor progress, and they adequately evaluate impacts and effect of improvement - Methods moderately assist teachers in developing confidence	- Total variety of methods that are effective used to deliver lectures. - Methods completely bestow recognition to the importance of the promotion of student learning. - Methods are entirely appropriate for the programme type as reflected in its design and all other programme areas. - Methods clearly set targets, rigorously plans implementation and mechanisms to monitor progress, and they effectively evaluate impacts and effect of improvement

		various methods other than group work.	in applying various methods other than group work	- Methods exclusively assist teachers in developing confidence in applying various methods other than group work?
Staffing	4	-Academic staff responsible for the programme are unduly qualified - Staff has inadequate and unrelated experience - Their teaching and assessment are incompetent - Their research profiles are inadequate for the nature and level of programme - They rarely attend professional development programmes	- Academic staff responsible for the programme are justifiably qualified - Staff has fairly adequate and fairly related experience - Their teaching and assessment are reasonably competent - Their research profiles are fairly adequate for the nature and level of programme - They at times attend professional development programmes	- Academic staff responsible for the programme is credibly qualified - Staff has adequate and satisfactorily related experience - Their teaching and assessment are entirely competent - Their research profiles are adequate for the nature and level of programme - They at all times attend professional development programmes
Student assessment practices, policies and procedures	5	- The modes of delivery of the programme have inappropriate assessment practices, policies and procedures for internal assessment, and internal and external moderation; -There exist no monitoring of student progress; therefore, they do not offer helpful and obliging feedback to learners. -There exist ambiguous and or lack of rigour, validity and reliability of assessment practices, - There is no recording of assessment results and settling of disputes, - the is poor or no recognition of prior learning (RPL) -There is poor and insufficient security of the assessment system - there is no form of development for staff competence in assessment	- The different modes of delivery of the programme have appropriate policies and procedures for internal assessment, internal and external moderation; -There is fair monitoring of student progress, and they offer helpful and obliging feedback for learners. -There are adequate measures for rigour, validity and reliability of assessment practices, - There is recording of assessment results and settling of disputes are done, - the is reasonable RPL. -There is adequate security of the assessment system - There are forms of development for staff competence in assessment	- The different modes of delivery of the programme have entirely appropriate policies and procedures for internal assessment, internal and external moderation; - monitoring of student progress is thoroughly and appropriately done, -there exist explicit and a variety measures for validity and reliability of assessment practices, - there are sufficient and systematic recording of assessment results and records of settling of disputes - - RPL imperatively an integral part of teaching and learning -there sufficient and tight security of the assessment system - there sufficient and adequate development for staff competence in assessment
Context	6	-Inappropriate and inadequate venues, IT infrastructure and library - Available resources are not sufficient for students and staff in programme, - Resources are also poorly managed and maintained - Do not offer academic support for students, and staff where necessary	-Resources are fairly available and adequate for students and staff in programme. - Resources are appropriate available and sufficient for students and staff in programme, -Resources are also moderately managed and maintained - Sometimes they do offer academic support for students, and staff	-Suitable and sufficient venues, IT infrastructure and library -Resources are appropriate available and sufficient for students and staff in programme, -Resources are also properly managed and maintained - Constantly they do offer academic support for students, and staff where necessary
Programme coordination	7	-The programme is poorly coordinated and there are no means to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are poorly outlined - There is no student and staff input and participation within the coordination of the programme - Insufficient academic development initiatives to promote student, staff and curriculum development	-The programme is adequately coordinated in order to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are fairly outlined - There exist a fair student and staff input and participation within the coordination of the programme - frequently available academic development initiatives to promote student, staff and curriculum development	-The programme is effectively coordinated in order to facilitate the attainment of its intended purposes and outcomes. - Mandate and responsibilities of the programme coordinators are clearly outlined - There exist interactive and integrative student and staff input and participation within the coordination of the programme -constantly available and sufficient academic development initiatives to promote student, staff and curriculum development

Appendix 2. Interview schedule for the UP-D&T staff

- Who are the developers, designers, coordinators and implementers of the UP-D&T programme?

  - **Probe**: What are their qualifications and present studies in technology education?

  - **Probe**: What professional development programmes do they usually engage in to keep them afloat with technology education developments?

- What forms the basis in terms of conceptualisation, planning, and design of the UP-D&T pre-service programme?

- What in your opinion are the important characteristics of a successful technology programme?

  - **Probe**: how do you suppose the above mentioned characteristics should be engaged to enhance effective practices of technology teaching and learning?

- What are your perceptions and reflections on the UP-D&T? Do you suppose that it is a good programme, with potentials to provide student teachers with enhanced understanding of technology and technology education?

  - **Probe**: Why?

Appendix 3. A rubric rating responses from interview questions

Questions	Inadequate	Adequate	Entirely adequate
Who are the developers, designers, coordinators and implementers of the UP-D&T programme? What are their qualifications and present studies in technology education? What professional development programmes do they usually engage in to keep them afloat with technology education developments?	No developers, designers or advisors within the UP-D&T pre-service programme. Lectures are poorly developed, there is no proper design to the programme and they receive no input from educational authorities or other stakeholders. The academic staff responsible for the programme is unduly qualified. They have inadequate and unrelated experience. Their teaching and assessment are incompetent. Their research profiles are inadequate for the nature and level of programme. They rarely attend professional development programmes.	Developers, designers and advisors are available for the UP-D&T pre-service programme. The programme is properly structured, lecturers follow the course outlines and other sources made available and they use that for the delivery of lectures. They receive input from educational authorities, network with colleagues and other stakeholders. The academic staff responsible for the programme is justifiably qualified. They has fairly adequate and fairly related experience. Their teaching and assessment are reasonably competent. Their research profiles are fairly adequate for the nature and level of programme. They at times attend professional development programmes.	The academic staff responsible for the programme is credibly qualified. They have adequate and satisfactorily related experience. Their teaching and assessment are entirely competent. Their research profiles are adequate for the nature and level of programme. They at all times attend professional development programmes.
What forms the basis in terms of conceptualisation, planning, and design of the UP-D&T pre-service programme?	Their programme has no basis, it is poorly conceptualised, and no planning took place prior to the implementation of the programme. It is not properly structured programme, lecturers just take what is available from textbooks and no other sources and they use that for delivery of lectures. Lecturers derisorily justified the structures and natures of the programmes.	The programme is based upon some of the Essential Features of a comprehensive technology programme. Developers could identify and justify the use of these features thereof; they also could reasonably justify the structures and natures of the programmes.	The programme is based upon all Essential Features of a comprehensive technology programme and the relevant aspects of each feature thereof. Developers could utterly identify and justify the use of these features and they also could outstandingly justify the structures and natures of the programme.
What in your opinion are the important characteristics of a successful technology programme?	They derisorily identify the most important characteristics of technology in their programmes. There are no identified Essential Features of a comprehensive technology programme forming a foundation for this programme and those identified shabbily are engaged in a traditional or not convincingly effective way.	They reasonably identified the most important characteristics of technology in their programmes. They could identify some of the Essential Features of a comprehensive technology programme. They also confirmed that some of them are integrated and engaged within their programme.	They utterly could identify the most important characteristics of technology in their programmes. They could confirm that all those Essential Features of a comprehensive technology programme are engaged within their programme, and they could explain well how that is done thereof.
What are your perceptions and reflections on the UP-D&T? Do you suppose that it is a good programme, with potentials to provide student teachers with enhanced understanding of technology and technology education?	They are not sure if their programme is good or not, they can not confirm the effect it has on student teachers understanding of technology and technology education.	They suppose their programme is good, they believe it plausibly assist teachers in the understanding of technology and technology education. They also assume that how they train student teachers prepares them for enhanced teaching practices when they complete their training.	They are completely confident that their programme is good and it plausibly assist teachers in the understanding of technology and technology education. They are also confident that how they train student teachers prepares them for enhanced teaching practices when they complete their training.

Appendix 4. Interview schedule for the student-teachers

Question 1

- Which D&T programme are you enrolled for and why?

Question 2

- What kind of activities do you engage in within your D&T programme?

Probe: Do you suppose these activities are enriching and educative to you?

Question 3

- What content or what topics do you learn in the D&T programme you are enrolled for?

Question 4

- What is your understanding of what technology is and its impact in the society?

Probe: How does the D&T programme you are enrolled for assist you in understanding of what technology is and its impact in the society?

Appendix 5. A letter of consent for respondents

Number 2 Valley Road
Bordeaux
Randburg
2194
02/03/2006

Faculty of Education: Design & Technology Staff
University of Pretoria- Groenkloof Campus
P/Bag X…
Pretoria

Dear Sirs/ Madams

Re: Request for participation as respondents in the study- Investigating the use of essential features within technology pre-service programmes: a case of University of Pretoria

I hereby request permission from the UP-D&T staff as well as the programme coordinator for participation in the above entitled study. The process will include recorded interviews with individuals, analysis of programme documents, lecture observations, and evaluations of some of the assessment strategies and students projects used throughout the delivery of the programme.

Below is a list of what the researcher requires from respondents as well as consent from the staff in authority to use them:

- A copy of the pre-service programme outline of D&T offered for the BEd student-teachers at UP
- All materials that are used within the delivery of the programme, such as national policy documents, study guides, etc
- All timetables indicating venues of attendance
- Research documents, projects and reports compiled over the period of delivery by the D&T department; it can be impact studies, document or module analysis, or any form of research.

I will appreciate if my request will be granted and I hope to hear from you at your earliest convenience.

Yours faithfully
MJ Maphutha (student #: 25444931)

…………………………………

Appendix 6. Observation schedules

- Lecture 1

Topic: Unique characters of the design process Module: JOT 152 Date: 27/03/06 Duration: 120 minutes

Important aspects of the lecture	**Expected competencies**	***Researcher' s comments***
Topic	- Derived from which learning outcome within the technology RNCS?	LO 1
	- Addresses which aspects of technology?	Design processes
Researcher's comments	***The topic is relevant because it correlated with the aspect of Learning Outcome 1 of the RNCS, which is technological process and skills, as well as its assessment standard: design, make and evaluate.***	
Introduction	- Gathers students' attention	Yes, short and guiding.
	- Clearly explains the mission of the 'day', outlines the objectives	Yes
	- Reviews relevant prior knowledge	Not discussed
Researcher's comments	***The introduction is direct; the lecturer told student-teachers that they were going to discuss the nature and the purposes of the design process. The introduction also clearly informed the student-teachers of what was expected of them during the upcoming learning activity.***	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Yes
	- Explorative, promotes inquiry	Yes
	- Targets basic knowledge, skills and values required in technology	Yes
	- Poses challenge, educative, help learners construct knowledge	Yes, possibly
Researcher's comments	***The learning activity was a class presentation, where the lecturer explained the aspects of the nature of the design processes. She therefore used questions to engage student-teachers into thought processes of how familiar products such as televisions and computers were designed and made based on the design process. Then she divided them into groups and gave them fifteen minutes to discuss technology products of their own choices, as to how technological processes were applied to design and make them. She then gave each group five minutes to report back to the rest of the class on their discussions. This was an initial design lecture and some student-teachers were not used to presentations because though some were audible, they clearly lacked presentation skills; others were shy, uninformed, non-coherent and they exceeded the time allocated to present, hence they were cut while still presenting. This gave the lecturer an idea to dedicate the next lecture on evaluation tools to familiarise the student-teachers on presentation skills and criteria used to assess technology products. She informed them to read point 3 of their study guides and access all reading materials recommended for this module, especially the National Curriculum Statement and the two design and technology books by Garratt and Caborn.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes
	Clear explanations of concepts and ideas given	Yes
	Make good use of visual aids	Yes, the lecturer used PowerPoint™ slides
	Student participation encouraged through range of questioning techniques	Yes
	Relates theory to current industry practice	Yes, because they related concepts to daily used products
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were cooperative
Researcher's comments	***The lecturer used a class presentation, discussions, question and answering, as well as group discussions at different parts of the session, to keep students attention and to clarify concepts. Students actively participated and cooperated throughout the session.***	
Assessment strategies	Strategies available? Particular project given for future sessions?	None
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Researcher's comments	***The lesson was an introductory, introducing a particular concept. So assessment strategies were not necessary for this type of a lesson.***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Researcher's comments	***All intended to be done in the learning activity happened during the time allocated for the period. Plans for procession in following lectures were explained. No aspects of the topic were instructed to students to study further at home.***	

- Lecture 2

Topic: The nature and the purposes of the design process Module: JOT 152 Date: 29/03/06 Duration: 120 minutes

Important aspects of the lecture	**Expected competencies**	***Researcher' s comments***
Topic:	- Derived from which learning outcome within the technology RNCS?	LO 1
	- Addresses which aspects of technology?	Design processes
	- Can be divided into which subtopics	Designing , investigating, making and evaluating
Researcher's comments	***This is a follow up lecture of lecture 1.***	
Introduction	- Gathers students' attention	Yes
	- Clearly explains the mission of the 'day', outlines the objectives	Yes
	- Reviews relevant prior knowledge	Yes, students were instructed to work in groups to use what they have learnt a day before about the nature and the purpose of the design process to identify a common technology product that they will design, make and evaluate
Researcher's comments	***Students were instructed to work in groups to use what they have learnt a day before about the nature and the purpose of the design process to identify a common technology product that they will design, make and evaluate. They were to start by discussing the importance of each stage of the design process for that particular product and they were to plan how they were going to apply all those stages thereof.***	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Yes
	- Explorative, promotes inquiry	No
	- Targets basic knowledge, skills and values required in technology	Yes
	- Poses challenge, educative, help learners construct knowledge	Yes, possibly
Researcher's comments	***The student-teachers were discussing and planning as instructed during the introduction. They were keen throughout; they exchanged turns of sharing ideas and planning for their projects. One group decided that they will share different stages of the design process amongst themselves to compile the portfolio; one decided that each member would work on all the processes and they will meet later in the day to combine their compilations and come up with one portfolio; two other spent a lot of time discussing the processes that they did not get to planning for their project by towards the end of the lecture.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes
	Clear explanations of concepts and ideas given	No
	Make good use of visual aids	None
	Student participation encouraged through range of questioning techniques	Yes
	Relates theory to current industry practice	No
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were cooperative
Researcher's comments	***The lecturer used group work to plan and discuss how they would engage various stages of the design process to design and make their models.***	
Assessment strategies	Strategies available? Particular project given for future sessions?	None
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Researcher's comments	***This was a planning lecture, so assessment strategies were not necessary***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Researcher's comments	***The lecturer consolidated by telling the students that they should therefore use the rest of the day and the following day's lecture to work together and consult with her on the model of the product they have selected. She mentioned that a lecture of the day after tomorrow will be used for presentations of all the groups on their models***	

- Lecture 3

Topic: the nature and purposes of the design process Module: JOT 152 Date: 01/04/06 Duration: 120 minutes

Important aspects of the lecture	**Expected competencies**	***Researcher' s comments***
Topic	- Derived from which learning outcome within the technology RNCS?	LO 1
	- Addresses which aspects of technology?	Design processes
Summery	***This is a follow up lecture of two days after the introduction of the nature and the purposes of the design process.***	
Introduction	- Gathers students' attention	Yes, indicated how student-teachers were going to make presentations of their models
	- Clearly explains the mission of the 'day', outlines the objectives	Yes
	- Reviews relevant prior knowledge	Not discussed
Summery	***The lecture started with an explanation of how and how much time each group is going to present. She explained that this lecture was a follow up of a lecture that took place two days after the introduction of the unique features of the design process. For a day and a half student-teachers were working in groups to plan how they were going to apply the design process to design and make a model of a technology project of their choice. So she encouraged them to listen, participate and cooperate with the presenting groups.***	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Yes
	- Explorative, promotes inquiry	No
	- Targets basic knowledge, skills and values required in technology	Yes
	- Poses challenge, educative, help learners construct knowledge	Yes, possibly
Summery	***Student-teachers were given a task to present to the whole class the models which they have designed and made, as well as evidence of engaging design processes throughout this inquiry. They needed to include explanations of the purposes of their selected products and why design processes were conducted in the design and make of those products. Various groups presented their models, which were different types of technology products. They showed how they worked together to go through various design processes; some groups had posters to discuss their presentations and others only presented their portfolios and models. Student-teachers cooperated well with each other during group work, they were enthusiastic about the task and they listened to each other during presentations.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes
	Clear explanations of concepts and ideas given	Yes
	Make good use of visual aids	None
	Student participation encouraged through range of questioning techniques	Yes
	Relates theory to current industry practice	No
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were cooperative
Summery	***The lecturer used classroom presentations where various groups presented their models and portfolios showing the unique features of the design processes.***	
Assessment strategies	Strategies available? Particular project given for future sessions?	None
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Summery	***The lecturer did not assess the student-teachers' presentations because this was the first presentation they made and it was some form of practice for future technology products the student-teachers will design, make and evaluate. Assessment strategies were not necessary at this point.***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Summery	***All groups managed to present during this period, though some groups exceeded the five minutes given to them for presentation. The lecturer indicated towards the end of the lecture that the following lecture will be about the roles of the design processes in the educational curriculum and context.***	

- Lecture 4

Topic: Food production, processing and preservation Module: JOT 252 Date: 24/03/06 Duration: 120 minutes

Important aspects of the lecture	Expected competencies	Researcher' s comments
Topic	- Derived from which learning outcome within the technology RNCS?	LO 2
	- Addresses which aspects of technology?	Technological knowledge and understanding
Researcher's comments	***The topic is relevant because it combined all the aspects of the learning outcomes1&2 of the RNCS, namely technological process and skills, technological knowledge and understanding.***	
Introduction	- Gathers students' attention	Yes
	- Clearly explains the mission of the 'day', outlines the objectives	Yes, students knew that this was a lecture for presentations
	- Reviews relevant prior knowledge	Not discussed
Researcher's comments	***This was a product-presentation lecture, where each group was going to present their products to the whole class. They were instructed to include as part of the presentation explanations of all stages of the design process, their portfolios of evidence, observation boards and give the whole class food samples of their final products. Each group was allocated twenty minutes thereof, where the whole group, not only representatives would share on their projects as well as their experiences throughout.*** **They all showcased how their products showed authenticity, they indicated what they "added" to make their products original and different from other products in the market; aestheticism because they showcased how their packaging was attractive; and ergonomics because their packaging was user-friendly, with nutritional information indicating daily dietary allowances**	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Probably
	- Explorative, promotes inquiry	No
	- Targets basic knowledge, skills and values required in technology	No
	- Poses challenge, educative, help learners construct knowledge	Not precisely
Researcher's comments	***The lecturer gave the whole class evaluation tools that will be used to assess the projects of the presenting groups, including their portfolios entailing all stages of the design process, their observation posters, and their food samples. All the groups made remarkable food products; the first group to present has made marmalade jam, the second yogurt, the third biltong, and the last group made fruit punch. They all demonstrated how they engaged processes of processing, packaging and preservation during the making of their products. They also shared with the class the marketing strategies for their products and how they are going to advertise them thereof; each group had a catchphrase for their products. They worked hard because all these products resembled real productions; they all had well designed observation posters, prestigious portfolios and they gave the whole class samples of their final products which showed authenticity and tasted really good. Their advertising slogans were showed creativity and aesthetics and their marketing plans were showed potential.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes, only presentations were used
	Clear explanations of concepts and ideas given	No
	Make good use of visual aids	Yes, some groups used PowerPoint™ slides to present their projects
	Student participation encouraged through range of questioning techniques	Yes, Student-teachers and the lecturer asked them follow-up questions engaging issues of authenticity, ergonomics and aesthetics. The lecturer
	Relates theory to current industry practice	No
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were attentive
Researcher's comments	***None***	
Assessment strategies	Strategies available? Particular project given for future sessions?	Yes, an evaluation tool with criteria to assess process and practical.
	Yes	Useful, reliable, transparent, does obtain information required
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	Yes, portfolios of evidence, observation posters and samples of real food products
Researcher's comments	***Throughout the presentations, the rest of the class and the lecturer had evaluation tools to assess the presenting groups, which the lecturers afterwards will calculate average marks to assess the groups and give them a percentage for their work.***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Researcher's comments	***The lecturer consolidated by commenting on the good work of the presenters. He thanked the rest of the class for their participation and promised the presenters of their product marks in the next period.***	

- Lecture 5

Topic: Group presentations exhibiting various food technology products Module: JOT 252 Duration: 120 minutes

	Time management achieved	Yes
Important aspects	**Expected competencies**	**Researcher' s comments**
Researcher's of the lecture comments	***The instructor told student-teachers that the following two lectures will be for their projects preparations and the lecture after two days will be for presentations of completed projects.***	
Topic	- Derived from which learning outcome within the technology RNCS?	LO1, LO 2 and LO 3
	- Addresses which aspects of technology?	Design processes, skills, knowledge, understanding and contexts.
Summery	***The topic is relevant because it combined all the aspects of the learning outcomes within the RNCS, namely technological process and skills, technological knowledge and understanding and technology, society and the environment.***	
Introduction	- Gathers students' attention	Yes, it instructed clearly how student-teachers were going carry out their presentations
	- Clearly explains the mission of the 'day', outlines the objectives	Yes
	- Reviews relevant prior knowledge	Yes, student-teachers were to use their knowledge of the nature and purposes of the design process to carry out this task
Researcher's comments	***Student-teachers were instructed to work in groups to design and make real food technology products of their choices, engaging production, processing, packaging and preservation thereof. They also had to compile portfolios of evidence and observation boards entailing all the stages of the design process, and to come up with plans to advertise and market their products.***	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Yes
	- Explorative, promotes inquiry	No
	- Targets basic knowledge, skills and values required in technology	Yes
	- Poses challenge, educative, help learners construct knowledge	Yes, possibly
Researcher's comments	***Each group was allocated 10 minutes to decide on what product they were going to design and make, 20 minutes to make a plan of action and the rest of the period to share ideas and responsibilities of how they would work on their projects. The instructor walked around during discussions to monitor and facilitate all processes.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	Yes
	Clear explanations of concepts and ideas given	Yes
	Make good use of visual aids	None
	Student participation encouraged through range of questioning techniques	Yes
	Relates theory to current industry practice	No
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were cooperative
Researcher's comments	***The lecturer used classroom presentations and group work to entask student-teachers to work on their projects***	
Assessment strategies	Strategies available? Particular project given for future sessions?	none
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Researcher's comments	***The lecturer gave each group an evaluation tool that had criteria and ratings, which will be used during presentations to assess and rate all products. This evaluation tool assesses various stages of the design process, the actual making processes of the products and the presentation thereof.***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	no

- Lecture 6

Topic: Orientation lecture on an examination Module: JOT 253 Duration: 60 minutes

Important aspects of the lecture	Expected competencies	Researcher' s comments
Topic	- Derived from which learning outcome within the technology RNCS?	LO 2
	- Addresses which aspects of technology?	Technological knowledge and understanding
Researcher's comments	***This lecture took place towards the end of a specific term, and it was a short orientation lecture on an examination student-teachers were going to write.***	
Introduction	- Gathers students' attention	Yes
	- Clearly explains the mission of the 'day', outlines the objectives	No
	- Reviews relevant prior knowledge	Not discussed
Researcher's comments	***The introduction was a short and precise explanation by the lecturer of what his portion of the examination was going to cover.***	
Activities	- Interesting, understandable (clear instructions)	Yes
	Has potential to achieve lecture outcome (s)	Probably
	- Explorative, promotes inquiry	No
	- Targets basic knowledge, skills and values required in technology	No
	- Poses challenge, educative, help learners construct knowledge	Not precisely
Researcher's comments	***The lecturer indicated his portion of the examination, as to what the paper was going to cover and he allowed students to ask him questions based on their expectations, frustrations, and experiences of preparations. He later started discussing with them a forthcoming module that he was going to offer; that it requires dedication and responsibility as they were going to learn skills of how to handle different machinery to work on and process various materials. He therefore took the whole class to a technology laboratory, where he showed student-teachers the kind of equipments they were going to use within that module. He also showed them a few projects that were designed and made by student-teachers who previously learned that module. Then he dismissed the class early.***	
Teaching methods	Appropriate where a variety of modes used at different parts of a session	No
	Clear explanations of concepts and ideas given	No
	Make good use of visual aids	None
	Student participation encouraged through range of questioning techniques	No
	Relates theory to current industry practice	No
	Links application of knowledge to career	No
	Handles disciplinary matter effectively	No need, students were attentive
Researcher's comments	***The lecturer used the lecture method to inform students of what was in the forthcoming examination. Then he used discussions to engage them of their expectations, frustrations, and experiences during preparations. Then he used orientation method s when he took the whole class to observe the technology laboratory and the equipments thereof.***	
Assessment strategies	Strategies available? Particular project given for future sessions?	None
	Evidence of engagement in design process: portfolio, product or projects? Evaluation of the products?	None
	Useful, reliable, transparent, does obtain information required	None
Researcher's comments	***This was an orientation lecture towards an examination paper, so assessment strategies were not necessary.***	
Conclusion	Summarizes key point and consolidate the session by relating future lecture topics	Yes
	Time management achieved	Yes
Researcher's comments Researcher's comments	***The lecturer consolidated by encouraging students to work hard for the exams and he indicated that they could only work in that laboratory next term if they passed. It was a very short lecture that took half the time for a normal lecture and students were released.***	

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University of Pretoria

< School of Teachers Training >

< Department of Science, Mathematics and Technology Education>

<Structures: JOT 354>

Welcome to the Structures module in the Design and Technology (GET) program. Technology has existed throughout history. People use the combination of knowledge, skills and available resources to develop solutions that meet their daily needs and wants. Some of these solutions have been in the form of products, while some solutions have involved combining products into working systems.

The Technology Learning Area will contribute towards learner's technological literacy by giving them opportunities to:

- Develop and apply specific skills to solve technological problems
- Understand the concepts and knowledge used in Technology, and use them responsibly and purposefully and
- Appreciate the interaction between people's values and attitudes, technology, society and the environment

Compiled by:
<W.J. Rauscher>

Date of last revision:
<January 2006>

Table of Contents

Organisational Component

Study Component

Organisational Component

1. General premise and educational approach

Significance of this module	The significance of the Structures module is directly related to the overall goal of the Revised National Curriculum Statement Grades R-9 (Schools), which is to develop citizens who can display the competencies and values encapsulated in the critical and developmental outcomes. This module focuses on practical solutions that involve supporting loads and ways of making products that are stiff, stable and strong when forces are applied to them. The learner can explore these issues within the contexts of housing, habitats, shelters, containers, towers, bridges, packaging, transport, storage, and so on.
Instructions for using the study guide	Learners should study this guide carefully and consider the educational approach, the content as well as the guidelines set out in the supplementary study material, *WebCT™* and the school curriculum.
Educational approach	The foundation of the educational approach followed by the Design and Technology Programme as a whole, is outcome-based. This it does by setting the outcomes to be achieved at the end of the process. The outcomes encourage a learner-centred and activity-based approach to education. The Design and Technology Programme builds its Learning Outcomes on the critical and developmental outcomes that were inspired by the Constitution. Academic responsibility and independence are expected of learners in the Design and Technology Programme. A great deal of self-study and independent work is expected of the learners, although sufficient contact time will be allocated.

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2. Contact information

	Name	Room no and building	Telephone no	E-mail address
Lecturers				
Programme manager	Mrs G. Haupt	C02 Aldoel Building	420 5631	grietjie.haupt@gk.up.ac.za
Lecturer	Mr W. Rauscher	C01 Aldoel Building	420 5573	rauscher@gk.up.ac.za
Secretaries	Mrs E. Smith	106 Natural Science Building	420 5575	esmith@gk.up.ac.za
	Mrs R. Smit	106 Natural Science Building	420 5552	

Venues or facilities:

- Lecture hall: F108
- Consulting hours: By appointment

3. Study materials and purchases

- Class notes (email via *WebCT™*)
- Internet sites

4. Learning activities

4.1 Contact time and learning hours

This is a seven-week module and will commence at the beginning of quarter 4 (semester 2).

This module carries a weighting of 6 credits, indicating that a student should spend an average of 60 hours to master the required skills (including time spent preparing for tests and examinations). There are 2 contact sessions of 2 hours each per week. The scheduled contact time is 4 hours per week, which means that another 4 to 5 hours per week of own study time should be devoted to the module.

You should devote an average of 8 to 9 hours per week to this module (60 ÷ 7 = 8,57 hours per week).

4.2 Contact sessions

There are 2 contact sessions of 2 hours each per week. These contact sessions with the lecturer will consist of tutorial classes as well as practical work in an integrative approach. The theoretical/practical ration for this module is 3:1.

5. Assessment

Attendance is compulsory as most of the practical work will be demonstrated, explained and carried out during contact hours. This module is based upon continuous assessment which consists of various activities which will be assessed. An assessment criterion will be provided upfront to enable the student to prepare adequately. A formal examination will be written at the end of the module. Marks will be allocated in the following manner:

Assignment 1 = 50 marks
Assignment 2 = 50 marks
Assignment 3 = 250 marks
Examination = 50 marks

TOTAL = 400 marks → ∴ **Final mark =** $\frac{400 \text{ marks}}{4}$ = 100%

No sub-minimum is required to write the examination.

6. General

It will be expected of students to use their time in a disciplined, responsible and productive manner.

According to the official Faculty policy regarding grievance procedures, any grievance a student has in connection with the module should be discussed with the lecturer involved first and thereafter with the program coordinator. If the matter can not be resolved on this level, a written complaint can be directed to the Head of Department who will decide which further action be should be taken. It is against the Faculty policy for grievance procedure to ignore these procedures and go to the Head of the School of Teachers Training or Dean of the Faculty directly.

Academic dishonesty of any kind will not be tolerated. This includes dishonesty during examinations as well as plagiarism in written assignments. Students should familiarize themselves with the Harvard method of referencing in written assignments and mere copying from the Internet is seen as a serious breach of the Copyright Act. Plagiarism and incorrect referencing methods will be penalized severely.

PLAGIARISM
Plagiarism refers to the appropriation of the work or ideas of others. Plagiarism is both unethical and illegal and may be regarded as a criminal offence in terms of the Copyright Act 98 of 1978. The University of Pretoria places a high premium on its academic standards and subscribes to a value system which requires strong action against plagiarism. Being regarded as a serious contravention of the University's rules, plagiarism can lead to expulsion from the University. For more information, see *http://upetd.up.ac.za/authors/create/plagiarism.htm*.

The University of Pretoria is keen to accommodate students with special needs. These needs are catered for without influencing academic standards. It is however, the student's responsibility to inform the lecturer in good time of any special needs in order to ensure effective communication in this regard.

STUDY COMPONENT

1. Module specifications

1.1 Purpose statement

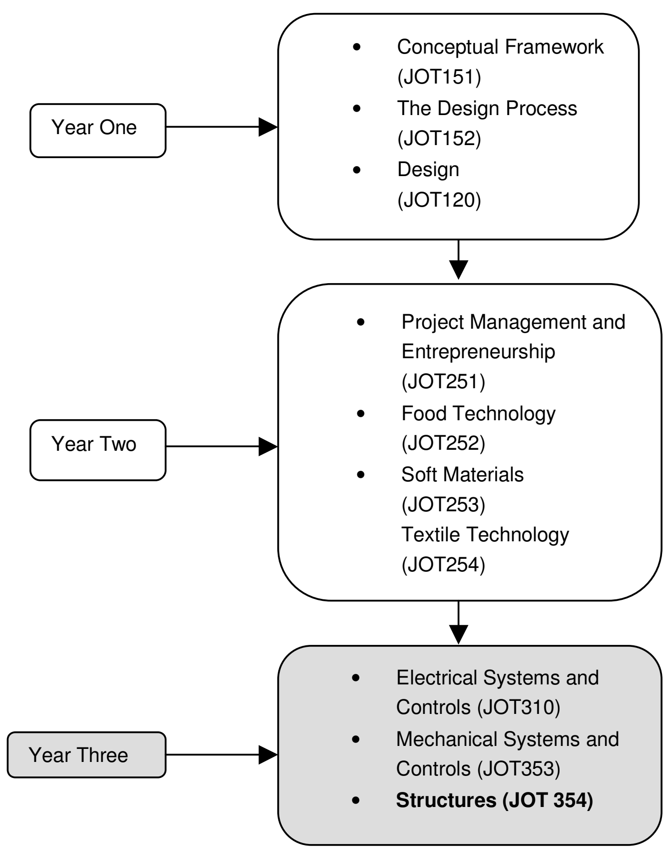
This module aims to develop an understanding of structures by exploring more complex person-made structures. The learner must choose and use specific materials for their structural properties, and should be able to demonstrate awareness of ways of strengthening and stabilizing structures under various loading conditions.

1.2 Learning presumed to be in place

Learners will apply their knowledge and understanding of the design process, research and visual and verbal communication skills. It will be presumed that students are familiar with the correct referencing methods for written assignments, are computer literate in order to complete and present assignments in typed format. It will also be presumed that students know how to do Internet research and are familiar with *WebCT™*.

1.3 Articulation with other modules in the programme

The following diagram demonstrates the interrelationship of the modules and how they follow a logical sequence:



1.4 Critical cross-field outcomes

The critical cross-field outcomes include, but are not limited to:

- Identifying and solving problems by using critical and creative thinking.
- Working effectively with others as a member of a team, group, organisation, community.
- Organising and managing oneself and one's activities responsibly and effectively.
- Collecting, analysing, organising and critically evaluating information.
- Communicating effectively using visual, mathematical and/or language skills in the modes of oral and/or written persuasion.
- Using science and technology responsibly, effectively and critically, showing responsibility towards the environment and health of others.
- Demonstrating an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.
- Contributing to the full personal development of each learner and the social and economic development of society at large by making it the underlying intention of any programme of learning to make an individual aware of the importance of:
    - reflecting on and exploring a variety of strategies to learn more effectively;
    - participating as responsible citizens in the lives of local, national and global communities;
    - being culturally and aesthetically sensitive across a range of social contexts;
    - exploring education and career opportunities; and
    - developing entrepreneurial opportunities.

2. Module structure

Information on the study themes and study units, method of instruction, notional hours and contact sessions are provided in the table below:

Study theme and study units	Method of instruction	Notional hours	Contact sessions*
1. Introduction to structures	Tutorial & Class discussion	2	1
2. Forces acting on structures	Tutorial & Class discussion	4	2
3. Loads on structures	Tutorial & Class discussion	4	2
4. Materials: Properties of materials that affect their performance in structures	Tutorial & Class discussion	4	2
5. Shape of structure	Tutorial & Class discussion	4	2
6. Case studies	Tutorial, Class discussion, & Assignments	3	1
7. Research task		12	1
8. Capability task (project)	Practical project	25	2
9. Examination		2	1
	Total	60	14

** 1 Contact session = 2 periods (±2 hours)*

Note: *The notional hours include the contact time, as well as the estimated time to be allocated for self-study, preparation of assignments and preparation for tests and the examination.*

3. Study units and themes

The information given in this section of the study guide is intended to assist students in their learning in order to effectively acquire the required skills and achieve the learning outcomes.

3.1 Specific outcomes

At the end of this module the learner will be able to:

- Demonstrate an understanding of Structures by means of continuous assessment, formal and informal tests
- Apply technological processes and skills ethically and responsibly in designing and making a structural artefact (see 8 in the module structure)
- Demonstrate an understanding of the interrelationships between science, technology, society and the environment
- Demonstrate the application of Structures by means of practical experiments
- Research and prepare learning support material (LSM) for structures.

3.2 Assessment criteria

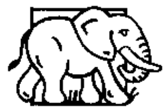
Refer to the attached criteria.

3.3 Assignments

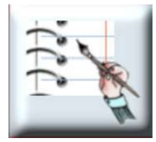
Refer to the attached assignments.

Choice of icons

A variety of icons may be considered for this version of the study guide. Customised icons can be designed to suit the nature of the study material. Here are some examples of different styles of icons:



Important Note



ACTIVITY