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THE COGNITIVE IMPACT OF THE IMPLEMENTATION OF AN ENTRY LEVEL CERTIFICATE IN INFORMATION TECHNOLOGY

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B.Comm., B.Sc. Honns.

Dissertation submitted in complete fulfillment of the requirements for the degree Magister Technologiae in the discipline Information and Communication Technology in the Faculty of Applied and Computer Sciences at the Vaal University of Technology.

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DEDICATION

This dissertation is dedicated to my family, grandfather Gerhardus van Deventer and the Van Deventer children.

ABSTRACT

The cognitive impact of the implementation of an Entry-Level Certificate in Information Technology

Research has found that learners find it difficult to solve programming problems in a logical way, therefore the failure rate in Programming I is high. The Entry-level Certificate in Information Technology was introduced as an intervention to address this problem. Four aspects were focused on in the Entry-level Certificate in Information Technology, namely English comprehension, academic competency, numerical skills and the problem-solving skills of learners. Basic computer literacy was the common theme used throughout the Information Technology Boot Camp (ITBC) to address the above-mentioned aspects, in order to broaden access to the Vaal University of Technology (VUT). The research indicates that English comprehension is a very important component of the Information and Communication Technology (ICT) modules, and that it is important for learners to have an English proficiency level of grade 12 before enrolling for a diploma in ICT. The ICT and numerical skills modules also narrowed the gap between secondary and tertiary education, by equipping the learners with prior knowledge that is crucial for being successful in the ICT diploma. To conclude access was broadened to the VUT and the intervention of the ITBC did impact positively on the cognitive functioning of learners.

ABSTRAK

Die kognitiewe impak van die implementering van 'n Toegangs Vlak Sertifikaat in Inligtingstegnologie

Navorsing het getoon dat leerders dit moeilik vind om probleme op te los deur 'n logiese wyse te volg en as gevolg daarvan is die druipsyfer in Programmering I hoog. Die kursus "Entry-level Certificate in Information Technology" is toe gebruik as 'n intervensie om die probleem aan te spreek. Daar is op vier aspekte gedurende die intervensie gekonsentreer; naamlik Engelse begripsvaardighede, akademiese vaardighede, wiskundige vaardighede en die probleemoplossing vaardighede van leerders. Basiese rekenaarvaardighede is in ITBC as tema gebruik om die voorafgenoemde aspekte aan te spreek en sodoende 'n groter toegang van studente tot die "Vaal University of Technology" te vergemaklik. Die navorsing toon dat Engelse begripsvaardighede 'n baie belangrik komponent van die "Information and Communications Technology (ICT)" kursus is en dat dit van kardinale belang is dat leerders oor die nodige Engelse begripsvaardighede beskik op graad 12 voor hul inskryf vir 'n diploma in ICT. Die ICT en wiskunde vaardighede modules het ook bygedra tot die vernouing van die gaping tussen sekondêre en tertiêre onderrig vlakke, deur die leerders toe te rus met die nodige kennis om suksesvol te wees in die ICT diploma. Gevolglik kan daar gesê word dat toegang tot die "Vaal University of Technology" verhoog is en dat die intervensie wel 'n positiewe invloed op die leerders se kognitiewe vaadighede gehad het.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ii
DEDICATION iii
ABSTRACT iv
ABSTRAK v
TABLE OF CONTENTS vi
LIST OF FIGURES x
LIST OF TABLES xi
LIST OF ANNEXURES xiii
LIST OF ACRONYMS xiv
CHAPTER ONE – PURPOSE OF THE STUDY 1
1.1 Introduction 1
1.2 Background to the research study 1
1.2.1 Low pass rates of learners in the discipline computer science 1
1.2.2 Computer Science as a discipline 3
1.2.3 The influence of curriculum design on pass rates 4
1.3 Problem definition 5
1.4 Research questions 5
1.5 Research objectives 6
1.6 Research methodology 6
1.6.1 Literature study 6
1.6.2 Target population 7
1.6.3 Empirical research 7
1.6.4 Data analysis 7
1.7 Structure of this research report 8
1.8 Summary 8

CHAPTER TWO – LEARNING ARCHITECTURE OF THE INFORMATION TECHNOLOGY BOOT CAMP COURSE 9

2.1 Introduction 9

2.2 Term clarification 11

2.3 The nature, scope and content of the Information Technology Boot Camp (ITBC) course 13

2.3.1 Background of the National Institute of Information Technologies (NIIT) 13

2.3.2 The Information Technology Boot Camp course content 14

2.4 Approaches towards learning and teaching 17

2.5 Foundation for a teaching and learning strategy 19

2.5.1 Outcomes-Based-Education (OBE) 20

2.5.2 Constructivism 21

2.5.3 Experiential learning 22

2.5.4 The "Learning Architecture based on Collaborative Constructivism" 23

2.5.5 Improved information processing supported by LACC 25

2.5.5.1 Learning and interaction skills 27

2.6 Assessment strategy 28

2.6.1 Implementation of Bloom's levels of learning in the assessment strategy 28

2.7 Comparison between tertiary institutions 30

2.8 Conclusion 32

CHAPTER THREE – RESEARCH DESIGN 33

3.1 Introduction 33

3.2 Research design 34

3.2.1 Population and sampling 35

3.3 Quantitative data 36

3.3.1 VaalScan as an instrument for measuring learner's awareness about teaching and learning strategies 37

3.3.1.1 Importance of English proficiency for Higher Education learners 38

3.3.1.2 Vocabulary in context 39

3.3.1.3 Learners' familiarity with English 41
3.3.2 SpEEX as an instrument for measuring learner's aptitude and career orientation 43
3.3.2.1 Problem solving as a component of the SpEEX instrument 43
3.3.2.2 Numerical skills as a component of the SpEEX instrument 46
3.3.3 LASSI measurement tool for strategic learning 48
3.3.4 Assessment results 52
3.4 Qualitative data 52
3.4.1 Questionnaires 52
3.5 Conclusion 53
CHAPTER FOUR – RESEARCH FINDINGS AND DISCUSSION 54
4.1 Introduction 54
4.2 Descriptive measures 54
4.3 The response 56
4.4 Data analysis 57
4.4.1 The influence of ITBC English Proficiency module on programming and logic techniques 57
4.4.1.1 VaalScan results 58
4.4.1.2 Correlations 60
4.4.1.3 Correlations between English Proficiency and ITBC modules 61
4.4.1.4 Correlations between English Proficiency and Programming I 62
4.4.1.5 English Proficiency assessment results 63
4.4.2 The influence of Problem Solving and Numerical Skills on programming and logic techniques 63
4.4.2.1 SpEEX results 64
4.4.2.2 Correlations 66
4.4.2.3 Correlations between the ICT and Numerical Skills modules 67
4.4.2.4 Correlations between ICT, Numerical Skills and Programming I modules 67
4.4.2.5 Assessment results of ICT modules and Numerical Skills 68
4.4.2.6 Assessment results of Programming I 69
4.4.3 The influence of the formal Life Skills module on the performance of

1st year ICT learners 69
4.4.3.1 LASSI results 70
4.4.3.2 Correlations of LASSI 72
4.4.4 The nature and scope of the ITBC course 73
4.4.4.1 Relevance, structure, objectives and content of ITBC course 73
4.4.4.2 Teaching strategy 76
4.4.4.3 Learning strategy 78
4.4.4.4 Assessment strategy 79
4.4.4.5 Overall satisfaction of nature and scope of ITBC course 80
4.5 Conclusion 81
CHAPTER FIVE – CONCLUSIONS AND RECOMMENDATIONS 82
5.1 Introduction 82
5.2 Overview 83
5.3 Findings 84
5.3.1 The nature and scope of the ITBC course 85
5.3.2 The influence of the ITBC language comprehension module on programming and logic techniques 86
5.3.3 The influence of the ITBC on problem solving and numerical skills 86
5.3.4 The influence of the Life Skills module on 1st year ICT learners 86
5.3.5 Research summary 87
5.4 Recommendations 87
5.4.1 Nature and scope recommendations for the ITBC 87
5.4.2 Recommendations regarding the English Proficiency module 88
5.4.3 Recommendations regarding the PLT and Numerical Skills modules 88
5.4.4 Recommendations on the Life Skills module 89
5.5 Conclusion 89
BIBLIOGRAPHY 90
ANNEXURES 104

LIST OF FIGURES

		Page
Figure 1:	Curriculum being followed by the VUT in the ITBC-course	15
Figure 2:	Concept map	18
Figure 3:	Collaborative constructivism methodology, learning sessions and learning styles of experiential learning, integrated by the NIIT	24
Figure 4:	Learning Architecture of Collaborative Constructivism as integrated by the NIIT	25
Figure 5:	Model of cognition according to information processing theories	26
Figure 6:	Relationship between different kinds of knowledge	27
Figure 7:	Procedures that were followed during research design	34
Figure 8:	The different dependent and independent variables used during the research	36
Figure 9:	Interpersonal skills of ITBC learners	42
Figure 10:	Enrolment procedure for ITBC 2003	110

LIST OF TABLES

		Page
Table 1:	Pass rates of learners at the VUT	2
Table 2:	Cognitive functioning	10
Table 3:	Information Technology Boot Camp course	16
Table 4:	Linear scheduling of ITBC modules at the VUT	17
Table 5:	Learning style deliverable mechanism	24
Table 6:	Bloom's Taxonomy	29
Table 7:	Comparison between VUT, TUT and PET	30
Table 8:	Comparison between the assessment strategies at three tertiary education institutions in South Africa	31
Table 9:	Variable categories that were used in the research	35
Table 10:	VaalScan measuring levels	37
Table 11:	Vocabulary in context scores	39
Table 12:	Familiarity with English	41
Table 13:	Components of the communication process	42
Table 14:	Types of thinking	44
Table 15:	Distribution of learners according to VaalScan test-results	58
Table 16:	Statistical results of the VaalScan pre- and post-test	58
Table 17:	The VaalScan frequency table	59
Table 18:	Vocabulary in context scores of learners as measured by VaalScan	59
Table 19:	English familiarity levels of ITBC learners as measured with the VaalScan	60
Table 20:	Correlations between VaalScan and SpEEX pre- and post-instruments	61
Table 21:	Correlations between the ITBC modules	61
Table 22:	Correlations between the ITBC modules and Programming I	62
Table 23:	English Proficiency mean and assessment results	63
Table 24:	Learner distribution based on the pre- and post-SpEEX results	64
Table 25:	Percentage of learners who scored below or above level 12 in SpEEX	65
Table 26:	Statistical results of the SpEEX pre- and post-results	65

		Page
Table 27:	SpEEX frequency distribution	66
Table 28:	Analysis of Numerical Skills and ICT module results	68
Table 29:	ICT diploma Programming I results	69
Table 30:	Programming I June results for the last five years	69
Table 31:	The LASSI differences in pre- and post-test scores	71
Table 32:	Statistical results of the pre- and post-LASSI test	71
Table 33:	Correlations of the LASSI skills pre- and post-test results	73
Table 34:	Learners' perception of relevance and structure of ITBC course	73
Table 35:	Learners' perception of relevance of the different ITBC modules	75
Table 36:	Learners' perception of the facilities	76
Table 37:	Learners' perception of the ITBC course educators	77
Table 38:	Educators' role in the ITBC course	77
Table 39:	Learners rating of their ability to learn	78
Table 40:	Learners' perception of their ability to apply knowledge gained after the ITBC course	78
Table 41:	The learner's preference of a pass percentage	79
Table 42:	Learners' perception of assessment of the different ITBC modules	79
Table 43:	The educators and ITBC learners' overall satisfaction of ITBC course	80
Table 44:	ITBC or ICT diploma Enrolment criterion	108
Table 45:	English Proficiency assessments	125
Table 46:	Numerical Skills assessment	125
Table 47:	Information and Communication Technology modules assessment	126
Table 48:	Recognition of Prior Learning handled by the VUT for the ITBC course	127
Table 49:	Contribution of ICT modules to ITBC learner final mark	127

LIST OF ANNEXURES

ANNEXURE A	ITBC learner questionnaire during ITBC course
ANNEXURE B	ITBC learner questionnaire after completion of the ITBC course
ANNEXURE C	ITBC enrollment procedure
ANNEXURE D	ITBC course outline
ANNEXURE E	Calculation of ITBC course assessment results
ANNEXURE F	ITBC educator questionnaire 2004

LIST OF ACRONYMS

AC	Abstract Conceptualisation
AE	Active Experimentation
CE	Concrete Experience
CHE	Council on Higher Education
DOE	Department of Education
HE	Higher Education
ICT	Information and Communication Technology
ICCS	International Certificate of Computer Studies
ITBC	Information Technology Boot Camp
L2	English second language
LACC	Learning Architecture based on Collaborative Constructivism
LASSI	Learning and Study Strategies Inventory
MC	Multiple Choice
NIIT	National Institute of Information Technologies
NQF	National Qualifications Framework
OBE	Outcomes-based Education
PET	Port Elizabeth Technikon
RO	Reflective observation
RPL	Recognition of prior learning
SA	South Africa
SpEEX	Situation Specific Evaluation Expert
TUT	Tshwane University of Technology
VUT	Vaal University of Technology
WRS	Weighted Rating Scale

CHAPTER ONE – PURPOSE OF THE STUDY

1.1 Introduction

Computer programming concepts are quite abstract and difficult for learners who have no prior exposure to computers (Cohoon & Davidson 2002:ix). Learners studying computer science as a discipline need critical life skills, such as logical thinking, mathematical skills, application, comparing, contrasting, problem-solving, and strategic learning skills (Merrill *et al.* 1986:11; Gray 1994:45; Engelbrecht *et al.* 1996:438).

Furthermore not all learners studying at tertiary education institutions have worked with computers (IEEE 2001:23). This is even more true in South Africa (SA), and for this reason an Entry-level Certificate, namely the Information Technology Boot Camp (ITBC) course was introduced during 2003 at the Vaal University of Technology (VUT) in order to expose learners to computers and to help them design, develop, and implement strategic and cognitive abilities. The ITBC was also introduced to deal with the didactic situation at the VUT in the module Programming I, which is characterised by low pass rates. The goal furthermore was to overcome and bridge the gap between secondary and tertiary education, by emphasising learning and success (Hirsch & Weber 1999:149; Du Prè 2003:3).

1.2 Background to the research study

This research was conducted in order to determine the impact of the ITBC course on learning. As part of the research, the researcher investigated what other Universities of Technology (previously referred to as Technikons) in SA are doing to overcome the problem of low pass rates in the discipline of computer science.

1.2.1 Low pass rates of learners in the discipline computer science

Results from other institutions in SA, such as UNISA, also reflect a problem with the comprehension of programming skills in the computer science discipline (Naudé & Hörne 2004:726). When discussing the performance of learners, it is necessary to consider both the pass rate and the time that a learner takes to complete a three year qualification. In order to analyse the pass rate and throughput rate it is necessary to briefly describe these terms. **Pass rate** can be defined as the number of learners that passed an exam in a particular field, such as

computer science, while **throughput rate** can be defined as the number of learners who "exit" a program with a qualification in the minimum time (Landman 2002:7).

The pass rate of learners doing programming courses at tertiary education institutions is problematically low, and the situation is still deteriorating (Borkosky *et al.* 1998; Naudé & Hörne 2004:726). The average pass rate (1997 – 2002) of programming learners in the Department of Software Studies at the VUT is 47 per cent, compared to Mathematics with 58 per cent and Information and Communication Technology (ICT) with 60 per cent (VUT 2004). The average time spent on a three-year course at the VUT is 4,4 years, whereas the throughput time specifically for ICT learners is 4,6 years (VUT 2004). The figures are summarized in Table 1.

Table 1 : Pass rates of learners at the VUT

Year	Software Studies	Mathematics	Information Systems
1997	64%	55%	46%
1988	48%	62%	62%
1999	44%	53%	65%
2000	36%	64%	53%
2001	45%	57%	64%
2002	47%	58%	71%
Average %	47%	58%	60%

For the VUT, the challenge is to improve throughput rates while broadening access without lowering the high quality and standards of the curriculum. Increased access must not lead to a 'revolving door' syndrome for learners with high failure and dropout rates (RSA 1997).

On a national level, graduation rates in 2001 revealed that only 7 per cent of African learners graduated, compared to the 27 per cent of white learners (Cloete, Bunting & Bunting 2002). The National Plan for Higher Education (NPHE) (RSA 2001) stipulates that throughput rates have to be improved from 15 per cent to 30 per cent within the next five years. It furthermore proposes that the participation rate in higher education should be increased from 15 per cent to 20 per cent in the long-term, i.e. ten to fifteen years, to address both the imperative for equity, as well as changing human resource and labour needs. In order to balance the enrolments over the next five to ten years between humanities, business and commerce and science, engineering and technology, the ratios should be shifted from 49 per cent: 26 per cent: 26 per cent to 40 per cent: 30 per cent: 30 per cent. The NPHE also acknowledges the fact that further adjustment to

the ratio is not possible in the short to medium-term because of the low number of learners leaving the school system with the required proficiency in mathematics (RSA 2001).

1.2.2 Computer Science as a discipline

Computer science as a discipline encompasses many vital disciplines with their own integrity and pedagogical traditions, such as programming languages, computer architecture, data structures, algorithms, databases and information retrieval, artificial intelligence, expert systems, computer security, software engineering and operating systems (IEEE 2001:3). It is important for learners to be introduced to as many of these areas as possible and to know how they relate to one another in an integrated ICT environment.

Computer science is a discipline that require an in-depth knowledge of concepts as a foundation for continuation in the discipline (Engelbrecht *et al.* 1996:438). The primary reason for instructional difficulty in the discipline of computer science stems from the fact that problem solving requires an individual to perform at a rather high and complex cognitive level (Goosen 2004:266). Extensive practical experience is required in applying the basic principles of problem solving (Finch & O'Reilly 1974:47). Computer science offers a new approach to problem solving, by which the thought processes of learners can be drastically enriched (Van Solms 1979:10). The programming taught in computer science can be linked to the development of practical abilities in problem solving (Goosen 2004:266). Before a learner can implement a program, the learner should understand how to solve the problem. Programming instructions are used as an instructional environment to promote higher-order thinking skills (Merrill *et al.* 1986:11; Palumbo 1990:65). It would be for the learner's own benefit to understand and realise that every bit of information in computer science is based on what was previously learned (Engelbrecht *et al.* 1996:438). According to Gray (1994:45) problem-solving activities provide learners with opportunities to create and evaluate designs and to experience knowledge-seeking processing and application.

From the above it is evident that problem solving plays a profound role in computer science. Learners need to use the same cognitive functioning skills, such as logical thinking, conceptualism with prior knowledge, relationship forming and analysing, in computer science. It is therefore necessary that learners realise the relationship between the different units of programming and understand these units in order to use them correctly when writing a

computer program. For example, after explaining the sequential processing structure of a program, one normally explains selection control structures. Often learners cannot link these concepts and use one structure nested within another structure.

1.2.3 The influence of curriculum design on pass rates

The pass rates of ICT learners can be influenced by the way the curriculum has been designed. For example, if a programming-first approach is followed in curriculum development of a diploma or degree, international studies cited concerns, such as the following (IEEE 2001:23).

- If the course focuses on programming to the exclusion of other topics, learners are given a limited sense of the discipline and this causes a misperception that "computer science equals programming" (IEEE 2001:23).
- If theoretical topics that would enhance the learners' understanding of the practical material are moved to a later module in the curriculum, the theory no longer has the same relevance. Learners then conclude that theory is irrelevant for their educational and professional needs.
- If educators focus too much on syntax and particular characteristics of a programming language, the learners tend to spend more time on unimportant details (IEEE 2001:23), rather than the more important algorithmic skills, trial-and-error and heuristic approaches of problem solving (Jordaan & Jordaan 1989:440).
- If the programming course is over-simplified for beginners, too little weight for design, analysis, and testing are assigned. Thus,

  "the superficial impression students take from their mastery of programming skills masks fundamental shortcomings that will limit their ability to adapt to different kinds of problems and problem-solving contexts in the future" (IEEE 2001:23).
- If the programming course is too intensive, learners who have no prior exposure to computers will be overwhelmed and disadvantaged. However learners who have previously used computers often simply continue with bad habits, for example, not using indentation in programming (IEEE 2001:23).

It is therefore important to consider these points in the design of an ICT curriculum, in particular the ITBC.

1.3 Problem definition

At the VUT, learners from diverse backgrounds and different mother tongues, enrol for courses such as ICT or Industrial Engineering and are confronted with problem-based instruction (Du Prè 2003:2).

Management of the VUT and lecturers in the Department: Software Studies and Information Technology, have experienced the following problems with teaching programming.

- The first year learners have a misperception of computer science.
- The learners find it difficult to transfer theory into practice.
- The learners have insufficient knowledge of how to analyse a problem, how to use previous experience and how to use a step-by-step approach to plan, design and implement the solution to solve the problem. The learners encounter problems with problem solving if too much emphasis is placed on the syntax of a programming language (Engelbrecht *et al.* 1996:438).
- Generally, learners entering higher education institutions are academically under- prepared (Du Prè 2003:2).
- Learners who have had no exposure to computers are overwhelmed (Du Prè 2003:2).

These concerns led to the design and implementation of the ITBC course in an attempt to:

- improve pass rates;
- broaden access;
- improve problem-solving skills through cognitive strategies; and
- overcome the gap between secondary and tertiary education, by improving strategic learning skills.

1.4 Research questions

To determine the effectiveness and impact of the ITBC course, the following research questions were formulated:

- What are the nature and scope of the ITBC course and the satisfaction levels of learners and educators participating in the ITBC course?
- Does the enhancement of language comprehension have a positive influence on programming and logic skills?

- Does the implementation of problem solving and mathematical techniques have an influence on learners' programming abilities?
- What is the impact of formal introduction to life skills on the performance of 1st year ICT learners?

1.5 Research objectives

In accordance with the problem definition the following objectives for the research project were identified.

- Determine the nature and scope of the ITBC course and the satisfaction levels of learners and educators participating in the ITBC course.
- Expose learners to a language comprehension programme to improve their English proficiency and determine the impact thereof on programming skills.
- Integrate a mathematical skills course into the ITBC course to develop logical thinking skills of learners and to determine the impact thereof on programming skills.
- Determine the impact of formal introduction to life skills on the performance of 1st year ICT learners.

1.6 Research methodology

This research study addresses the challenge to determine the impact of an ITBC course on learners and to make a scientific contribution towards the field of ICT education.

1.6.1 Literature study

The literature review should consist of a compilation of separate, isolated summaries of individual studies of previous researchers (Welman & Kruger 1999:35). An intensive literature study will be conducted in order to identify and gain knowledge about the skills needed by ICT learners and determine the nature and scope of the ITBC course. Comparison will be drawn with other institutions in SA offering similar courses.

In order to identify resources to understand the context of the research problem, computer searches were done on the EBSCo-host, ERIC, SABINET, INFOTRAC, NEXUS, NETSCAPE, and IXQUICK databases. Searches were launched by using the following keywords: Entry Level Certificate, bridging, extended, foundation, cognitive, logical thinking

skills, comprehension skills, numerical skills, problem-solving, information technology, computer competency/skills, constructivist, curriculum development, learning strategy, teaching strategy, ICT skills/literacy/competency, and outcomes-based education.

1.6.2 Target population

The population of 69 first year learners who had applied for an ICT diploma but did not meet the set criteria and who were therefore referred to attend the ITBC course, will be the unit of analysis (Welman & Kruger 1999:49).

Due to resource limitations in terms of class size and a shortage of larger class rooms, the ITBC group had to be divided into three groups, ranging between 25 and 30 per group.

1.6.3 Empirical research

Applied research using quantitative and qualitative techniques was conducted (Welman & Kruger 1999:65; Page & Meyer 2000:11). All learners enrolled for the ITBC course (the intervention) had to write a pre-measurement and post-measurement test bank, specifically designed to evaluate the fundamental problem-solving skills, vocabulary, reading comprehension, mathematical skills, and strategic learning skills. The test bank consists of three instruments called: SpEEX, LASSI, and VaalScan. Correlations between the intervention and the results of the pre- and post-measuring test bank, was compared.

The researcher also made use of an open-ended and scaled questionnaires (Annexure A and B). The questionnaires were handed out to learners during class sessions, allowing them to act spontaneously upon the questions and to raise their expectations, experience and concerns during and after the course.

Summative assessment results were recorded.

1.6.4 Data analysis

The statistical package that was used for the data analysis is called: Statistica. The Statistical Consultant Service of the North-West University was consulted for statistical analysis of questionnaires and quantitative data. Qualitative feedback was used to analyse and further clarify research results.

1.7 Structure of this research report

The objective of the second chapter entitled, 'Learning architecture of the Information Technology Boot Camp course', is to outline the philosophy, nature, scope, and content of ITBC. The teaching and learning styles, the assessment methods and a comparison between other tertiary institutions are outlined and described.

In the third chapter entitled, 'Research design', the different components of the qualitative and quantitative tools that are used to measure the learners' cognitive and strategic learning skills are outlined and described.

The objective of the fourth chapter entitled 'Research findings and discussion' is to report on the results of the procedures and measuring instruments that have been used as well as an analysis of the qualitative and quantitative data.

The objective of the fifth chapter entitled, 'Conclusion and recommendations', is to make conclusions and recommendations, as well as to provide a recapitulation of the findings for the complete research project.

1.8 Summary

In this chapter, the research problem was stated, and the objectives and significance of the research were argued. The reader was introduced to the research methodology, as well as the structure that will be followed through the research report.

CHAPTER TWO – LEARNING ARCHITECTURE OF THE INFORMATION TECHNOLOGY BOOT CAMP COURSE

2.1 Introduction

This chapter will investigate the nature, scope, learning architecture, and assessment strategy as applied in the ITBC course. The minimum criteria for enrollment in the ITBC course at the VUT are also explained. Benchmarking with other tertiary institutions, such as Port Elizabeth Technikon (PET) and Tshwane University of Technology (TUT), previously known as Pretoria Technikon (PT), are conducted.

In order to deal with the didactic situation at the VUT in the module Programming I, it is necessary to understand the nature of the problem (see 1.3). The term under-preparedness refers to a number of constructs including the learners' innate ability, which might be masked by deficiencies in knowledge, skills, and academic proficiencies, so that learners are likely to perform below their potential and in most cases will fail, when in fact they may have the ability to pass (Woollacott & Henning 2004:2). According to our prior knowledge about the learners, as stated in Chapter 1, the under-preparedness of the ITBC learners is understood as the condition where the knowledge and competencies of the first year learner entering the VUT's ICT programme, compare negatively with assumed knowledge and competencies on which the programme is based (Woollacott & Henning 2004:2).

One aspect of under-preparedness is a shortage of sophistication in a learners' cognitive functioning (Woollacott & Henning 2004:2). Woollacott and Henning (2004:3) also mention that the shortage of sophistication cognitive functioning is particularly manifested when dealing with complex, open-ended or ill-structured problems. The levels of cognitive functioning are identified as shown in Table 2 (Strohm Kitchener 1983; Amos 1999).

A second aspect of under-preparedness is the shortage of 'academic literacy', which refers to the ability to read and write effectively within the higher education institution context (Amos 1999).

Table 2: Cognitive functioning

Levels of cognitive functioning	Meaning
Thinking, reasoning and abilities	Refers to the learners' ability to perceive, do calculations, solve problems and the ability to conceptualise and function at an abstract level.
Meta-cognitive functioning	Means thinking about one's thinking. Knowledge about cognitive strategies and tasks, knowledge about when and how to apply them and the ability to recognise the 'success' or 'failure' of any of these processes.
Epistemic cognition	This has to do with understanding how to approach problems and to 'monitor' the epistemic nature of a problem and the truth value of alternative solutions.

Amos and Fisher (1998) also state that effective access to disciplines, such as ICT, means more than just admission to the institution, but entails retention and socialisation within the institution and growing intellectual and social competencies, advancement and success, by understanding the ground rules of the specific discipline. The ground rules refer to the structure of the values, attitudes and way of thinking and doing necessary for success within a particular discipline (Amos 1999).

The last aspect of under-preparedness deals with 'academic proficiency'. The ability to function effectively in a tertiary learning environment, which is characterised, for example, by a high staff/learner ratio, traditional lecture format, high content loads, fast pace and limited number of lectures per week (Alfred *et al.* 1999). Typical academic proficiencies required by learners include note-taking, effective preparation skills for lectures, tutorials, practicals and exams, learning and study skills, questioning skills and appropriate motivation and approaches to learning (CHE 2001:6). Academic proficiency also includes life skills such as time management, basic financial and social skills and the ability to adapt to an unfamiliar social environment. Even the awareness of the facilities and resources that are offered by an institution and how to access them can be seen as part of academic proficiency.

In this research the term 'academic competency' will be used as an umbrella term for the three areas, cognitive functioning, academic literacy and academic proficiency.

The objectives of the VUT's management are to provide for the redress of past inequalities, to improve the learning results and to develop competent programmers, which also forms part of the national plan for higher education institutions that are focused on generating learners with

'enhanced cognitive skills' (DOE 2001:108). Management of the VUT and the research team investigated possible course material and appropriate teaching and learning strategies that could be used in the computer science discipline to address academic competency problems of learners. Management and the research team then decided to use the course material, and the teaching and learning strategies of the National Institute of Information Technologies (NIIT). The research team, in collaboration with members of the NIIT, designed and formulated the ITBC course, with intended learning outcomes, based on specific areas of teaching and learning of generic skills that need to be contextualised and integrated into the knowledge and skills of programming (Olivier 1998:2; DOE 2001:109).

2.2 Term clarification

Intervention courses at Higher Education (HE) institutions in SA, such as VUT, TUT and PET, can be classified as bridging, foundation, extended or short courses. It is therefore important to define the terms bridging, foundation, extended, and short course. The time required to cover a module or unit is also important to define.

According to the National Qualifications Framework (NQF) **bridging certificates** are on level 4[1] (Landman 2002:7), with a total credits of at least 120, of which a minimum of 72 credits is at level 4 (CHE 2001:3). The bridging certificate can be seen as a further education and training, rather than a higher education, qualification. The purpose of a bridging qualification is to serve as a bridge from level 4 to level 5, in order to enable learners to attain a complete level 4 qualification, and 'catch up' or 'fill the gaps' in the content or disciplinary knowledge in order to meet the requirements of the higher education programme of their choice at level 5 (CHE 2001:4). The bridging certificate is not covered by state subsidy. The nature of the bridging certificate is intensive and focuses on building a knowledge base and discipline/field-specific skills in target areas such as computer science. Entry requirements for a bridging certificate are appropriate level 4 qualifications or unit standards (CHE 2001:4).

According to the NQF a **foundation certificate** on level 5 (Landman 2002:7), has a total credit value of at least 120, of which a minimum credit of 72 is at level 5 (CHE 2001:5). The

[1] The NQF levels correspond to the 10 level NQF framework

foundation certificate will be awarded if a learner successfully completes an academic development programme. Higher education can use foundation certificates to admit learners who do not fully meet the level 4 admission requirements, for direct entry to level 5 programmes (CHE 2001:6). The purpose of this qualification is to develop in learners a foundation of academic and generic skills in order to equip them for academic study and lifelong learning. The design of the qualification is based on the disciplinary or field-specific areas, to provide learners with basic introductory knowledge, cognitive and conceptual tools to function successfully in a specific field such as computer science (DOE 2001:106; Woollacott & Henning 2004). The entry requirement for a foundation certificate is a Senior Certificate (or equivalent) that does not meet the regular entry requirements set by the higher education institution for admission to a diploma/degree programme. A learner may be granted admission to the first 120 credits of an appropriate diploma/degree in either general or career-focused tracks. The credits attained in the foundation certificate may thus be transferred and accredited at level 5. The department of education (DOE) proposed that up to 25 per cent of the credits earned may be transferred to an appropriate mainstream undergraduate qualification.

An **extended** programme allows learners to obtain some main stream credits while at the same time developing their knowledge, skills and strategic learning (Woollacott & Henning 2004:2).

The VUT decided to classify their course as a **short course** and named it the **Entry-level Certificate ITBC-course,** as it is not a bridging, foundation or extended course, and because it is offered over a four-month period and the learners obtain no credits towards the main stream. Furthermore, most of the outcomes of the ITBC course are based on unit standards pitched at NQF levels 4 and 5 of the Entry-level certificate, hence referred to as the ITBC-course. This course is not covered by state subsidy. The ITBC course is not a compulsory prerequisite for the diploma/degree in ICT. Learners who have satisfactory matriculation results with 24 points on the Swedish scale, and with Computer Studies on Grade 12 are not required to complete the ITBC course (see Annexure C).

It is important to define and determine the time required to cover a unit or module. The term **notional hours** refers to the learning time that it would take an average learner to meet the outcomes defined (Isaacs 2000:9). The notional hours include contact time, time spent in structured learning in the workplace, individual learning and assessment. SAQA uses a credit

system based on the idea that one credit equals 10 notional hours of learning (Isaacs 2000:9). The time will be indicated in hours, which corresponds to the total number of hours a learner should engage with the module (DOE 2001). The total notional hours for the ITBC course is less than 72, which is a further reason why the ITBC cannot be classified as either a bridging, foundation or extended course.

2.3 The nature, scope and content of the Information Technology Boot Camp (ITBC) course

The quality of learning that takes place in an educational institution depends on

- the quality of the design of the learning tasks and the materials set before the learners;
- the quality of the teaching methods used; and
- the assessment strategy that are deployed (Bernstein 1982:10).

Topics central to the design of the ITBC course are the role of the programme, length, sequence, and strategies for integration of knowledge and skills.

Management of the VUT, with delegates from the NIIT, enumerated the set of concept knowledge and skills that they believed should be part of an ideal introductory course and with the research team designed the ITBC course, consisting of:

- Life Skills;
- English Proficiency skills;
- Numerical Skills; and
- the NIIT modules. The NIIT modules can be classified as a combination of both programming and function-first approaches (IEEE 2001:24).

2.3.1 Background of the National Institute of Information Technologies (NIIT)

The NIIT consists of two units, the NIIT Technologies and the NIIT Education. The NIIT Technologies spread from global banks, financial institutions to industry, support products, and services ranging from software development to knowledge solutions (NIIT 2003c).

The NIIT Education has offered courses since 1974 in the field of the ICT learning domain. The domain spread from entry-level ICT literacy programs to advanced courses. The NIIT

Education supports individuals and organizations. The NIIT Education can be split up into four categories, namely:

- career programs;
- skill enhancement programs;
- awareness programs, and
- e-learning. (NIIT 2003b).

The above-mentioned categories are not mutually exclusive. The ICT modules of the ITBC course have characteristics that can be associated with all four categories.

The NIIT provides an eNcore Student Management System that is a centralised database for learner's data (VUT 2003a:2). The eNcore system will be implemented at the VUT during 2004. The NIIT further provides online services for educators such as expert answers, testing, an online library, global forums, and communication tools. All of the afore-mentioned can be accessed on the web, through a login and password (Shamsi 2003a). A trainer's instruction manual for educators to conduct their classes is also available and includes tools for educators as listed below (Shamsi 2003a).

- Co-ordinator guides that the educators can use as a manual when preparing for lectures.
- Data files that contain solutions to problems for all the exercises in the learner guides.
- Power Point slides that the educators can use in their presentation of lessons.
- A computer-based training tool that consists of demos for the topics covered in each module, to enhance the knowledge of learners.
- Internet solutions of HTML files needed in one of the ICT modules of the ITBC course (VUT 2003b).

2.3.2 The Information Technology Boot Camp course content

The ITBC course consists of two parts: firstly, the added skills modules and secondly, the NIIT ICT modules. Figure 1 indicates the curriculum design being followed by the management and research team in the ITBC course.

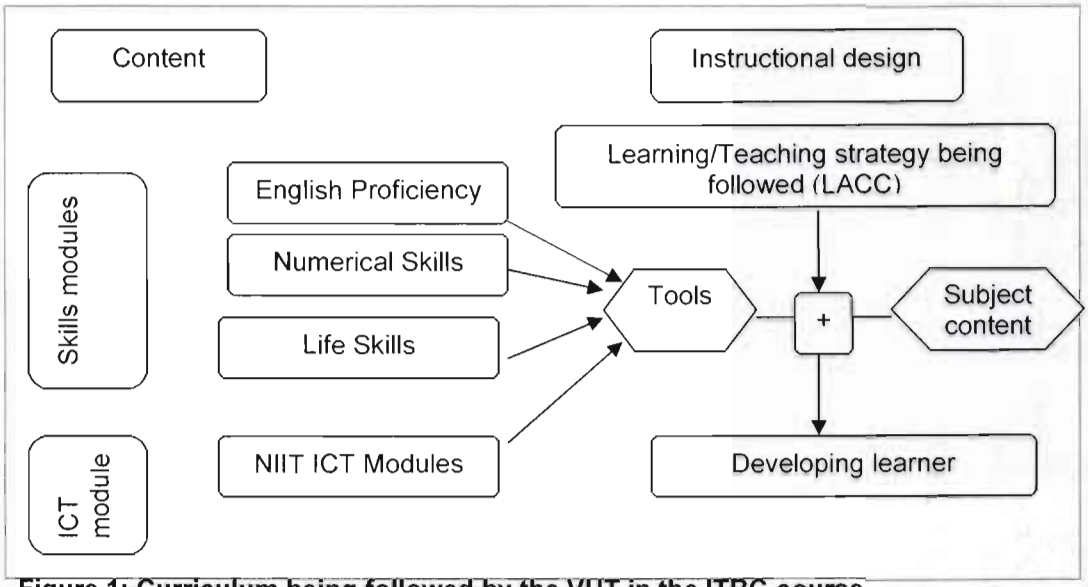

Figure 1: Curriculum being followed by the VUT in the ITBC-course

The VUT added three skills modules to the ITBC course in order to add value to the learning process and to provide remedial actions (see Figure 1). The three modules are:

- **English Proficiency**: in which the learners' vocabulary, language and reading skills are stimulated. Academic literacy is addressed, developed and reinforced.
- **Numerical Skills**: in which the learners' numerical, logical thinking, and problem-solving skills are stimulated.
- **Life Skills**: in which the learners are equipped with study related skills, such as, time management, learning to prepare for a class, how to study and how to review work, in order to face the challenges facing them at tertiary level (DAD 2003).

Further attention is given to the development of academic competency in order to facilitate development of relevant professional competencies needed by learners.

The ICT part of the ITBC course consists of four modules comprising course material compiled by the NIIT. The ICT modules consist of:

- an overview of computer concepts, Microsoft Windows, and networking essentials;
- Microsoft Office Word, Microsoft Excel, Microsoft Power Point, and Microsoft Outlook;
- e-mail communication skills, Internet, HTML, Front Page, Access and web page design; and
- program logic and techniques (PLT). In a higher education institution, learners are engaged in complex reasoning when they are learning. Cagné, Kendler and Rothkopf's research on problem solving focuses on problem solving as a form of learning (Laurillard

1997:12). The basic assumption in this type of approach is that the human mind operates in a particular way, when it learns, thinks and solves problems. It can thus be used to derive appropriate teaching methods. In the PLT module learners are taught generic programming skills by using pseudocode and flowcharts in order to foster the fundamentals of problem solving and logical thinking (NIIT PLT).

In the development of the ITBC course the research team used clearly defined outcomes, objectives and goals, that constitute standardisation with regard to the desired education and training outcomes and associated assessment criteria (see Annexure D).

Table 3 gives an indication of the ITBC number of hours per week, number of weeks required, contact hours and composition of modules. The workloads of Module 3 and Module 4 were not evenly distributed.

Table 3: Information Technology Boot Camp course

The VUT added skills	Number of weeks	Total hours per week	Total contact hours	At the end of this module, a learner will be able to
Skills modules				
English Proficiency	5	9	45	Demonstrate writing and reading skills in English. Summarise content-related work in the field of ICT.
Numerical Skills	16	3	48	Apply numerical skills related to Programming I in the field of ICT.
Life Skills	6	3	18	Identify the various factors, such as anxiety, motivation, concentration that influences academic competency in the field of ICT.
The NIIT ICT modules				
Module 1	4	1 ½	6	Describe and understand the fundamental concepts of computers, Networking and Windows.
Module 2	6	9	54	Use and manipulate Microsoft Office software, such as: Word, Excel, and PowerPoint.
Module 3	4 6	3 6	12 36	Understand, apply, and use E-mail, HTML, and Front Page to design small web pages. Design and develop small databases for businesses in Access
Module 4	6 3	6 3	36 9	Apply generic programming solutions in PLT.

The ITBC learners were provided with timetables and milestones in order for them to apply time management effectively. The milestones contained the dates when learners would be

assessed. The linear application of modules can be seen in the sequence/order of modules being conducted in Table 4 below (Shamsi 2003b).

The reason the English Proficiency module is completed in a block is to allow learners to undertake other modules armed with appropriate reading and writing skills. The Numerical Skills module is offered over a period of 15 weeks, in order for the learners to develop numerical skills. In the ICT modules a linear approach is followed because the learners need to accumulate knowledge that builds units progressively.

Table 4: Linear scheduling of ITBC modules at the VUT

Modules in order	Contact hours	Chart indicating the weeks that each module will utilise															
Weeks		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VUT added-skills modules																	
English Proficiency	45																
Numerical Skills	48																
Life Skills	18																
The NIIT ICT modules																	
Module 1 Overview	1 ½																
Concepts	1 ½																
Windows	3																
Module 2 Word	18																
Excel	18																
Power Point	18																
Module 3 MS Outlook	12																
Internet	36																
Module 4 Access	6																
Programming Logic Techniques	39																

The next section deals with the teaching strategy that is used in the ITBC course. Before discussing the teaching and learning strategies, it is necessary to elaborate on the impact of learning theories on teaching and learning, in terms of curriculum development, instruction, and assessment.

2.4 Approaches towards learning and teaching

Learners can take different approaches towards learning; some will tend towards a deep approach, while others will tend towards taking a surface approach (Biggs 2003:12). Research over the last 25 years by Marton, Säljö, Hounsell and Entwistle reflected on how learners go

about their learning and specifically comprises studies of deep, surface, and strategic learning (Biggs 2003:11).

Learners who tend to take a deep approach have the intention of understanding, engaging with, operating in, focusing on what is significant, making use of evidence, are motivated by interest, relate knowledge from different modules, and value the course (Atherton 2003:1; Bradford 2004:1). Research done by Bradford (2004:2) also suggests that a deeper approach to learning is linked to a higher level of understanding during learning. Good teaching and assessment can influence learners to take a deep approach while poor teaching will influence learners to take a surface approach (Biggs 2003:16; UCD 2004:1). According to Atherton (2003:1) deep and surface approaches show a correlation with motivation: deep with intrinsic motivation, and surface with extrinsic, but they are not necessarily the same thing. A learner can adopt either approach with either motivation.

The surface approach arises from an intention of the learner to get the task out of the way with minimum trouble while appearing to meet course requirements (Biggs 2003:14). In order to do this type of task, low-cognitive-level activities are used when higher-level activities are required to do the task appropriately (Biggs 2003:14).

The third approach, called 'achieving' or strategic, can be summarised as a very well organised form of surface approach, and in which the motivation is to get good marks (Atherton 2003:1). Strategic learning describes learners with an intention to achieve the highest grade possible through effective time management, organised study methods. Strategic learners ensure that the conditions and materials for studying are appropriate, and alert to the assessment process to be used (Bradford 2004:3). Figure 2 illustrates how teaching creates messages that influence learning (Biggs 2003:87).

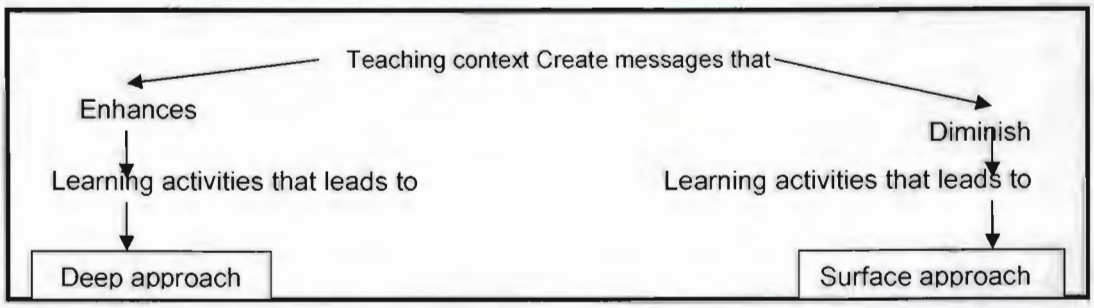

Figure 2: Concept map

Laurillard (1997:9) stresses the importance of meaningful learning. The mechanism by which meaningful learning occurs can be described in terms of "theory of subsumption". Laurillard (1997:10) specifies that

> "new information is meaningful when it can be related to existing components in the cognitive structure, and this relation aids retention."

This implies that educators should first provide general concepts under which the new information can then be subsumed. For example, when explaining a computer concept such as repetition control structure, the educator should use a meaningful example that will be understood by learners (VUT 2003a).

Management and the research team encouraged educators to change the learners' learning environment through course design and challenging teaching methods (Bradford 2004:3).

The instructional design was aimed at motivating and encouraging learners to take a combination between deep and strategic approaches towards learning the module content.

2.5 Foundation for a teaching and learning strategy

There are different approaches, theories, and phases involved in the developing learner (Gordon 1969; Pikunas 1976; Jordaan and Jordaan 1989; Engelbrecht *et al.* 1996; Louw *et al.* 1998; Santrock 1998; Steffe *et al.*1998; Demetriou *et al.* 1999; Santrock 2001; Schickedanz *et al.* 2001). Developmental theories were developed by theorists such as Wertheimer, Bandura, Lewin, Khohler, Koffka, Festinger, Hebb, Miller, Newell, Craik & Lockhart, Paivio, Ausubel, Bruner, Piaget, Vygotsky, Kolb, Flavell, Cagné, and Maslow (Cooper 2001).

According to academic theorists, learning refers to a mental activity that the learner actively engages in. Theorists see learning as a descriptor for an activity that takes place whenever a relatively permanent change in behaviour occurs within the learner resulting from experience or activities such as thinking, reasoning, and evaluating (Laurillard 1997:5; Louw *et al.* 1998:8; On Purpose Associates 2001; Schickedanz *et al.* 2001:14). The definition of learning from an experimental perspective emphasises several critical aspects of the learning process (Kolb 1984:12).

- The emphasis on the process of adaptation and learning as opposed to content or outcomes.

- Knowledge is a transformation process being continuously created and recreated, not an independent entity to be transmitted or acquired.
- Learning transforms experience in both objective and subjective forms.

Learners learn in different ways and interpret problems differently (see 2.4). It is therefore necessary to investigate existing teaching methods and determine how they can be implemented in computer science in order to enhance the lecturing skills of computer science educators. The need for new and improved teaching methods is very high on the list of priorities of tertiary education institutions, for example, as necessitated by the implementation of Outcomes-based Education (OBE). Tertiary education institutions need to keep track of the latest developments and trends in training and education (Du Plooy & Coetzee-Van Rooy 1999).

Part of the reason why the majority of educators find it difficult to discharge their teaching obligations is that they are not sufficiently trained and empowered (Hartshorne 1992:3; Nyamapfene & Letseka 1995:161; Erasmus & Van der Westhuizen 1996:11; Monyooe 1999:71). Management and the research team of the VUT invited one of the NIIT educators to train the educators at the VUT in the teaching strategy being used at the NIIT, which is based on OBE, constructivism, and experiential learning. The training of the VUT educators took place at the start of the semester.

2.5.1 Outcomes-Based-Education (OBE)

Outcomes-Based Education means clearly focusing and organising teaching and learning around what is essential for all learners to be able to do successfully at the end of their learning experience (Spady 1994:1). Olivier (1998:2) states that an outcomes-based curriculum emphasises a holistic and integrated approach towards learning. The learners should be able to master the content, competencies, and processes within a specific context (Olivier 1998:2).
OBE further requires that organising the curriculum, the processes of preparation, performance, completion, interaction and assessment phases become part of the learning process and consequently part of what will be assessed as well (Olivier 1998:23; Spady 1994:1).

The delivering of the ITBC course will be according to OBE guidelines and closely linked to real-world situations (Olivier 1998:3). The approach towards the advancement of learning is based on the demonstration of achievement of outcomes.

The learners furthermore need to be actively involved in the learning process to become aware of their cognitive strategies including planning, monitoring, allocation of resources, self-regulation, and self-direction. The ITBC course not only uses an OBE approach but a constructivist approach towards development, learning and teaching.

2.5.2 Constructivism

Constructivism as a teaching approach, assists learners to become autonomous learners and thinkers and has been implemented in academic development programs in SA (Buffer & Allie 1993:8). Within the new educational paradigm educators act as facilitators of learning (Buffer & Allie 1993:8). Constructivism supports the creation of knowledge through interaction between the developing learner's current understanding and the environment, by starting with a problem and not an objective. Two renowned constructivists are Piaget and Vygotsky.

Piaget, a biologist and psychologist, is renowned for constructing a highly influential model of child development and learning (On Purpose Associates 2001; Santrock 2001:203; Schickedanz *et al.* 2001:18). Piaget believes that cognitive development is determined by various factors such as the outcome of interaction between maturation, experience and practice, social interaction and transmission, and equilibration (Louw *et al.*1998:71). Piaget's theory explains cognitive functioning in terms of the interaction of individuals with their environment (Demetriou *et al.* 1999:16).

The component, co-operative learning and peer group teaching, relates to Vygotsky's theory, which emphasises that the 'zone of proximal development' is extended through problem solving and advancing of knowledge, under adult (educator) guidance or in collaboration/interaction with more capable peers (Doolittle 1997; Santrock 2001:37; Schickedanz *et al.* 2001:22). Vygotsky analyses the social origin of higher mental functions such as conscious attention, consciously controlled and memory (Louw *et al.* 1998:18). A good example is the acquisition of conscious action plans and selective attention in complex problem solving. Vygotsky specified that the higher mental function in the learner's cultural

development appears on two planes, where 'knowing' and 'knowing how' are transformed (Louw *et al.* 1998:18; Blanton *et al.* 1999). Language is the most important cognitive functioning tool, especially when the learner starts to plan activities and solve problems.

The knowledge of cognitive development makes it possible for educators to design curricula in any field in such a way that subject matter could be taught appropriately to learners at any stage of cognitive development (Kolb 1984:25). Furthermore the learner constructs reality, mediates thoughts, feelings and behaviours through language (Nicholl 1998). Language provides a framework through which we perceive, experience and act (Nicholl 1998). Words are both used to think and to communicate. These findings support the inclusion of the English Proficiency module in the ITBC course (see 2.3.2).

2.5.3 Experiential learning

Experiential learning offers the foundation for a lifelong learning approach to education (Kolb 1984:4). Learning methods that combine work and study, theory and practice, provide a more familiar and therefore more productive area for learning.

Experiential learning has been accepted as a method of instruction in colleges and universities nation wide (Kolb 1984:14). Experiential learning changes educational processes in two ways:

- it changes the content of curricula, providing new ways of teaching modules; and
- it alters the learning process – the way that learners go about learning modules.

According to Kolb (1984:68) experiential learning involves four principal stages.

- **Concrete experiences** (CE), which reflects the learner's personal involvement through concrete experience.
- **Reflective observation** (RO), which means the learner reflects on experience and looks for meaning.
- **Active experimentation** (AE), which means the learner applies this meaning to form a logical conclusion, then experiments with similar problems, which then lead to new concrete experiences.
- **Abstract conceptualisation** (AC), which means the learner experiments with similar problems, which leads to new concrete experience.

According to Kolb (1984:77) the CE/AC and AE/RO dimensions are polar opposites as far as learning styles are concerned and, depending on the preference of the style of an individual's learning stages, four distinct types of learners are found:

- divergers or imaginative learners,
- assimilators or analytic learners,
- convergers or precision learners, and
- accommodators or dynamic learners.

The research team investigated curricula, which are based on OBE, constructivism, and experiential learning. They found that the course structure and learning architecture of the NIIT best suited their requirements.

2.5.4 The "Learning Architecture based on Collaborative Constructivism"

The NIIT uses a "Learning Architecture based on Collaborative Constructivism" (LACC), which encompasses the theory of situated cognition and collaborative constructivism (NIIT Access 2003). The research team decided to equip learners to become competent through participation in social practices by using the NIIT's learning architecture as medium for instruction, which calls for lower-order as well as higher-order cognitive processes.

Each of the NIIT modules is presented through the following four learning sessions:

- a **construct** session over one or two periods, during which the new concepts are constructed (class room session);
- a **collaborative** session, during which learners collaborate with concepts (self-study session);
- an **experimental** session during which the learners are exposed to active experimentation in a microcomputer lab, to experiment with their understanding of the concepts and observations to form logical conclusions that lead to better learning effectiveness and experience;
- a **machine room** session with an '**apply**' phase during which the learner develops conceptual clarity, learns, refers, compares, thinks and applies his/her entire knowledge spectrum and creates solutions for case studies.

The NIIT's collaborative constructivist methodology uses learning sessions that are oriented towards the four stages of experimental learning and it is also suitable to apply to all possible types/profiles of learners. The following diagram in Figure 3 shows how the four learning sessions and four learning styles of learners are linked together and Table 5 explains the learning style mechanisms used in the learning cycle as a basis for learning in the ITBC course.

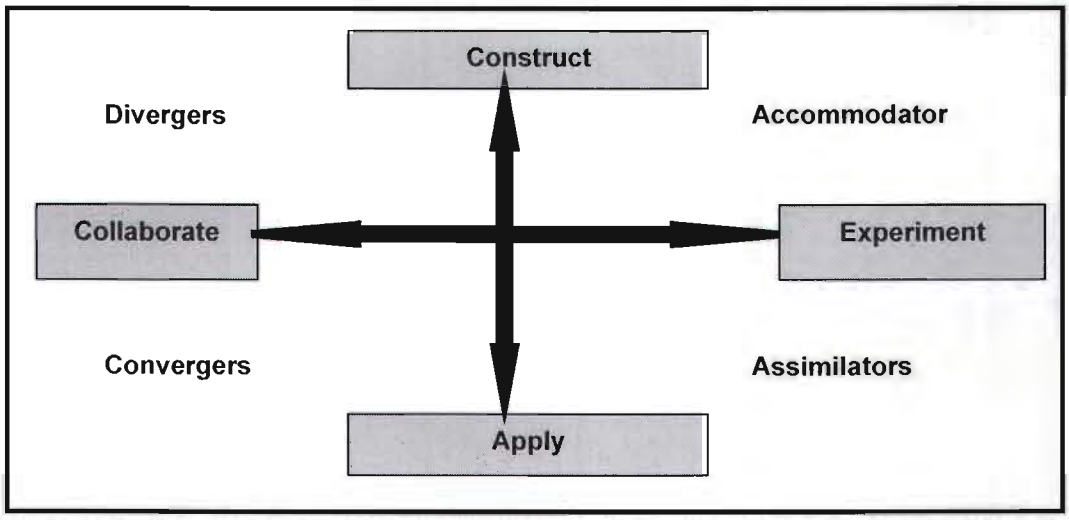

Figure 3: Collaborative constructivism methodology, learning sessions and learning styles of experiential learning, integrated by the NIIT

Table 5: Learning style deliverable mechanism

Learning style Component	Objective
Construct	Concrete experience shared by subject matter expert.
Collaborate	Reflective observation through case studies, scenarios, best practices to fit into larger picture.
Experiment	Active experimentation by experimenting with problems.
Apply	Abstract conceptualisation by reference reading and implementing theory practically into projects.

Figure 4 shows an architecture (LACC) of how the NIIT integrates constructivism, learning sessions, experimental learning style stages, and types or learners.

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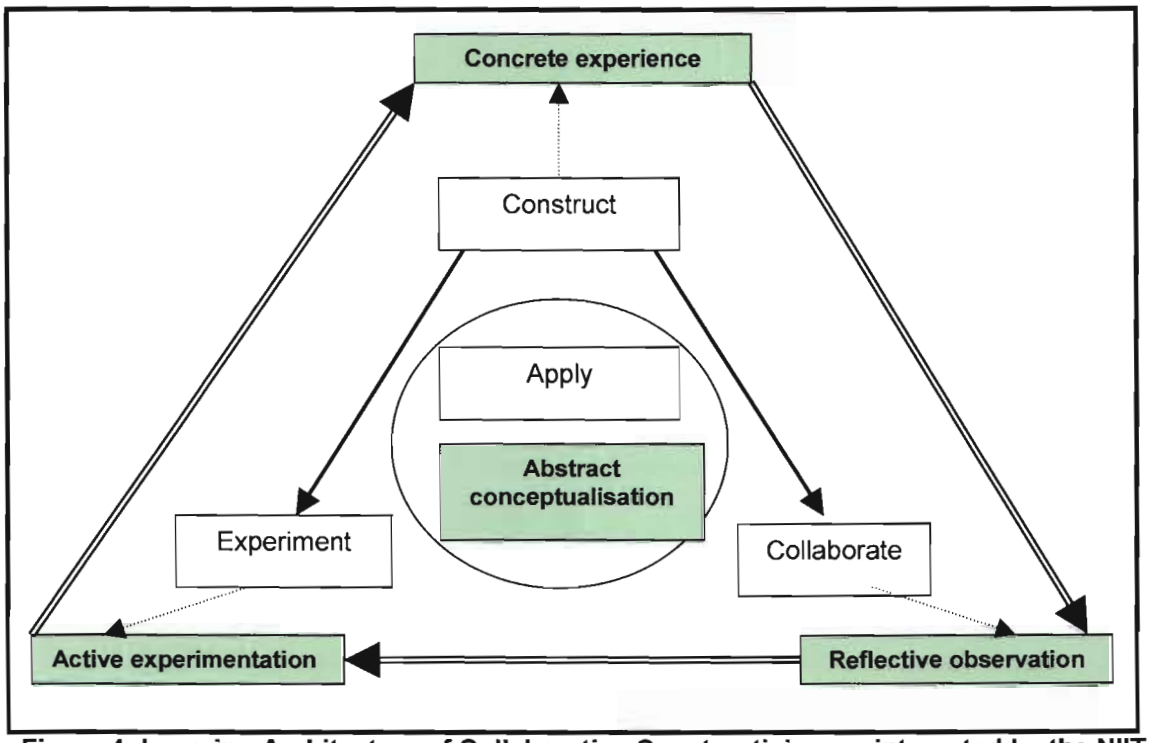


Figure 4: Learning Architecture of Collaborative Constructivism as integrated by the NIIT

The research team applied the learning architecture for the ITBC course, to enhance the quality of teaching and learning, and to apply resources-based teaching and training. The research team finds in the LACC and the experiential learning theory, a conceptual rationale and guiding philosophy as well as practical educational tools, to design deliverable mechanisms that will improve the learners' ability from unconscious incompetent to adding/share knowledge.

In order to understand how learners learn, and to react to the teaching methods, it is necessary to investigate how learners process information.

2.5.5 Improved information processing supported by LACC

Information processing theorists examine how people of different ages process information or manipulate symbols, how information enters the mind through their sensory and perceptual processes of memory, such as storing, transformation and retrieval, and how people perform complex activities such as problem solving in various cognitive tasks (Louw *et al.* 1998:83; Schickedanz *et al.* 2001:24; Santrock 2001:38). Information processing theorists investigated

the different aspects of cognition (e.g. attention, perception, or memory) and the processes in information processing (Louw *et al.* 1998:83).

Craik and Lockhart designed a processing-levels model of memory where the importance of how much time and attention are paid to the information that needs to be learnt is stressed, as well as the depth of processing (Louw *et al.* 1998:83).

Atkinson and Shiffrin explained in their multiple-store memory model how information is stored in memory (Louw *et al.* 1998:83). They further showed how information is transferred from the sensory registers for vision, learning, touching, tasting or smelling, to short-term memory and then placed in long-term memory (Louw *et al.* 1998:83). The control of transfer of information between the different stores is controlled by control processes such as 'rehearsal', which refers to repeating information mentally or verbally, and 'encoding', which refers to selective changing of information or the addition of other information from long-term memory to the information in the short-term memory (Santrock 2001:238).

The information processing model is simple and designed to illustrate the main cognitive processes and interrelations. Information processing begins when information from the environment is detected through sensory and perceptual processes; it is then stored, transformed and retrieved through the process of memory, as can be seen in Figure 5 (Santrock 1998:48).

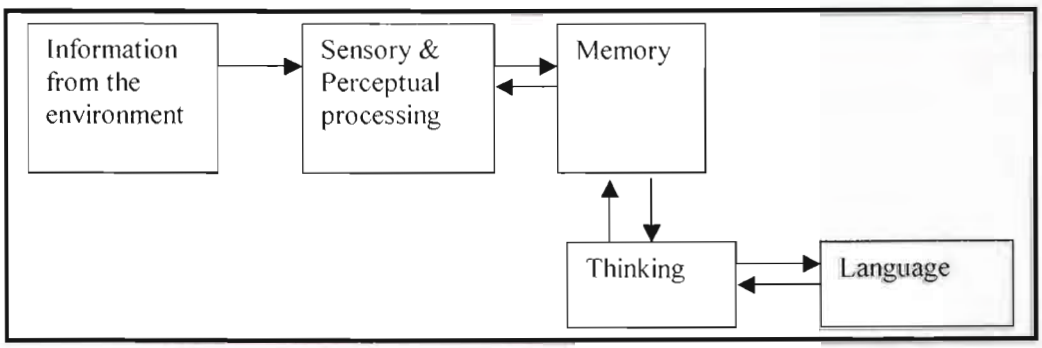


Figure 5: Model of cognition according to information processing theories

When asked to represent a simple idea in any way that comes to mind, learners will choose different forms. Learners tend to represent information in a number of different, but predictable ways: linguistic, pictorial, and a combination of linguistic and pictorial. The

mental processing of putting information into one of these three preferred formats aids in understanding the information (Keller 2000:2). Note taking, outlining, charting, and concept mapping are some examples of ways learners use to represent or facilitate learning. Many learners, for example, relying on a rote linguistic note-taking method, (e.g. writing educator notes almost word-for-word) may find that representing the lecture material in a new format (pictorial) is an effective way of understanding and committing the information to memory. Pikunas (1976:96) states that the capacity to learn new subject matter is also dependent on neurological and emotional maturity, general adjustment, and the method of presentation.

2.5.5.1 Learning and interaction skills

Functioning knowledge involves declarative knowledge (academic knowledge base), procedural knowledge (having the skills), and conditional knowledge (knowledge of the circumstances for using them), which in turn tells learner what the curricula might address (Biggs 2003:43).

The research team's target for the ITBC course is to use functioning knowledge where theoretical knowledge needs to be developed to relational/extended abstract levels to provide both the knowledge of the specific context, and the conditional knowledge that enables the skills to be performed adequately. Figure 6 demonstrates how declarative, procedural, conditional, and functioning knowledge are linked together (Biggs 2003:42).

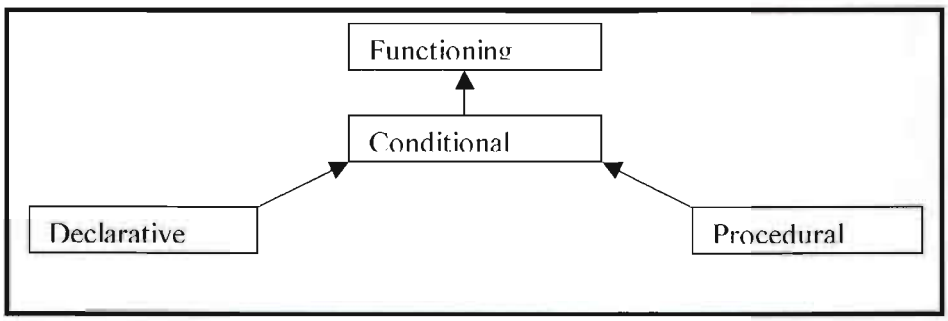


Figure 6: Relationship between different kinds of knowledge

When a learner encounters a new interface on the computer, he has an intended outcome in mind but only a limited knowledge of how to use the interface. For example, consider a learner who has never used a specific software package and who is required to learn to use it as part of his job or for education purposes. There are three ways a person can find out how to use a software package (Lansdale & Ormerod 1994:148). The first approach will be by reading

instruction manuals. Secondly, by experimenting with systems; for example, hypermedia interfaces are designed to support exploration as a learning strategy. Lastly, receiving guidance from experienced users; for example, an educator in computer science is an immediate source of instruction, feedback, wisdom and encouragement to the novice learner who is learning to interact with an interface.

2.6 Assessment strategy

Traditional education and training consist of written tests/exams and competency tests, where learners are measured according to how they mastered the knowledge (Olivier 1998:3). OBE assessment is a continuous activity, based on assessment of knowledge, skills and adherence to specific processes and the achievement of outcomes (Olivier 1998:3). Summative assessment is used for grading purposes (Biggs 2003:192). The work is assessed holistically and feedback is provided together with a rating to the learner (Biggs 2003:193).

Progressive or continuous assessment is used during the ITBC course as well as summative assessment events at the end of a module. Learners have the opportunity to re-write the module test for all the modules, in order to improve their marks, or to rectify mistakes made during the first attempt of the assessment. The summative assessment consists of:

- multiple choice and short-answer questions;
- projects and problem-solving exercises; and
- practical exercises (especially in ICT modules and English Proficiency to determine learners understanding of content.)

The question cues defined by Bloom are used to demonstrate the learners' levels of learning in the field of ICT and will be discussed in more detail in the next section.

In order for an ITBC learner to qualify for a certificate the learner needs to obtain 60 per cent in each module. If the learner fails to do so in one or more module, they need to repeat the module in order to qualify for a certificate. More detail about the calculation of the certificate results can be found in Annexure E.

2.6.1 Implementation of Bloom's levels of learning in the assessment strategy

Bloom together with Karthwohl developed a classification system called taxonomies of educational objectives, which is referred to as Bloom's Taxonomy, and which attempts to

divide cognitive objectives into subdivisions ranging from the simplest behaviour to the most complex (Bell 1983:169).

Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order, which is classified as evaluation (Bell 1983:170; Evans *et al.* 2004:6). Table 6 will demonstrate the six levels of Bloom's taxonomy from the lowest to the highest cognitive level, with the skills that the learner will demonstrate in each level and the cues to questions that can be used to assess the levels (Bell 1983:170; Evans *et al.* 2004:6).

Table 6: Bloom's Taxonomy

Bloom's levels	Skills demonstration	Question cues used in assessment
Knowledge	Focus on recall and remember. Observation and recall of information. Knowledge of events, places and dates. Mastery of subject content.	Choose, define, give, label, list match, memorise, name, observe, outline, provide, recall, recite, repeat, and state.
Comprehension	Understand or grasp meaning. Interpret information. Translate knowledge into new context. Interpret facts, compare, and contrast. Order, group and infer causes.	Describe, discuss, explain, express, give examples, identify, paraphrase, report, summarise, tell, and understand.
Application	Use information. Generalise and use learning in new situations. Solve problems by using required skills or knowledge.	Apply, illustrate, manipulate, modify, organise, select, solve, show, and use.
Analysis	Apply top-down design to determine relationships. See patterns. Organise parts. Recognise hidden meanings. Identification of components.	Analyse, classify, categorise, compare, distinguish, differentiate, and examine.
Synthesis	Compose or put together elements. Generalise from given facts. Relate knowledge from several areas. Predict, draw conclusions.	Combine, develop, generate, produce, design, formulate, plan, and propose.
Evaluation	Judge values	Argue, assess, evaluate, interpret, justify, prioritise, recommend, and summarise.

Assessment covered all six areas, with the multiple choice and summative assessment questions focusing on the lower levels and the practical work and projects focusing on the higher levels.

2.7 Comparison between tertiary institutions

The philosophy concerning introductory curriculum has been the subject of intense debate throughout history (IEEE 2001:22). Many a strategy has been suggested and approved, but no ideal strategy has yet been found, and every approach has its own strengths and weaknesses (IEEE 2001:22). Introductory programs differ in their goals, structure, resources, and intended audience. In most institutions in SA, in particular the VUT, as well as the United States, the primary audience of introductory computer science consists of learners who have not been exposed to computer science and who are seeking to acquire programming skills (IEEE 2001:24). There is no one-size-fits-all approach that can be followed at all institutions.

The structure and format, of course, vary significantly from tertiary institution to tertiary institution and from country to country, as can be seen from the explanation in this section (IEEE 2001:16). All the institutions under investigation use a semester system. The number of weeks, hours, order, and periods used for the units or modules are however different. On average a module is scheduled three times a week over a period of 15 weeks.

Table 7 compares the bridging, foundation, extended, or short courses offered by the VUT, TUT and PET (Sharwood 2002).

Table 7: Comparison between VUT, TUT and PET

Arguments	Vaal University of Technology	Tshwane University of Technology	Port Elizabeth Technikon
Entry requirements for ICT diploma	Swedish scale Math's HG C SG D English HG C SG D	A formula used in the Technikon Pretoria Potential Assessment (TPPA) test Math's HG Pass SG C	Weighted Rating Score (WRS) = 35 or higher; two subjects on the higher grade (English and Mathematics weight x2), worked out on Swedish scale and multiplied by weight.
Entry requirements for course	Learner did not meet the requirements set by the diploma criteria. The learner is a boarder case on SpEEX and/or math's and English requirements is not acceptable. Learners should first pass the short course before entry to diploma is granted.	If learners failed to meet the diploma requirements they are requested to do the bridging course before they are allowed to continue with a diploma.	If the learners failed to meet the diploma requirements they are requested to do the foundation course before they are allowed to continue with a diploma.

Arguments	Vaal University of Technology	Tshwane University of Technology	Port Elizabeth Technikon
Name of course	Information Technology Boot Camp	Bridging short course	Extended program: Information Technology
Classification of course	Short course	Bridging programme	Extended/foundation programme
Provision of state subsidy	No	No	Did not answer
Is it compulsory for all learners?	No, only the once that have not completed the diploma requirements.	No, only learners that did not meet the diploma requirements.	No, those who do not qualify for the ICT diploma needs to do it.
Credit value	None (short course)	60	120
Does this course contribute any credits towards the diploma?	None	None	10
When did the course start the first time?	July 2003	January 2000, two times a year	Did not answer.
Duration of course	4 months (16 weeks)	6 months (18 weeks)	10 months (28 weeks)
Cost of course	R4 500.00	R5 500.00	R 6 000.00 per year
Programs offered in course?	NIIT and own modules	International Certificate of Computer Studies (ICCS)	Developed their own

The assessment strategies used by the three tertiary education institutions are summarised in Table 8.

Table 8: Comparison between the assessment strategies at three tertiary education institutions in South Africa

Arguments	Vaal University of Technology	Tshwane University of Technology	Port Elizabeth Technikon
Measuring instruments used to test performance of course?	SpEEX LASSI VAALSCAN	SpEEX	None
Time of measurement	Before and after	Before	Not applicable
Method of assessment being used	Continuous with small tests covering specific learning outcomes of the work and summative assessment at the end.	Continuous with summative assessments for each module.	Continuous evaluation and summative assessment.

2.8 Conclusion

Historically, the majority of the population in SA was denied access to education and training, which resulted in unskilled labour, according to the White Paper on Higher Education Department of Education (RSA 1997:2) and Du Prè (2003:1). One of the national goals is to produce learners with skills and competencies that build the foundation for lifelong learning, including critical, analytical, problem-solving and communication skills, as well as the ability to deal with change and diversity as viewed by the White Paper on Higher Education (Department of Education) (RSA 1997:5). Against this backdrop, the VUT wants to provide training to develop the academic competency skills and innovation necessary for national development through the ITBC course.

A paradigm shift is needed from assumptions about learning as a form of knowledge transfer to thinking about learners constructing their own knowledge and meaning in relation to their prior knowledge, expectations and their perception of the purpose of learning (Crebbin 2001:1). The Life Skills module guided the ITBC learners to think about and understand content in different ways.

A further paradigm shift is needed from thinking about theory and practice as separate entities towards understanding theory and practice as inseparable (Crebbin 2001:2). With the ITBC course a combination of constructivism, OBE, and experiential learning approaches are followed that emphasise the importance of implementation and application of theory into practice.

CHAPTER THREE – RESEARCH DESIGN

3.1 Introduction

The objective of chapter three is to show the research design, procedures and measuring instruments that have been used to report on the impact that language comprehension, problem-solving skills, numerical skills, and life skills had on learning, success, and academic competencies in the field of ICT.

In order to address the low pass rates in computer programming courses (see 1.2.1), it is necessary for the educator to understand the factors that play a role in the development of a learner's cognitive styles and strategic learning abilities (see 2.4 & 2.5). With this, the challenge is also to find a tool that can measure these abilities.

Research has established various influences on cognitive capabilities. These factors can be categorised according to:

- personal style – describes the way in which a person habitually approaches or responds to the learning task;
- cognitive style – reflects the way in which the individual learner thinks;
- learning strategy – reflects those processes which are used by the learner to respond to the demands of a learning activity;
- language comprehension – reflects the way in which the learner comprehends with language; and
- logical thinking skills – reflects the way in which the learner will think and solve problems, especially in computer science (Riding & Rayner 1998:7).

This chapter provides an overview of tools that are utilised in an effort to measure English proficiency, cognition, and logical thinking skills, in order to determine the influence on problem solving, numerical skills, and programming skills (see 2.1).

3.2 Research design

In the research design the researcher describes how the participants (ITBC learners) were involved. The research design can be defined as the plan according to which we obtain research participants (subjects) and collect information from them (Welman & Kruger 1999:46).

The research design is influenced by the research questions and can be compared to a blueprint of an architectural drawing (Merriam 1988:6). It is a plan that will help the assembling, organising, and interpreting of information, and results in a product or research finding. Figure 7 shows the procedure being followed for the research design.

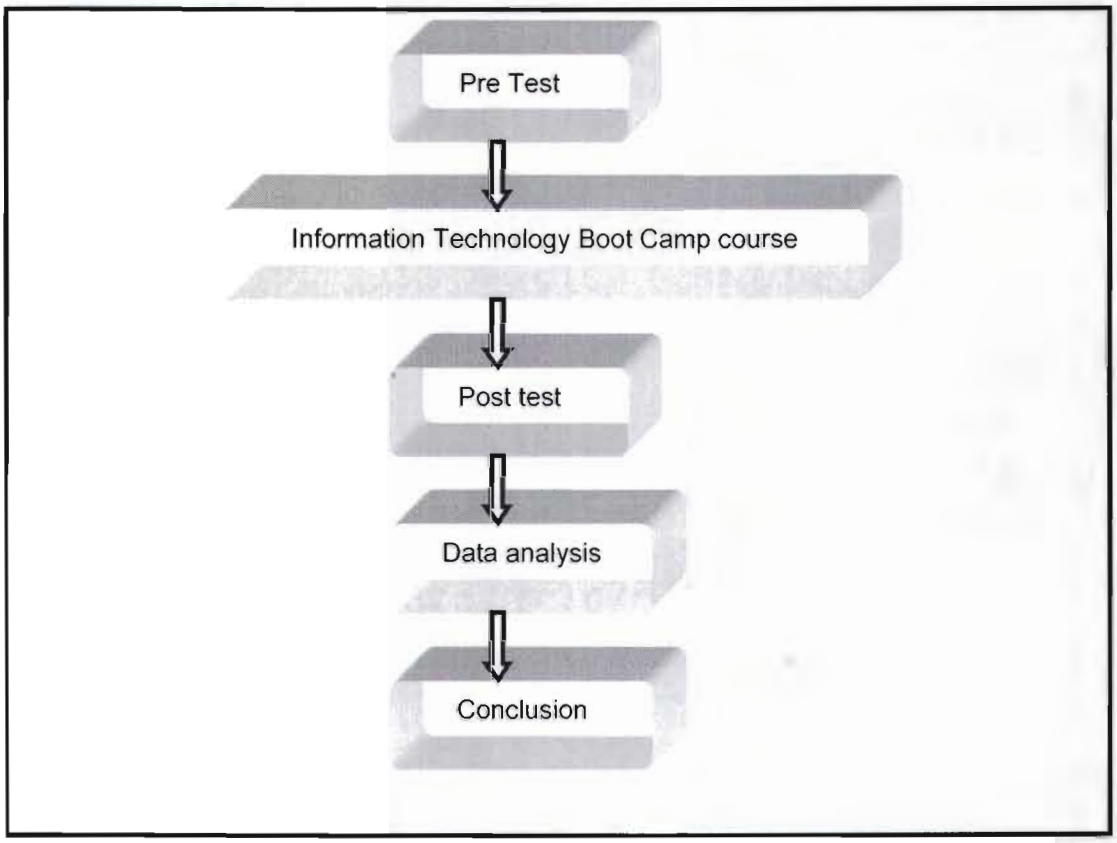


Figure 7: Procedures that were followed during research design

In this research, data had to be collected, coded and analysed (Creswell 1994:148). Coding means to identify variables, which need to be analysed statistically, and to decide on the different code values and variable level representation (Welman & Kruger 1999:208; Page & Meyer 2000:87). Variables can be defined as the properties of objects or events that can take on different values (Howell 1999:20). Variables can be categorised as shown in Table 9 (Howell 1999:20; Welman & Kruger 1999:208; Page & Meyer 2000 145).

Table 9: Variable categories that were used in the research

Variable category	Description of variable	Examples of the variable used in research design
Discrete	This variable can take only a relatively few possible values, such as gender, marital status or yes/no.	The ITBC learners and educators had to answer yes/no in some of the questions used in the questionnaires.
Continuous	Variables that take on only values between lowest and highest points on the scale.	Questions with answers ranging from poor to satisfactory were used in the questionnaires. The SpEEX and LASSI results may be regarded conceptually as a continuous variable.
Independent	Variables that can be manipulated by the experimenter.	The ITBC course.
Dependent	Variables that are not under the experimenter's control data or the variables being measured.	The measuring instrument results.

The pre-test was written before commencement of the ITBC course in July 2003 and the post-test was written after the completion of the ITBC course in November 2003.

The ITBC course was conducted in a natural setting, in the computer labs situated at the VUT, where the ITBC learners were studying.

3.2.1 Population and sampling

The population refers to the individuals who possess specific characteristics under measurement, and consists of all 69 learners enrolled for the ITBC course in June 2003 (De Vos 1998:190; Babbie 2002:181). The ITBC learners had to follow an admission and registration procedure, as listed below.

- Learners applies at the registration department by completing a form and paying an initial registration fee.
- The ICT educators then evaluate the learners' mathematics and English marks together with the Swedish scale mark to determine if the learner qualifies to enrol (see Annexure C).
- The learner then needs to finish the placement tests.
- Only after completion will they be enrolled and receive their study material, after payment of initial class fees (VUT 2003a).

3.3 Quantitative data

The research design of this project is based on educational research that is both quantitative and qualitative and is, as such, exploratory, because of the social behaviour and experiences of learners (Merriam 1988:16; Mouton & Marais 1990:51; McMillan 1992:9; Rubbin & Babbie 1993:36; Creswell 1994:1; Babbie 2002:84). The next section will elaborate on the quantitative and qualitative tools that were used to collect and analyse data in order to answer the research questions.

Figure 8 reflects the different dependent and independent variables, used in the research design process of the ITBC course.

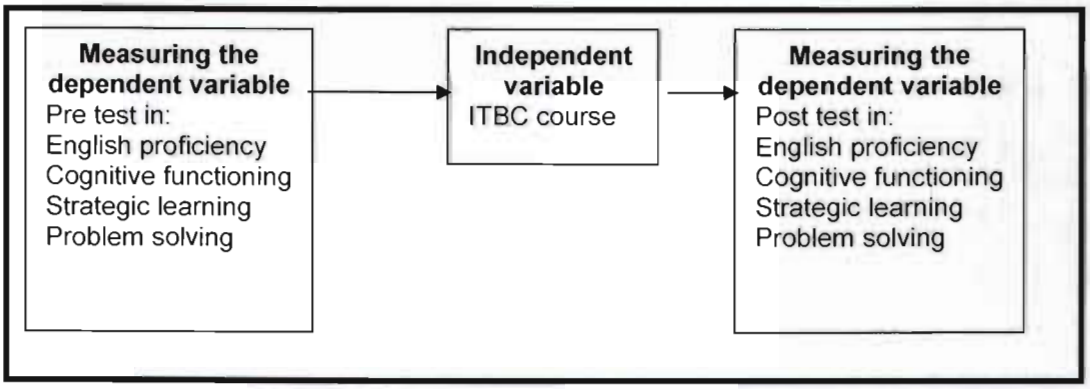


Figure 8: The different dependent and independent variables used during the research

Quantitative data was collected by analysing the successes, effects, and influences of the ITBC course in the field ICT with a test bank consisting of three measurement tools.

- The **VaalScan** test that measures the learners' English proficiency. The VaalScan was developed by Hough and Hornè (Consultants: Functional Literacy and Communication Skills) for the management of the VUT, to measure the level of English literacy of first-year learners (Hough & Hornè 1994; De Beer 1998:2). The test consists of two vocabulary sections that give a score on learner's level of English competency.
- The **SpEEX** (Situation Specific Evaluation Expert) test measures the learners' cognitive ability to comprehend concepts in computer science by testing their vocabulary, mathematical skills and English skills (Coetzee 2000:3). The SpEEX is a psychometric testing instrument, as it measures relevant characteristics and plays an important part in the differentiation of people in specific roles. The SpEEX determines a learner's creativity, reading comprehension, mental alertness, vocabulary, general knowledge, numerical

ability, object assembly skills, spatial reasoning skills, and perception skills (Coetzee 2000:3).

- The **LASSI** (Learning and Study Strategies Inventory) test that measures the learners' strategic learning skills. LASSI refers to: Learning and Study Strategies Inventory (Weinstein *et al.* 2003:1). The LASSI assessment tool is used to statistically diagnose the study skills of a learner, such as the learners' awareness and use of learning and study strategies related to skill, will and self regulation components of strategic learning (Weinstein *et al.* 2003:1). LASSI focuses on both covert and overt thoughts, behaviour, attitude and beliefs that relates to successful learning and that can be altered through educational instructions (Weinstein *et al.* 2003:1).

3.3.1 VaalScan as an instrument for measuring learner's awareness about teaching and learning strategies

The VaalScan measuring instrument is used to measure the ITBC learners' English literacy skills more specifically:

- vocabulary skills and
- familiarity with English.;

The learners need to fill in missing words and complete the sentences. The learners need to complete a set of 30 multiple-choice questions within 10 minutes for the vocabulary in context questions. With the multiple choice questions the learner needs to select the correct meaning of the words, in order to verify learner's level of vocabulary skills. The tests are then marked and graded, according to the results. The total score gives an indication of the level of English competency of learner. Table 10 reflects the grading levels used by the VaalScan measuring instrument.

Table 10: VaalScan measuring levels

Scores out of 50	Level	Number used for statistical analysis
0 – 19	Below grade 8	1
20 – 25	Grade 8 to 9	2
26 – 30	Grade 10 to 11	3
31 – 50	Grade 12 and above	4

The next section will explain the importance of English comprehension for higher education learners and more specifically for ICT learners, and how a module, English Proficiency, is implemented in order to address English deficiencies.

3.3.1.1 Importance of English proficiency for Higher Education learners

Many tertiary institutions in South Africa, including the VUT, use English as the language of instruction while many learners often have English as their second or third language.

Kilfoil (1999:46) made the following statement:

> "English is an important language for South African students studying science subjects at tertiary level, partly because it is a medium of instruction, but also because most scientific writing is in English."

Coetzee-Van Rooy (2000:160) investigated the proficiency in English of learners at the VUT and how they perceived their own ability to speak, write and read English. The majority of Southern Sotho respondents regarded themselves as successful at speaking, writing, reading and understanding English. Southern Sotho respondents, in general, achieved low scores on the English second language (L2) proficiency test, even though they had an inflated perception of their English L2 proficiency. The problem with this finding is that learners are taught and examined in English at tertiary level. Furthermore, learners at the VUT enrolled for Computer Science are evaluated with the VaalScan test, before enrolling for the ICT diploma, in order to determine their language proficiency.

Coetzee-Van Rooy (2000:165) also indicated the implications of the learners' attitude towards English as a second language and their proficiency in the subject. The inflated positive perception of English proficiency by Southern Sotho learners could influence their willingness to participate in supplemental exercises to improve English proficiency. If they do not believe that they have a "problem" with English, they will receive well-intended opportunities as patronizing and unnecessary. (Coetzee-Van Rooy 2000:165).

Coetzee-Van Rooy (2000:160) also specified that several studies have proved that high socio-economic status has an influence on language and academic achievement in general. Language and vocabulary are interwoven and are two categories that play a profound role in cognitive development, conceptualisation and learning, which in turn influence the learner's ability to solve problems in computer science.

Many of the problems that under-prepared learners encounter when entering tertiary institutions are related to language (Lubbe 1997). The number of under-prepared learners is increasing and tertiary institutions find it necessary to create programmes to assist learners with their learning difficulties (Agar & Knopfmacher 1995).

The learner's language development is extremely important in cognitive development and learning. Through speech, one explains a concept to the learner. The learner forms a specific perception of it in his mind and the learner will retrieve it when needed. If the learner's language development is not good, the learner might have difficulty understanding the real meaning of the concept the educator is trying to explain.

The English Proficiency module is designed to counteract the under-preparedness of learners and to upgrade the learner's level of proficiency and to assist learners with understanding of computer science terminology and solving problems.

3.3.1.2 Vocabulary in context

The vocabulary in context component of the VaalScan is used to measure learners' level of understanding the vocabulary in context, by using the following scores as given in Table 11.

Table 11: Vocabulary in context scores

Scores	Description of score
29 – 30	Excellent
27 – 28	Well developed
22 – 26	On par with scholastic level claimed
15 – 21	Slightly below scholastic level claimed
8 – 14	At least 2 levels below scholastic level claimed
3 – 7	Inadequate
2 and below	Totally inadequate

If learners lack a good vocabulary, they will experience difficulty and will be seriously handicapped in tertiary education institutions, because educators traditionally have tested knowledge of concepts verbally. Gordon (1969:191) mentioned that the development of vocabulary and the development of concepts are closely related. Through words, learners can manipulate ideas. Learner's vocabulary consists not only of the words they use in speech or can recognise on a printed page, but also the words they use in comprehension. It is through this 'understanding' vocabulary that learners gain knowledge and mastery of the world.

Vocabulary development is influenced by motivation, opportunities to learn, social-class position and gender (Louw *et al.* 1998:62; Santrock 2001:8; Schickedanz *et al.* 2001:12).

Cultural background could influence the fact that the learners' exposure to and experience of language is limited and, therefore, such learners have difficulty in grasping the basic concepts of learning (Santrock 2001:8). In addition to vocabulary, syntactical differences also influence educational performance. Sentence structure is another indication of thought, and may even influence thought. How the learner arranges words and the meaning of words will together influence further learning. The meaning learners assign to words, which reflects their real understanding of the words, influences their ability to use the words to arrive at concepts, which may often differ from meaning held by subject experts. They assign 'common sense' meanings that grow out of their own experiences rather than the 'technical' meanings the educator uses (Louw *et al.* 1998:9). This can also be seen in the class situation where the educators have learners from foreign countries that speak different languages, but the classes and textbooks are presented in English (Kairuz 2000:10). These learners have difficulty in understanding the work properly. Sometimes they misunderstand the meaning of words. Language ability and acquisition play a profound role in the learning of computer programming languages because the problems to be solved are normally presented in a descriptive manner.

The emotional and cultural setting in which learners are taught heavily influences the meaning of words, as they make progress toward "dictionary" meanings (Gordon 1969:105; Schickedanz *et al.* 2001:21). Language gives individuals great power to generalize. The learners increased power to generalise through the use of words contributes to thought and thinking and, in turn, contributes to further vocabulary development, greater precision in the use of words, and a larger area of common meanings learners can share with others (Schickedanz *et al.* 2001:21).

Every subject area in education has its own terminology and each science its own concepts, formulated in technical language. A person who cannot comprehend this terminology cannot follow the scientific discourse (Griessel 1992:9). The learner needs to grasp what the educator (expert) has to say in technical language or in a module such as Programming Logic that uses computer languages.

3.3.1.3 Learners' familiarity with English

The VaalScan also measures learners' familiarity with English in different levels as indicated in Table 12.

Table 12: Familiarity with English

Levels of measure	Rating
16 – 20	High degree
12 – 15	Limited
9 – 11	Rare/lacking
8 and below	Very little

The ITBC learners are given the opportunity in the English Proficiency course to equip them with language and communication skills in order to present work in a written, oral and verbal format (see Annexure D).

Evans (2004) identified several interpersonal skills needed by ICT people and one of them is clear communication skills (oral and written). The following are six reasons in support of why ICT learners need familiarity and good communication skills in English in the ICT industry.

- It is necessary for ICT learners in industry to communicate ideas and concepts effectively and efficiently to colleagues and customers (Harvey *et al.* 1997)
- A pre-requisite for ICT professionals is business communication and interpersonal skills (Mclean *et al.* 1996)
- The ICT industry needs young learners with minds of their own, who can present orally or in writing their views on particular proposals of developments (Kelly 1996)
- For effective teamwork, learners need effective communication, constructive feedback and to deal with controversy in group discussions. (Janz & Wetherbe 1995).
- Learners do not only need core communication skills; other higher-level interpersonal skills include negotiation skills and group communication skills that are also considered as important (Becker 1997)
- A successful system development and ICT project depends on effective communications between users and developers. When the parties involved fail to understand each other, it hinders effective communication and even causes conflict (Wynekoop & Walz 1999)

The aim of the English proficiency module is to improve learners' communication skills by addressing the components, as listed in Table 13.

Table 13: Components of the communication process

Components	Definitions and explanation of component
Sender	The person/s giving the message, for example the educator or in the ICT.
Receiver	The person/s needing to understand the message, for example the ITBC learner.
Message	What they say or write (communicate).
Feedback	When the learner demonstrates understanding of module content to the sender (lecturer). Feedback in the ITBC course is done orally/written.
Interference/ barriers/noise	Obstacles in the communication environment that can hinder the effective sending/receiving of a message, such as negative attitudes, perceptions, music, or cell phones.
Encoding	The process whereby the sender converts ideas into symbols such as written documents, for example memorandums, notes or spoken sentences or oral feedback after evaluations
Decoding	The receiver interprets the message. The interpretation of the receiver can be influenced by the medium, noise and the receiver's skills and knowledge.
Influences	Feelings, attitudes, values, experiences, culture and self-esteem are things that can influence the way in which the sender/receiver communicate.

The English Proficiency and Life Skills modules contribute to the mastering of primary and secondary listening skills needed by ICT learners. By developing learners' familiarity with English it is predicted that learners' self-motivation, management skills and self-esteem will improve (Evans 2004). Figure 9 reflects how the ITBC learners' interpersonal skills are connected (adopted from Evans 2004).

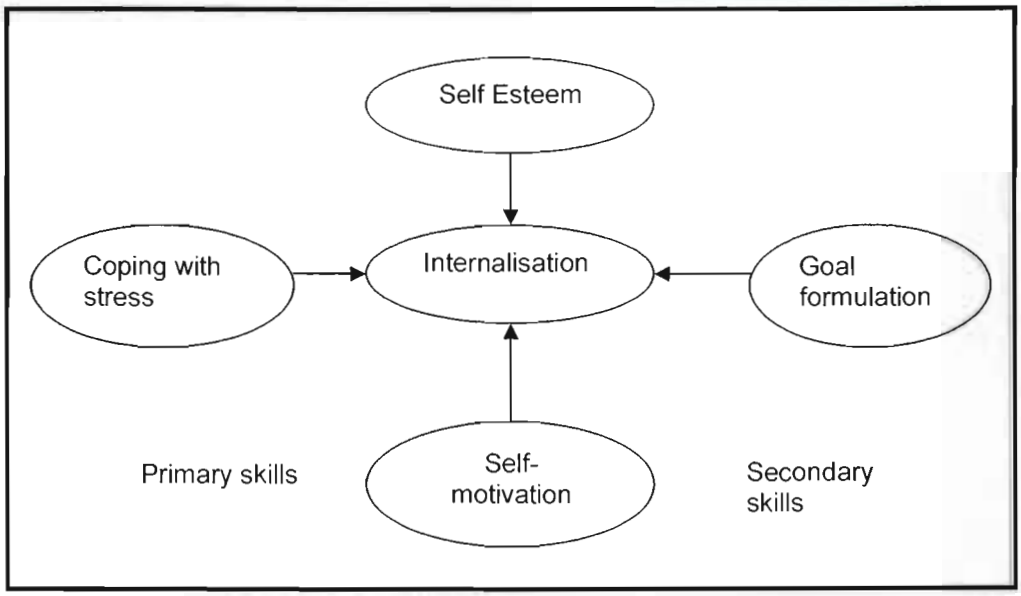


Figure 9: Interpersonal skills of ITBC learners

3.3.2 SpEEX as an instrument for measuring learner's aptitude and career orientation

The SpEEX pre- and post-measuring instrument are used to determine the learners' level of conceptualisation, observation, mental alertness, assembling (advanced), comparison skills, advanced linguistic proficiency, advanced calculation, insight, and reading comprehension.

The SpEEX measuring instrument's acceptable scales are in the range of six to twelve. The scores of each of the batteries in the SpEEX are based on a 9-point scale. If the learner scores below three in a battery, no points are allocated. The learner must have above five for at least three of the double points allocated, in order to score between six and twelve.

3.3.2.1 Problem solving as a component of the SpEEX instrument

The SpEEX uses four batteries to test the learners' **ability to form concepts** and **solve problems**:

- The conceptualisation battery (SpEEX 100). This battery assesses the learners' potential or capacity to reason in spatial terms; to see the relationship between parts; to 'complete' the picture; to envisage the whole or end-result; and to anticipate the outcome.
- The observation (mental alertness) battery (SpEEX 400). This battery assesses the learners' potential or capacity to pay attention; to understand; and to be 'sharp' or alert.
- The assembling (advanced) battery (SpEEX 502). This battery assesses the learners' potential or capacity 'to put together'; and to arrange parts into a whole or wholes of more advanced complexity or sophistication.
- The comparison battery (SpEEX 0700). This battery assesses the learners' competency to see the relationship between objects and situations; to classify on the basis of detail of comparable detail; and to detect or perceive 'inconsistencies' and 'irregularities'.

The next section will explain the importance of the learners' ability to handle logical thinking skills, conceptualise information, their observational mental alertness that are needed in ICT and advanced linguistic proficiency, in order to solve problems.

Logical thinking skills can be described as a person's way of thinking, way of forming opinions, or reasoning ability given certain perceptions about a situation (Jordaan & Jordaan 1989:464; De Bono 1993: 20; Santrock 2001:506).

Learners need to learn how to think, how to use the right thinking processes, how to develop problem-solving strategies, how to improve their mental representation, how to expand their knowledge base, how to process data and how to memorise information (Botha & Cilliers 1999:151; Santrock 1997:300). When learners want to think critically, solve problems or learn any new knowledge, they need to take an active role in learning (Santrock 1997:300).

According to Engelbrecht *et al.* (1996:135) there are basically three types of thinking processes. These are listed below.

- Meta-components control cognition, select strategies and monitor performance in terms of goals.
- Performance components operate on data directly at a lower level of generality. Comparing stimuli, selecting responses and working out relations between stimuli are examples of performance components.
- Knowledge acquisition components are necessary for gaining new knowledge and include selective encoding, selective combination and selective comparison.

These thinking processes take into account the influence of motivational and environmental factors, as well as the different types of memory that play a role in thinking. De Bono (1993:132) argues that there are different types of thinking. These types are shown in Table 14.

Table 14: Types of thinking

Types of thinking	Meaning
Exploring	Means to look around increase knowledge and awareness of the subject.
Seeking	We have a definite need for something specific. We may need a design or a new creative idea or we may need to resolve conflict to gain a solution to a problem. This is very different from just exploring. In this context the word "seeking" also means, "constructing". It is not as if the solution lies hidden somewhere and we just have to find it. We have to construct the solution just as we have to put together a design.
Choosing	There are a number of alternatives and we have to make a choice or decision. There might be just one course of action and our choice is whether to use it or not. To some extent choosing comes into most thinking. For example, in design or problem solving we reach the point where several possible alternative solutions exist and we have to choose between them.
Organising	All the pieces are present (like the pieces of a puzzle.) We have to put the pieces together in the most effective way. Designing a solution to a programming problem is part of creative thinking and part of "seek" thinking. Putting the program together is part of organised thinking. Laying out a plan and carrying out the plan can both be part of organised thinking, especially in computer system design.

Types of thinking	Meaning
Checking	Critical thinking addresses evidence, correctness and acceptability. We judge or evaluate what is put before us and we check it for correctness. Obviously there is a certain amount of checking that goes into all thinking (problem solutions, designs, choices, organising, etc.) but this type of thinking also exists in its own right.

In writing a computer program one needs to make use of all the above-mentioned thinking skills and processes. It is necessary to explore a problem statement, organise and sort all the given information needed to solve the problem. One needs to seek a solution to the problem. In the seeking process there might be more than one possible solution. In the Programming Logic module learners are lead to explore, seek, choose, and organise information in order to solve problems.

The process of forming concepts forms an important aspect of constructing information (also seen in the information processing scale of LASSI.) Concepts can be defined as the categories used to group objects, events and characteristics on the basis of common properties (Santrock 2001:255).

Perceptual constancy is the ability to recognise an object, regardless of its position, size, background or texture, as the same object in a different environment (Santrock 2001:151). When learners are faced with computer programming problems, they need to recognise specific objects, for example, input variables and data types that are needed to solve a problem. Learners should be able to recognise the same object or programming concept in a different environment or problem situation and thus need perceptual constancy in order to solve problems. Part/whole are the ability to perceive parts of the whole, and to be able to perceive the whole from its parts. It is also the ability to see the whole, and to break it down into parts (Santrock 2001:152). The ability to perceive parts of the whole is a necessity when using top-down modular approaches in computer science. Sequencing ability develops out of spatial perception. Perceptions are laid down in learners' minds. When placed in a specific situation they make use of these perceptions to form a conclusion.

It is possible for the computer science educator to help learners to discover and think about concepts in order to lay down the perceptions of programming concepts. The perception of the learner involves a process where the learner should be able to identify the information

presented to him based on prior knowledge or perceptions of the information, or the forming of new perceptions if it is new information. It is then the task of the learner to deal with these concepts, assign meaning to them, analyse them and remember them. The learner needs to think and bring the theory and problem together to form a solution.

In a computing environment one is quite often confronted with decision-making and problem solving, and writing programs is a process of solving problems (Santrock 2001:38). Problem solving is based on step-by-step procedures (Pikunas 1976:190).

When learners are faced with new problems, they interpret them with reference to better-understood, previously encountered ones. The key to analogical problem solving is the extrapolation from better-understood to less-understood problems, which resembles the process used in scientific reasoning (Santrock 2001:261).

As soon as the concept of cause and effect is part of a learner's life, the learner can apply it quite efficiently in computer programming. Implementing programming instructions on the computer and seeing the effects and causes are ways of exploring. When seeing a new occurrence of a problem, the learner should be encouraged to find out what caused this occurrence.

3.3.2.2 Numerical skills as a component of the SpEEX instrument

Mathematics is an important tool in developing a learner's logical thinking skills. Mathematics enhances one's reasoning, which is the basis of logical thinking skills and problem solving (De Bono 1993). Research by Greyling (2000), Calitz (1997), and Evans and Simkin (1989) indicated that mathematical abilities play an important role in the successful learning of programming skills.

The SpEEX uses four batteries to test the learners' **numerical skills ability**:

- The advanced calculation battery (SpEEX 302). This battery assesses the learners' potential or capability to work and deal with numbers and figures of advanced complexity.
- The insight battery (SpEEX 1000). This battery assesses the learners' potential or capacity to understand; to reflect on insight; intuition; vision; wisdom.

- The reading comprehension battery (SpEEX 1600). This battery assesses the learners' potential or capacity to read as well as understand what has been read clearly and objectively.
- The advanced linguistic proficiency (SpEEX 2502). This battery assesses the learners' competency with language that the learner needs to speak in the workplace and how proficient the learner could be in using it for communication purposes.

The next section will explain how ITBC learners need to be able to deal with numbers, show insight, the importance of reading comprehension in problem solving and the learners' linguistic proficiency.

Gordon's (1969:193) idea of mathematical and scientific concepts of number, space, and distance follow essentially the same pattern as vocabulary development, because numbers and words are both symbol systems (Langrehr 1988:vii). Mathematical scientific concepts held by learners are subject to change (Gordon 1969:233). The process of discrimination of number concepts grows as the individual develops cognitively. Concept formation is a function of intelligence, direct experience, and instruction and understanding (Gaudia 1973:227; Santrock 2001:255). Adolescents are not dependent only on direct experience, although they use this where applicable, but can shift to a more conceptual, abstract approach when direct experience is insufficient. Learners cannot develop a concept without experience, but the experience no longer needs to be direct. When learners start to develop arithmetic skills they are capable of hypothesizing a piece of work, building abstract categories, perceiving cause-effect relationships, between the different abstract objects, principles and meanings, and show insight into problems that need to be solved in ICT (Louw *et al.* 1998:81; Demetriou *et al.* 1999:201). So the better a learner is educated the better his concept of relationship forming will be and the better he will be able to show insight into identifying components needed to solve problems. The experience of concepts is also important in the cognitive-development process.

Language acquisition permits symbolic representation of the object and of sequence and behaviour. The way that language acquisition develops will determine how the learner will be able to represent problems symbolically (Doolittle 1997; Nicholl 1998; Louw *et al.* 1998:19). Engelbrecht *et al.* (1996:439) suggest that learning problems that are experienced in the mathematics class can frequently be related to reading problems. However, there are learners who suffer from what one can refer to as 'arithmetical inability'. Learners who develop more

slowly than the average pupil in the class, or who are younger or smaller than the rest, are often candidates for mathematical problems (Engelbrecht *et al.* 1996: 440). Arithmetic skills and abstraction form two major parts of cognitive skill development.

3.3.3 LASSI measurement tool for strategic learning

A study on integrated study and thinking skills in bridging programs for disadvantage learners at a university in SA, done by Cilliers and Kilpin (1997) identified different perspectives of the same underlying problems between learners and educators. The educators identified problems such as poor time management, insufficient preparation, etc., which the learners experienced as symptoms, namely excessive volume, pace of work, etc. The inability of the learners to identify actual causes/effect relationships stems from the dysfunctional learning habits and attitudes, especially in science and mathematics (Cilliers & Kilpin 1997). In order to break these habits and attitudes, learners need to understand the shortcomings in their learning culture and be willing to operationalise new cognitive, motivational, and behavioural strategies. Meta-cognitive skills are among the strategies learners need to utilise within a constructivist approach towards learning so as to ensure generative learning.

The management and research team acknowledge the interdependence of study methods and thinking skills that are crucial factors in successful academic study, and therefore integrated it into the ITBC course.

Although there is no summative assessment event for the Life Skills program, the LASSI pre-post measuring instrument will be used in this study as an indication of the influence that the Life Skills module had on learners in areas such as strategic learning and study skills (VUT 2003b).

The LASSI measuring instrument scales are in the range of 0 to 100 and are split up into three categories.

- **Skills:** information processing, the ability to select main ideas, the use of study aids, and test strategies.
- **Will:** attitude, motivation, and levels of anxiety.
- **Self-regulation** strategies employed by learners: concentration, time management, and self-testing abilities (Weinstein *et al.* 2003).

During the Life Skills module learners are actively engaged in exercises on how to pay attention, concentrate, focus their mental resources on the modules at hand, and how to select the main ideas and concepts in the different modules, in order to remember the information. In the next section the relevance and influence that these topics can have on learners are briefly investigated, under the following components information processing, testing strategies, selecting main ideas, study aids, and anxiety.

Information processing

The 'Information processing' scale assesses how well learners can use imagination, verbal elaboration, organisation strategies and reasoning skills as learning strategies in order to build bridges between what they already know and what they are attempting to learn. When learners score low on this scale they may have difficulty making information meaningful and storing it in memory in a way that will allow them to retrieve it in the future (Weinstein *et al.* 2003).

In the Life Skills module learners are introduced to the three main learning styles: visual, auditory, and kinesthetic (DAD 2003). The learning styles would determine how learners store information and how they represent information in memory, as implemented in the ITC course (also see 2.5.1 and 2.5.3). In the Life Skills module learners are guided to take notes, concentrate, select main ideas out of content and how to use their memory optimally.

Testing strategies

The 'test strategies' scale assesses the learners' use of test preparation and test taking strategies. Learners with low scores on this scale may need more effective techniques when preparing for and taking tests so that they are able to effectively demonstrate their knowledge of the subject matter (Weinstein *et al.* 2003).

Furthermore, by reducing the learners' anxiety level, motivation levels might also be influenced. In the Life Skills module, learners are educated on how to approach, prepare for, and reduce anxiety during assessment, how to interpret the questions and how to answer the questions (DAD 2003).

Selecting main ideas

The 'selecting main idea' scale assesses the learner's skill at distinguishing between important information, less important information and supporting details. Learners who score low on this scale may need to develop their skills at identifying critical information on which to focus their attention (Weinstein *et al.* 2003). Encoding is a very critical process for memory and the way that the learner pays attention, will have an influence on the encoding of knowledge gained.

Learners who take a deep approach towards learning will be able to focus their attention on what is significant and they will be able to extract main ideas, while learners with a surface approach tend to memorise information and procedures for assessment, as discussed in 2.5.3 (Appendix D; DAD 2003).

Study aids

The 'study aids' scale assesses the learners' use of support, such as educators and peers, or resources, such as learning material, library, notes, mind maps, learning style, etc., available to help them learn or retain information. Learners with low scores may need to develop a better understanding of the resources available to them and how to use these resources to be more effective and efficient in learning, as discussed in learning and ITBC learners 2.5. Without adequate memory skills much information needed for learning new concepts is lost, and the learning process is hampered.

During the Life Skills module the ITBC learners are taught different note-taking techniques, such as effective listening techniques and determining what information to write down (DAD 2003). Different methods of note-taking are explained, for example, the Cornell system, outlining, mapping, and sentence method (DAD 2003).

Anxiety

The 'anxiety' scale assesses the degree to which the learners are concerned about the tertiary institution and their academic situations and performance. Learners who score low on this scale are experiencing high levels of anxiety associated with tertiary education institutions. High levels of anxiety can help to direct the learner's attention away from completing academic tasks (Weinstein *et al.* 2003). For example, the learner's concern about doing poorly can interfere with the assessment result. Learners that score low on this scale may need to develop

techniques for coping with anxiety and reducing concern so that attention can be focused on the task at hand. The learner using a deep approach towards learning does not have any fear of summative assessments, but the surface approach learner is motivated by fear of failure and this leads to anxiety (2.5.3).

During the Life Skills module learners are exposed to:

- how test anxiety affects the learner;
- what causes anxiety; and
- how to reduce anxiety (DAD 2003).

Anxiety has physiological, behavioural and psychological affects on learners, such as rapid heartbeat, nausea, inability to make decisions, feelings of apprehension and uneasiness, upset or self-doubt (DAD 2003). The level of anxiety might cause a mental blocking which means going blank on questions, exercises or projects and possibly only remembering the correct information when the assessment is over.

With anxiety there is some real or perceived activating agent. It might be a past experience of blanking out or failure. It could also be a lack of under-preparedness for a summative assessment, which is the real reason to be concerned about the performance (DAD 2003). Lack of poor time management, poor study habits, failure to properly organise learning material and "chunking" the information the night before the due date might increase anxiety.

The Life Skills module guides learners to allow adequate time to accomplish all the work, exercise, projects and practical tasks, before the assessment. The ITBC course guides learners to build up confidence by reviewing the material frequently, setting study goals and how to use appropriate exercises to reduce anxiety when faced with anxiety that is building up.

When the ITBC learner feels motivated, satisfied, and confident that they will be able to handle the subject matter they will be more effective and be able to set goals in order to accomplish a task (DAD 2003). Motivation and performance go together. Motivation leads to performance and in return performance can increase motivation (DAD 2003).

3.3.4 Assessment results

If the ITBC learner obtains a 60 per cent average/more for the ITBC course the learner could enrol for the ICT diploma/degree.

3.4 Qualitative data

Qualitative research is concerned with the meaning of human behaviour and experience, and the function of social action (Merriam 1988:16). Qualitative research occurs in natural settings, where human behaviours and events occur (Creswell 1994:162). Qualitative research allows for understanding of an action or an event in context (Rubbin & Babbie 1993:36). Questionnaires are used to collect qualitative data.

3.4.1 Questionnaires

The questionnaire used consisted of a combination of dichotomous, multiple-choice and ordinal questions (De Vos 1998:161). Likert scales were also used in the questionnaire, for example no confidence, limited confidence, or confident (Page & Meyer 2000:126). The scales measures bipolar extremes in thinking with a neutral mid-point, three-point and five-point scales were used. By nature the Likert scales (agreement with extremes or strong disagreement) are qualitative, because they measure subjective bipolar perceptions of what is positive or negative.

A survey was conducted to collect original data to describe some of the perceptions/expectations of the ITBC learners and educators regarding relevance and structure of modules used in the ITBC course, to improve the modules where needed (Page & Meyer 2000:127).

Both the questionnaires were administered by using an interactive procedure of group administration (Page & Meyer 2000:111). The first questionnaire had been administered to the learners after completion of the numerical skills, HTML, Office Access and programming logic modules in class (see Annexure A). The questionnaire reflects on perceptions regarding:

- ***relevance*** of course content, such as the objectives being defined, achieved and the learners' confidence to apply knowledge;
- learners' perception of learning material ***structure***, for example exercises and pace of course;

- the learners' expectations and perceptions of ***lecturers'*** presentation skills, knowledge and interest in the module;
- the learners' overall ***satisfaction*** of module; and
- comments on things the learners ***liked* or *disliked*** about the module.

The ITBC learners had to complete a questionnaire after the completion of the ITBC course in March, 2004 (see Annexure B). The researcher administered the questionnaire to the learners who returned and enrolled for an ICT diploma.

The lecturer questionnaire was administered by using an interactive procedure of one-on-one (Page & Meyer 2000:111). Lecturer questionnaire/interviews were taken after the course as a supportive source of data collection during the observation, to assess the ITBC course curriculum (see Appendix F).

3.5 Conclusion

The VaalScan measurement instrument will be used to measure whether the English Proficiency module lead to an improvement of the ITBC learners language comprehension and communication skills.

The SpEEX measurement instrument will be used to measure how the ITBC learners' ability to solve problems and numerical skills improved after the intervention of the English Proficiency, Numerical Skills and ICT modules.

The LASSI measurement instrument will be used to determine the impact of the Life Skills module in the ITBC course on the ITBC learners' strategic learning skills.

Chapter 3 described the different components of the three measuring instruments by reporting on the meaning, use and importance of each component, the assessment results and questionnaires being administered. This chapter also explained how the ITBC course attempts to address the components. The influence on the ITBC learners will be seen in Chapter 4.

CHAPTER FOUR – RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

Chapter 4 focuses on the descriptive measures that were used in the research, in order to explain the data and the impact of the ITBC course. The research design that was followed for the collection, recording, analysis and interpretation of data gathered during the research project will be reported in accordance with the research problems (see 1.3).

4.2 Descriptive measures

After designing and implementing the research project, data needs to be collected and analysed to produce the research findings (Page & Meyer 2000:119). Written permission for administering and reporting of the results has been obtained from the Research Directorate of the VUT. In all cases, the use of the instruments has been transparent and clearly conveyed to all the learners who participated in the study. The research has thus been carried out with the full consent of all participants. The next section will define the descriptive measures and the response of the research project.

The following descriptive measures will be used to statistically explain the data (Page & Meyer 2000:155).

- **Correlations**

  Correlations (r) are used to describe relationships between variables; furthermore they estimate the extent to which the changes in one variable are associated with changes in other variables (Welman & Kruger 1999:72). A correlation between variables X and Y may be the result of either a mutual relationship between X and Y, or of a third variable Z.

  Positive correlation (+1.0) reflects a direct/perfect relationship, one in which an increase in one variable corresponds to an increase in another variable. When two variables are inversely related it would produce a negative correlation (-1.0), which indicates that an increase in one variable is associated with a decrease in the other. A coefficient close to zero indicates no relationship at all (Welman & Kruger 1999).

Correlations were calculated to determine if a relationship exists between pre- and post-VaalScan and SpEEX measuring scores. Case wise deletion of missing data was taken into consideration for all correlations. Correlations between the assessment results of ITBC course and Programming I results will be calculated to determine if the results display the same trends or distributions. When the correlation is more than 0,33, it is not only statistically significant because of the level of significance (α = 0,05), but it is also of practical significance. Bold marked correlations are significant at $p < 0,05$ and statistical significant values are indicated with an *.

- **Difference**

  Difference (diff) represents the difference between the pre- and post-test mean values. The following formula will be used:

  $$\text{diff} = \overline{X}_{Post} - \overline{X}_{Pre}$$

- **Difference percentage**

  Difference percentage (diff %) represents the percentage increase/decrease from the pre-test to the post-test means scores.

  $$\text{diff\%} = \text{diff} / X_{pre} * 100$$

- **Frequency**

  The frequency distributions are useful for detecting multi-modal situations. It gives an indication of the spread in the data, which reports how often each score occurred (Howell 1999:32). The frequency is represented with marked cells that have counts > 10 and the marginal summaries are not marked.

- **Mean**

  The mean represents the average (Struwig & Stead 2001:158). The means will be determined for the pre- and post-measurements of the VaalScan, SpEEX and LASSI measurement instruments, and assessment results of the ITBC course modules. The mean is determined by totaling the individual scores, dividing it by the number of learner scores involved, as follows:

  $$\bar{X} = \frac{\sum X}{N}$$

- **Modes**

  Modes (Mo) are useful measures of the centre for continuous data, where X is the value that corresponds to the highest point of the distribution. The mode represents

the majority response, especially with the questionnaires. Expressing the mode algebraically, we can say that:

$p(X_i = \text{mode}) > p(X_i = \text{any other score})$

- **p-Values**

  The p-value of $p < 0{,}05$ is used in calculations and in correlations to determine if the test is statistically significant for this research project. A p-value of less than 5 per cent is considered a significant test result (Page & Meyer 2000:167). A p-value that is not less than 5 per cent, is called a non-significant test result.

- **Standard deviation**

  The standard deviation (stDev) will be used as a measure of variability or spread. When the mean is used as the measure of centre, the standard deviation is the most important of measures. The standard deviation measures the square root of the average deviation from the mean, using squared distances to emphasis the influence of unusual data (Page & Meyer 2000:152).

$$s_x = \sqrt{\frac{\sum (X - \ddot{X})^2}{N-1}}$$

4.3 The response

After completion of the ITBC course the following responses were used in data analysis. During the data analysis the symbol N will be used to represent the number of responses.

A total of 69 learners enrolled for the ITBC course. Of the original 69 learners, 39 completed both the pre- and post-VaalScan and LASSI tests, while 48 learners completed both the pre- and post-SpEEX test. A total of 37 learners completed both the VaalScan and SpEEX pre- and post-tests, and these responses were used to calculate correlations. A total of 39 ICT learners completed the questionnaire at the end of the ITBC course. Percentages will be used to represent learners' responses to questionnaires. A total of 26 learners qualified for the Programming I examination and their Programming I results will be used to draw correlations.

All the ITBC learners completed the content-related assessment events during the ITBC course. From the 69 learners, 53 learners (77 per cent) completed the ITBC course successfully. From the 53 learners that passed the ITBC course 41 returned (77 per cent) to

enrol as ICT learners. Only these learners wrote the post-test, as the others were no longer on campus.

In total five educators participated in the lecturer interviews and because of this small number of educators, numbers will be used to represent their responses.

4.4 Data analysis

The nature and scope of the ITBC course have been discussed in the preceding chapters. The data analysis and discussion will follow under the following headings, based on the research objectives (see 1.5):

- the influence of the ITBC English Proficiency module on programming and logic techniques;
- the influence of problem solving and numerical skills on programming and logic techniques;
- the influences of formal Life Skills module on the performance of 1st year ICT learners; and
- Nature and scope of ITBC course.

4.4.1 The influence of ITBC English Proficiency module on programming and logic techniques

The first research objective was to establish whether improved English Proficiency will positively contribute to the success rate of programming and logic techniques. An intervention in the form of an English Proficiency module (see 2.3.2) was conducted. The research team found that English comprehension is a very important component for ICT modules, and that it is strongly recommended that learners do an English Proficiency module or have appropriate English comprehension skills before enrolling for an ICT diploma.

English comprehension was measured by using the VaalScan measuring instrument (see 3.3.1). The VaalScan measures the learners *'scholastic level'*, *'vocabulary in context'*, and *'familiarity with English'*. In the discussion, a comparison between the pre- and post-results of the VaalScan, as shown in Table 15 through to Table 19, will be given to reflect on the increase in VaalScan scores and the statistical results that reflect on the statistical significance of the VaalScan measuring instrument. Secondly, the correlation results display the direct

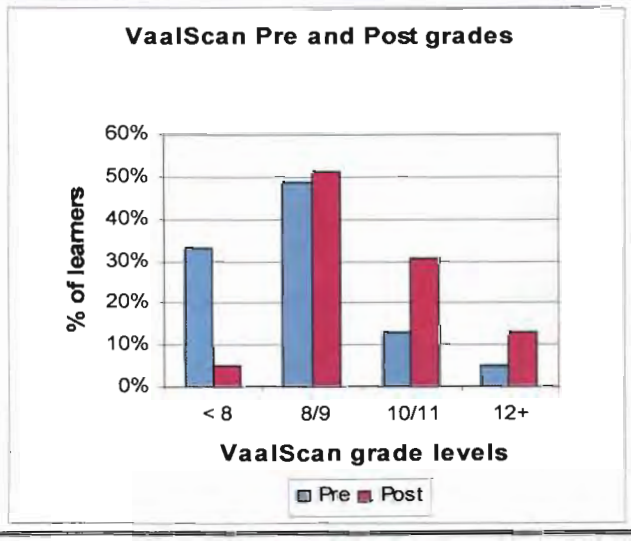
relationships between the VaalScan and SpEEX as well as correlations between the different ITBC modules and Programming I Tables 20 through to 22. Lastly, the assessment results of the English Proficiency module will be discussed in Table 23.

4.4.1.1 VaalScan results

The following paragraphs reflect on the VaalScan pre- and post-results, in respect of number of learners who scored on different levels, statistical data, frequency change from pre- to post results and the difference between the pre- and post results. Table 15 indicates the percentage of ITBC learners who scored in each level of the pre- and post-VaalScan test.

Table 15: Distribution of learners according to VaalScan test-results

VaalScan levels	Learners (%)	
	Pre	Post
Below grade 8	33%	5%
Grade 8/9	49%	51%
Grade 10/11	13%	31%
Grade 12	5%	13%



It is clear from the graph that the majority of ITBC learners improved from the pre- test to the post-test. It is however still a problem that the majority of learners (51 per cent) are on a *'Grade 8/9'* level - it would be ideal if the majority of learners are on ***'Grade 12'***. A statistical analysis of these results is reflected in Table 16.

Table 16: Statistical results of the VaalScan pre- and post-test

Pre vs Post	Pre		Post		N	Diff	Diff %	Std Dev Diff	P
	Mean	Std Dev	Mean	Std Dev					
VaalScan	1,90	0,82	2,51	0,79	39	0,62	32%	0,75	0,000009

The mean of the VaalScan has increased form *'Grade 8/9'* to a *'Grade 10/11'* (see 3.3.1). The difference in the means from pre- to post-VaalScan resulted in a 32 per cent increase. The standard deviation for the pre-VaalScan is 0,82 and for the post-VaalScan 0,79. The p-value is

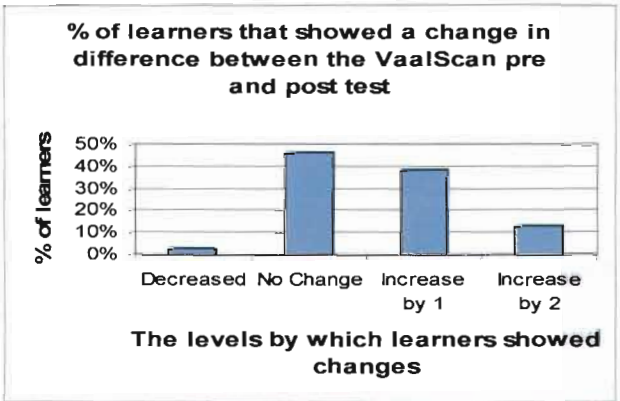
less than 5 per cent, which indicates that the VaalScan test scores are significant (p = 0,000009).

Table 17 represents the frequency of the pre- and post-VaalScan measuring scores.

Table 17: The VaalScan frequency table

Pre \ Post	Below grade 8	Grade 8/9	Grade 10/11	Grade 12	Row totals
Below grade 8	2	7	4	0	13
Grade 8/9	0	12	6	1	19
Grade 10/11	0	1	2	2	5
Grade 12	0	0	0	2	2
All groups	2	20	12	5	39

Difference	Learners (%)
Decreased by 1 level	3%
Showed no change in level	46%
Increased by 1 level	38%
Increased by 2 levels	13%



The frequency table indicates the number of ITBC learners who showed a decrease, increase or no change from one level to the next between the pre- and post-test scores of the VaalScan. In total 38 per cent of learners increased by one grade while 13 per cent increased by two grades in the VaalScan test from pre- to post-tests, which is, in total a 51 per cent increase. Only one learner decreased by 1 grade and 46 per cent of learners showed no change.

The VaalScan measuring instrument also determined the learners' scholastic levels in terms of their understanding of *'vocabulary in context'* as shown in Table 18.

Table 18: Vocabulary in context scores of learners as measured by VaalScan

Scholastic levels	Pre VaalScan	Post VaalScan
Excellent	0%	0%
Well developed	0%	0%
On par with scholastic level claimed	0%	0%
Slightly below scholastic level claimed	5%	15%
At least two levels below scholastic level	51%	72%
Inadequate	44%	13%
Totally inadequate	0%	0%

The learners were rated according to the categories specified in Table 11, in descending order from *'excellent'* to *'totally inadequate'* (see 3.3.1.2). Table 18 reflects that the learners improved from 5 per cent to 15 per cent for the *'slightly below scholastic'* level. The course had a definite impact as only 13 per cent of the learners are still categorised as *'inadequate'* in contrast to the 44 per cent who were *'inadequate'* before. There is also major improvement from 51 per cent to 72 per cent for the *'two levels below scholastic'* level. The results imply that the learners' vocabulary thus improved from *'inadequate'* to *'slightly below scholastic'* level. It is however not *'well developed'* or *'excellent'* as anticipated.

The VaalScan also determined the learners' exposure to and *'familiarity with English'*. Chapter 3 suggested ways of improving language familiarity of the ITBC learners (see 3.3.1.3). Table 19 demonstrates the learners' exposure levels to English as measured by VaalScan, ranging from the *'high degree'* to *'very little'* in descending order (see Table 12 and 3.3.1.3).

Table 19: English familiarity levels of ITBC learners as measured with the VaalScan

Level	Pre VaalScan	Post VaalScan
High degree	5%	13%
Limited	28%	23%
Lacking	38%	49%
Very little	28%	15%

The intention of the English Proficiency module is to improve the ITBC learners' levels of *'familiarity with English'* to the *'high degree'* level away from the *'very little'* level. However the majority of learners are still on the *'lacking'* level (49 percent), but the *'high degree'* level increased from 5 percent to 13 percent. The majority of learners improved from *'very little'* to *'lacking'* and a few improved from *'limited'* to a *'high degree'* of the *'English familiarity'* component of the VaalScan.

4.4.1.2 Correlations

After considering the pre- and post-VaalScan tests and the differences of the VaalScan, correlations were drawn between the VaalScan and the SpEEX measuring instrument, because measurement of comprehension, vocabulary and linguistic performance of learners is also included in the SpEEX. Table 20 represents the correlations between the VaalScan and the SpEEX pre- and post-test scores.

Table 20: Correlations between VaalScan and SpEEX pre- and post-instruments

	VaalScan Pre	VaalScan Post	SpEEX Pre	SpEEX Post
VaalScan Pre	1	**0,62***	**0,36***	**0,37***
VaalScan Post	**0,62***	1	0,21	0,31
SpEEX Pre	**0,36***	0,21	1	0,31
SpEEX Post	**0,37***	0,31	0,31	1

A correlation of 0,62 indicates the statistical and practical significance of the VaalScan pre- and post-test. This emphasizes the validity of VaalScan as an English Proficiency measuring instrument. The correlation also emphasizes the direct relationship between the VaalScan pre- and post-tests.

A correlation of 0,36 between the pre- VaalScan and pre-SpEEX, implies that there is a direct relationship between the two measuring instruments and this further implies that an increase in one will correspond to an increase in the other. A significant correlation of 0,37 between the pre-VaalScan and post-SpEEX also exists. The post-VaalScan and post-SpEEX correlation is 0,31, which implies that there is a relationship between the two, but it is not as strong as the pre-test scores. Refer to 4.4.2.2 for an analysis of the SpEEX results.

4.4.1.3 Correlations between English Proficiency and ITBC modules

It is possible to calculate correlations between the different ITBC modules such as ICT modules, Numerical Skills and English Proficiency, as indicated in Table 21.

Table 21: Correlations between the ITBC modules

	ICT modules	Numerical Skills	English Proficiency
ICT modules	1	**0,36**	**0,53***
Numerical Skills	**0,36**	1	0,19
English Proficiency	**0,53***	0,19	1

A statistically and practically significant 0,53 correlation exists between the ICT and English Proficiency modules, which implies that an increase in either of the two modules is associated with a change in the other module and that there is a direct relationship between these modules.

The research results further support findings made by Greyling (2000), that English is a very important component for ICT modules and that it is statistically more important than Numerical Skills. The correlation between the English Proficiency and the Numerical Skills is

only 0,19. Since this is close to zero, we can conclude that there is very little correlation between the English Proficiency and the Numerical Skills modules.

4.4.1.4 Correlations between English Proficiency and Programming I

Initially the ITBC population consisted of 69 learners. Only 53 passed the course at the end of 2003. At the start of 2004, only 41 learners returned to enrol for the ICT diploma. A total of 26 of these learners who received a year mark for Programming I and were examined on Programming I, completed the exam.

It is possible to calculate correlations between the different ITBC modules such as Numerical Skills, English Proficiency, ICT modules, and the Programming I results of the ICT diploma learners. Table 22 represents the correlation results of the N = 26 learners who returned to the VUT and completed the Programming I exam.

Table 22: Correlations between the ITBC modules and Programming I

	Programming I
ICT modules	**0.45***
Numerical Skills	0.08
English Proficiency	**0.41***

A statistically and practically significant correlation of 0,41 exists between the English Proficiency and the Programming I modules, which implies that an increase in English comprehension will correspond to an increase in Programming I results. The correlation also reflects the direct relationship between the English Proficiency and Programming I modules.

Qualitative feedback supports these findings. A number of ITBC learners who completed the ITBC course were contacted and telephonically interviewed. The ITBC learners had to answer the following two questions:

- How did the ITBC change your attitude?
- Overall impression of ITBC?

The learners have a positive perception of the ITBC course and they do believe that the English Proficiency module contributed towards improved communication skills that are needed in the field of ICT, as seen by the following quotes:

> "[My] English Proficiency and communication skills improved"
>
> "[My] learning skills improved because of English and communication skills"

Access was widened for a very small group, as only three learners improved to *'Grade 12'*, while two stayed on *'Grade 12'*. Only these learners were exempted from the Vocational English module in their first year of enrolment for the diploma in ICT.

4.4.1.5 English Proficiency assessment results

From the group of ITBC learners 86 per cent passed the English Proficiency module. Table 23 reflects on the English Proficiency results of the ITBC course.

Table 23: English Proficiency mean and assessment results

Descriptive data	Response%
Mean – average score	**63%**
The percentage of learners who passed the module	86%
The percentage of learners who failed	14%

The system further supports the improvement of English by making it compulsory for the learners who failed the English Proficiency module or the VaalScan to enrol for a first year Vocational English module as part of the ICT diploma.

4.4.2 The influence of Problem Solving and Numerical Skills on programming and logic techniques

The second research objective was to establish whether improved problem-solving skills and numerical skills positively contribute to the success rate of programming and logic techniques. The SpEEX measures whether the Numerical Skills and ICT modules helped to improve learners' logical thinking skills, numerical ability and problem-solving skills. In the discussion, Table 24 through to Table 27 reflects on the increase in the SPEEX scores and the statistical significance results and relationships of the SpEEX measuring instrument (see 3.3.2). Secondly, it will become clear that the ICT modules and the Numerical Skills did broaden access, by empowering learners with prior knowledge that can be used in the ICT diploma, and by doing so it addressed the under-preparedness problem of learners in the field of ICT (see 2.1). Thirdly, the correlation results display the relationships between the Numerical Skills, ITBC modules and Programming I. Lastly, the assessment results of the ICT, Numerical Skills and Programming I modules will also be discussed in Table 28. The research has found that ICT learners need appropriate numerical skills and problem-solving skills in order to become competent programmers.

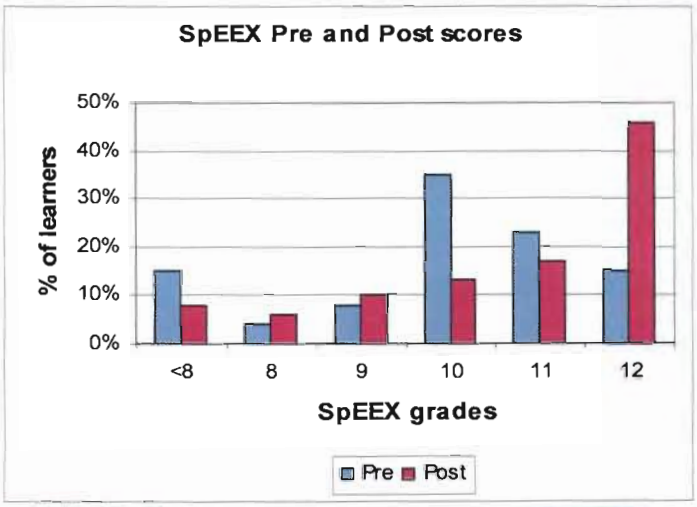
This section concludes that the improved problem-solving skills and numerical skills positively contributed to the broadening of access of learners to the ICT diploma.

4.4.2.1 SpEEX results

The following paragraphs reflect on the SpEEX pre- and post-results, with respect to the number of learners who scored on different levels. It also indicates the statistical results, frequency change from pre- to post-results and the difference between the pre- and post-results. Table 24 indicates the percentage of ITBC learners who scored in each level of the pre- and post-SpEEX instrument.

Table 24: Learner distribution based on the pre- and post-SpEEX results

SpEEX Levels	Learners (%)	
	Pre	Post
Below 8	15%	8%
8	4%	6%
9	8%	10%
10	35%	13%
11	23%	17%
12	15%	46%



The graph reflects the percentage of the ITBC learners who completed both the pre- and post-SpEEX test. It is clear from the graph that the majority of ITBC learners improved from the pre-test to the post-test. It is also clear that the majority of learners are on level 12 **after** the post-SpEEX test (46 per cent). The required entry-level score for the SpEEX in the field of ICT is 12.

Table 25 indicates the percentage of learners who scored below or above level 12 in the SpEEX measuring instrument.

Table 25: Percentage of learners who scored below or above level 12 in SpEEX

Levels	Learners (%)	
	Pre	Post
Below level 12	85%	54%
Greater or equal to level 12	15%	46%

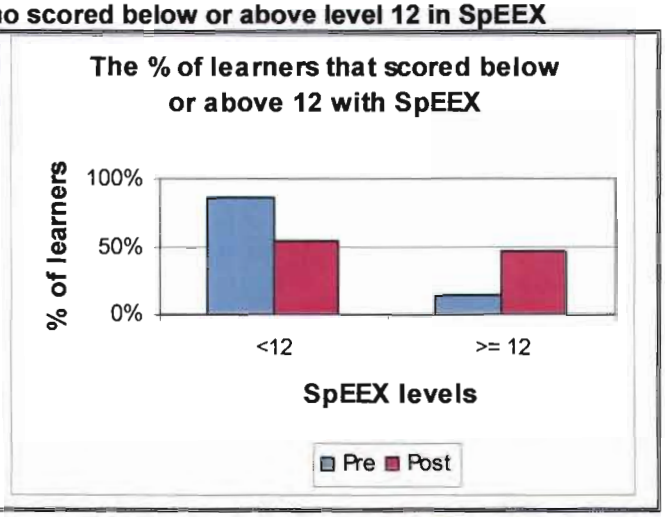


Table 26 reflects the statistical analysis on data obtained from the pre- and post- SpEEX tests.

Table 26: Statistical results of the SpEEX pre- and post-results

Pre vs Post	Pre		Post		N	Diff	Diff %	Std Dev Diff	p
	Mean	Std Dev	Mean	Std Dev					
SpEEX	9,28	2,02	10,58	1,72	48	1,30	14%	2,13	0,0079

The mean of the SpEEX pre- and post-test improved from 9,28 to 10,58 a difference of 1,3, which means a 14 per cent increase and it further reflects that the means of the pre- and post-test groups are statistically, significantly different. The increase is also valid because of the p value (p = 0,0079) that is less than 5 per cent, which implies that the SpEEX test scores are significant. The standard deviation for the pre-SpEEX is 2,02, and for the post-SpEEX it is 1,72.

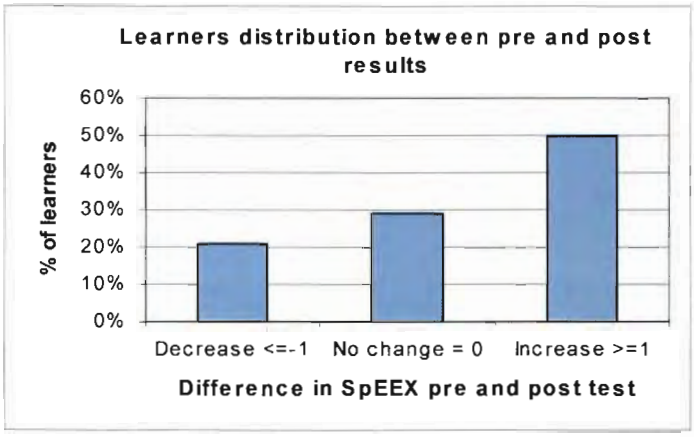
The most significant improvement was the frequency distribution of 17 per cent of learners who scored 10 in pre-SpEEX and improved to 12 with the post-SpEEX. One learner improved dramatically from level 3 with pre-SpEEX to level 11 with post-SpEEX.

Table 27 indicates the number of ITBC learners who showed a decrease, increase or no change from one level to the next between the pre- and post-test scores of the SpEEX. It is clear from the frequency data that the majority of ITBC learners improved from the pre-test to the post-test.

Table 27: SpEEX frequency distribution

Pre \ Post	6	7	8	9	10	11	12	Row Totals
3	0	0	0	0	0	1	0	1
4	0	1	0	0	0	0	0	1
6	0	1	0	0	0	1	0	2
7	0	0	0	1	0	0	2	3
8	0	0	1	0	0	0	1	2
9	1	0	0	1	1	1	0	4
10	0	1	1	3	2	2	8	17
11	0	0	1	0	3	3	4	11
12	0	0	0	0	0	0	7	7
All groups	1	3	3	5	6	8	22	48

Differences in levels	%
Decrease by 3 levels	6%
Decrease by 2 levels	2%
Decrease by 1 level	13%
Showed no change	29%
Increase by 1 level	17%
Increase by 2 levels	21%
Increase by 3 levels	2%
Increase by 4 levels	2%
Increase by 5 levels	6%
Increase by 8 levels	2%



In total 21 per cent of learners increased by two grades while 17 per cent increased by one grade in the SpEEX test from pre- to post-SpEEX test. There is a two per cent increase for learners moving up with three, four and eight scores. The learner that moved up with eight scores, scored three initially - in total a 50 per cent increase. A total of 13 per cent of learners decreased by one grade, two per cent by two grades and six per cent with three grades - in total a decrease of 21 per cent. A significant proportion of the learners (29 per cent) showed no change and stayed on the same level. Table 27 represents the frequency results of the pre- and post-SpEEX measuring scores and it also indicates an improvement from lower levels to higher levels of the SpEEX instrument.

The research findings imply that the ITBC did indeed broaden access as the majority did meet the required SpEEX levels (46 per cent).

4.4.2.2 Correlations

Results are reflected in Table 20 through to 22 and only the results related to problem solving and numerical skills are provided in this section. Table 20 indicates the significant correlation

"In the beginning of this course, I was thinking that you just want to waste our time, energy and money, but you didn't. IT Boot Camp has helped me in such a way that I can hunt for a job with the knowledge that I have. I am 100% sure that next year, I'll make it."

Qualitative data obtained from module feedback forms indicates that the learners perceived the ITBC course as a *'good'* tool to improve their knowledge of computer science as quoted by learners in interviews conducted at the end of the ITBC course:

"If I did not do the Boot Camp I would not do as well" and "[I] learned much about computers."

The learners show confidence in what they have done and a need to do the ITBC before the ICT diploma, as quoted:

"The ITBC build my confidence and I feel much more confident to do the ICT diploma than how I did after school."

4.4.2.5 Assessment results of ICT modules and Numerical Skills

The ITBC courses, Numerical Skills and ICT modules assessment results will be reflected in Table 28.

From the group of 69 ITBC learners the majority (92 per cent) passed the Numerical Skills module, 93 per cent passed ICT module I and 80 per cent ICT module II. Table 28 reflects the ITBC learners' results for the ICT modules and the Numerical Skills modules.

Table 28: Analysis of Numerical Skills and ICT module results

Descriptive data	ITBC course modules		
	Numerical Skills	ICT Module I	ICT Module II
Mean	66%	74%	58%
Passed	92%	93%	80%
Failed and asked to redo module	7%	6%	19%
Not recommended	1%	1%	1%

The remaining learners who failed the modules were required to redo the module(s) and were not awarded a certificate. Only one learner was not allowed to enrol for the ICT diploma. The assessment results support the learners' comments that the ICT modules helped to improve their knowledge of computer science and to prepare them for the ICT diploma.

4.4.2.6 Assessment results of Programming I

The assessment results of Programming I show a significant relationship from the previous year(s), which implies that the ITBC contributed to the success of learners' Programming I results. The next paragraphs will elaborate on the Programming I results for the ITBC learners who continued with the ICT diploma and a comparison between Programming I results for the last five years will be drawn.

Table 29 reflects research data and results for Programming I of the ITBC learners who continued with the ICT diploma.

Table 29: ICT diploma Programming I results

Descriptive data from	N
ITBC learners who continued with the ICT diploma out of the 53 that passed the ITBC course	41
Number of learners who got a year mark to write exam	26
Learners who wrote exam and passed	12

The data indicates that 77 per cent of the ITBC learners who passed the ITBC continued with the ICT diploma. A total of 63 per cent of the ITBC learners were admitted to the Programming I exam. In total 46 per cent of the ITBC learners who have written the Programming I exam have passed.

Table 30 reflects research data and results of Programming I for the last 5 years.

Table 30: Programming I June results for the last five years

Year	Number of learners				Pass and throughput rate %	
	Enrolled	Admitted to exam	Wrote exam	Passed	Pass exam %	Throughput – overall pass %
2000	183	109	109	46	42%	26%
2001	119	87	87	46	53%	39%
2002	32	14	13	9	69%	28%
2003	93	52	51	29	57%	32%
2004	61	35	34	29	85%	48%

4.4.3 The influence of the formal Life Skills module on the performance of 1st year ICT learners

The third objective was to determine the influence of a formal Life Skills module on the performance of 1st year ICT learners. An intervention in the form of a Life Skills module (see

2.3.2) was conducted, in an attempt to improve/address the learners' strategic learning skills. The research found that the ICT learners benefit from an introduction module such as the Life Skills module to overcome the gap between secondary and tertiary education and to improve the learners' strategic learning skills.

The LASSI measuring instrument was used to measure the following strategic learning skills of ITBC learners (see 3.3.2):

- **skill** – the learners' information processing, selecting main ideas, study aids, and test strategies;
- **will** – the learners' attitude, motivation, and anxiety; and
- **self-regulation** – the learners' concentration, time management and self-testing strategies.

The research concluded that the Life Skills positively contributed to the learners improved *'information processing'* skills, *'testing strategies'*, *'selecting main ideas'*, *'study aids'*, *'anxiety'*, *'motivation'*, and *'concentration'*. The research findings suggest an improvement of academic competency and strategic learning skills. It is however evident from the findings, that the learners still are not well immersed in *'time management'* and *'self-testing'* skills.

In the discussion, a comparison between the pre- and post-results of the LASSI is provided to reflect on the increase, no change and decrease in LASSI scores in Table 31. The statistical results (Table 32), reflect the statistical significance of the LASSI measuring instrument.

Secondly, from the data in Table 33, it will become clear that the Life Skills module prepared the learners by empowering them with strategic learning skills that can be used in the ICT diploma, and by doing so addressed the under-preparedness, of learners in the field of ICT (see 2.1). Thirdly, the correlation results display the relationships between the different LASSI components as shown in Table 34.

4.4.3.1 LASSI results

The following paragraphs reflect on the LASSI pre- and post-results, in respect of number of learners. Table 31 indicates the change from pre- to post-LASSI test scores, whether learners increased, decreased or showed no change in scores.

Table 31: The LASSI differences in pre- and post-test scores

		Percentage of learners who showed a(n):		
	LASSI	Increase	No Change	Decrease
Will	Attitude	31%	26%	44%
	Motivation	**51%**	8%	41%
	Anxiety	**56%**	5%	38%
Self re-gulation	Time management	41%	28%	31%
	Self testing	36%	18%	46%
	Concentration	49%	21%	31%
Skills	Information processing	**59%**	8%	33%
	Selecting main ideas	46%	15%	38%
	Test strategies	**59%**	10%	31%
	Study aids	**54%**	15%	31%

It is clear from the values that the majority increased their scores or stayed on the same level. The positive change implies that the Life Skills module did have an influence on the learners' strategic learning skills, according to the LASSI measuring instrument.

The *'attitude'*, *'motivation'* and *'self-testing'* components showed a large decrease from pre- to post-testing and it is recommended that attention should be paid to the decrease. Factors that might have contributed to the decrease were the availability of classes and the fact that the classes started late in the beginning of the semester until the milestones were finalised.

Table 32 reflects the statistical analysis of the LASSI results. According to Table 32 the *'information processing'* and the *'testing strategies'* components of the LASSI are the only two components that are statistically significant.

Table 32: Statistical results of the pre- and post-LASSI test

Pre vs Post	Pre		Post		N	Diff	Diff %	Std Dev Diff	p
	Mean	Std Dev	Mean	Std Dev					
Information processing	**62,41**	**26,89**	**72,69**	**16,81**	**39**	**10,28**	**16%**	**24,47**	**0,01243**
Selecting main ideas	66,10	30,99	70,77	27,40	39	4,67	7%	36,10	0,42000
Study aids	67,03	25,09	72,18	22,50	39	5,15	7%	22,89	0,16776
Testing strategies	**54,97**	**24,98**	**62,62**	**27,85**	**39**	**7,64**	**14%**	**24,10**	**0,05496**
Attitude	69,85	28,17	68,62	27,72	39	-1,23	-2%	33,87	0,82171
Motivation	55,28	24,22	57,17	24,22	39	1,90	3%	28,29	0,67770
Anxiety	48,90	28,27	52,56	28,27	39	3,67	7%	26,22	0,38805
Concentration	76,62	19,55	81,33	15,72	39	4,72	6%	20,62	0,16112
Time management	79,85	15,20	81,64	15,11	39	1,79	2%	17,58	0,52760
Self testing	76,77	23,50	79,10	15,64	39	2,33	3%	21,84	0,50871

The mean of the *'information processing'* component improved from 62,47 to 72,69, a difference of 10,28, an increase of 16 per cent (p = 0,0161) and a statistical and practical significant correlation of 0.45 between the pre- and post-test (see Table 33). The mean of the *'testing strategies'* increased from 54,97 to 62,62, a difference of 7,64, an increase of 14 percent (p = 0,054) and a statistical and practically significant correlation of 0.59 between the pre- and post-test (see Table 33).

The difference between the other LASSI components, except the *'information processing'* and the *'testing strategies'*, pre- and post-test results for the LASSI, are not statistically significant, because the p-values are bigger than 5 per cent.

The following list represents the statistical data in a descending order of differences between the *'pre- and post- means'* and the components corresponding *'pre- and post- correlations'* (see Table 32 and Table 33).

- The *'study aids'* component shows a 7 per cent increase and a statistically significant correlation of 0.54.
- The learners *'anxiety'* levels shows a 7 per cent increase and a statistical significant correlation of 0.53.
- The *'concentration'* reflects a 7 per cent increase and a significant correlation of 0.33.
- The *'selecting main ideas'* scores reflects a 7 per cent increase and a correlation of 0.24.

4.4.3.2 Correlations of LASSI

Table 33 reflects the correlation between the pre- and post-tests scores related to the skills, will and self regulation components of the LASSI.

The pre-*'testing strategies'* component shows a statistically significant correlation with the post:

- 'motivation' (0,42),
- *'anxiety'* (0,48), and
- 'concentration' (0,44).

A statistically significant correlation between the pre-*'anxiety'* and post-*'concentration'* of 0,51 exists, which implies that anxiety levels and concentration influenced one another.

Table 33: Correlations of the LASSI skills pre- and post-test results

		Skill				Will			Self regulation		
	Pre \ Post	Information processing	Selecting main ideas	Study aids	Test strategies	Attitude	Motivation	Anxiety	Concentration	Time management	Self testing
Skill	Information processing	**0,45**	0,23	0,06	0,27	-0,12	-0,04	0,18	0,30	0,14	0,10
	Selecting main ideas	0,24	0,24	0,07	0,31	-0,14	-0,14	0,30	**0,34**	0,02	0,19
	Study aids	0,13	-0,10	**0,54**	-0,08	-0,11	-0,14	-0,12	0,15	0,26	0,14
	Test strategies	0,19	0,29	0,01	**0,59**	0,24	**0,42**	**0,48**	**0,44**	0,26	0,10
Will	Attitude	0,12	0,13	0,03	0,22	0,27	0,21	0,07	0,09	**0,50**	0,17
	Motivation	0,24	0,12	0,32	0,18	0,06	0,22	0,29	**0,33**	0,18	0,21
	Anxiety	0,28	0,37	0,06	0,30	0,04	0,09	**0,53**	**0,51**	0,07	0,12
Self	Concentration	0,28	0,11	0,10	0,22	-0,05	-0,13	0,20	**0,33**	0,29	0,05
	Time management	0,1	-0,16	0,24	0,20	0,24	0,07	0,11	0,22	**0,33**	0,11
	Self testing	**0,47**	0,20	0,14	0,26	0,01	0,05	0,21	**0,38**	0,16	**0,43**

4.4.4 The nature and scope of the ITBC course

The fourth research objective was to determine the nature and scope of the ITBC course. The research findings indicate that the ITBC learners and the educators of the VUT are satisfied with the nature and scope of the ITBC course. The following feedback in Tables 36 through to Table 48 will support the findings. The nature and scope of the ITBC involved not only the structure, relevance, objective, and content of the course, but it also included the teaching methodology, and assessment strategies used to deliver the ITBC.

4.4.4.1 Relevance, structure, objectives and content of ITBC course

Questionnaires were used to determine the learners' expectations, perceptions and concerns towards the relevance and structure of the ITBC course (see Annexure A & B). Table 34 reflects the learners' perception of the hands-on practical exercises, the pace of the program, how clear the objectives have been defined at the start of the ITBC, and to what extent learners believe module objectives have been achieved.

Table 34: Learners' perception of relevance and structure of ITBC course

Practice of concepts, for example enough hands-on exercises					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	9%	11%	24%	27%	29%
HTML	5%	3%	11%	34%	47%
Office	0%	0%	22%	44%	33%
PLT	0%	0%	12%	15%	73%

Pace of the program					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	7%	7%	27%	43%	16%
HTML	3%	0%	14%	53%	31%
Office	0%	0%	28%	36%	36%
PLT	0%	4%	12%	52%	32%
How clear were objectives defined at the start of the module					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	4%	11%	22%	27%	36%
HTML	3%	3%	16%	47%	32%
Office	3%	0%	22%	33%	42%
PLT	0%	0%	8%	46%	46%
To what extend does learners feel the objectives were achieved in the module					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	5%	5%	27%	30%	34%
HTML	0%	3%	13%	50%	34%
Office	0%	0%	19%	47%	33%
PLT	0%	4%	4%	50%	42%

During teaching of the ITBC course educators used examples, exercises, projects, and practical applications of knowledge (see 2.5.4). While busy with the ITBC course the ITBC learners perceived the amount of hands-on exercises and examples as enough for PLT, HTML and Windows Office, as mentioned in the qualitative feedback for PLT:

"enough practice" and "learners understand and apply"

The qualitative feedback forms further indicate that in the HTML module the learners liked the web pages that they had to create, access to the Internet, the application of theory into practice, and the mails they send, but they found theory concepts difficult.

For the Windows Office module learners liked the practice and exercise as well as the thorough explanation of the educator, but they had difficulty in understanding the text books. The learners did however have a problem with the number of hands-on exercises and examples as well as the explanation of the Numerical Skills module as quoted:

"not enough exercises" and "explanation not understood"

A total of three educators perceived the number of hands-on exercises to grasp the concepts as enough while two felt the need to do more or add more exercises in the modules. When comparing the Numerical Skills and PLT modules to one another, the results indicate that there might be a problem with the Numerical Skills module as only 29 per cent selected *'excellent'* while 79 per cent of the learners thought the PLT was *'excellent'*.

The majority of learners' perceived *'pace of the modules'* as positive, 52 per cent selected *'good'* and 32 per cent *'excellent'*. The qualitative data for PLT shows that a few of the learners thought the educator is "*going too fast*" and" *not enough time*" is allocated to finish assignments.

The learners had a negative perception of the pace of the Numerical Skills module: *"too much work in little time*". Only 43 per cent selected *'good'* while 16 per cent perceived the pace as *'excellent'*.

The relevance of the ITBC course regarding the objectives being defined were perceived as *'good'* or *'excellent'* by the majority of learners (see Table 34). In the PLT, HTML and Windows Office modules the majority of learners feel that the objectives were achieved but for Numerical Skills the learners did not all agree that the objectives had been met.

Table 35 reflects the learners' perception of the relevance of ICT modules content, in the ITBC, towards the ICT diploma.

Table 35: Learners' perception of relevance of the different ITBC modules

Relevant	Sometimes relevant	Very relevant	Not relevant
32%	13%	55%	0%

The majority of ITBC learners (55 per cent) believed that the content of the ITBC course was *'very relevant'* to what they are doing currently in the ICT diploma, 32 per cent thought it was *'relevant'*, 13 per cent thought it will *'sometimes be relevant'*.

The educators' perception of the relevance of the objectives of the ICT modules, indicate that the majority (four) believe that the objectives are *'very relevant'* and only one believes that it is *'relevant'*.

After completion of the ITBC course the ITBC learners who continued with the ICT diploma, completed a structured questionnaire (Appendix B).

Table 36 reflects on the learners' perception of the availability of facilities and their adequacy.

Table 36: Learners' perception of the facilities

Poor	Satisfactory	Good	Excellent
11%	26%	**50%**	13%

The ITBC learners perceived the facilities as adequate, 50 per cent selected *'good'*, while 13 per cent selected *'excellent'*. The ITBC learners perceived the facilities as part of the supporting system and resources available to complete their studies.

4.4.4.2 Teaching strategy

The educators needed to implement the milestones given to them. They had to use the LACC methodology and they had to use the course content of the NIIT in the ICT modules of the ITBC course (see 2.5.4). The majority of educators implemented the teaching strategies successfully and it is suggested that the LACC should also be implemented in the main stream ICT diploma. The educator fulfilled the role of a facilitator and the learners experienced it as a good combination. Data that supports these findings are listed.

Milestones

The learners are given time-tables to plan their time and manage their time according to the milestones set by the educator for them at the beginning of each module. The milestones are practical according to four of the educators and implemented successfully in the ICT modules of the ITBC-course.

Linear approach

The educators' opinion on the linear approach is that learners understood work and that it worked better than the traditional way. Educators experienced the linear approach as a building process and a good way of obtaining knowledge. According to the qualitative feedback educators defined the objectives to the learners at the beginning of each module and learners agreed that objectives were clearly defined and achieved at the end of the module.

Table 37 indicates the ITBC learners' perception of the educators of the ITBC course, by reflecting the educators' presentation skills, knowledge of the modules, and interest in the modules. The majority of learners perceived the presentation skills of the educators as *'excellent'*, except for the Numerical Skills module where only 22 per cent agreed on

'excellent' presentation skills. The PLT module was perceived as *'excellent'* by 73 per cent of the learners. The learners perceived the knowledge of the educators in the different modules as *'excellent'*, especially in the PLT, Office and HTML modules. For the Numerical Skills module the only 31 per cent perceived the educators knowledge of the module as *'excellent'*. The majority of learners perceived the educators interest in the modules as positive. In the PLT module learners perceived interest as 19 per cent *'good'* and 81 per cent *'excellent'*.

Table 37: Learners' perception of the ITBC course educators

Educators' presentation skills					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	7%	11%	22%	38%	22%
HTML	3%	3%	24%	27%	43%
Office	0%	0%	8%	33%	58%
PLT	0%	0%	0%	27%	73%
Educators' knowledge of module					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	2%	9%	18%	40%	31%
HTML	0%	3%	8%	29%	61%
Office	0%	0%	6%	22%	72%
PLT	0%	0%	4%	4%	92%
Educators' interest in the module					
Modules	Poor	Average	Satisfactory	Good	Excellent
Numerical	2%	2%	20%	29%	47%
HTML	0%	0%	8%	37%	55%
Office	0%	0%	8%	28%	64%
PLT	0%	0%	0%	19%	81%

To conclude it can be said that the majority of the ITBC learners experience of the educators during the ITBC course was *'good'* or *'excellent'* regarding their presentation skills, knowledge of modules and interest in modules.

Table 38 reflects the learners' perception of the educators' role in the ITBC course.

Table 38: Educators' role in the ITBC course

According to the learners educators major tasks should be:	%
Assist learner step-by-step in solving problems in order to succeed	33%
Facilitate learner in order to do work on their own	67%
Educator allowed learner to make mistakes, correct errors and to learn in the process	**%**
Yes	84%
No	16%

According to the ITBC learners the educators were available and willing to assist when needed. In total 67 per cent of the ITBC learners perceived the role of the educator as a *'facilitator'*, who will be able to guide and facilitate, allowing for mistakes and enabling each learner to learn at his/her own pace, in contrast to learners who were taught in the traditional way.

4.4.4.3 Learning strategy

The learners demonstrated confidence in their ability to learn new concepts, and to apply the knowledge gained to new concepts. The learners demonstrated a positive attitude and they are motivated to do the ICT diploma.

Table 39 reflects on the learners' confidence level to learn new concepts and their perception of improved study skills.

Table 39: Learners rating of their ability to learn

Ability to learn	%	Statement
Learners confidence to learn new concepts	77%	Confident that they will be able to learn new concepts
	23%	Limited confidence in specific environment
Learners perception of improved study skills	79%	Yes – we have improved our study skills
	21%	No – we have not improved our study skills

The majority of learners have confidence to learn new concepts (77 per cent). Nearly all the learners believe that they have attained better study skills through the Life Skills module than those they employed at school (79 per cent).

Table 40 reflects on the learners' perception of how they view their ability to apply knowledge gained in the ICT diploma.

Table 40: Learners' perception of their ability to apply knowledge gained after the ITBC course

ICT	Sections	Poor	Satisfactory	Good	Excellent
Module I	Computer overview	3%	13%	26%	58%
	Microsoft: Word, Excel, and Power Point	0%	8%	33%	59%
Module II	HTML and Access	3%	18%	41%	38%
	PLT	10%	33%	44%	13%

The learners perceive their ability to apply knowledge gained in the ITBC in practice as either *'good'* or *'excellent'*. The ITBC learners' confidence in applying Microsoft Word, Excel, and Power Point skills is the highest (92 per cent) and for PLT the lowest (57 per cent).

A total of three educators' perceived the learners' attitude as three *'good'* and one as *'excellent'*. One educator did not respond on the attitude of the learners. Two of the educators perceived the learners' motivation as *'good'*, one as *'excellent'* and two as *'satisfactory'*. The educators did not have any problem with learners not attending classes, 80 percent of the learners had excellent attendance. The educators' experience of learners' eagerness to learn is positive and the majority agreed that it was *'excellent'*.

4.4.4.4 Assessment strategy

Learners had the opportunity to state how they view the 60 per cent pass rate and the assessment strategies that were used. The majority of learners (44 per cent) and educators (four), agreed that the pass rate was *'good'*, compared to the learners (33 per cent) and educators that said it should be 50 per cent. Table 41 indicates the learners and educators perception of the 60 per cent pass rate of the ITBC course.

Table 41: The learner's preference of a pass percentage

	It should be:		
	60%	**50%**	**70%**
Learners	44%	33%	23%
Educators	4	1	0

Table 42 reflects on the learners' perception of the assessment strategies being followed in the ITBC modules.

Table 42: Learners' perception of assessment of the different ITBC modules

Statement	Agree	Disagree
Constructive feedback was received	85%	15%
Learners who find the opportunity to assess themselves helpful	87%	13%

A total of 85 per cent of the learners received feedback after assessments in the form of written comments, class discussions, remedial homework, or oral feedback. This is very positive because receiving feedback is a crucial part of successful learning.

Learners had the chance to assess themselves and 87 per cent of them found it very helpful, especially after doing the Life Skills module where they were guided on how to assess themselves and the purpose of assessment. The educators were also eager to assist learners to identify areas not understood.

The qualitative feedback indicates that the learners furthermore agreed that the self-assessment helped them to prepare for summative assessments. The learners perceived the self-assessment as part of the learning process. Then finally the learners perceived the facilitator role of educators as a positive contribution to identify areas not understood.

The qualitative and quantitative data indicates that learners accept the 60 per cent pass rate and that the method of assessment contributed to the learning process.

4.4.4.5 Overall satisfaction of nature and scope of ITBC course

Table 43 reflects the learners' and educators' perception on the overall satisfaction of the ITBC course.

Table 43: The educators and ITBC learners' overall satisfaction of ITBC course

		Poor	Satisfactory	Good	Excellent
Learners	Computer overview	0%	16%	28%	56%
	Microsoft: Word, Excel, and Power Point	0%	15%	23%	62%
	HTML and Access	0%	28%	36%	36%
	PLT	5%	23%	51%	21%
Educators	ITBC	0	2	2	1

The PLT module was perceived by the mode of learners as *'good'* (51 per cent) and 21 per cent selected *'excellent'* after completion of the PLT module. The computer overview and Microsoft Office were perceived as *'excellent'* by the majority of learners. The HTML perception is spread almost evenly over the *'satisfactory'*, *'good'* and *'excellent'* options for learners. In total two of the educators perceived the overall satisfaction of the ITBC as *'satisfactory'* and two perceived it as *'good'*, only one thought that it is *'excellent'*.

In summary it will be recommended that Accounting be included in the ITBC course as learners felt the need for an Accounting module, in order to prepare them for the business management modules that are included in the ICT diploma.

4.5 Conclusion

After the research project was designed and implemented data was collected at several stages and analysed to produce research findings.

The research found that English comprehension is very important for the successful completion of an ICT diploma.

The research found that problem-solving skills are needed in order to become competent programmers, based on the PLT, Programming I results and correlations.

No conclusive empirical evidence could be found that ICT learners need appropriate numerical skills in order to become competent programmers.

The Life Skills module that was added shows possible improvement of learners' strategic learning skills. The qualitative data indicates a positive evaluation of the course by learners and educators. The feedback did point out that Numerical Skills need improvement and it also indicates that an ITBC course can indeed help the VUT to broaden access in the field of ICT.

CHAPTER FIVE – CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Many Computer Science Educators have been exploring how OBE, constructivism, and experiential learning approaches can be utilised in the field of Information and Communication Technology (ICT) in order to assist the learners' cognitive processes in constructing knowledge. Information and Communication Technology (ICT) has been identified as one of the crucial pillars of economic growth. Henceforth the development and availability of skilled manpower in this sector is gaining crucial importance. The Vaal University of Technology (VUT) joined hands with NIIT in working towards promoting and contributing to the development of this skills base.

One of the concerns of the research team is the gap in base skill level and maturity of a learner who wishes to enter the ICT stream directly from secondary level. Past analysis of data has shown that a high number of learners wish to pursue a career in ICT, but are unable to do so due to many reasons, some of which are:

- lack of required foundational skills to be successful in pursuing the ICT program;
- lack of understanding of ICT or "Technology Fear" leading to learners shying away from ICT programs; and
- limited exposure / weakness in communication and numerical skills.

The Information and Technology Boot Camp (ITBC) course was formulated and implemented as an ideal launch pad for the growth-spurt in ICT learners.

During the first implementation of the ITBC course during the second semester of 2003, the following research questions emerged:

- What is the nature and scope of the ITBC course?
- Does the enhancement of language comprehension have a positive influence on programming and logic skills?
- Does the implementation of problem solving and mathematical techniques have an influence on learners' programming abilities?

- What is the impact of formal introduction to life skills on the performance of 1st year ICT learners?

The aim of this research was to report and reflect the impact of an ITBC course on Programming I and to broaden access to the ICT diploma. The next section provides an overview of the previous chapters.

5.2 Overview

As discussed in Chapter 1, learners from diverse backgrounds and different mother tongues enrol for courses such as ICT and are confronted with problem-based instruction (see 1.3). The educators experience problems with the teaching of Programming, as a field of study, due to factors such as learners' misperception of computer science, their difficulty to relate theory to practice, and their insufficient knowledge of problem solving. The key areas of consideration for the launch of the preparatory ITBC course are as follows.

- The course could form a mandatory entry-level requirement for all learners who wish to pursue the B.Tech program in ICT at the VUT.
- The course could include ICT as well as non-ICT components to provide the learners all the required basics to be able to successfully pursue the B.Tech program in ICT.
- The course could also be offered as a certificate program, with the "outcome" being clearly mapped to basic skill requirements in the industry today. This will enable even learners not wishing to pursue higher education to obtain life-skills towards employment.

To conclude, the research problem was stated, and the objectives and significance of the research were argued, the reader was introduced to the research methodology, as well as the structure that was followed through the research report. The ITBC course was used as a mandatory entry-level requirement for learners and as a basis for the ICT qualifications at the VUT.

In Chapter 2 the outcomes and assessment criteria of the ITBC course are clearly defined and the literature on teaching and learning strategies was investigated and reported on. The ITBC consists of four components, namely: English Proficiency, Numerical Skills, ICT modules and Life Skills. The ITBC course focuses on introducing computer science concepts and developing academic competency, through the ICT modules.

The learners are oriented towards a learning approach in terms of goals of instruction, the input of information, the processes adopted, and the outcomes of learning, that indicate something about high-level, meaningful learning, which should be found in higher education. The learning architecture of the ITBC course is intended to enhance the quality of teaching and learning by using and applying the resources available such as the Learning Architecture on Collaborative Constructivism (LACC) methodology (see 2.5.4).

The VUT uses a combination of OBE, experiential learning and LACC for teaching modules in the ITBC course. The teaching and assessment methods used by the educators focused on a strategic approach of learning. The formative and summative assessment strategies were used to determine learners' performance in the ITBC course. The literature review highlighted the inconsistencies and gaps, which justified further research.

Chapter 3 describes the research design that was followed by this research project, by emphasising processes that had to be followed and the different qualitative and quantitative data that had to be gathered in order to make conclusions. Three measuring instruments were used to measure the ITBC course's impact on the ITBC learners' cognitive functioning with respect to different components. The VaalScan instrument was used to measure English comprehension. The SpEEX was used to measure learners' cognitive ability to comprehend concepts in computer science in order to solve problems, by testing their vocabulary, mathematical skills and English comprehension skills and the LASSI was used as an indicator of strategic learning skills.

Chapter 4 reported on the data analysis after the intervention of the ITBC course. These findings are summarised in the following paragraphs.

5.3 Findings

The findings will point out the practical implications of the results specifically for the Department Software Studies at the VUT. The findings are based on the analysis of qualitative and quantitative results. The next section provides a recapitulation of the findings for the complete project, in terms of the problem definition and research question in order to determine if the research objectives have been achieved.

5.3.1 The nature and scope of the ITBC course

The research findings indicate that the ITBC learners and the educators of the VUT are satisfied with the nature and scope of the ITBC course. The nature and scope of the ITBC involved the structure, relevance, objective, and content of the course, but it also included the learning, teaching and assessment that took place during the course. The learners and educators experienced the course objectives, structure and relevance as *'excellent'* or *'good'* (see 4.4.4.1). The learners perceived the content as relevant to the ICT field. The objectives were clearly defined and the milestones set, were implemented.

The educators fulfilled the role of facilitators and they implemented the LACC methodology during the ITBC course as a teaching method. The educators perceived the linear approach towards teaching of the ICT modules as positive, because it contributes to the learners' understanding of the work (see 4.4.4.2). Learners perceived the educators of the PLT (Programming and Logic Techniques) module as *'excellent'*. Learners were of the opinion that the educators know their work, they explain well and are willing to assist when needed.

The learners demonstrated a large degree of confidence to apply what they have learned into the field of ICT, and to apply knowledge into practice (see 4.4.4.3). The learners showed immense confidence and positive attitudes towards the ICT modules: Computer Overview, Microsoft Word, Microsoft Excel, Microsoft Power Point, HTML and Access, but they demonstrated less confidence with the PLT module.

The majority of learners experienced the assessment practices of the ITBC course as *'good'* and they believe that the objectives were clearly defined and achieved (see 4.4.4.4). Even the 60 per cent pass rate of the ITBC course and minimum requirement for the ICT diploma was accepted by the majority of learners, indeed some learners even wanted it to be set to a higher standard. The ITBC learners were able to learn strategically and believed the computer science modules contributed to the improvement.

5.3.2 The influence of the ITBC language comprehension module on programming and logic techniques

The application of the English Proficiency module had an influence and instigated the change of learners' English comprehension, cognitive functioning and problem-solving skills, as seen from the SpEEX results (see 4.4.1.1). Previous research proved that English is more important than Mathematics for ICT learners and the significant correlation between the English Proficiency, ICT modules and Numerical Skills of this research supports this claim (see 4.4.1.3).

The results in Chapter 4 indicate that after successfully completing the ITBC English Proficiency module, the learners' English comprehension improved significantly from *'Grade 8/9'* to *'Grade 10/11'*, which is an improvement of 32 per cent.

5.3.3 The influence of the ITBC on problem solving and numerical skills

The results in Chapter 4 indicate that the ITBC learners improved their numerical skills and problem-solving skills after the ITBC intervention. The SpEEX results further indicate that the majority of ITBC learners showed a significant improvement in problem solving and numerical skills from level *'9'* to *'11'*, a 14 per cent increase, which in turn broadened access.

By improving learners' problem-solving skills and cognitive functioning, access is broadened at the VUT. At first access was broadened by lowering the Swedish scale entry requirements, and offering the learner the chance to go through the ITBC course before enrolling into a particular diploma. The ICT modules, especially the PLT module, offered extensive practical application of knowledge and problem solving through projects, practical sessions and the formative continuous assessment. In the PLT module learners learned to solve problems generically in order for them to design programs. When considering the pass rate of Programming I, it indicates that the practical exposure to computers and integration of fundamental computer science concepts slightly helped to solve the under-preparedness of learners in the field of ICT.

5.3.4 The influence of the Life Skills module on 1st year ICT learners

The results indicate that the ITBC learners *'information processing'* and *'testing strategies'* improved significantly. The other LASSI components did not improve significantly. The

attitude of the learners, for example, showed a decrease of 2 percent. The Life Skills module prepared the learners with necessary strategic learning skills required in tertiary education and by doing so, overcame the gap between secondary and tertiary education and contributed to the learners' ability to process information successfully.

5.3.5 Research summary

To conclude it can be stated that:

- the nature and scope of the ITBC was determined;
- the English Proficiency module had a significant impact on Programming I;
- Numerical Skills showed little correlation to Programming I; and that
- the formal introduction of a Life Skills module had an impact on 1st year ICT learners.

5.4 Recommendations

The recommendations will point out practical suggestions, strategies or further research needed to further improve pass rates and to ensure the future success of the ITBC course and of learners in the field of ICT. The recommendations are based on the findings and analysis of qualitative and quantitative results.

5.4.1 Nature and scope recommendations for the ITBC

Recommendations regarding the nature and scope of the ITBC course are listed.

- Educators should receive training to implement the LACC methodology before commencing the ITBC course and it should furthermore be implemented in all the modules of the ITBC course.
- It is recommended that the LACC methodology should also be implemented into the mainstream ICT diploma and that all staff members of the Department Software Studies undergo such training.
- It is recommended that further investigation be undertaken to determine if it will be feasible and practical to implement the different ITBC modules parallel with one another, in order to optimize resources. For example if the learner fails ICT module I he should be able to redo it while the other learners are busy with ICT module II.

- It is further recommended that the throughput rate of learners enrolled for the National Diploma in ITC be investigated at the end of 2006, to determine whether the ITBC course indeed contributed to the successful completion of an ICT diploma within 3 years.
- It is furthermore suggested that educators and student counselling bureaus work together to advise learners in career decisions. After the completion of the ITBC course learners need guidance to make decisions regarding their careers.
- Qualitative feedback underlined the importance of a proper teaching methodology; therefore educators should be trained in suitable teaching methods that can be used specifically in computer science courses to bring about educational change and to improve learner performance.
- It is recommended that access and recognition of prior learning regarding introductory programs should be covered by the institutional policy of the institution.

5.4.2 Recommendations regarding the English Proficiency module

The English Proficiency module did indeed comply with its objectives in the short term with regard to the improvement of Programming I and it is recommended that:

- the ICT learners should always have an appropriate English level *'Grade 12'* or should either attend an English Proficiency module before enrolling into the ICT programme; and
- for future research it is recommended that the influence of the English proficiency training be evaluated over a longer period of time and investigated at different kinds of tertiary education institutions.

5.4.3 Recommendations regarding the PLT and Numerical Skills modules

The Numerical Skills modules did not comply, as it should have, with the objectives in regard to the improvement of Programming I and it is recommended that:

- further investigation is needed into the prerequisite of Mathematics mark (SG C and HG D) for learners before they can enrolled into the ICT diploma otherwise they need to do the ITBC Numerical Skills module; and
- for future research it is recommended that the influence of Numerical Skills on problem solving, cognitive functioning and Programming I be evaluated over a longer period of time and at different tertiary education institutions, in order to determine the specific effect of integration of Numerical Skills on cognitive development of learners in the field of ICT.

The PLT and ICT modules did comply with the objectives in regard to the improvement of Programming I and it is recommended that:

- the number of hours spend on the PLT module should be increased as supported by the qualitative results; and
- a tutorial period should be added during which more hands-on exercises should be worked through.

5.4.4 Recommendations on the Life Skills module

The Life skills module did comply with the objectives regarding the improvement of 1st year learners' performance, but the following recommendations can be taken into consideration.

- Focus attention on or further investigate the reasons why the learners' attitude and motivation score were not adequate. The learners' attitude in the feedback forms however indicates a difference from the LASSI scores and because of this discrepancy it is necessary to investigate it further.
- It is recommended that for the Life Skills module a textbook by Nina Evans *et al.* (2004) should be prescribed, which is specifically designed to prepare ICT learners with the required life skills needed to become a competent IT person. The book being used currently is acceptable for the broader population but not specifically for the field of ICT.

5.5 Conclusion

The results indicate that the exposure of the ITBC learners to English Proficiency, Numerical Sills, ICT modules and Life Sills contributed to a change in the learners' strategic learning, problem-solving skills, logical-thinking skills, cognitive- functioning skill, English comprehension and academic competency.

"Learners should not be seen as jars to be filled, but rather as lamps to be fuelled in order to provide light"

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ANNEXURES

ANNEXURE A ITBC learner questionnaire during ITBC course

VAAL TRIANGLE TECHNIKON

Faculty of Applied and Computer Sciences

Department Information Technology

MODULE FEEDBACK FORM

Course Title: ***Information Technology Boot Camp***

Module: _____

Date: _____

Dear learner,

Your expectations and concerns are of great value to us, because we want to offer our learners the best learning experiences possible. Would you be so kind to complete the questionnaire below in the space provided? Your opinions are confidential and you do not have to state your name.

Indicate with a cross in the applicable block, whether the actions mentioned were unsatisfactory (1-2), on average (3-4) or whether you were completely satisfied with the action (5).

	Unsatisfied 1	2	***Average*** 3	4	***Satisfied*** 5
1. RELEVANCE					
1.1 How clearly were the objectives defined by the lecturer at the beginning of the module ?	☐	☐	☐	☐	☐
1.2 How well were the objectives as stated in your manual achieved by the end of the module?	☐	☐	☐	☐	☐
1.3 How confident are you that you will be able to apply what you have learned (i.e. what is your personal effectiveness)?	☐	☐	☐	☐	☐
2. STRUCTURE					
2.1 Practice of concepts learnt: were there enough hands-on exercises, examples etc.?	☐	☐	☐	☐	☐
2.2 How would you rate the pace of the program.	☐	☐	☐	☐	☐
If unsatisfactory, state whether it is too slow, or too fast:_____					
3. LECTURERS					
How would you rate your lecturer's					
3.1 Presentation skills	☐	☐	☐	☐	☐
3.2 Knowledge of subject	☐	☐	☐	☐	☐
3.3 Interest in this Module	☐	☐	☐	☐	☐
4. OTHERS					
4.1 Please rate your overall satisfaction with the module	☐	☐	☐	☐	☐

5. COMMENTS

5.1 Things you like most about the module

5.2 Things you like least about the module

ANNEXURE B ITBC learner questionnaire after completion of the ITBC course

VAAL UNIVERSITY OF TECHNOLOGY
Faculty of Applied and Computer Sciences
Department Information and Communication Technology

MODULE FEEDBACK FORM

Course Title: ***Information Technology Boot Camp***

Module: _____
Date: _____

Dear learner,
Your expectations and concerns are of great value to us, because we want to offer our learners the best learning experiences possible. Would you be so kind to complete the questionnaire below in the space provided? Your opinions are confidential and you do not have to state your name.

This module feedback form is designed, based on module1 – Computer Overview, module 2 – Word, Excel, and PowerPoint, module 3 – HTML and ACCESS and module 4 Programming logic, of the computer science side of the Entry Level Certificate programme.

Indicate with a cross X in the applicable block, whether the actions mentioned were, for example, unsatisfactory, or whether you were completely satisfied with the action

1. RELEVANCE

1.1 How confident are you that you will be able to apply what you have learned (i.e. what is your personal effectiveness?)

No confidence	***Limited confidence in specific environment***	***Confident***

1.2 How relevant is what you have learned in the ITBC-course to what you are doing know?

Relevant	***Sometimes relevant***	***Very relevant***	***Not relevant***

2. STRUCTURE

2.1 Were you able to cope with the pace of the ITBC-course?

To slow	Slow	To fast	Fast	Excellent

2.2 How would you rate the facilities used during the programme?

Poor	Satisfied	Good	Excellent

2.3 How would you rate the time spend on practical exercises?

Poor	Satisfied	Good	Excellent

3. ASSESSMENT

3.1 How do you feel about the 60% pass rate?

Yes it is good	No it should be more than 60%	It should be less than 60%	No it should be more than 70%	It should be 50%

3.2 Did you get sufficient feedback from lecturer?

Yes	No

3.3 In what format was feedback supplied? (You may select more than one)

Comments	Class discussions	Remedial help	Oral

3.4 Was the method of assessment being defined in outcomes and objectives of modules?

Poor	Satisfied	Good	Excellent

3.5 How would you rate the time allocated to complete an assessment?

Poor	Satisfied	Good	Excellent

3.6 Did you find the opportunity to assess yourself helpful?

Yes	No

3.6.1 For what reason did you find it helpful?

Helped me to identify areas not understood	It was part of learning	It was part of summative assessment

Any other specify:

4. ABILITY TO APPLY KNOWLEDGE INTO PRACTICE

4.1 How would you rate your ability to what you have learned in the ITBC-course to your current studies?

Module1 - Computer Overview	Poor	Satisfied	Good	Excellent
Module2 - Word, Excel, and PowerPoint	Poor	Satisfied	Good	Excellent
Module3 - HTML and ACCESS	Poor	Satisfied	Good	Excellent
Module4 - PLT Programming logic	Poor	Satisfied	Good	Excellent

4.2 Did the learning content provide you sufficient knowledge and skills to apply the theory into practice?

Module1 - Computer Overview	Poor	Satisfied	Good	Excellent
Module2 - Word, Excel, and PowerPoint	Poor	Satisfied	Good	Excellent
Module3 - HTML and ACCESS	Poor	Satisfied	Good	Excellent
Module4 - PLT Programming logic	Poor	Satisfied	Good	Excellent

4.3 Do you feel that there is an improvement to what you have learned?

Yes	No

4.4 Did the learning content provide you with sufficient knowledge and skills to apply the theory into programming – Software Development I?

Poor	Satisfied	Good	Excellent

5. LECTURERS

5.1 How did you perceive the lecturers participation in class?

Poor	Satisfied	Good	Excellent

5.2 How would you rate your own participation in class?

Poor	Satisfied	Good	Excellent

5.3 The major task of the lecturer should be to: (select only one)

Assist me step-by-step in solving problems so that I can succeed	Facilitate me so that I will be able to work on my own

5.4 Did your lecturers allow you to make mistakes, correct errors, so that you can learn from the process?

Yes	No

5.5 How would you rate the lecturers pace compared to your own pace to learn as well as all the other learners?

Poor	Satisfied	Good	Excellent

6. ABILITY TO LEARN

6.1 Do you feel confident in your ability to learn new context?

No confidence	***Limited confidence in specific environment***	***Confident***

6.2 Do you feel that you have a structured – better – improved – study method, than what you had at school?

Yes	No

6.2.1 If yes in which way?

6.3 Do you have a fear for exams?

Yes	No

6.3.1 If yes why are you afraid?

6.4 Do you feel empowered to succeed?

Yes	No

7. OTHER

7.1 Please rate your overall satisfaction with the programme:

Module1 - Computer Overview	Poor	Satisfied	Good	Excellent
Module2 - Word, Excel, and PowerPoint	Poor	Satisfied	Good	Excellent
Module3 - HTML and ACCESS	Poor	Satisfied	Good	Excellent
Module4 - PLT Programming logic	Poor	Satisfied	Good	Excellent

8. COMMENTS

8.1 Please write down your own understanding of the reason for scheduling the ITBC-course?

ANNEXURE C ITBC course enrolment procedure

A learner can only enroll as an ICT learner if he meets the set criteria, as indicated in the table 44. If the learner does not meet the criteria for the diploma/degree the learner needs to first complete the ITBC-course and pass it with a 60 per cent average.

Table 44: ITBC or ICT diploma Enrolment criterion

ITBC course	ICT diploma/degree
Mathematics and/or English was not greater than D on higher grade or C on standard grade.	Mathematics and English can be on higher/standard grade. If on higher grade a mark greater/equal to a D and on standard grade a mark greater/equal to C needs to be obtained.
Learner scored greater than 22 and less than 28 on the Swedish scale	The learner should score 28 or more on Swedish scale.
Placement tests scores are used to determine if the learner improved his life skills, English profisiency, numerical-, problem solving skills, and strategic learning skills.	Placement test scores are used to determine if a learner needs extra classes, for example, reading comprehension, life skills or numerical skills.

The learners need to follow the procedure listed below, they need to meet the set criteria for either the ITBC/diploma/degree programme. Figure 10 shows the selection process of ICT learners during 2003.

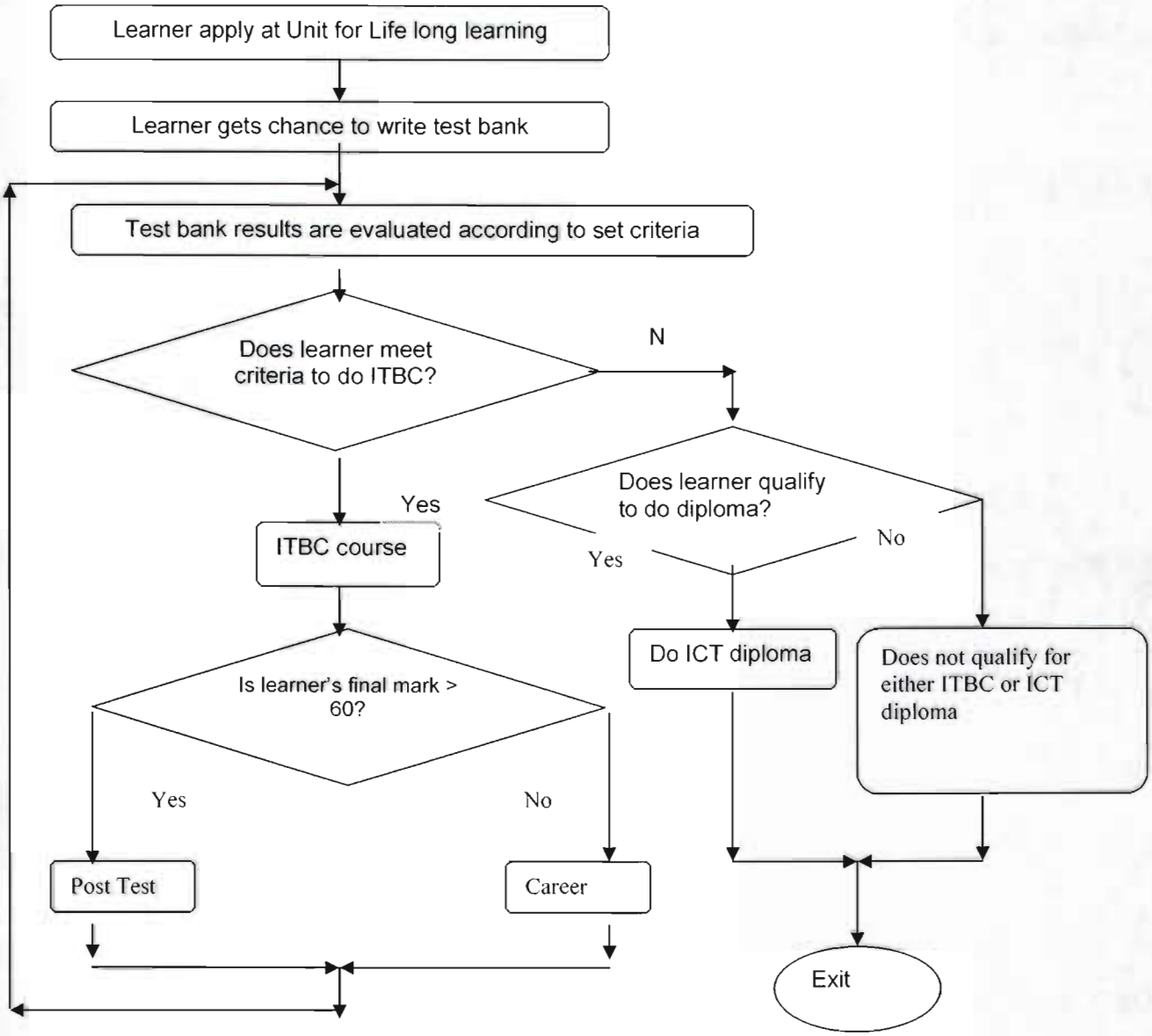

Figure 10: Enrolment procedure for ITBC 2003

ANNEXURE D ITBC course outline

The following Annexure will concentrate on the ITBC module outlines.

English Proficiency module

The general objectives of the English Proficiency course is to equip learners with language and communication skills for business, public, and professional world, in order to function competently in the work situation. The main objectives are to improve each learner's skills in listening, speaking, reading and writing in English.

Objectives

Learners will be introduced to:

- comprehension – vocabulary, spelling and grammar;
- reading and writing skills;
- speaking skills and oral presentations;

Goals

At the end of the module the learner should be able to:

- fluent in reading comprehension;
- show improvement in reading skills and techniques;
- write effectively and with confidence;
- speak effectively and using these techniques to solve problems, conduct meetings, participate in sales presentations and become involved in formal speaking situations;

Numerical Skills module

The purpose of the Numerical Skills module is to give learners a 'working knowledge' of the subject. At the end of each session a summary is given as an aid for revision to learners. Many examples are given, as well as exercises on the relevant topics covert.

Objectives

Learners will be introduced to:

- the different number systems, exponents, logarithms, factorisation, equations and inequalities;
- graphs, optimisation, calculus and
- elementary matrix algebra.

Goals

At the end of the module the learner should be able to:

- use the different number systems;
- apply and understand exponents;
- understand logarithms (the laws, expressions and equations);
- understand factorisation (standard types as well as the factor theorem);
- apply equations (linear, quadratic and higher order polynomials);
- apply inequalities (linear, quadratic, and higher order);
- use absolute values (equations and inequalities);
- create graphs (polynomials up to third power, exponential, logarithmic);
- apply optimisation (linear programming);
- understand calculus (differentiation and integration); and
- apply elementary matrix algebra (the basic principles).

Life Skills module

The objective of the Life Skills module is to assist and advice the learners with strategic learning skills in order to cope with the daunting and yet exhilarating and rewarding experience of tertiary education.

Objectives

Learners will be introduced to:

- how to settle in tertiary education situation;
- proper time management;
- setting of reasonable goals;
- study habits and strategies;
- preparing for lectures and exams; and
- attending and review all lectures and tutorials.

Goals

At the end of the module the learner should be able to:

- get settled and share accommodation;
- plan and use time management skills;
- set their own goals;
- prepare and attend lectures;

- apply appropriate study strategies; and
- prepare for exams by taking notes and following appropriate approaches for examination.

There are two ICT modules, the first consisting out of two modules each. Module I, concentrate on overview of computers (module 1) and Microsoft Office (module 2), while the Module II concentrate on HTML, Access (module 3) and Programming Logic Techniques (module 4). The next section will elaborate on the content of these four components of the ICT modules.

Module 1: The first ICT module consists out of an overview of computer concepts, Microsoft Windows, and networking essentials.

Computer overview and fundamentals

Objectives

Learners will be introduced to the:

- different areas in which computers are used;
- benefits of computers;
- Input-Process-Output cycle;
- different hardware components and various types of software;
- principles of data organization in files;

Goals

At the end of the module the learner should be able to:

- list the different means in which computers are used;
- list the benefits of computers;
- identify the various hardware components;
- explain the Input-Process-Output cycle;
- differentiate between the various types of software;
- state the principles of data organization in files;

Computer concepts

Objectives

Learners will be introduced to:

- different types of personal and new generation computers, and in particular size and function;

- common input and output devices;
- different storage media and storage devices;
- the components of the system unit;
- the components attached to the motherboard;
- the types of display adapters;
- prevent virus infections on the computer;
- terms, concepts, and devices that are used in context of computer science;
- the Internet with its activities together with introduction to networking and Internet;
- to the Intranet;
- techniques of managing hard disks and floppy disks for optimal performance;
- the need for compression utilities;
- the principles of virtual reality;
- methods that can be used to rectify minor problems with the computer and its devices;
- networking and devices used to connect computers, and advantages and disadvantages of networking arrangements;
- the various types of network media and what techniques can be used to extend local area network (LAN's).

Goals

At the end of the module the learner should be able to:

- classify computers based on size and function;
- list the types of personal and new generation computers;
- identify input and output devices;
- differentiate between storage media and storage devices;
- list common storage devices;
- list the components of the system unit;
- list the components attached to the motherboard;
- list the types of display adapters;
- explain what a computer virus is, identify the different types of and methods that can be used to prevent virus infections;
- explain the importance of Internet in today's world;
- define Intranet;
- apply disk management principles to hard disks;

- apply disk management principles to floppy disks;
- state the need for compression utilities;
- list the principles of virtual reality;
- rectify minor problems with the computer and its devices;
- state the need for networking;
- list the roles of computers in a network;
- classify networks based on the distance covered by them;
- list the common communication devices available;
- list the various network topologies;
- state the need for a protocol;
- list the various wireless transmission techniques used in a LAN;
- explain the various types of network media and what techniques can be used to extend LAN's.
- list the services used in mobile computing;
- explain the different internal components of a computer and their function that they perform;
- provide an overview of activities that can be performed on Internet and Intranet;
- discuss compression techniques to compress files for storage and explain what utilities are used for this purpose;
- explain what is meant by computer networks, devices used to connect computers, arrangements of networks with advantages and disadvantages of arrangements

Microsoft Windows

Objectives

Learners will be introduced to:

- the components of a Graphical User Interface;
- how to move or resize a window;
- the features of Windows NT Workstation 4.0;
- the icons of the desktop;
- ways to customise and organise the desktop settings;
- the need for organising files and folders;
- creation of documents in Notepad;

- the attributes of a file;
- various file-related operations on files and folders;
- mapping of a network drive;
- programs available in the Accessories group;
- the setting of properties of the taskbar;
- drawing of pictures using Paint accessory.

Goals

At the end of the module the learner should be able to:

- list the components of a Graphical User Interface;
- move or resize a window;
- list the features of Windows NT Workstation 4.0;
- identify the icons of the desktop;
- customise and organise the desktop settings;
- state the needs for organising files and folders;
- create documents in Notepad;
- identify the attributes of a file;
- perform various file-related operations on files and folders;
- share a folder;
- map a network drive;
- identify programs available in the Accessories group;
- set the properties of the taskbar;
- draw pictures using Paint accessory.

Networking essentials

Objectives

Learners will be introduced to:

- the general communication model;
- what is meant by networking;
- the advantages of networking;
- differences between Local Area Networks (LAN), Metropolitan Area Networks (MAN), and Wide Area Networks (WAN);
- the advantages of LAN;

- the requirements for connecting a PC to a network;
- the types of networks: peer-to-peer networks, server-based network;
- the design considerations of a network layout;
- the three standard topologies: bus, star, and ring topology;
- the functions of a Network Operating System;
- the components of a network operating system;
- the elements of Client software;
- the elements of Server software;
- the functions of network services;
- the benefits of sharing an application across a network;
- the installation of applications that can be shared across a network;
- the problems occurring with shared installations and their possible solutions.

Goals

At the end of the module the learner should be able to:

- understand the general communication model;
- understand what is meant by networking;
- describe the advantages of networking;
- differentiate between Local Area Networks (LAN), Metropolitan Area Networks (MAN), and Wide Area Networks (WAN);
- list the advantages of LAN;
- identify the requirements for connecting a PC to a network;
- identify the types of networks: peer-to-peer networks and server-based network;
- understand the design considerations of a network layout;
- identify the three standard topologies: bus, star, and ring topology;
- enumerate the functions of a Network Operating System;
- identify the components of a Network Operating System;
- identify the elements of Client software;
- identify the elements of Server software
- understand the functions of network services;
- appreciate the benefits of sharing an application across a network;
- install applications that can be shared across a network;
- identify the problems occurring with shared installations and their possible solutions.

Module 2: this module consists out of Microsoft Office Word, Excel, Power Point, and Outlook.

Microsoft Office Word

Objectives

Learners will be introduced to:

- the toolbars to be used in Word;
- the creation, location, protected viewing, and formatting of documents;
- Word Help and Office Assistant, in order to enable learner to explore and find details of topics;
- comments and the objects placed in Word documents;
- formatting the document in detail, such as, formatting paragraphs, indenting, aligning text, bulleting, and numbering text;
- hyphenation of document;
- how to include headers and footers in a Word document;
- bookmarks, performing grammar check in a Word document;
- adding table of contents, using auto correct features, cross-referencing and printing documents;
- customising a toolbar according to requirements;
- creation of new toolbars and deletion of old ones;
- creation of tables and explain how text can be added, selected, deleted when it is in a table;
- how cells of a table can be managed and how rows and columns can be manipulated in Word table;
- saving the document as a Web page, creation of hyperlinks, labels and envelopes;
- create and edit index entries and creation of macro's and forms;
- how charts and graphs can be created and modified.

Goals

At the end of the module the learner should be able to:

- use the toolbars in Word;
- create, locate, use protected viewing, and formatting of documents;
- explore and find details of topics in Word Help and Office Assistant;
- deal with comments and the objects placed in Word documents;

- format the document in detail, such as, formatting paragraphs, indenting, aligning text, bulleting, and numbering text;
- hyphenate the document;
- include headers and footers in a Word document;
- use bookmarks, perform grammar check in a Word document;
- add a table of contents, using auto correct features, cross-referencing and printing documents;
- customise a toolbar according to requirements;
- create new toolbars and delete old ones;
- create tables and explain how text can be added, selected, deleted when it is in a table;
- demonstrate how cells of a table can be managed and how rows and columns can be manipulated in a Word table;
- save the document as a Web page, create hyperlinks, labels and envelopes;
- create and edit index entries and create macro's and forms;
- demonstrate how charts and graphs can be created and modified.

Microsoft Office Excel

Objectives

Learners will be introduced to:

- working of spreadsheets and handling data;
- functions, formulas, and referencing of data;
- text, numbers, and data series;
- formatting of an Excel document;
- creation of charts and handle printing;
- Report Manager, importing and exporting data;
- the concept of auditing worksheets;
- comments and protection in a worksheet;
- information on macro's and data validation;
- dealing with different analysis tools along with the concept of Pivot tables.

Goals

At the end of the module the learner should be able to:

- work with spreadsheets and handle data;

- understand and work with functions, formulas, and referencing of data;
- work with text, numbers, and data series;
- format an Excel document;
- create charts and handle printing;
- work with Report Manager, importing and exporting data;
- understand the concept of auditing worksheets;
- handle comments and protection in a worksheet;
- supply information on macro's and data validation;
- deal with different analysis tools along with the concept of Pivot tables.

Microsoft Office Power Point

Objectives

Learners will be introduced to:

- the features of PowerPoint and how to start PowerPoint;
- creation of a presentation, adding headers and footers;
- inserting and editing of text;
- inserting and deleting of slides in a presentation;
- concepts of various views available in PowerPoint;
- fonts and using of Format Painter;
- different types of object that can be created using the Drawing Toolbar, Clip Art, tables, Office Clipboard and how to import text from Word;
- customising a presentation, using bullets, speaker notes, process of viewing a slide show, transition and animation effects;
- modification of text alignment, tab, and indent settings;
- creating a Web folder and saving presentation in it. It covers the publishing of presentation on the Web, printing the presentation and using the Office Assistant;
- the use of templates in a presentation;
- hyperlinks and action buttons, and their use in a presentation ;
- advanced topics related to PowerPoint presentation, such as generating meeting notes during a presentation and export them along with actions;
- Charts and toolbars.

Goals

At the end of the module the learner should be able to:

- understand the features of PowerPoint and how to start PowerPoint;
- create a presentation, add headers and footers;
- insert and edit text;
- insert and delete slides in a presentation;
- identify the various views of concepts available in PowerPoint;
- use fonts and Format Painter;
- differentiate between different types of object that can be created using the Drawing Toolbar, Clip Art, tables, Office Clipboard and how to import text from Word;
- customise a presentation, using bullets, speaker notes, process of viewing a slide show, transition and animation effects;
- modify text alignment, tab, and indent settings;
- create a Web folder and save presentation in it. It covers the publishing of presentation on the Web, printing the presentation and using the Office Assistant;
- use templates in a presentation;
- use hyperlinks and action buttons in a presentation ;
- identify advanced topics related to PowerPoint presentation, such as generating meeting notes during a presentation and export them along with actions; and
- understand charts and toolbars.

Microsoft Outlook

Objectives

Learners will be introduced to:

- the functions and interface of Outlook 2000;
- composition and managing messages;
- customising toolbars and working with messages;
- the navigation in a Calendar tool of Outlook 2000, which is used for the purpose of managing and scheduling appointments, meetings, various activities, and events;
- customising menus and toolbars;
- the creation, modifying, deleting, and organising of notes in Outlook 2000;
- managing, organising and sending contact details;

- the creating, assigning, accepting, sending a task status report, changing the view for tasks, and managing Tasks;
- creating tasks from other Outlook components;
- organising tasks using categories.

Goals

At the end of the module the learner should be able to:

- identify the components and benefits of Outlook 2000;
- list the functions and interface of Outlook 2000;
- use composition and managing of messages;
- customise toolbars and work with messages;
- navigate the Calendar tool of Outlook 2000, which is used for the purpose of managing and scheduling appointments, meetings, various activities, and events;
- customise menus and toolbars;
- create, modify, delete, and organise notes in Outlook 2000;
- manage, organise, and send contact details;
- create, assign, accept, send a task status report, change the view for tasks, and manage Tasks;
- create tasks from other Outlook components;
- organise tasks using categories.

Module 3: consists out of e-mail communication skills, Internet, HTML, Front Page, Access and web page design.

E-mail communication skills, Internet, HTML, and Front Page

Objectives

Learners will be introduced to:

- the basics of Internet;
- the usage and development of the Internet;
- importance of the Internet and the methods of accessing the Internet;
- the World Wide Web (WWW);
- the methods used to access the Internet from an Internet Service Provider (ISP);
- the Uniform Resource Locator (URL) and its components;
- various services provided on the WWW are discussed;

- the Internet Explorer – Microsoft's Internet browser;
- the HTML programming language and the basic document structure elements of HTML;
- the formatting of HTML documents and elements;
- the usage and importance of escape sequences in HTML programming;
- the creation of marquees, hyperlinks, and insert images in a Web page;
- frames and forms, that will enable the learner to display a number of HTML pages in the same browser window, and enable the learner to accept information from the Web site;
- the basics of Web design;
- the key points to remember while creating a Web site;
- the use of graphics effectively in a Web page;
- Microsoft FrontPage – a Web authoring tool;
- creation and administration of Web sites;
- usage of both HTML and FrontPage;
- creating and formatting a Web page using FrontPage Editor;
- images maps are also introduced.

Goals

At the end of the module the learner should be able to:

- understand the basics of Internet;
- understand the usage and development of the Internet;
- understand the importance of the Internet and the methods of accessing the Internet;
- identify the World Wide Web (WWW);
- use different methods to access the Internet from an Internet Service Provider (ISP);
- understand the Uniform Resource Locator (URL) and its components;
- identify various services provided on the WWW;
- use the Internet Explorer – Microsoft's Internet browser;
- understand and use the HTML programming language and the basic document structure elements of HTML;
- format HTML documents and elements;
- understand the usage and importance of escape sequences in HTML programming;
- create marquees, hyperlinks, and insert images in a Web page;

- understand frames and forms, that will enable the learner to display a number of HTML pages in the same browser window, and enable the learner to accept information from the Web site;
- understand the basics of Web design;
- identify the key points to remember while creating a Web site;
- use graphics effectively in a Web page;
- use Microsoft FrontPage – a Web authoring tool;
- create and administrate a Web site;
- use both HTML and FrontPage;
- create and format a Web page using FrontPage Editor;
- understand images and maps.

Access

Objectives

Learners will be introduced to:

- creating of databases, tables, and relationships;
- setting data validations;
- modifying the contents of a table and deleting data from a table;
- sorting and filtering data in a table;
- creating a query and print query results;
- creating forms;
- entering data in a table using a form;
- add controls to a form and printing the form;
- creating a report.

Goals

At the end of the module the learner should be able to:

- create databases, tables, and relationships;
- set data validations;
- modify the contents of a table and delete data from a table;
- sort and filter data in a table;
- create a query and print query results;
- create forms;

- enter data in a table using a form;
- add controls to a form and print the form;
- create a report.

Module 4: concentrates on program logic and techniques (PLT).

Program logic

Objectives

Learners will be introduced to:

- the core concepts of computer problem-solving and algorithm designs in terms of pseudocode, such as variables, constants, comment entries, keywords, arithmetic, relation, logic, decision-making constructs etc.;
- writing pseudocode for problems involving arithmetic calculations and decision-making;
- the development of skills for writing pseudocode using iteration;
- array-processing algorithms;
- arrays that are coupled with iteration in algorithm development, to process numeric as well as alphanumeric data;
- large and complex problems by breaking them up into smaller modules, each which are solved separately;
- pseudocode that are written to represent algorithms for all concepts.

Goals

At the end of the module the learner should be able to:

- understand the core concepts of computer problem-solving and algorithm designs in terms of pseudocode, such as variables, constants, comment entries, keywords, arithmetic, relation, logic, decision-making constructs etc.;
- write pseudocode for problems involving arithmetic calculations and decision-making;
- write pseudocode using iteration;
- use and understand array-processing algorithms;
- use and understand arrays that are coupled with iteration in algorithm development, to process numeric as well as alphanumeric data;
- break up large and complex problems into smaller modules, which will be solved separately;
- write pseudocode to represent algorithms for all concepts.

ANNEXURE E Calculation of ITBC course assessment results

The following Annexure contains the detail of how the assessment results have been calculated for the ITBC course.

Table 45 shows how English Proficiency assesses the content covered.

Table 45: English Proficiency assessments

Method/type	Marks awarded to			Format of assessment
	Year mark out of 100	Final mark	RPL	
Class test 1	20 %			Written format
Class test 2	20 %			Reading out load
Class test 3	20 %			Summary on written report
Class test 4	20 %			Written piece of work
Project	20 %			Prepared speech
Year mark minimum	40 % →	40 % year mark	40%	Show proof of qualification
Exam/re-write mark		60 %	Pre test similar to exam	
Final mark		Year mark + Exam mark	Year mark + pre test mark	
Pass mark		60 %	60%	

Table 46 shows how Numerical Skills assess the content covered.

Table 46: Numerical Skills assessment

Method/type	Marks awarded to			Format of assessment
	Year mark out of 100	Final mark	RPL	
Class test 1	20 %			
Class test 2	20 %			
Class test 3	20 %			
Final test	40 %			
Year mark minimum	40 % →	40 % year mark	40 %	Proof of qualification
Exam/re-write mark		60 %	Pre test similar to exam	
Final mark		Year mark 40 + Exam mark 60 = 100	Year mark 40+ pre test mark 60 = 100	
Pass mark		60 %	60%	

Table 47 shows how the NIIT ICT modules was assessed.

Table 47: Information and Communication Technology modules assessment

Module 1 Introduction Windows Networks				
Method/type	**Marks awarded to**			**Format of assessment**
	Year mark	**Final mark**	**RPL**	
Final mark for module that contributes towards year mark	5 %	5%	5%	Class test practical or for RPL – learner will get credits for class test provided that learner shows proof of qualifications
Module 2 Micro Soft Office, Word, Excel, and Power Point				
Method/type	**Marks awarded to**			**Format of assessment**
	Year mark	**Final mark**	**RPL**	
Final mark for module that contributes towards year mark	5 %	5 %	5 %	Class test practical or for RPL learner will get credits for class test and the learner needs to provide proof and results of qualification.
Module test 1 / re-write				For RPL learners need to finish the project and module test for first 2 modules. Module test 1 consisting out of:
Theory paper		**15%**	**15 %**	theory multiple choice/RPL pre-test
Practical paper		**15%**	**15 %**	practical paper/RPL pre-test
Project 1		**10 %**	**10 %**	Project based on Word, Excel, and Power Point/RPL pre-project
Module 3 Internet, HTML, and Outlook				
Method/type	**Marks awarded to**			**Format of assessment**
	Year mark	**Final**	**RPL**	
Final mark for module that contributes towards year mark	5 %	5 %	5 %	Class test practical or for RPL learner will get credits for class test and the learner needs to provide proof and results of qualification.
Module 4 Access and Programming Logic				
Method/type	**Marks awarded to**			**Format of assessment**
	Year mark	**Final**	**RPL**	
Final mark for module that contributes towards year mark	5 %	5 %	5 %	Class test practical or for RPL learner will get credits for class test and the learner needs to provide proof and results of qualification.
Module test 2				**Module test 2 is theory and multiple choice**
Theory paper		**30%**	**30 %**	theory multiple choice/RPL pre-test
Project 2		**10 %**	**10%**	**Project on PLT and Access**
Final total mark		**100%**	**100%**	

For RPL purposes the ICT modules will contribute as shown in Table 48.

Table 48: Recognition of Prior Learning handled by the VUT for the ITBC course

Assessment method	Marks awarded	Calculation
Class test	20%	The learner applied to be credited for parts of modules already finished at other institutions. The learner will only get 5% credit for each module already completed. The rest of the class test marks will then be gained by finishing the required modules.
Module test 1	30%	The pre test will be given to the RPL learner as a way of assessing the learners knowledge of the module. The test will be similar to the module test being written by th ITBC learners, consisting out of multiple choice theory plus a practical paper, covering all the work covered in first part of semester up to hiloday. This test will then be written by learner when he applies.
Module test 2	30%	The second pre test for RPL purposes will only be completed if learner already finished the first 4 modules at another institutions, and applied for creditation or exception. The learner also need to write the first pretest and finish both projects before the learner will be awared credit for 4 modules. The pre test will be simular tot he module test that the ITBC learners write, consisting out of 30 multiple choice questions, which is randomly selected from a test bank. This test is then written when learner applies for credits.
Project	20%	First project is in first part of the semester and is contributing 10%. In the second part of the semester the project at end contributes 10%.
Final mark	100%	Class test + Module test1 + Module test 2 + project

The contribution of the different units of the ICT modules in the ITBC-course towards summative assessment can be seen in Table 49 below.

Table 49: Contribution of ICT modules to ITBC learner final mark

Assessment method	Marks awarded	Calculation
Class test	20%	4 class tests are written, the average determined and only 20 % extracted or 4 class test marks added together for 4 IT modules divided by 4.
Module test 1	30%	Multiple choice theory plus a practical paper, covering all the work covered in first part of semester up to hiloday. This test is written at end of first part of semester.
Module test 2	30%	Multiple choice consisting out of 30 questions which is randomly selected from a test bank This test is written at end of semester.
Project	20%	First project is in first part of the semester and is contributing 10%. In the second part of the semester the project at end contributes 10%.
Final mark	100%	Class test + Module test1 + module test 2 + project

For module 1:

- the two class test, each counting out of one-hundred, and

- the project, counting out of one-hundred, were added together, divided by three and multiplied by 0.4,
- plus 60% of the first module test, counting out of one-hundred.

If the mark were less than 60% the learner were advised to redo the module.

For module 2:

- the two class test, each counting out of one-hundred, and
- the project, counting out of one-hundred, were added together, divided by three and multiplied by 0.4,
- plus 60% of the first module test, counting out of one-hundred.

ANNEXURE F ITBC educator questionnaire 2004

VAAL TRIANGLE TECHNIKON
Faculty of Applied and Computer Sciences
Department Information and Communication Technology

ITBC LECTURER STRUCTURED INTERVIEW FORM

Course Title: ***Information Technology Boot Camp***

Module: _____
Date: _____

Dear educator,
Your expectations and concerns are of great value to us, because we want to offer our learners the best learning experiences possible. Would you be so kind to complete the interview below in the space provided? Your opinions are confidential and you do not have to state your name.

Indicate with a cross in the applicable block, whether the actions mentioned were unsatisfactory (1-2), on average (3-4) or whether you were completely satisfied with the action (5).

	Poor	Average	Satisfied	Good	Excellent
1. MILESTONES	**1**	**2**	**3**	**4**	**5**
1.1 How would you rate the milestones set for your module?					
1.2 How would you rate the practicality of milestones set for your module?					
1.3 Was the milestones implemented successfully?					
1.4 What do you feel about the linear implementation of modules, how will you rate it?					
1.4.1 Supply a reason for answer in 1.4.					
1.5 Did you define the module objective to learners at the beginning of each session?				YES	NO
1.5.1 If not why not? Supply a reason.					

	Poor	Average	Satisfied	Good	Excellent
*2. **STRUCTURE***	**1**	**2**	**3**	**4**	**5**
2.1 How would you rate the pace of the module?					
2.1.1 Supply reason for answer in 2.1					
2.2 How would you rate the module content/notes supplied by NIIT?					
2.2.1 Supply reason for answer in 2.2					
2.2.2 Do you have any suggestions to improve the module content/notes?					
2.3 How would you rate the standard of the module?					
2.3.1 If poor supply a reason					
2.3.2 If excellent, is it within the reach of students to pass the module?					
2.4 Were their enough hands-on exercises and experience for learners to grasp concepts?				YES	NO

	Poor	Average	Satisfied	Good	Excellent
3. ATTITUDE/MOTIVATION	1	2	3	4	5
3.1 How would you rate the attitude of the learners?					
3.2 How would you rate the motivation of learners?					
3.3 How would you rate the learners attendance of module?					
3.4 How would you rate the learners eagerness to learn?					
3.5 How would you rate your contribution towards a positive attitude fostered in learners?					
3.6 How would you rate your contribution towards motivating the learners?					
	Poor	**Average**	**Satisfied**	**Good**	**Excellent**
4. UNDERSTANDING	1	2	3	4	5
4.1 How would you rate the performance/understanding of learners?					
4.2 How would you rate the learners ability to implement theory to practice?					
4.3 How would you rate the learners understanding of theory?					
4.4 How would you rate the learners ability to practice on their own?					
	Poor	**Average**	**Satisfied**	**Good**	**Excellent**
5. ASSESSMENT	1	2	3	4	5
5.1 How would you rate the standard of assessment?					
5.2 How would you rate the method of assessment?					
5.3 How would you rate the implementation of OBE?					
5.4 How would you rate the objectives of the module?					
5.5 Was all the objectives that was set being assessed?				YES	NO
5.5.1 If no specify why not.					
5.6 How reliable is the outcomes of the module?					
5.7 How fair is the assessment(s)?					
5.8 How valid is the assessment(s)?					
	Poor	**Average**	**Satisfied**	**Good**	**Excellent**
6. OTHER	1	2	3	4	5
6.1 Is it necessary to improve anything?					
6.1.1 Specify what need to be improved if you said yes to 6.1 6.1.2 Can you suggest any method to improve					
6.2 Are you willing to write a lecturer proficiency test?				*YES*	*NO*
6.2 If no specify your concerns and reasons.					
6.3 Please rate your overall satisfaction of the module.					