Using E-learning to Support IT Education in a University Environment: A Case Study Approach

Marinda Taljaard

Submitted in fulfilment of the requirements for the
Degree Magister Scientiae (Computer Science) in the
Faculty of Science at the
University of Port Elizabeth

February 2003

Supervisor: Prof Janet Wesson

Acknowledgements

To my supervisor, Prof Janet Wesson, thank you for all the time, patience, guidance and advice. You have taught me so many aspects of research and I am grateful to you.

To all my colleagues within the department who supported me through the process, without you I might not have come this far. Thank you to you all.

To my friends and family who suffered but still kept on caring, supporting and asking about progress. Thank you for being there for me.

Last, but not the least, thank you to my Father in heaven who carried me all the way.

Summary

At the University of Port Elizabeth (UPE), the End User Computing course (EUC) acts as a service course for many departments. This implies that many students are forced by their curricula to register for this course. The ever-increasing numbers in EUC place a considerable load on existing human and physical resources. In lecture groups of 120 –160, students rarely get the attention they need, and the pace at which the content is delivered (too slow or too fast) may also inhibit the learning process.

During an initial investigation into E-learning at UPE in 1999, a prototype virtual classroom was developed. There were, however, a number of problems with this prototype. Firstly, it was implemented using a number of different technologies, which made it difficult to extend and maintain. Secondly, it only addressed some aspects of an E-learning environment, which proved insufficient for the EUC course.

In the existing EUC course at UPE, the students are already exposed to some E-learning concepts, as a section of their skills training component is handled by using multimedia software in a simulated environment. The objective of this project was to extend the E-learning component further to determine the advantages and disadvantages of using E-learning to support information technology (IT) education in a contact-university environment.

This project included a literature search and survey of existing E-learning environments at other universities. This research was used to develop a draft framework for an E-learning environment. The framework was used to select a tool to create an E-learning environment at UPE. An experiment was designed using this E-learning environment to support two IT courses at different year levels. The results of the experiment were analysed using qualitative and quantitative methods to determine the impact of using E-learning to support IT education at UPE.

The results of this research show that E-learning can be used to support IT education at UPE. More success, however, was achieved at postgraduate level than at first-year level. Making use of E-learning increased student satisfaction and promoted active learning, while providing benefits like convenience, communication, flexibility and scaffolding. We conclude, therefore, that E-learning can provide a flexible approach to IT education in a university environment in the future.

Keywords: E-learning, IT education, Course management software, Usability, Virtual classroom.

Opsomming

Die Eindgebruiker rekenaar kursus by die Universiteit van Port Elizabeth (UPE) is ‘n dienskursus vir baie departemente. Dit impliseer dat baie studente deur hul kursus kurrikulum verplig word om vir die kursus te registreer. Die steeds groeiende aantal studente in die kursus plaas ‘n aansienlike lading op die bestaande menslike en fisiese hulpbronne. In lesing groepe van 120 – 160, kan studente nie werklik die aandag kry wat hulle toekom nie, en die pas waarmee die inhoud oorgedra word (te vinnig of te stadig) kan ook die leerproses benadeel.

Tydens ‘n aanvanklike ondersoek in E-leer by UPE, is in 1999 ‘n model van ‘n virtuele klaskamer ontwikkel. Daar was egter ‘n aantal probleme met hierdie model. Eerstens is dit ontwikkel deur verskillende tegnologieë te gebruik, wat die uitbreiding en onderhoud van so ‘n stelsel bemoeilik. Tweedens, het dit slegs sekere aspekte van ‘n E-leer omgewing ondersteun, wat nie voldoende was vir die Eindgebruiker kursus nie.

In die betaande Eindgebruiker kursus by UPE, is die studente reeds blootgestel aan E-leer. ‘n Gedeelte van die vaardigheids-opleiding komponent word deur programmatuur hanteer en opleiding vind plaas in ‘n gesimuleerde omgewing. Die doel van hierdie projek was om hierdie E-leer ondervinding uit te brei, en die voordele en nadele van die gebruik van E-leer, ter ondersteuning van inligtings tegnologie (IT) onderrig aan ‘n universiteit, te bepaal.

Die projek het ‘n literatuur oorsig en ondersoek van huidige E-leer omgewings aan ander universiteite ingesluit. Die navorsing is gebruik om ‘n voorlopige raamwerk vir ‘n E-leer omgewing saam te stel. Die raamwerk is verder gebruik om ‘n instrument te kies waarmee ‘n E-leer omgewing by UPE geskep kan word. ‘n Eksperiment is ontwerp waarin onderrig in twee IT kursusse, op verskillende jaar vlakke, ondersteun is. Die resultate van die eksperiment is ontleed met behulp van kwalitatiewe en kwantitatiewe metodes, om sodoende die uitwerking van E-leer ondersteuning vir IT onderrig, by UPE, te bepaal.

Die resultate van hierdie studie het gewys dat E-leer gebruik kan word om IT onderrig by UPE te ondersteun. Meer suksus is egter op nagraadse vlak behaal as op eerstejaar vlak. Die gebruik van E-leer het die bevrediging van studente verhoog en aktiewe leer aangemoedig en terselfdertyd voordele soos gerief, kommunikasie, buigbaarheid en ondersteuning voorsien. Ons sluit af deur te sê dat E-leer dus ‘n buigsame benadering vir IT onderrig in ‘n universiteits-omgewing, in die toekoms kan verskaf.

Sleutelwoorde: E-leer, IT onderrig, Kursusbeheer programmatuur, Bruikbaarheid, Virtuele klaskamer.

Table of Contents

List of Figures

List of Tables

Glossary of Terms

CMC	Computer Mediated Communication
CMS	Course Management System
CS&IS	Computer Science and Information Systems
EUC	End User Computing
HE	Higher Education
HCI	Human Computer Interaction
ICT	Information and Communication Technology
IT	Information Technology
JITT	Just-In-Time Teaching
LMS	Learning Management System
SG	Study guide
TOC	Table of contents

C h a p t e r 1 Introduction

The goal of this project is to investigate the use of E-learning to support IT education in a university environment. A case study approach will be used to determine the impact of using E-learning to support IT education at the University of Port Elizabeth.

1.1 Situation of concern

At the University of Port Elizabeth (UPE), the End User Computing course (EUC) acts as a service course for many departments. This implies that many students are forced by their curricula to register for this course. The ever-increasing numbers in this course place a considerable load on existing human and physical resources. In lecture groups of 120–160, students rarely get the attention they need, and the pace at which the content is delivered (too slow or too fast), may also inhibit the learning process. The number of students in a lecture group often leads to very little interaction and active learning taking place. There are two EUC semester courses, with the first semester being a prerequisite for the second semester. The EUC course has a theoretical component, which is taught with traditional lectures, as well as a practical (or skills) component, which is handled in practical sessions as well as partially in the lecture periods.

Many educators see information technology (IT) as an essential feature at all levels of education, both as a facilitator of learning and as an increasingly important skill in itself (Furnell, Evans, Phippen and Abu-Rgheffi 1999). In their opinion, technology has advanced so significantly in recent years that, in conjunction with delivery techniques such as the World Wide Web (WWW), IT networks can be viewed as a medium through which entire learning programmes can be conducted remotely.

Initial research into E-learning at the University of Port Elizabeth (UPE) investigated the use of multimedia technologies to create a virtual classroom (Calitz 2000). The term multimedia technologies refers to a collection of software programs, which can be used to create multimedia programs. The virtual classroom was implemented using client-side and server-side scripting to provide dynamic data to a web browser. The virtual classroom allowed registered students to

view mostly text-based course material, and to complete simple online tutorials and multiple-choice tests.

A large number of different technologies had to be integrated to develop the UPE virtual classroom. These included ASP, ADO, JavaScript and Macromedia Flash. Several problems resulted from this, especially with regard to incompatibility among the different technologies. The other problem with the implementation of this virtual classroom was the fact that course material and system maintenance could only be done by programmers. This effectively precluded many educators from using such a system to develop online course material. To resolve these problems, it was decided to investigate alternative solutions which could be used to create an E-learning environment without having the prerequisite programming knowledge.

1.2 Problem Statement

The goal of this project is to investigate the use of E-learning to support IT education in a university environment. This project will also involve an investigation into different types of technologies which can be used to create E-learning environments. A further goal is to design an E-learning environment to support an End User Computing course at UPE based on these findings, to implement this E-learning environment using the chosen technology and to evaluate the results.

1.3 Research Questions

This research project will attempt to answer the following research questions:

1. What is E-learning?
2. What are the benefits of using E-learning?
3. How do you evaluate E-learning?
4. To what extent is E-learning being used in higher education (HE) in South Africa today?
5. What should a framework for E-learning consist of?
6. Which is the most suitable tool to create an E-learning environment?
7. What is the impact of using E-learning to support IT education at UPE?

Different methods will be used to determine answers to these questions. The different methods used are indicated in Table 1.1. Where possible, a literature review will be used to form the basis of the research. Additional research will be provided by means of a survey to Southern African academics. Thereafter experimental design will be used to design an experiment, collect data and analyse the results. The chapter(s) that will address each of these questions are also shown in Table 1.1. The definition, benefits and evaluation methods for E-learning are addressed in Chapter 2. Chapter 2 will also highlight the extent to which E-learning is currently used in HE in South Africa today. The identification of some E-learning components in Chapter 2 led to the creation of the framework for E-learning. This framework is discussed in Chapter 3. The sixth question, on the selection of an E-learning tool, is addressed in Chapter 4. The impact of E-learning to support IT education at UPE (the final research question) is evaluated, analysed and discussed in Chapters 5, 6 and 7.

Research question	**Research Methods**	**Chapter**
1. What is E-learning?	Literature Review	2
2. What are the benefits of using E-learning?	Literature Review	2
3. How do you evaluate E-learning?	Literature Review	2
4. To what extent is E-learning being used in higher education in South Africa today?	Literature Review	2
5. What should a framework for E-learning consist of?	Literature Review, Survey	2 and 3
6. Which is the most suitable tool to create an E-learning environment?	Literature Review, Extant systems analysis	4
7. What is the impact of using E-learning to support IT education at UPE?	Experimental Design Evaluation	5, 6 and 7

Table 1.1: Research questions and methods used to answer these questions.

1.4 Scope and Constraints

This research project is operating within the following boundaries: it will only investigate E-learning used within HE institutions, and the experiment will only involve IT education at UPE.

1.5 Structure of Dissertation

Chapter 2 contains the results of a literature survey undertaken to define the concepts of E-learning. It will also discuss the evaluation of E-learning and highlight the current situation with regard to E-learning at HE institutions in South Africa. Chapter 3 discusses an initial framework for an E-learning environment and the goals and results of the questionnaire survey given to Southern African IT academics, which resulted in the updated framework. Chapter 4 compares two high-level E-learning tools, namely WebCT and TopClass, which can be used for the creation of an E-learning environment. Chapter 5 discusses the research hypotheses and methodology followed, while Chapter 6 describes the research results obtained. In Chapter 7 the analysis of the results is described. Chapter 8 contains the conclusions from the research and suggests several ideas for possible future research.

C h a p t e r 2 What is E-learning?

2.1 Introduction

This chapter will attempt to answer the first four research questions (Section 1.3). It will firstly define E-learning, and secondly try to describe the benefits of E-learning. To answer the third research question (how do you evaluate E-learning), a study will be made of different evaluation strategies. Finally, the extent to which E-learning is being used in HE in South Africa today, will be discussed.

2.2 Definition of E-learning

Several different terms have emerged to describe E-learning. These include a virtual classroom, online learning, computer-based training, E-learning, web-based learning and distance learning (Tsai and Machado 2002).

A virtual classroom is defined as follows: "*The virtual classroom is a wildly interpreted but widely accepted interface metaphor for the growing volume of learning, collaborative, and administrative spaces used to deliver education across the Internet*" (Cervino 1997). E-learning is seen as more than this, as E-learning is a term that covers the broad spectrum of possible ways of using a computer in a teaching and learning environment (Masie 1999b). E-learning involves using new mechanisms for communication, including computer networks, multimedia, content portals, search engines, electronic libraries, distance learning and Web-enabled classrooms (Broomes Consulting 2001; Govindasamy 2002). E-learning is characterized by speed, technological transformation and mediated human interactions. Online learning and online learning systems, virtual classrooms, CBT (computer-based training) are all types of E-learning.

Tsai and Machado describe E-learning as follows: "*E-learning is mostly associated with activities involving computers and interactive networks simultaneously*"(Tsai and Machado 2002). The computer does not need to be the central element of the activity or provide learning content. However, the computer and the network must hold a significant involvement in the learning activity. E-learning does not require learning materials to be delivered by computer.

Broadbent defines E-learning in a very simplistic way as "*E-learning is a way to teach. It replaces or supplements brick and mortar schools and training centres with a computer*" (Broadbent 2000). He describes three elements of E-learning, consisting of 1) a student; 2) technology, including a computer; and 3) information or skills to be learned. He maintains that E-learning is important to each of us because it offers a new way to learn anyplace, anytime. Masie believes that the term E-learning can be used to reflect both the technology and the experience of learning in this new age (Masie 1999b). Masie says that the experience side of E-learning can address several factors including engagement, curiosity, simulation and practice, remediation, coaching, peer learning, action learning, performance support, intensity, assessment and feedback.

An E-learning environment (sometimes called a Portal) can be defined as any site which offers a student or an organisation a consolidated access to learning and training resources (Masie 1999a). Portals can range from a simple page filled with links to a sophisticated virtual classroom and learning centre. An E-learning environment can be created by designing and implementing it in a programming language, or by using one of the many software tools available for that purpose.

For the purposes of this research, the definition of E-learning by Broadbent, as given above, will be used. This definition can be expanded by saying *"E-learning involves using new mechanisms for communication, including computer networks, multimedia, content portals, search engines, electronic libraries, distance learning and Web-enabled classrooms"* (Broomes Consulting 2001; Govindasamy 2002).

2.2.1 Trends in E-learning

For each E-learning programme, it is logical to assume there will be a market with specific characteristics (Forman, Nyatanga and Rich 2002). Programmes need to specifically address the needs of the student. Trends in the United States of America (USA) suggest that E-learning will increase from 31% in 1998 to 90% by 2001 (Edelson 2001). E-learning is seen as having the capability to promote real employability and adaptability of the workforce as outlined in the European Employment Strategy (EU 1997).

Several institutions have expressed considerable interest in blending different E-learning approaches, especially synchronous and asynchronous learning, via the Web (Ravaglia 2001),

(Abrams and Haefner 2002), (Milner-Bolotin and Svinicki 2001). At the University of Colorado at Colorado Springs, a project was started where the classroom environment was, for the most part, a traditional one, but the instructor wrote on a graphics tablet rather than on the blackboard (Abrams and Haefner 2002). These images, together with the voice of the instructor, were streamed to distance students. Homework assignments could be submitted by fax, or e-mail attachments. It was observed that some students would physically attend the first few minutes of the lecture, submit and collect homework, and then go directly to the computer laboratory, where they joined the class synchronously via the Internet.

An interactive course web site was created for a physical science course at the University of Texus at Austin. This site comprised a course syllabus, goals, evaluation procedures and expectations (Milner-Bolotin and Svinicki 2001). Students could also access a class schedule, interesting links and answers to frequently asked questions. This provided an opportunity for everyone to express opinions, concerns and suggestions on e-mail and bulletin boards, and allowed instructors to respond almost instantaneously by continuously adjusting the course, demonstrating that student's requests were being heard. This mechanism reinforced student active participation and their interest in creating a course that was effective for them. Students could also do assignments on-line, or complete them off-line, and then submit the answers on-line.

At the Center for Computing Research, Mexico, an interactive web-based collaborative learning environment, called EVA, was created (Sheremetov and Arenas 2002). The EVA philosophy is congruent with the existing classroom practice as it mainly addresses learning goals and outcomes already embedded in traditional curricula, and it does not neglect the use of conventional learning materials. The objective is to develop and implement a software learning environment which is personalised and collaborative. This environment will allow different academic and administrative activities to be offered in a distance manner to the students of different institutions and public and private companies.

2.2.2 E-learning Components

According to Furnell *et al* the information that a lecturer needs to present to a student differs from module to module, and from lecturer to lecturer, according to the module's requirements, and the lecturer's own style (Furnell, Evans, Phippen and Abu-Rgheffi 1999). They recommend that, as a minimum, the following content components should be provided:

- Lecturer's slides and handouts;
- Detailed background information;
- Frequently asked questions; and
- A glossary of terms.

The lecturer's slides and handouts should be integrated into the framework through hyperlinks to more detailed information. The detailed background information should be written in a flowing style, and should be broad enough to cover all key concepts that would be presented in a lecture. The depth should be enough to explain the concepts to the student, but the student will be expected to retrieve more detailed information for themselves from other sources.

Simply using the web as a repository for electronic copies of documents which are available in hard copy, is not sufficient (Allen, M. 1998). An E-learning environment should function as a place to go to read and learn and, while there, students should be encouraged to begin using the computer-mediated communication (CMC) component (Allen, M. 1998), (Gal-Ezer and Lupo 2002). In this way they would be able to access many informational sources. Allen included the following components in his ARROW E-learning environment:

- More reading (lists of library resources);
- Web links (ever-expanding list of sites);
- More exercises (additional learning problems, complete with discussion and answers – arranged via hypertext);
- Trial problems;
- Revision questions; and
- Topical tips.

The interaction between students, their peers and their lecturers, is a crucial aspect of E-learning. In any learning environment, it is this interaction which most facilitates the learning process (Furnell, Evans, Phippen and Abu-Rgheffi 1999).

Distance education courses with no other E-learning component can also have CMC, to encourage contact of some kind. Salmon maintains that, in the case where the on-line students have no face-to-face or telephone contact, the instructor needs to ensure that these students feel part of a 'class', and that their problems and concerns do not happen in isolation (Salmon 2000). To facilitate this, the Open University requires students to 'workshop' some of the inquiries about assignments as a group, so that by exchanging ideas and opinions, students may develop a better understanding of the task at hand.

For the purposes of this research, the following E-learning components will be regarded as necessary:

- Lecturer's slides and handouts;
- Frequently asked questions;
- Glossary of terms;
- Exercises;
- Revision questions;
- E-mail; and
- Discussion boards.

2.3 Benefits of E-learning

Connecting people via the Internet opens up a number of new possibilities. Students need not feel as if they are part of a mass education system. By means of an Internet connection they can be virtually connected to their lecturers, facilitators and peers (Martin and Taylor 1997), (Furnell, Evans, Phippen and Abu-Rgheffi 1999). By doing this, students physically apart can be actively involved through interactions with others, and this can lead to higher-order learning. Bloom's taxonomy recognises the existence of different levels of learning (Bloom 1972). Firstly a student obtains knowledge, and thereafter comprehension, application, analysis, synthesis and evaluation follow. Naturally these do not come without effort, but Oliver *et al*, maintains that dialogue and

discourse enables and encourages this form of cognitive activity by providing a context and means for explaining, justifying and acquiring reasoning skills (Oliver 1997). The Internet can provide the means to incorporate dialogue into a course.

IT offers exciting opportunities to thoroughly redesign the education process and to achieve several benefits. These can include: integration of means (text, audio, animation and video), access to large quantities of information, interactivity, personalised planning, individual work rhythms and immediate answer to student's progress (Sheremetov and Arenas 2002). The introduction of new technologies in the real education environment, however, is a difficult problem. This may be as a result of some negative facets contained in videoconferences or online courses. For example, weak integration of the different means or poor interactivity among students, instructor and system.

Any HE institution wishing to deliver training and education to dispersed populations will require E-learning solutions (Wheeler and Magee 1999). Teachers can then deliver course materials direct to their students, offer remote access to learning resources and assess learning effectively, all without having to leave the parent institution. The potential value of IT is not only its use as an important learning tool, but also as a means of communication (McLean and Jackson 2002). IT can be used to build learning communities by creating opportunities for voices to enter into conversation, and can facilitate the development of student-centred classrooms (Mehlenbacher, Miller, Covington and Larsen 2000).

Using E-learning on campus can have several advantages including: greater student engagement, fostering of interaction among students and instructors, increased team work, changes to the classroom, accommodation of different learning styles, cross campus engagement and convenience (Wheeler and Magee 1999), (Broadbent 2000), (Masie 2002), (Broomes Consulting 2001). An additional benefit is that E-learning can be used to provide coaching or scaffolding for students during the learning process (Broomes Consulting 2001).

E-learning can be used in a flexible way, allowing students to opt for a blended model of online and face-to-face education (Le Roux 2002), (King 2002), (Allen, R. 1998). E-learning allows for the use of online course material, organizes and facilitates communication about studies easily in a flexible way. The Web can be used for course delivery or as a methodology for developing a learning environment (Alessi and Trollip 2001).

Broadbent states that the benefits of E-learning are not only for the students, but also for the instructors and administrators (Broadbent 2000). Instructors can communicate information in a more engaging fashion, the software retains records of discussion for later reference, and E-learning can also be more convenient as the software can be accessed any time and any place. Administrators can benefit by the automation of assessments, the variety of platforms which can be used and the use of templates to ensure consistency. Dringus maintains that while she also enjoys teaching in a traditional classroom environment, she finds the most interesting and compelling challenge is teaching in an online learning environment (Dringus 2002). She states that with teachers and students contributing, E-learning can result in a composite of useful resources that individuals or the class can extract on command.

The key benefits of E-learning can be summarised as convenience, integration of means, communication, interactivity, flexibility, scaffolding and remote access.

2.4 Evaluating E-learning

2.4.1 Background

Alessi and Trollip state that, when evaluating web materials, the material should be assessed in accordance with the factors that apply to the specific methodology used (Alessi and Trollip 2001). The most common methodology for web-based learning is that of hypermedia. Some of the factors most relevant to web materials are: navigation, hypertext links, orientation, speed, visual layout, structure, web tools provided and stability. The importance of accuracy of content, quality of writing and support for learning strategies must not be forgotten. The key to learning still depends on motivation, creativity, thinking, reflection and active participation in the knowledge building process.

Wesson foresees a substantial growth in the development and use of web-based learning (Wesson 2002). The usability of web-based material can, however, have a significant impact on the success of web-based learning. In a study to evaluate the usability of web-based learning tools, Storey *et. al.* found that most of the tools evaluated did not adhere to general usability principles and that this had a negative impact on the students' attitude and performance (Storey, Phillips, Maczewski and Wang 2000). If the tools are not professionally developed,

implemented, maintained and administered, the positive support for learning can be reversed (Storey, Phillips, Maczewski and Wang 2000), (Quinn 2001).

Quantitative studies emphasize the measurement and analysis of casual relationships between variables, not processes (Denzin and Lincoln 1998b). These variables can include aspects like demographics, marks and progress. Qualitative research implies an emphasis on processes and meanings that are not rigorously examined, or measured, in terms of quantity, amount, intensity or frequency. Qualitative investigators try to get closer to the actor's perspective through detailed interviewing and observation, while quantitative researchers rely on more remote, inferential empirical materials. When doing research, the use of multiple methods, or triangulation, reflects an attempt to secure an in-depth understanding of the phenomenon in question (Denzin and Lincoln 1998b). An evaluation process that incorporates both methods should therefore capture the essential issues of a research project.

To evaluate E-learning, both the software and the learning process should be evaluated. The usability of the software can be evaluated by means of questionnaires and interviews. The process can be evaluated by analysing the performance of students, attitude questionnaires and interviews. The methods used to evaluate these will be discussed in the next two sections.

2.4.2 Evaluating the software (E-learning environment)

Henke states that a critical factor for the success of web-based instruction is the incorporation of usability design into the development process (Henke 1997). The International organization for Standardization (ISO) defines usability as "*the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments*" (ISO9241 1997). Effectiveness implies that the user is able to carry out the intended task (Faulkner 2000). Efficiency implies a sense of time. User satisfaction is complex and can be related to all kinds of aspects of the system. It can be defined as being how acceptable the system is to the users, how comfortable they feel with the operation of the system or whether they prefer one system to another.

Various methods can be employed to evaluate the usability of computer software, such as observations, interviews, questionnaires and expert reviews (Shneiderman 1998), (Faulkner 2000). When the software is designed for educational use, additional principles become

important, such as the design of learning activities and the student's ability to control sequence, pacing, presentation medium and level of difficulty (Hannafin 1989).

Learnability is one of the most important measures of usability in E-learning (Feldstein 2002a) "*Learning is usually the use to which E-learning is supposed to be put*". Usability in E-learning can thus be defined as the ability of a learning object to support or enable a particular concrete cognitive goal. In order to evaluate the usability of E-learning, the definition of the cognitive goal has to bear a close resemblance to the way the student will define what he is trying to accomplish. Usability in E-learning is about the way the content is presented, and not just about the content itself. A number of researchers believe that a technique called heuristic usability testing, as developed by Jakob Nielsen (Nielsen 1993), can be used to determine the level of usability of software (Feldstein 2002a), (Smulders 2001), (Faulkner 2000). With heuristic evaluation a small team of experts look for violations of general guidelines (Feldstein 2002a). Heuristic evaluation has the advantage of being cost-effective and comparatively quick and easy (Parlangeli, Marchigiani and Bagnara 1999). The original ten heuristics were compiled for software in general (Nielsen 1993). These were slightly adjusted by Smulders for evaluation of web-based learning environments (Smulders 2001). The original and adjusted heuristics are contained in Table 2.1.

	Original heuristics (Nielsen)	**Adjusted heuristics (Smulders)**
1	Visibility of system status.	Indicate site status.
2	Match between system and the real word.	Match content to audience.
3	User control and freedom.	Give students control of navigation.
4	Consistency and standards.	Be consistent and follow standards.
5	Flexibility and efficiency of use.	Build flexible and efficient web pages.
6	Aesthetic and minimalist design.	Consider using a minimalist design.
7	Error prevention.	Prevent errors.
8	Help users recognise, diagnose and recover from errors.	Help users recognise, diagnose, and recover from errors.
9	Help and documentation.	
10	Recognition rather than recall.	

Table 2.1: List of heuristics for usability testing

2.4.3 Evaluating the process (E-learning experience)

May states that we cannot only offer a web-based syllabus or compilation of lecture notes, and expect to provide a quality learning experience (May 2000). Providing means for feedback must become our primary focus. Although assessment and evaluation are only one of the means to offer mass customisation in learning, they are certainly one of the most important steps to meet the needs of the student. May states that assessment should not be solely a process of gathering data and returning results, but rather a process of providing opportunities for learning. Effective assessment procedures need to employ methods for feedback which alert the student to areas in which they have a deficiency. The comprehensive assessment and evaluation model for the E-learning environment includes: pre-assessment, formative assessment, summative assessment and program evaluation. Pre-assessment identifies the student's current level of knowledge and skill and provides an overview of objectives and anticipated outcomes. Formative assessment provides opportunities for feedback and interaction. Summative assessment is used to evaluate the student's knowledge and skills gained through the learning experience. Program evaluation measures include student satisfaction, efficiency, effectiveness, impact and quality of learning.

Donald Kirkpatrik's four levels of evaluation (Kirkpatrick 1998) can also accommodate the E-learning environment. These are the following:

- **Level 1: Reaction** – measure of student satisfaction.
- **Level 2: Learning** – measures the extent to which students' knowledge, skills and attitudes change as a result of training.
- **Level 3: Behaviour** – examines the extent to which change in behaviour has occurred because of attending the training program.
- **Level 4: Results** – the final results that occurred because of students attending the training.

The Knowledge and Learning Systems Group (NCSA) found that, while Kirkpatrick's model is commonly accepted by trainers, it is rarely fully implemented and its applicability in today's organisations is increasingly questioned (NCSA 2000). Regardless of the delivery method, organisations are looking to training professionals to identify how training helps the organisation. Hence E-learning initiatives should be subject to the same effectiveness measures as traditional training programs.

Another method to get feedback from students is the qualitative research method of group interviews (also called focus group interviews) (Denzin and Lincoln 1998a). The use of the group interview is not meant to replace individual interviewing, but is an option that deserves consideration because it can provide another level of data gathering or a perspective on the research not available through individual interviews.

2.4.4 Evaluations Conclusions

When evaluating E-learning, it is important to evaluate both the software and the learning process. The usability of the E-learning environment can be determined by using heuristic evaluation, observations, interviews and questionnaires. The effectiveness of the E-learning process can be determined by analysing the performance of the students, the student satisfaction and the attitudes of students.

2.5 Situation in South Africa

To determine the extent to which E-learning is being used in HE in South Africa today, several techniques were used. These included a literature review, a review of the HE institutions' web sites and personal communication. Some institutions are using course management software (CMS), while other institutions have decided to write their own software to create E-learning environments.

A number of examples will be given to describe the current (end of 2002) E-learning situation in South Africa. A summary of this situation is contained in Table 2.2.

Institution	Level of E-learning	Software used
University of Pretoria	Committed – own department to handle E-learning. Many courses involved.	WebCT
Potchefstroom University	Committed – own centre to handle E-learning. Many students involved.	In-house software
Technikon South Africa	Committed – All students can use for communication, only some courses have courseware online.	In-house software
University of the Free State	Beginning – only some courses supported	Handled by E-degree
Rand Afrikaans University	Committed – own department to handle E-learning. Many courses involved.	WebCT
Stellenbosch University	Committed – One coordinating body. Many courses involved.	WebCT
University of Western Cape	Beginning - Some departments involved.	In-house software
University of Port Elizabeth	Beginning – Some departments have course material on web sites.	Browser

Table 2.2: E-learning situation in South Africa in 2002

2.5.1 University of Pretoria (UP)

UP has a dedicated team at the Department for Telematic Education and Innovation (TLEI) to provide support for their on- and off-campus students and technical support for lecturers (Drysdale 2002). TLEI implemented WebCT in 1997 as a learning management system. WebCT is used to create student and lecturer portals for a virtual campus (Le Roux 2002). There are currently about 400 web-based courses and approximately 60 postgraduate programmes online (Drysdale 2002).

Before a course is added to the virtual campus, lecturers meet with the design team and the specific needs of the course are determined. For example, some courses might only need support on the Web (e.g. chat forums), while others might want all the content online. This process ensures that the lecturer can customise the E-learning environment according to his/her specific needs

On a pedagogical level, UP maintains that the Web should be used to support learning. In a recent survey, UP students indicated that most students found it convenient to study on the Web (Le Roux 2002). On a technical level, Le Roux concludes that an integrated UP-portal needs to be in place with access to WebCT, with a single log-on facility, and that student support should be in place at least 18 hours per day

2.5.2 Potchefstroom University (PU for CHE)

An in-house system (called Varsite) was written to support E-learning at Potchefstroom University and is used by a number of courses. A no-contact ICT course was implemented on their learning management system (Pretorius 2002). In this course they have approximately 3000 students (over 2 campuses), as this course is compulsory for all first year students. Assessment is also handled online, and on completing their course evaluation, most students described their IT knowledge as good, and agreed that it is sufficient to have no lecturer contact.

2.5.3 Technikon South Africa (TSA)

TSA wrote their own software to create an E-learning environment, called COOL (http://cool.tsa.ac.za). The virtual infrastructure not only provides solid administrative infrastructure for lecturers but also a communication tool to remove the distance from distance education (Möller 2000). The COOL system aims to facilitate communication and learning among students, lecturers, tutors and TSA administrative staff. Not all courses have courseware on the system.

2.5.4 University of the Free State (UFS)

At the University of the Free State, a couple of programmes are offered as distance learning programmes. The administrative aspects are handled by E-degree (http://www.edegree.co.za), while the course material is set up by the lecturers and the assignments and assessments are also marked by the lecturers.

2.5.5 Rand Afrikaans University (RAU)

WebCT (http://www.webct.com) has been used for three years at the Rand Afrikaans University (RAU) (Broere, Geyser and Kruger 2002). Formal teaching and learning policies or support mechanisms do not include WebCT as a mode of delivery. WebCT is only used by a small number of faculty members who could be seen as pockets of innovation. At RAU, the dynamic

interaction between these driving forces led to the development of an integrated multi-modal teaching and learning strategy. The focus of this teaching and learning strategy is to guide, promote and support student learning. This strategy for teaching, learning and assessment based on a multi-modal approach to delivery has been accepted at RAU, and includes WebCT as a platform of delivery that complements face-to-face classroom instruction.

2.5.6 Stellenbosch University (US)

An E-learning initiative was initiated at Stellenbosch University (US) in 1999. US has 3 WebCT servers, two live servers and one development server. In 2002 there were 534 and 105 modules on the two WebCT servers respectively, with 698 modules being developed on the development server. A total of 15 285 students make use of these modules (Van der Merwe 2002).

2.5.7 University of the Western Cape (UWC)

From 1998 some departments at UWC created static websites for courses (Keats 2000). This was later expanded to online courses, using their own software to create an E-learning environment (http://kewl.uwc.ac.za/).

2.5.8 University of Port Elizabeth (UPE)

At UPE many departments are providing students with course information and practical assignments by means of web pages. This includes those courses offered by the Department of Computer Science and Information Systems (http://www.cs.upe.ac.za). As UPE has no course management software (CMS), it is not possible to keep track of the students' use of the online information and discussions with other peers and lecturers.

2.5.9 Situation Conclusions

Most HE institutions in South Africa are aware of the potential of E-learning and many institutions are actually using E-learning in the teaching process. Some institutions have bought software to create E-learning environments, e.g. UP and RAU, while others have created their own software, e.g. PU for CHE and TSA. Those institutions committed to using E-learning, namely UP and PU for CHE, have a department dedicated to this purpose. E-learning is still in an infant stage at UPE and no CMS is currently being used.

2.6 Conclusions

This chapter addressed the first four research questions. The definition of E-learning given by Broadbent was selected as providing a simple but valuable meaning to the E-learning concept. "*E-learning is a way to teach. It replaces or supplements brick and mortar schools and training centres with a computer*". While exploring the different definitions of E-learning, certain trends and E-learning components were identified (Section 2.2).

The benefits of E-learning were investigated (Section 2.3). The key benefits identified were convenience, integration of means, communication, interactivity and remote access. Different methods that could be used to evaluate E-learning were identified (Section 2.4). These methods include a usability evaluation of the software and an evaluation of the learning process.

A number of universities in South Africa are committed to using E-learning (Section 2.5). For example, Pretoria University, Potchefstroom University, Technikon South Africa, Rand Afrikaans University and Stellenbosch University are committed to using E-learning, and have a department or unit to handle the process. At these universities IT and other departments make use of the E-learning facilities. UPE is, however, still investigating E-learning and has not implemented any CMS.

The literature review described in this chapter laid the foundation for creating a draft framework for an E-learning environment. The development and refinement of this draft framework is described in Chapter 3.

C h a p t e r 3 A Framework for E-learning

3.1 Introduction

It is important to decide which features to include in an E-learning environment (fifth research question). This chapter describes the process followed in the creation of a framework for E-learning. A literature survey was used to draft an initial framework, which was then circulated to IT academics in Southern Africa. From the feedback received from the survey, a revised framework was created.

3.2 Framework Components

3.2.1 Background

Sheremetov, *et al*, created a system, called EVA (the acronym comes from the Spanish for Virtual Learning Spaces), which uses technology to accomplish some rudimentary tasks and to enhance students' knowledge systematically (Sheremetov and Arenas 2002). The conceptual architecture of EVA is structured into the four essential learning elements, namely knowledge, collaboration, consulting and experimentation. These four elements are complemented with the personal element where user-related information is accumulated.

Furnell *et al* state that it is important for academic staff to be willing to create the online material in a format appropriate to online delivery (Furnell, Evans, Phippen and Abu-Rgheffi 1999). In the evaluation of modules at the University of Plymouth, lecturers highlighted a number of requirements that they considered necessary for the effective realisation of an online distance learning experience, namely, content creation, interaction, monitoring, assessment, training, and system requirements.

Content creation covers both the type of information and its presentation. The content presented to the student is the core component of the entire framework. Like a textbook, it must contain information of a quality sufficient for the student to learn from. As a minimum, the following content components should be provided: lecturer's slides and handouts, detailed background information, frequently asked questions, glossary of terms and content linked to the owner's e-mail address. Clear navigation is also crucial. Feldstein maintains that there are some unique

aspects of E-learning content that must be kept in mind, namely that learning content is interactive, it requires a broad range of presentation styles and it is particularly hard to write well (Feldstein 2002b).

In any learning environment the interaction facilitates the learning process. Interaction can be split into two categories: student-lecturer interaction and student-student interaction. At a basic level, standard Internet facilities such as e-mail and discussion groups can be used to realise these concepts.

Throughout the learning process, the progress of the student should be monitored at least as much as is currently performed in traditional lectures (Furnell, Evans, Phippen and Abu-Rgheffi 1999). Salmon emphasises the importance of CMC in online teaching (Salmon 2000). It would be beneficial, however, if this level of monitoring could be improved to give the lecturer more feedback. The means to achieve this could include multiple choice tests, small quizzes, e-mail audits and questionnaires.

The work completed by students will need to be submitted to the lecturer online (Furnell, Evans, Phippen and Abu-Rgheffi 1999). This can be in the form of e-mail, or a specific submission process can be developed using standard web technology. The principle problem with online assessment is that of security. It may be preferable for the students to sit their examinations under supervision (Furnell, Evans, Phippen and Abu-Rgheffi 1999).

The browsing paradigm and hypertext may not be familiar to some lecturers or students (Furnell, Evans, Phippen and Abu-Rgheffi 1999). Creating content according to a hypertext medium is different from creating standard linear text and care must be taken to ensure the content is created effectively. For this, training may need to be given. Students may also require some training to get the most out of the course.

In order to be able to effectively use the online course, the student will need to have a certain level of equipment (Furnell, Evans, Phippen and Abu-Rgheffi 1999). Different courses may have different expectations.

An investigation into several existing E-learning environments (Section 2.3) and a literature search was conducted in order to obtain a deeper understanding of E-learning in order to create a

framework for an E-learning environment. This framework was created for two main reasons. Firstly, in order to determine a set of functional requirements, and secondly to develop a framework for comparing different tools used to create such E-learning environments. This framework will be discussed in more detail in the next section.

The literature search revealed a number of feature or evaluation lists for tools that can be used to create E-learning environments. For example see Survey on online education tools (http://www.visc.vt.edu/succeed/wwwframework/survey.html), "A Comparison of Online Educational Applications" (http://www.edutools.info/course/compare/all.jsp), "Swiss Virtual Campus: WBC Tools: Evaluation grid" (http://www.edutech.ch/edutech/tools/grid_e.asp) and "Tools for Developing Interactive Academic Web Courses" http://www.umanitoba.ca/ip/tools/courseware/evalmain.html.

The content and structure of these feature lists differ considerably. According to some authors, certain features are regarded as essential whilst others regard these as optional. For example, some educators see synchronous communication as a vital part of the course, where others feel that asynchronous communication should be responsible for the main interaction between students and instructors.

The two main sources used to construct the framework were "A Comparison of Online Educational Applications" (http://www.edutools.info/course/compare/all.jsp) and "Swiss Virtual Campus: WBC Tools: Evaluation grid" (http://www.edutech.ch/ edutech/tools/grid_e.asp). In the evaluation grid from the Swiss virtual campus project, an indication of importance was included. This helped in the process of setting up the framework. It is important to note, however, that all the issues discussed in the framework should be included when designing an online course, in order to ensure that something is not left out unintentionally.

3.2.2 Draft Framework

The main issues in the framework were identified as follows (Table 3.1):

- The learning environment;
- The author's environment;
- The teacher's environment;
- Administration;
- Technical requirements; and
- General properties.

The learning environment mainly encompasses the interaction section, as seen by Furnell *et al* (Furnell, Evans, Phippen and Abu-Rgheffi 1999), while the author's environment can be seen as comprising the content creation issues. The teacher's environment and administration falls into the areas of monitoring and assessment while technical requirements and general properties falls within the area of system requirements.

The learning environment incorporates issues such as access to course material, private space and customisation, asynchronous and synchronous communication and pedagogical tools. Pedagogical tools in this section imply the availability of quizzes and progress tracking.

The usability of the author's environment depends on the production of online material, features available for quizzes and the capturing of data. The teacher's environment (pedagogical tools) includes features such as being able to set up more than one teacher for any course, being able to form groups of students, asynchronous communication and course evaluation.

Administration features include being able to upload data for the registration process and setting access rights. Under technical requirements is included the client and server platforms – being able to run the E-learning environment on the required operating system and with a standard browser. General properties include the availability of documentation and support as well as the stability, initial and on-going costs and limitations of the package (e.g. the number of students per course).

Based on the above, a draft framework for E-learning was created (Taljaard 2000). The draft framework for an E-learning environment can be seen in Table 3.1.

A	**Learning Environment**	**C**	**Teacher's Environment / Pedagogical Tools**
1	**Access to course material**	**1**	**General**
	Keyword search		Multiple teachers support
	Course download / off-line working	**2**	**Team working**
	Course can be printed		Teacher can set up group of students
	CD-ROM support		Group file upload capability
	Ergonomic user interface	**3**	**Tutoring**
2	**Private space and customisation**		Asynchronous tutoring (i.e. by email)
	Student can make private annotations of course material		Synchronous tutoring (i.e. Audio-, Videoconference)
	Student can make bookmarks		Teachers can assign material to group of students
	Individual choice of learning sequence	**4**	**Course evaluation**
	Stop and resume learning session		Student progress tracking
	Username and password security		Statistical/graphical reports
3	**Asynchronous student-student communication**		Marks administration
	One-to-one email	**D**	**Administration**
	One-to-many email	**1**	**General**
	Discussion forums		Registration and follow-up of students
	Teamwork tools		Management of student files
	File upload capability / submission of work		Access rights
4	**Synchronous student-student communication**		Crash recovery
	Chat room, Shared Whiteboard	**E**	**Technical requirements**
5	**Pedagogical tools / Student tools**	**1**	**Client platform**
	Quiz, Self-assessing, Progress tracking		Standard Web browser (platform independent)
B	**Author's environment / Support tools**		Win 9x, NT (software or plugins)
1	**Production of Course Material**		MacOS (software or plugins)
	No technical knowledge required to develop course material		UNIX, Linux (software or plugins)
	Web interface for course development	**2**	**Server platform**
	Support to convert existing material		Win 9x, NT, UNIX, Linux, MacOS
	Multiple authors support	**F**	**General Properties**
	Index creation support, Glossary support	**1**	**Support**
	Ergonomic development interface		Technical support (Student and Instructor Help desk)
2	**Module management**		Pedagogical support (Instructional designing)
	Course structure editor / manager		System documentation
	Curriculum manager (learning objectives) / course planning	**2**	**Cost**
3	**Quizzing features**		Start-up costs
	No HTML knowledge required to develop quizzes		On-going costs
	Quiz editor/manager included		Technical Support
	Multiple choice, Image map and other question types	**3**	**Limitations of package**
	Randomised and calculated questions		Number of courses
	Actions based on test results		Number of students
4	**Data**		
	Marking on-line, Managing records, Analysing and tracking		

Table 3.1: Draft framework for an E-learning environment

3.3 Questionnaire Survey

To validate the framework proposed in Table 3.1, a questionnaire was created and made available on the Internet (Appendix A). Lecturers from universities and technikons in Southern Africa were asked to rate the items identified in the draft framework as either Essential, Optional or Not Required. For several items, the terms Critical, Important and Not Important were used, as this seemed more appropriate. The questionnaire was published on the Internet, and requests to complete the survey were sent via email to academics. All the computer lecturers in Southern Africa were reached using two distribution lists, one for universities (SACLA) and one for technikons (TECLA). Individual emails to other lecturers involved in E-learning were also sent. From the 25 universities in Southern Africa, 11 lecturers completed the questionnaire (representing 7 universities), while only 3 technikon lecturers completed it.

The data from the questionnaires was analysed by determining the mean rating for each item. In the analysis process, the ratings were converted to numbers, with Essential being represented by 1, Optional by 2, Not Required by 3 and Unsure by 4. The mean ratings varied between 1.08 and 2.58. Items with mean ratings between 1 and 1.4 were then regarded as Essential, items with ratings up to 2 as Optional, and those with ratings above 2 as Not Required.

The items indicated in Table 3.2 were rated as Essential components of an E-learning environment.

A	**Learning Environment**	**C**	**Teacher's Environment / Pedagogical Tools**
1	**Access to course material**	**1**	**Tutoring**
	Course download / off-line working		Asynchronous tutoring (i.e. by email)
2	**Private space and customisation**		Teachers can assign material to group of students
	Stop and resume learning session	**2**	**Course evaluation**
	Username and password security		Student progress tracking
3	**Asynchronous student-student communication**		Marks administration
	Email	**D**	**Administration**
	File upload capability / submission of work	**1**	**General**
4	**Pedagogical tools / Student tools**		Registration and follow-up of students
	Progress tracking		Management of student files
B	**Author's environment / Support tools**		Access rights
1	**Module management**		Crash recovery
	Course structure editor / manager	**E**	**Technical requirements**
	Course managing (student progress and access)	**1**	**Client platform**
	Course customising (structure and layout)		Standard Web browser (platform independent)
2	**Quizzing features**	**F**	**General Properties**
	Self-assessment (data not stored)	**1**	**Limitations of package**
	Multiple choice questions		Number of students
	Randomised questions		
3	**Data**		
	Marking on-line		
	Managing records, Analysing and tracking		

Table 3.2 Essential components of an E-learning environment

Items such as support in the creation of course material and team working were rated as Optional, with synchronous communication and the ability of the software to work on platforms like Unix, rated as Not Required. Technical and Pedagogical support and documentation were rated as Important together with the costs involved. The only item seen as Critical was the number of students who could use the environment.

The questionnaire also included questions on the advantages and disadvantages as observed by lecturers using E-learning. A number of respondents stated that using an E-learning environment could promote active learning and interactivity among students. Additional advantages stated were supporting student-centred learning and reinforcing student responsibility for learning.

Disadvantages stated by respondents included the huge lecturer investment in the production of material, the reliance on technical infrastructure and the fact that students could decide to not use the material or do the exercises, depending on the level of lecturer control. Some students also

seemed to be not willing to study on their own (this is no different from the traditional classroom environment).

3.4 Framework for an E-learning Environment

After the results of the questionnaire were analysed, the updated framework (Table 3.3) was compiled. This framework includes the items rated as Essential and Optional, with an indication of which items were rated as Essential. The Critical and Important items were also incorporated into the framework (Table 3.4). Although these do not directly form part of the learning environment, they may still influence the decision making process.

Ratings: E – Essential I – Important			
Item	**Rating**	**Item**	**Rating**
A Learning Environment		**3 Quizzing features**	
1 Access to course material		Question editor	**I**
Keyword search	**I**	Self-assessment (data not stored)	**E**
Course download / off-line working	**E**	Multiple choice questions,	**E**
Course can be printed	**I**	Use of graphics,	**I**
CD-ROM support	**I**	Other question types	**I**
2 Private space and customisation		Randomised questions	**E**
Student can make private annotations	**I**	**4 Data**	
Student can make bookmarks	**I**	Marking on-line, Managing records	**E**
Individual choice of learning sequence	**I**	Analysing and tracking	**E**
Interrupt and resume learning session	**E**		
Username and password security	**E**	**C Teacher's Environment / Pedagogical Tools**	
3 Asynchronous student-student communication		**1 General**	
Email	**E**	Multiple teachers support	**I**
Discussion forums	**I**	**2 Team working**	
Teamwork tools	**I**	Teacher can set up group of students	**I**
File upload capability / submission of work	**E**	Batch upload (to create groups)	**I**
4 Synchronous student-student communication		**3 Tutoring**	
Chat room	**I**	Asynchronous tutoring (i.e. by email)	**E**
5 Pedagogical tools / Student tools		Teachers can assign material to group of students	**E**
Quiz, Self-assessing,	**I**	**4 Course evaluation**	
Progress tracking	**E**	Student progress tracking	**E**
B Author's environment / Support tools		Statistical/graphical reports	**I**
1 Production of Course Material		Marks administration	**E**
No technical knowledge required to develop course material	**I**	**D Administration**	
Web interface for course development	**I**	**1 General**	
Support to convert existing material	**I**	Registration and follow-up of students	**E**
Multiple authors support	**I**	Management of student files	**E**
Index creation support, Glossary support	**I**	Access rights	**E**
Multimedia Support	**I**	Crash recovery	**E**
2 Module management			
Course structure editor (components and structure)	**E**	**E Technical requirements**	
Guidelines for course structuring	**I**	**1 Client platform**	
Course managing (student progress and access)	**E**	Standard Web browser (platform independent)	**E**
Course customising (structure and layout)	**E**	Win 9x, NT (software or plugins)	**I**
		2 Server platform	
		Win 9x, NT	**I**

Table 3.3 Framework for an E-learning environment (revised)

Ratings: C – Critical I – Important		
Item		**Rating**
F	**General Properties**	
1	**Support**	
	Technical support (Student and Instructor Help desk)	**I**
	Pedagogical support (Instructional designing)	**I**
	System documentation	**I**
2	**Cost**	
	Start-up costs	**I**
	On-going costs	**I**
	Technical Support	**I**
3	**Limitations of package**	
	Number of courses	**I**
	Number of students	**C**

Table 3.4 Other issues of importance for an E-learning environment

3.5 Conclusions

A draft framework for E-learning was created based on the results of a literature survey (Table 3.1). The relative importance of these items in South Africa was determined by means of a survey amongst IT and other academics at HE institutions using a 3-point scale (Not required, Optional or Essential). The results of this survey were used to refine the draft framework to consist of those items that were regarded as Essential or Important (Table 3.3).

A discussion of how the draft framework was used to determine the most suitable tool to create an E-learning environment at UPE is contained in Chapter 4.

C h a p t e r 4 Selection of an E-learning environment

4.1 Introduction

The goal of this chapter is to determine suitable software (sixth research question) to use for the creation of the E-learning environment at UPE. It was decided to investigate WebCT and TopClass, as many South African Universities were using WebCT at that time (Section 2.5), and TopClass was advertised as having useful features, especially in the area of on-line testing. The final decision on the software program was based on the results of a heuristic evaluation and a comparison of the features provided by these tools. The framework for an E-learning environment, as given in Chapter 3, will form the basis of this comparison.

4.2 Course Management Software

New developments in IT have resulted in several tools becoming available to create E-learning environments without any actual programming. These tools can be evaluated by comparing the extent to which each caters for the issues identified in the framework given in Chapter 3. Web-based course management systems such as WebCT or Blackboard provide simple, yet elegant vehicles to create course infrastructure to promote knowledge transfer and improve access to learning resources (DeBourgh 2002). Web-based learning tools provide integrated environments of various technologies to support diverse educators' and students' needs via the Internet (Storey, Phillips, Maczewski and Wang 2000). The goal of these tools is to enhance face-to-face instruction and to deliver distance-learning courses.

Govindasamy states that all efforts to implement E-learning will eventually move towards total automation of administrating the teaching and learning processes using software known as learning management systems (LMS) (Govindasamy 2002). These learning management systems are sometimes called course management software. Course management software (CMS) does not write good content for you, but removes most of the clutter that distracts you from writing good content (Feldstein 2002b). Feldstein states that up until recently, CMS was not being used in online learning, because the return on investment was not there. CMS is usually an expensive piece of software both to buy and to set up. In the last few years, a

significant number of organizations have started producing enough in-house custom E-learning content to justify the expense of CMS.

A number of feature lists are available on the Internet to help the evaluation process, although some of these lists were compiled with older versions of the programs, which render them obsolete. Some of these feature lists are given in the format of a comparison between available tools which can be used to help the decision making process.

Some South African Universities (RAU, UP and PU for CHE) have investigated the available technologies (Section 2.5), and have decided to use WebCT to support E-learning. The other tools worth further investigation are TopClass (http://topclass.adelphi.edu/) and VirtualBook (http://www.eduflex.com/). All these tools give the educators the facilities to:

- Deliver content;
- Do course administration; and
- Assess online.

Currently the assessment often only allows for testing of knowledge (not skills), for example by means of multiple-choice questions. New versions however, promise to incorporate other functions, which are supposed to broaden the assessment possibilities. It was decided, however, not to use VirtualBook as it does not use the browser paradigm.

4.3 Usability Evaluation of WebCT and TopClass

A heuristic is a guideline or general principle or rule of thumb that can guide a design decision or be used to critique a decision that has already been made (Dix 1998). Heuristic evaluation, as developed by Jakob Nielsen and Rolf Molich, is a method for structuring the critique of a system using a set of relatively simple and general heuristics (Nielsen 1993). The goal of this heuristic evaluation was to determine if any usability problems exist in WebCT or TopClass. Both systems support three types of users, namely lecturers (designers of the course material), instructors and the actual students. In the following sections, aspects of both the designer and the student user are investigated. Instructors have some of the rights of the designers, but not all.

The adjusted list of heuristics for usability testing of E-learning software was given in Chapter 2 (Table 2.1). The usability problems identified using these heuristics can then be rated using a severity rating scale, as given by Nielsen (Nielsen 2002), on a five-point scale. The five-point scale is as follows:

0 I don't agree that this is a usability problem at all.

1 **Cosmetic:** need not be fixed unless extra time is available on the project.

2 **Minor**: fixing this should be given low priority.

3 **Major:** important to fix, so should be given high priority.

4 **Catastrophic**: imperative to fix this before product can be released.

4.3.1 Heuristic evaluation of WebCT

The heuristic evaluation of WebCT (version 3.0) identified some usability problems (see Table 4.1), but no problems were allocated a severity rating above 2.

Heuristic	Usability problems	Severity Rating
Indicate site status	Yes	2
Match content to audience	No	0
Give students control of navigation.	Yes	2
Be consistent and follow standards.	No	0
Build flexible and efficient web pages.	Yes	2
Consider using a minimalist design.	Yes	2
Prevent errors.	Yes	2
Help users recognise, diagnose and recover from errors.	Yes	2
Help and documentation.	Yes	1
Recognition rather than recall.	No	0

Table 4.1: Heuristic evaluation of WebCT

A description of the problems, which led to the allocated severity ratings, is given below.

Indicate site status (Severity rating 2)

On creating course material in WebCT, changes to the student view were not immediately visible, as if there was a time delay between updating material and viewing it in the student view.

Give students control of navigation (Severity rating 2)

The browser's 'back' button is always available as a type of undo facility, while 'cancel' buttons are occasionally provided. A redo option is not available.

WebCT keeps track of pages visited (since last visit to the home page) by means of a history list of pages (shown as links). This can then also be used as a navigation tool.

Build flexible and efficient web pages (Severity rating 2)

By providing templates for courses, the novice course designer is helped in that certain components can be created by the system. Unfortunately the novice user needs more help (possibly in the form of documentation), in order to do certain things. The system is flexible in the sense that course material need not be created in the WebCT editor, but existing html material can be uploaded into the system.

Consider using a minimalist design (Severity rating 2)

When adding a page or tool in WebCT, the designer needs to scroll to see all the available options, even though there are just 5 top-level tools, each with its own sub-tools or pages.

The designer can change the look and feel of the E-learning environment by changing background colours and icons. Where the designer needs to create html material, font size and colour may also be changed.

Prevent errors (Severity rating 2)

In the course creation process, error messages are few and not really helpful, e.g. when uploading existing html material into WebCT, a message was displayed indicating that there was an 'Illegal character'. After a long search for the illegal character, it was determined that WebCT cannot accommodate spaces in filenames.

Help users recognise, diagnose and recover from errors (Severity rating 2)

As stated previously, error messages are few, and those that do exist are vague.

Help and documentation (Severity rating 1)

WebCT has context-sensitive help, available from a link at the top of the page, which supplies the designer with a number of possibilities, and a list of steps of how to successfully complete each task.

The off-line documentation for WebCT (version 3.0) was only partly available (at the time of this evaluation). Unfortunately, in the initial creation of the example E-learning environment, only the documentation for version 2.0 was available, while version 3.0 was running. This therefore complicated the course creation process.

4.3.2 Heuristic evaluation of TopClass

The heuristic evaluation of TopClass also identified some usability problems (see Table 4.2), but again no problems were allocated a severity rating above 2.

Heuristic	Usability problems	Severity Rating
Indicate site status	Yes	2
Match content to audience	Yes	1
Give students control of navigation.	Yes	2
Be consistent and follow standards.	Yes	2
Build flexible and efficient web pages.	Yes	2
Consider using a minimalist design.	Yes	2
Prevent errors.	No	0
Help users recognise, diagnose and recover from errors.	Yes	2
Help and documentation.	Yes	2
Recognition rather than recall.	Yes	2

Table 4.2: Heuristic evaluation of TopClass

A description of the usability problems found is given below.

Indicate site status (Severity rating 2)

It was possible to create study material, but was not possible to view the material (a blank screen was displayed). This was actually a problem with access rights, but the system never displayed a message to indicate this.

Match content to audience (Severity rating 1)

TopClass uses an abbreviation (ULM) to indicate Units of Learning Material, unfortunately, the description of what is meant by a ULM, is not explained in an obvious place in the system, or in the on-line help. The off-line documentation states that units of learning material can be folders, pages or tests. For a novice designer this term (abbreviation) could be very confusing.

Give students control of navigation (Severity rating 2)

Unfortunately the 'back' button is not always available, but an alternative back button is sometimes provided on the toolbar. However, a link to the Home page was always available on the toolbar. Undo and redo are not supported.

TopClass keeps track of pages visited (since last visit to the home page) by means of a history list of pages (shown as links). This can then also be used as a navigation tool.

Be consistent and follow standards (Severity rating 2)

The 'back' button of the browser is not always available – which is contrary to the browser standard.

Build flexible and efficient web pages (Severity rating 2)

No templates exist, and material can be created in any html editor, and then uploaded into the system. A toolbar is always available to provide shortcuts to different pages.

Consider using a minimalist design (Severity rating 2)

In some of the TopClass screens, for example, when creating a class, a lot of information is asked from the designer, which inevitably leads to the need for scrolling. On one screen, the designer is asked to provide information on the course, the instructors, the course material and the period that the course must be available.

The designer can change the look and feel of the E-learning environment by changing background colours and icons. Where the designer needs to create html material, font size and colour may also be changed.

Help users recognise, diagnose and recover from errors (Severity rating 2)

Error messages are few, and those that do exist are vague.

Help and documentation (Severity rating 2)

On-line help can be accessed from a button on the toolbar, but is only available in the form of a restatement of the function of the menu options. Steps to be carried out to complete a specific task are not available. The off-line documentation is complete and helpful.

Recognition rather than recall (Severity rating 2)

A toolbar is always available at the bottom of the screen, which can take the user to all the main options available. Tooltips also appear for the menu options, to help the user remember the function of an icon. In some of the TopClass screens (as shown in Figure 4.1), a minimalist design was followed, therefore possibly not supplying the user with enough information. For example, the screen in Figure 4.1 does not supply sufficient information to enable the course designer to decide what to do next.

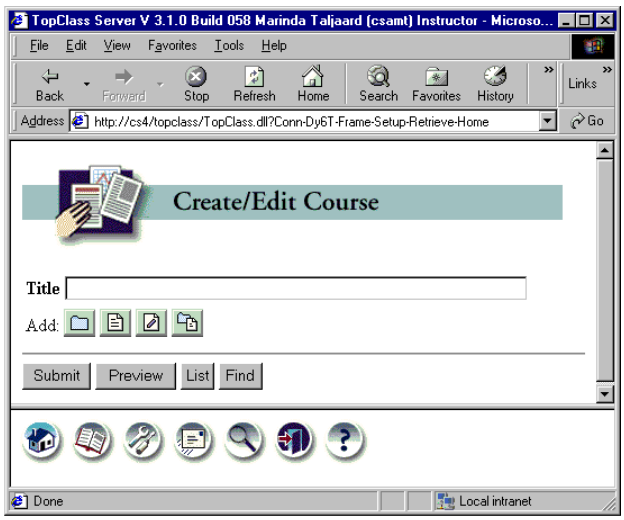

Figure 4.1: TopClass Create/Edit course screen

4.3.3 Evaluation Conclusions

In both systems it is fairly easy to load material, already in html format, into the E-learning environment. The content, layout and complexity (possible interaction) of the pages depend on the html knowledge of the designer.

Both systems have minor usability problems in the following areas: visibility of system status and error prevention and recovery, while TopClass has an additional problem with the lack of on-line help. Based on the heuristic evaluation, it was possible to conclude that WebCT had less usability problems than TopClass.

4.4 Comparison of feature lists

As shown in Table 3.3 the essential and important components of an E-learning environment can be divided into a number of categories. When comparing WebCT and TopClass in each of these

categories, WebCT appears to support **92%** of the components, while TopClass supports **80%**. In Table 4.3, the percentages are shown per category, with the number of items in each category shown in brackets after the category name. In the Learning environment category, WebCT does not allow students to work off-line, but students are able to print material, logout and login again later when they are ready to submit material or communicate with others. In the Author's environment, the item not supported by WebCT, is the incorporation of graphics into assessment questions.

Category	WebCT	TopClass	Difference
Learning environment / Student tools (16)	94%	63%	31%
Author's environment / Support tools (18)	88%	77%	11%
Teacher's environment and Pedagogical tools (8)	100%	75%	25%
Administration (4)	75%	75%	0%
Technical requirements (3)	100%	100%	0%
General properties / Other issues (8)	94%	88%	16%
Average support	92%	80%	

Table 4.3: Comparison of components per category for WebCT and TopClass

As shown in Table 4.3, there is a significant difference in the Learning environment (31%) and Teacher's environment (25%) categories. The reasons for these differences are the fact that TopClass does not support either group work or group communication. TopClass also does not allow students to make private annotations within course material. One area where TopClass is superior to WebCT (even though this does not show in the feature lists) is a more advanced testing system.

4.5 Cost comparison

At the time of the initial investigation, the estimated cost for WebCT was R 5025 for 100 user licences per year. The estimated cost for TopClass was, however, R 9800 per year for 100 users. This represents an increase in cost of approximately 51%.

4.6 Conclusions

The goal of this chapter was to compare and contrast the two candidate tools to create E-learning environments, namely WebCT and TopClass. A heuristic evaluation of these two systems was conducted to determine if either of these systems had significant usability problems. The result

of the analysis revealed that only minor usability problems exist in both these systems, specifically in the areas of Feedback and Error prevention (Section 4.3.3). A further analysis was performed to compare the features of these two systems using the framework of E-learning components described in Chapter 3, Table 3.3.

This analysis revealed that WebCT provides considerably more support than TopClass, especially in the areas of the learning environment and the teacher's environment (Table 4.3). There were some items in the framework that were not supported by WebCT (Section 4.4), but these were not regarded as essential in the revised framework (Table 3.3). It was therefore decided that WebCT (version 3.0) would be used as the implementation tool to determine the impact of using an E-learning environment to support IT education at UPE.

Chapter 5 Research Design

5.1 Introduction

In order to determine the impact of using E-learning to support IT education at UPE (seventh research question), an experimental design methodology was followed. The goal of this chapter is to describe the research method used to design an experiment to determine the impact of using E-learning to support IT education at UPE.

5.2 Research Hypotheses

According to Section 2.4, the impact of using E-learning can be divided into several different areas. This research will attempt to prove the following hypotheses:

- H_0: An E-learning environment cannot be used to support IT education at UPE (null hypothesis)
- H_1: Course Management Software can be used to create an E-learning environment for IT education at UPE
- H_2: Using an E-learning environment at UPE will have an effect on:
  - $H_{2.1}$: Student performance
  - $H_{2.2}$: Student collaboration
  - $H_{2.3}$: Student satisfaction
  - $H_{2.4}$: Student attendance
  - $H_{2.5}$: Learning style
  - $H_{2.6}$: Student time spent on course work
  - $H_{2.7}$: Student's level of preparation
  - $H_{2.8}$: Instructor skills and knowledge needed
  - $H_{2.9}$: Total time spent by instructors
- H_3: The level of participation of students in an E-learning environment will have an effect on:
  - $H_{3.1}$: Student performance
  - $H_{3.2}$: User satisfaction

5.3 Research Design

5.3.1 Course Selection

Two groups of IT students at UPE were selected for this experiment. One group consisted of students registered for the EUC (second semester) course, while the other group comprised students registered for a postgraduate course in Human-Computer Interaction (HCI). The EUC course has more than 400 students registered in the second semester. These students are divided into four different groups, based on their preference and timetable. It was decided to use one of the four groups for this project, and to create a control group from the other EUC groups. The control group was created based on the marks the students obtained for their first semester EUC course, to ensure that the experimental and control groups were similar. The demographics of the groups will be discussed in Section 5.3.2.

These two groups (EUC and HCI) were selected in order to obtain feedback from first-year as well as postgraduate students at UPE, as these groups may have different opinions about E-learning issues. The second semester EUC course was selected, rather than the first semester course, to ensure that the students would be computer literate and be able to interact with an E-learning environment.

5.3.2 The JITT Methodology

A decision was taken to use the Just-In-Time Teaching (JITT) methodology for the experiment. The JITT methodology is a way to blend active learning and web technology (Novak 1999). This can also be called a hybrid of web-based and classroom training (Horton 2000). The key is to use Web communication technology to prepare the students and the instructors for the events in the classroom (Novak 1999). Horton says that such a halfway approach may be better than jumping directly to 100% Web delivery. It gives the instructor and students time to learn to use the various technologies of web-based training.

Using the JITT methodology implied that students were asked to prepare for their contact session by working through the study material (available online as well as in a printed study guide), and were required to submit an assignment and/or quiz by a certain due date and time (on WebCT). The answers to the assignment and/or quiz were then used to determine the content and focus of the lecture. Novak *et al* states that the students must be keenly aware that the discussions and

activities in the JITT classroom stem from, and are focussed on, their actual responses (Novak 1999). If this is not the case, the crucial feedback loop between the Web and the classroom components is broken.

Students were required to answer quizzes and/or assignments on a weekly basis. To create a quiz using WebCT was an easy task, although the questions needed careful consideration. Based on the answers given, the lecturer was able to determine where the students encountered problems understanding the material. These aspects were then included in the lecture. The same rationale was used in the creation of the assignments. The quizzes and assignments had to be available at least one week in advance in order to give students enough time to complete them.

5.3.3 Course Demographics

EUC course

The experiment was conducted in the second semester of 2001. It was decided that, in order to keep the control and experimental EUC groups sufficiently similar, the same assessment and practical components would be used. This implied that rather than having an E-learning environment with no contact sessions, the hybrid approach of the JITT methodology would be followed (Section 5.3.2).

The experimental and control EUC groups were handled differently in the lectures where the theoretical concepts were covered. The experimental group followed the JITT methodology, while the control groups had traditional contact lectures. For the EUC experimental group, submission of tasks was compulsory, while attendance of contact sessions was optional. The EUC control group did not have to prepare for their lectures and they did not have additional assignments and quizzes. For the control group, lectures were compulsory. These two groups were handled the same way in the practical sessions and course assessments. The author was responsible for the teaching of the experimental group as well as one of the other EUC groups (Section 5.3.1).

Since the EUC students had their textbooks and study guides, it was not necessary to create study material for the learning environment, but the assignments and quizzes had to be created. To support active learning and communication with peers, discussion topics were posted on the discussion boards. Students were encouraged to take part in discussions. They were also

encouraged to make use of the discussion boards and e-mail facilities whenever they needed help with study material.

The EUC experimental group originally consisted of 70 students, but was reduced to 61, since the students in the original group were given the choice of changing to another group, if they were not comfortable with an E-learning environment. For the purpose of the research analysis, these 61 students were divided into different strata (above 80, 70 – 79, 60 – 69 and 50 – 59) based on their EUC course results in the first semester of 2001 (for the different strata; n = 3, n = 8, n = 21 and n = 29 respectively). The EUC control group was then created from the rest of the EUC groups, by selecting students randomly from the same strata, in order to ensure that the two groups were similar. The demographics of the students can be seen in Table 5.1, and is also depicted in Figures 5.1 to 5.3.

	Control (n=61)		**Experimental (n=61)**	
	Number	**Percentage**	**Number**	**Percentage**
Gender				
Male	36	59.0%	38	62.3%
Female	25	41.0%	23	37.7%
Home Language				
English	24	39.3%	28	45.9%
Afrikaans	16	26.2%	10	16.4%
Xhosa	14	23.0%	14	23.0%
Afrikaans/English	4	6.6%	4	6.6%
Other	3	4.9%	5	8.2%
Race				
Coloured	7	11.5%	11	18.0%
African	20	32.8%	20	32.8%
White	32	52.5%	27	44.3%
Indian	2	3.3%	3	4.9%

Table 5.1: EUC student demographics

The experimental and control groups had approximately the same proportion of Male and Female students (Figure 5.1). The majority of both groups were Male (59% in the control group, and 62.3% in the experimental group).

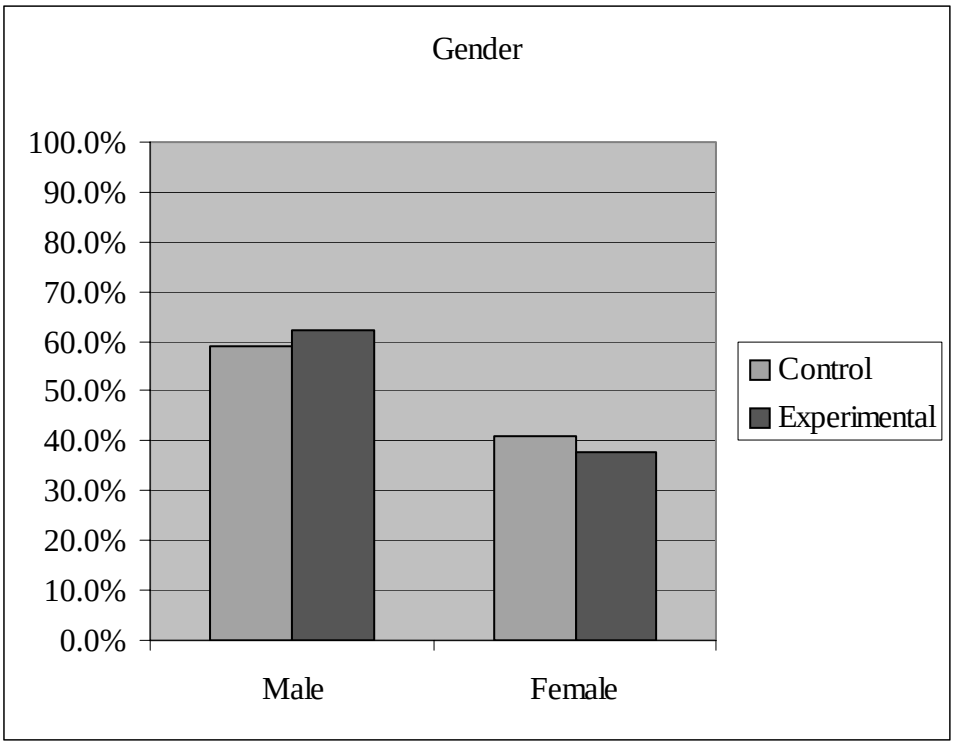

Figure 5.1: EUC student demographics - Gender

When looking at home languages, the proportions were again very similar in both groups, with exactly the same number of Xhosa home language students (23%) in each group (Figure 5.2). Most of the students' home language was English (39.3% in the control group, and 45.9% in the experimental group). The percentage of Afrikaans speaking students was 26.2% and 16.4% respectively, while 6.6% of the students (equal values in both groups) had both English and Afrikaans as their home languages.

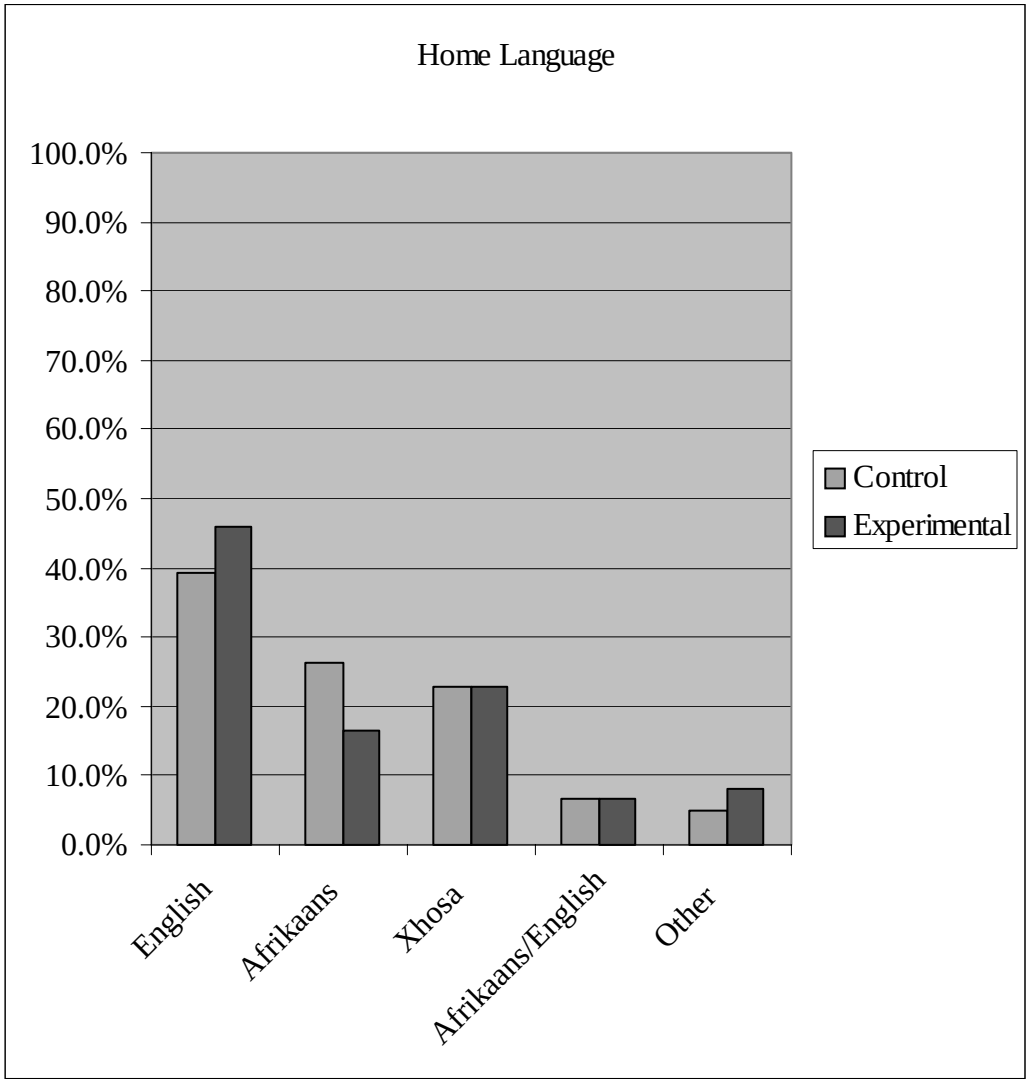

Figure 5.2: EUC student demographics – Home language

The race groups were proportionally very similar in both the experimental and control groups (Figure 5.3). The majority of students were White (52.5% in the control group and 44.3% in the experimental group), with 32.8% African students in each of the groups. 11.8% of students in the control group were Coloured, while the experimental group had 18% Coloured students. The remainder (3.3% in the control group and 4.9% in the experimental group) were Indian students.

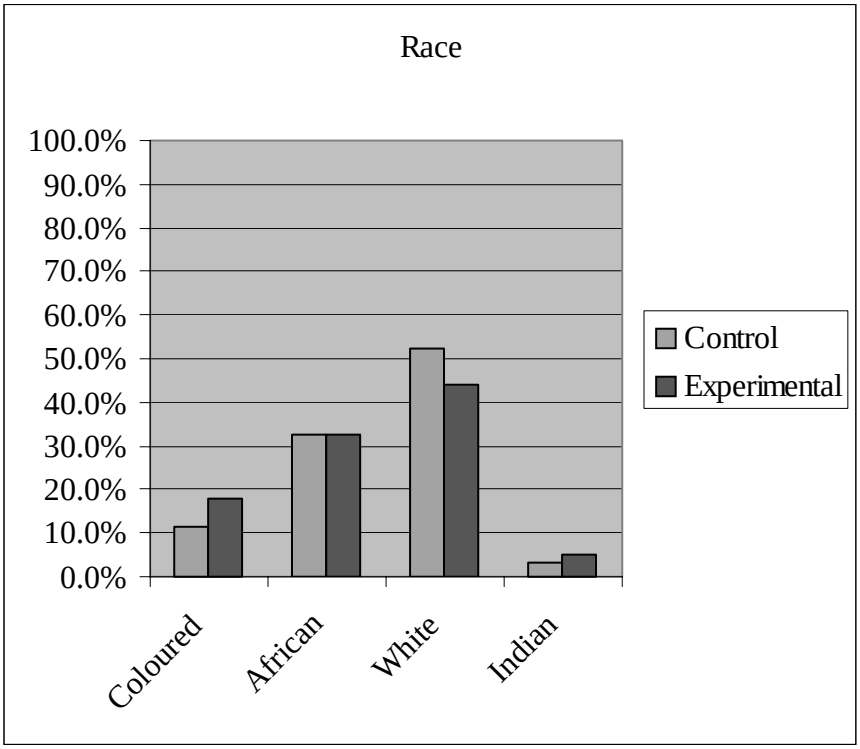

Figure 5.3: EUC student demographics - Race

HCI course

The HCI course is a year course offered to honours students in the Department of Computer Science and Information Systems (CS&IS). In the first semester of 2001, the course was presented using the traditional teaching style. During the second semester of 2001, the course presentation was changed to follow the JITT methodology, using WebCT. Prof J.L. Wesson presented this course in both semesters. The HCI group consisted of 23 students. The demographics of this group can be seen in Table 5.2. The majority of the students were Male (73.9%), and had English as their home language (65.2%). 91.3% of the students were White.

	Number	Percentage
Gender		
Male	17	73.9%
Female	6	26.1%
Home Language		
English	15	65.2%
Afrikaans	4	17.4%
Xhosa	2	8.7%
Afrikaans/English	1	4.3%
German	1	4.3%
Race		
African	2	8.7%
White	21	91.3%

Table 5.2: HCI student demographics

No control group was, however available for this group of students. For this reason, subsequent data analysis will focus on the EUC group only; the HCI group will only be used for qualitative research purposes.

5.3.4 Software Installation

WebCT must be installed on a web server and runs from a web browser. Unfortunately, because of the way that WebCT was installed at UPE, it was not possible for instructors and students to have off-campus access to the E-learning environment. WebCT uses a specific port for communication, but the CS&IS network administrator could not open that port because of security reasons (a firewall was installed on the web server). This could have been different if a separate server and phone line were available for the experiment. At the time of the experiment, two different networks existed at UPE, with WebCT being installed on the web server of the

CS&IS department. The firewall also excluded access from any workstation on the other networks at UPE.

5.3.5 Creation of Online Material

Task analysis

Task analysis was used to identify the tasks which an instructor would have to do in order to create an E-learning environment. Normative and descriptive models were constructed to determine if the steps to create an E-learning environment in WebCT follow the steps an instructor would normally do to create an online course.

Normative Model

A normative model describes what people normally do in order to complete a given task (Newman and Lamming 1995). Regardless of whether an instructor would create an E-learning environment in a high-level tool or in a programming language, the tasks as described in Figure 5.4 would have to be done:

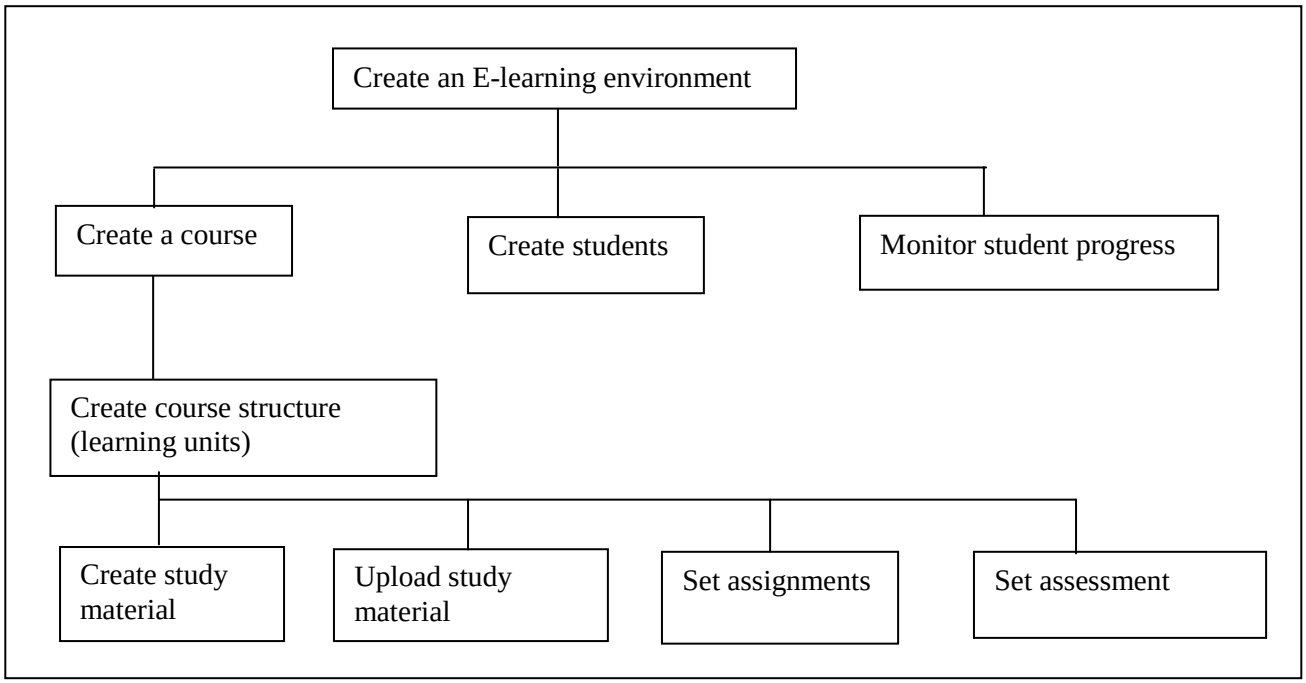

Figure 5.4: Normative model of creating an E-learning environment

When creating an online course (E-learning environment), instructors need to be able to create the course (with specific code or course details). To create a course involves the sub-task of creating the course structure, which again consists of the sub-tasks of creating and uploading

study material as well as the setting of assignments and assessments. The next task of an instructor would be to create students on the system, followed by the monitoring of the students' progress.

Descriptive Model

The actual process of creating an E-learning environment in WebCT is discussed below.

Create a course

The WebCT administrator needs to create the designers and the courses before the designer can start compiling or creating an online course. The templates available for the design of a course are only available when logged in as an administrator. It is possible, however, for the designer to add components later, if those components do not form part of a selected template (Eiffel-Inc.com 2000).

Create course structure (learning units)

There are no real guidelines provided to assist the designer to design the best possible course. Support is provided for certain parts of the learning unit (Figure 5.5 and Figure 5.6). Tools exist for the creation of a glossary and a syllabus page, where space is provided for issues such as the prerequisites and learning outcomes of a specific course. If, however, the designer needs prerequisites, learning outcomes and a glossary per individual learning unit, these pages have to be specifically created by the designer.

Create study material

In the off-line documentation it is advised that material should be created in an html editor such as FrontPage (Eiffel-Inc.com 2000). The designer is led through a process of creating folders (which need not have the same names and structure as the resulting course). Pages are then created, and saved to these folders. The next step is to log into WebCT and import the folders and files into the WebCT server.

Upload study material

WebCT has a facility to unzip files, which means that the process of importing the existing folders and files can be done with a single set of instructions. Once the designer has created all the course material on the WebCT server, he/she can go to the Content Module, from where he/she can create the course structure by adding headings, files or quizzes. The course structure is shown as a Table of Contents.

Set assignments

Assignments can be made available quite easily, since the material can be created in any html editor, and then imported into the server. When making an assignment available, the designer can specify when the assignment is due, and the total number of marks for the assignment.

Set assessment

To create a quiz, the designer goes to a quiz editor, where he/she can add questions to a database, and to the current quiz. The quiz is then connected to a particular course. The course designer can specify when the assessment should become available, until when it should stay available, the total marks for the assessment and the time allowed for the student to complete the quiz.

Create students

The administrator, designer and instructor (called a teaching assistant in WebCT) of the course can add students to a specific course. The biographical data of the student must be entered, as well as a WebCT username and password. An import facility exists whereby the instructor can create a number of users in an Excel spreadsheet to speed up the process.

Monitor student progress

The administrator, designer and instructor of the course can monitor student progress for a course. It is possible to see when a student has logged in for the first and last time, the number of pages visited, as well as the marks obtained for assignments.

Conclusions

All the tasks identified in the normative model can be easily mapped onto steps required by WebCT. It can therefore be concluded that the tasks are well supported by WebCT.

5.3.6 EUC Course Structure

Each of the End User Computing courses at the UPE is divided into a number of learning units. A learning unit can consist of one or more learning units. Each learning unit will have most of the components given in Figure 5.5. The structure of the course (the layout of the learning units) was created by the lecturers involved in the teaching of these courses over the past few years. Students need access to course prerequisites, learning outcomes and a course introduction. Summaries, references and a glossary must also be available. Because of the actual syllabus of the course, it is necessary to have theory as well as practical components for these courses. The course content pages therefore consist of theory sections as well as case studies, exercises and assignments. These assist students to master and apply the skills and knowledge obtained.

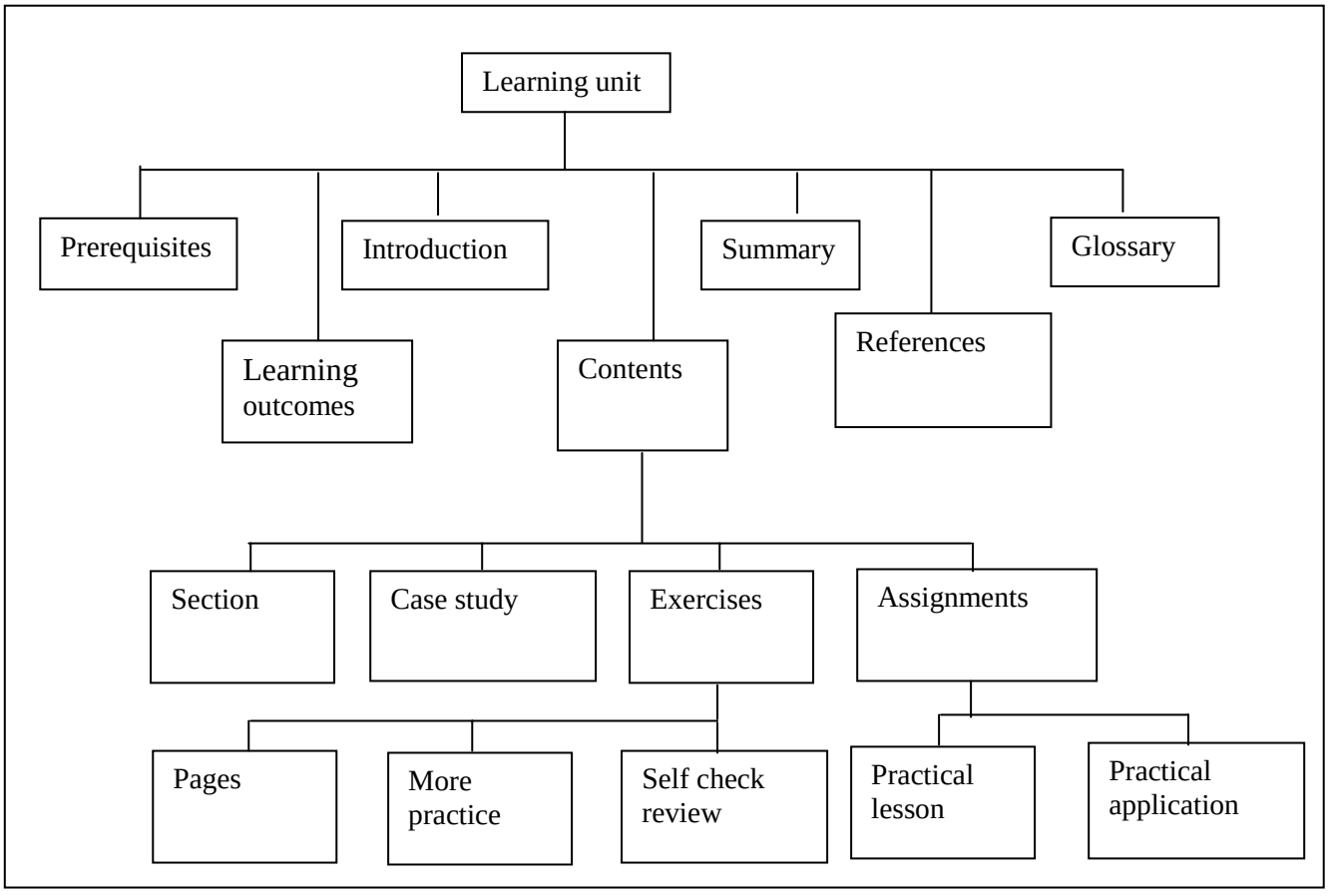

Figure 5.5: Architecture of a typical EUC learning unit

The E-learning environment for the EUC course should at least give students access to the learning material as shown in Figure 5.5. In addition, students should be able to interact with their peers and lecturer(s) using the tools provided by the E-learning environment. This agrees with the E-learning components identified in Section 2.2.2. The structure shown in Figure 5.5

might have different names from those in Section 2.2.2, but the reason for these differences are that the terms used correspond with the terms usually used in the EUC courses.

Since the course material for the EUC course is strongly supported by the prescribed textbooks and study guides, the contents pages of the learning units were designed not to cover all of the concepts covered in the textbooks, but only to add to them. This was done by giving lists of more readings, web links or guiding students through material by emphasising certain topics or issues. Exercises sections were included to assist students with the mastery of the knowledge and skills covered in the contents pages (Section 2.2.2).

It was decided that the main function of the E-learning environment would not be the presentation of course material, but rather support for guiding the student towards mastery through guidelines, exercises and interaction. Using the learning unit structure described in Figure 5.5, a structure was defined for the online EUC course. An example of this structure is given in Figure 5.6. Each learning unit refers to a study guide (SG), and although only study guide 13 is shown in detail in Figure 5.6, the other units were designed to follow the same structure.

WebCT supports email, discussion groups and bulletin boards. By using these tools, students can, without much effort, interact with their peers and lecturer(s).

The following elements were therefore included in the CMC component:

- Email
- Discussions
- Bulletin boards (in the form of announcements)

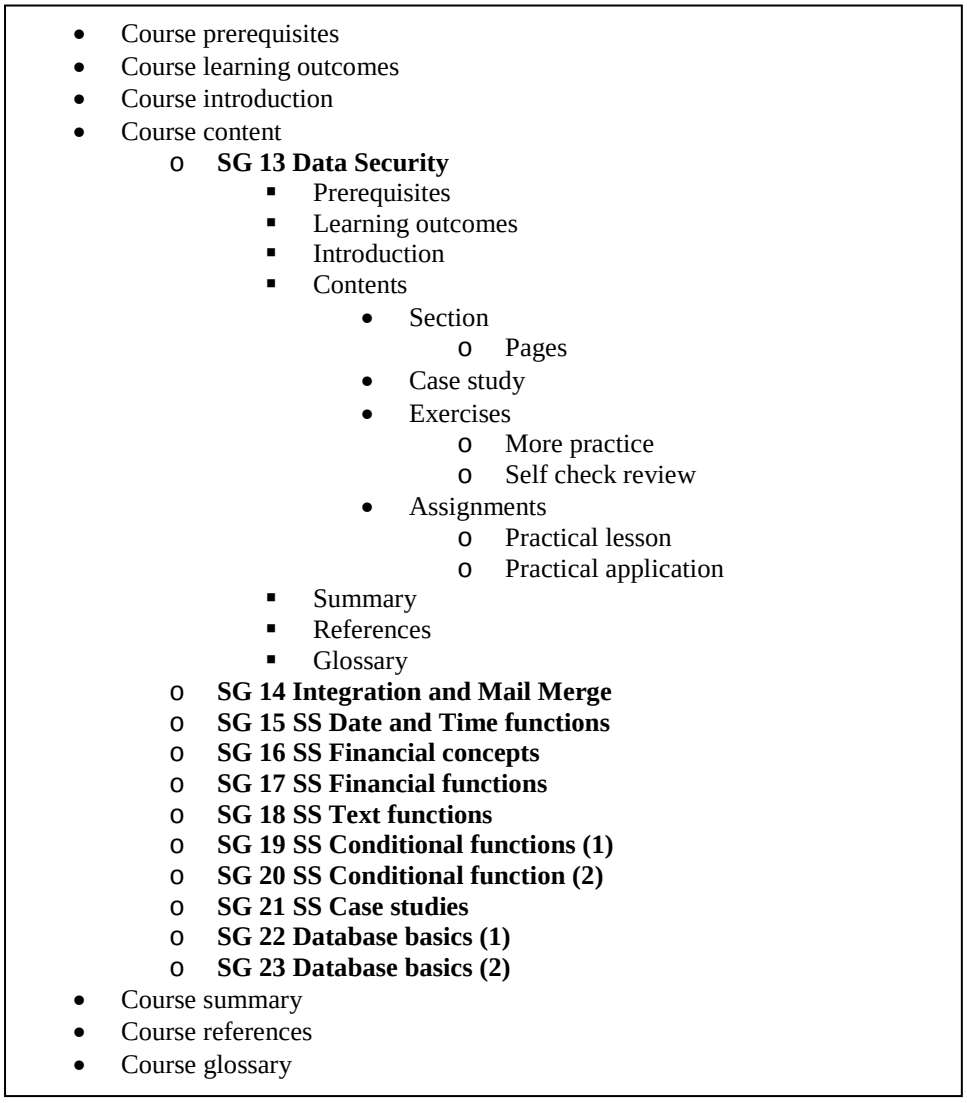

Figure 5.6: Structure of a EUC learning unit in WebCT

5.3.7 Creating the WebCT E-learning environment

The EUC E-learning environment in WebCT was created to include a syllabus page, learning outcomes, content pages, glossary, and assignments pages as well as quiz pages. This corresponds to the structure of Figures 5.5 and 5.6. In addition, the email and the discussion tools were included. After logging into the WebCT server, the first WebCT screen as seen by the EUC student is shown in Figure 5.7. This screen displays the course(s) for which a student is registered, the assignments due, as well as any announcements.

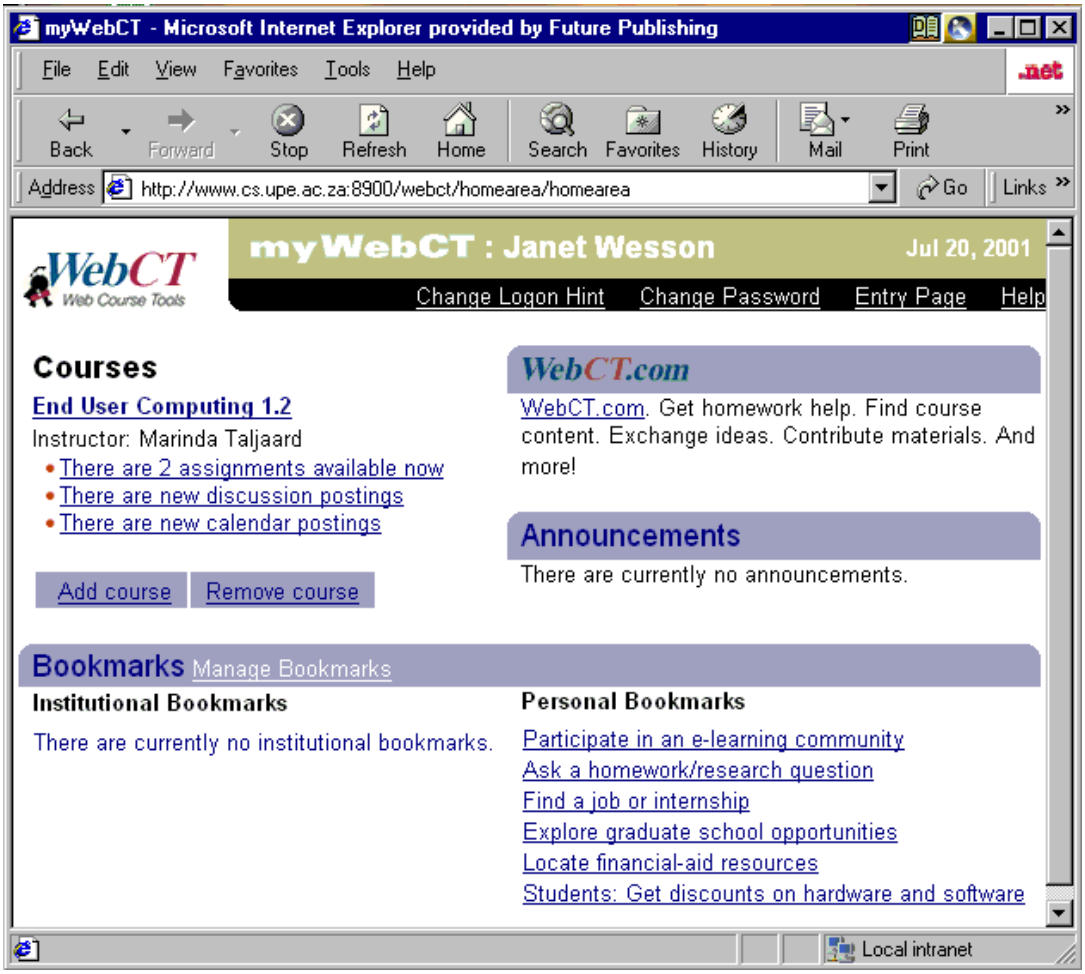

Figure 5.7: WebCT initial screen (EUC course)

Figure 5.8 displays the WebCT Table of Contents screen for the EUC course. The frame on the left displays the course menu, which can be used to go to any of the features that have been included in the E-learning environment. In the other frame, Figure 5.8 shows the Table of Contents, which students can use to navigate between sections of the course material. The TOC was created by specifying the headings and then uploading the relevant html files. The html files were created in MS Frontpage.

Although students can reach the course content, assignment and quiz pages from the menu that always remains in the left-hand frame, links to these pages were also created on the TOC. The reason for doing this was to provide flexibility to the students in using the E-learning environment.

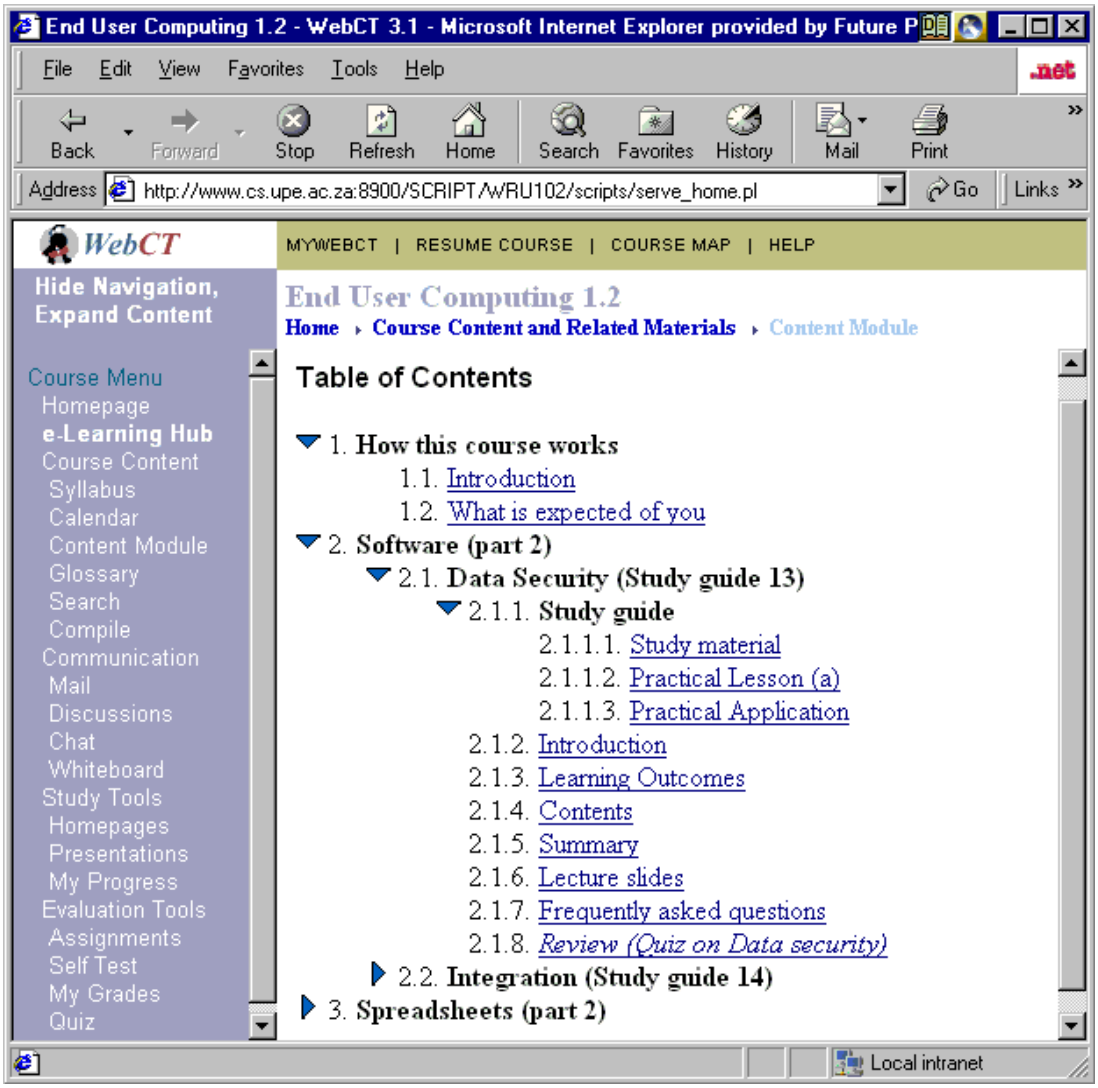

Figure 5.8: WebCT Table of Contents (EUC course)

The HCI course structure was similar to that of the EUC course. The layout of the TOC for this course is given in Figure 5.9. Only some of the topics are expanded, but all the topics followed a similar structure. Students could reach the lecture material, quizzes, class exercises, assignments and discussion questions from the TOC.

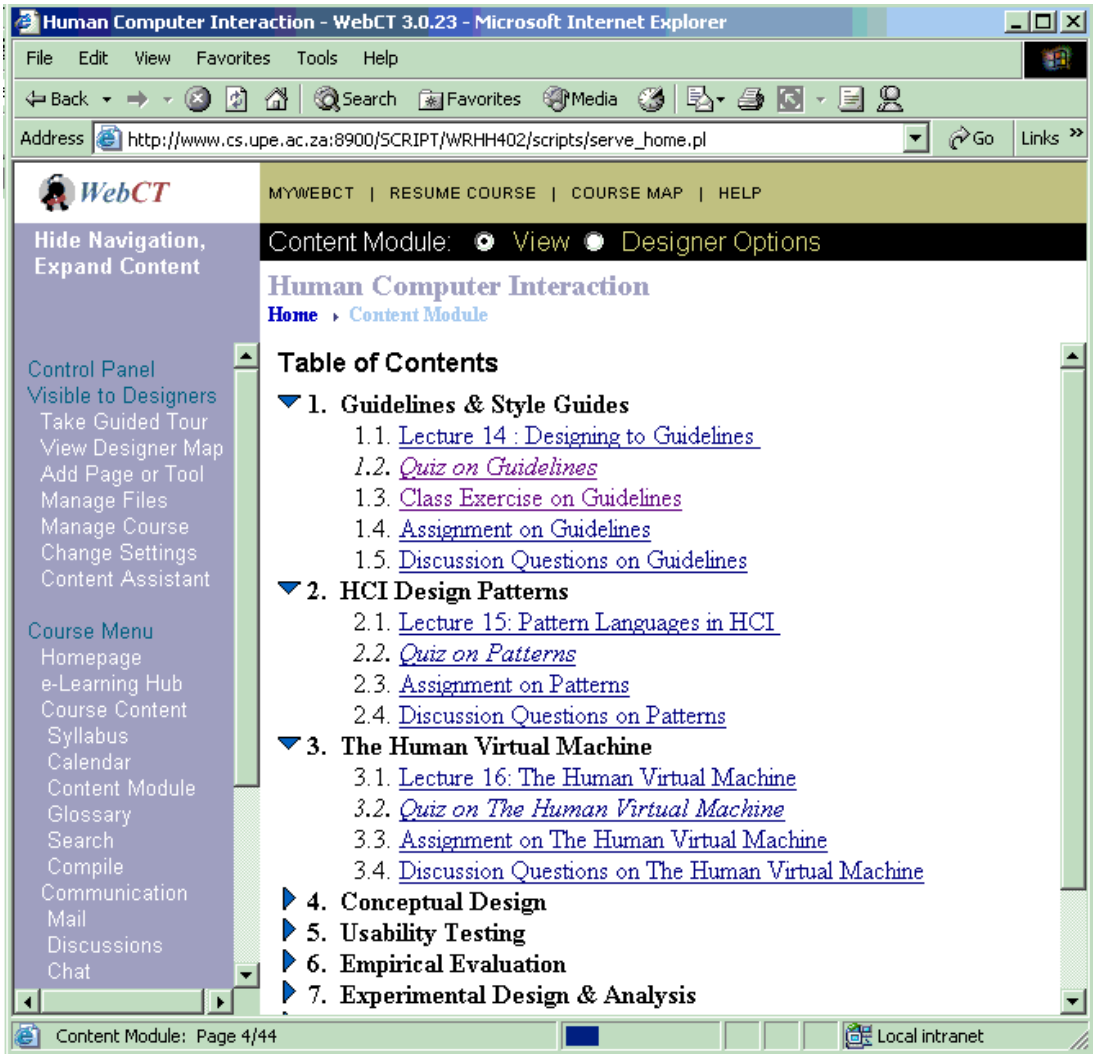

Figure 5.9: WebCT Table of Contents (HCI course)

An example of a quiz question for the HCI course can be seen in Figure 5.10. When creating a quiz question, the instructor specifies the type of question, the question text, the correct answer(s) as well as the marks obtained for each question. It was possible to create short answer questions, as well as multiple choice questions with more than one correct answer.

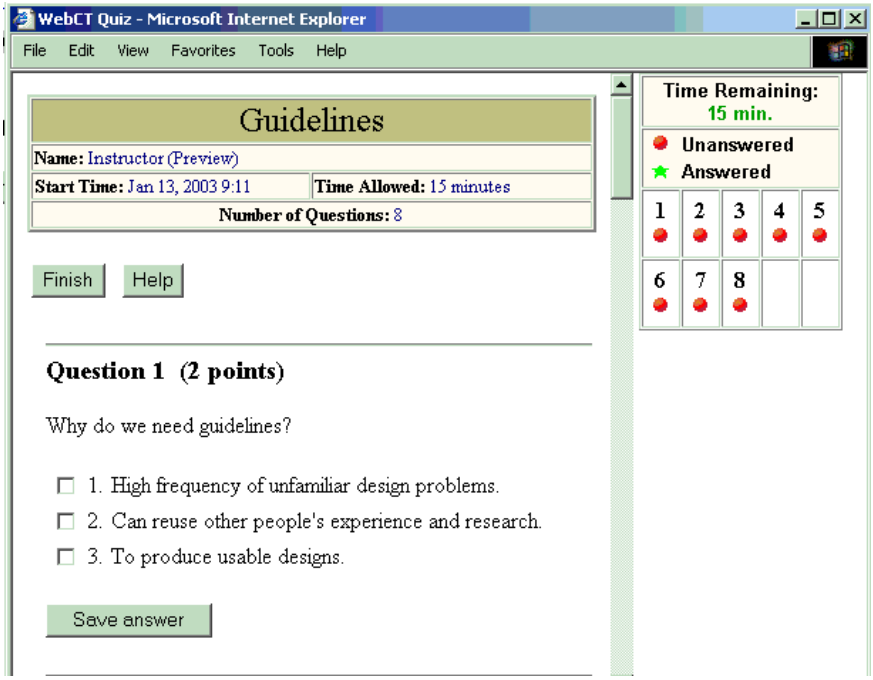

Figure 5.9: Example of a WebCT multiple choice question (HCI course)

5.3.8 Evaluation Measures

Quantitative as well as qualitative data was collected in order to analyse the results of the experiment (Section 2.4.2). For the experimental EUC group as well as the HCI group, WebCT recorded assignment submission and quiz results, while attendance of contact sessions was also kept. All the EUC groups had to complete the usual course assessments, namely theoretical and practical tests, as well as the examination, and results were determined for both the experimental and control groups. These results will be analysed in Chapter 6 to determine the impact on student performance ($H_{2.1}$).

At the end of the second semester, the EUC students were asked to complete a modified version of the Questionnaire for User-Interaction Satisfaction (QUIS™) (Norman 1995). The purpose of this was to determine their level of satisfaction with the WebCT user interface ($H_{2.3}$). This questionnaire covered the following topics: System experience, Past experience, Overall user reactions, Screen display, Terminology and system information, Learning, System capabilities as well as Tasks specific to the WebCT environment (Appendix D). The results of this questionnaire were used to determine whether WebCT satisfied the requirements of the users ($H_{2.3}$ and $H_{3.2}$). These results are discussed in Chapter 6.

All EUC students (control and experimental groups) were asked to evaluate the EUC course using a course evaluation questionnaire. The questionnaire included sections on the lecturer, lectures and practical components, as well as open-ended questions where students could express their opinions (Appendix C). These results are contained in Chapter 6. The goal of this evaluation was to determine the levels of student satisfaction with the course ($H_{2.6}$ and $H_{2.7}$).

Lastly, focus group interviews were held with the EUC and HCI students to address those issues which were not addressed by the quantitative methods. In the interviews, the students were asked to discuss how this experience affected their learning styles ($H_{2.5}$), their time ($H_{2.6}$), peer collaboration ($H_{2.2}$), attendance ($H_{2.4}$) and performance ($H_{3.1}$). They were also asked about any perceived benefits, their attitude towards E-learning, feedback received as well as the level of support provided by WebCT.

5.4 Conclusions

Several hypotheses were formulated to determine the impact of using E-learning to support IT education (Section 5.2). An E-learning environment was created for two groups of students, namely a group of EUC (first year course) students and HCI (postgraduate course) students. The second semester EUC course was used, since these students have sufficient levels of computer literacy, having already learned about files, some application programs and browsers. The HCI course was used to obtain data from senior students as well as from first-year students. The JITT methodology was followed to present these two courses. For the EUC group, a control group was created from the bigger EUC group in order to compare actual results between the experimental and control groups.

The students in the experimental EUC and HCI groups used the E-learning environment for the second semester of 2001, and qualitative and quantitative data was collected during and at the end of these courses. The results of the experiment will be discussed in Chapter 6.

Chapter 6 Research Results

6.1 Introduction

As discussed in Section 5.3.8, a number of different methods (e.g. course marks, submission marks in WebCT, questionnaires and focus group interviews) were used to collect research data. Quantitative as well as qualitative data was collected in order to analyse the results of the experiment. The data sources and possible questions which could be answered by the data are given in Table 6.1. This chapter will describe the results of the research experiment.

Data Source	Research questions
WebCT	Submissions, marks, time spent
Course marks	Student performance
Course evaluation	Course satisfaction
Questionnaire for User Interaction Satisfaction	User satisfaction, usability problems
Focus group interviews	Impact on learning style, time spent, student attitudes

Table 6.1: Summary of data sources and questions to be answered

6.2 WebCT Data (EUC course)

WebCT was used to record the marks that students obtained for each quiz or assignment. The students did not always have to submit both a quiz and an assignment per week. Table 6.2 shows a summary of the level of participation (submission). The percentage of students who submitted the assessments varied between 34% (representing 21 students) and 66% (40 students). The average marks obtained by the students ranged between 33% and 74%.

Study guide	Number of students	Submission %	Average mark
13	34	56%	62%
14	40	66%	39%
15	35	57%	45%
16	33	54%	33%
17	30	49%	34%
18	21	34%	74%
19	25	41%	58%
20	30	49%	46%
21	32	52%	51%
Mean	**31.1**	**51%**	**49%**
Std deviation	**5.6**	**9%**	**13%**
Maximum	**40**	**66%**	**74%**
Minimum	**21**	**34%**	**33%**

Table 6.2: Summary of quiz and assignment submission (EUC course)

Furthermore, WebCT recorded the number of times the students visited each screen. This information is shown in Table 6.3, and is sorted in descending order on the number of hits per page. It is clear that initially, students visited more pages (SG 13 was the first study guide). Most of these pages, however, were the same as those in their printed study guides, and when working with the other study guides, the students did not often use the electronic version. Unfortunately, WebCT only records the pages reached from the Table of Contents, and not those reached from the WebCT menu. Since students did submit assignments and quizzes, it is clear that they did so using the WebCT menu, and not by using the links provided in the Table of Contents.

Page	Hits	Total Time (seconds)	Mean Time/Hit (seconds)
SG 13 Study material	26	37:05	1:25
SG 13 Learning outcomes	23	11:29	0:29
SG 13 Summary	17	1:07:24	3:57
SG 13 Frequently asked questions	16	3:21:24	12:35
SG 13 Lecture slides	14	2:01:18	8:39
SG 13 Introduction	14	11:16	0:48
SG 15 Learning outcomes	13	7:43	0:35
SG 14 Study material	13	3:28:28	16:02
What is expected of you	10	7:36	0:45
SG 15 Quiz	10	2:34:53	15:29
Introduction to WRU102	7	0:00	0:00
SG 16 Study material	6	1:28:11	14:41
SG 16 Learning outcomes	6	28:34	4:45
SG 18 Practical lesson	6	0:00	0:00
SG 14 Learning outcomes	5	1:24:18	16:51
SG 13 Practical application	5	19:45	3:57
SG 15 Practical lesson	4	0:00	0:00
SG 19 Answers to preparation exercises	3	14:10	3:32
SG 15 Answers to preparation exercises	2	18:44	2:11
Average	**10.5**	**56:57**	**5:36**
Standard deviation	**6.7**	**68:18**	**6:15**
Maximum	**26**	**3:28:28**	**16:51**
Minimum	**2**	**0:00**	**0:00**

Table 6.3: Summary of pages visited (EUC course)

Lastly all email messages sent to the instructor were kept, as well as the history of bulletin board threads. Table 6.4 summarizes the threads from the discussion board. Considering that there were 61 students in the experimental group, it can be seen that the discussion board was not often used, and then more for some study guides than others. The maximum number of messages ever posted to the discussion board on a specific study guide (SG 16) was 29.

Topic	Total
Viruses (SG 13)	15
Linking (SG 14)	1
Date and Time (SG 15)	24
Financial concepts and formulas (SG 16)	29
Financial functions (SG 17)	21
Text manipulation (SG 18)	13
Conditions and logical functions (SG 19)	0
Nested if and vlookup (SG 20)	9
Main	1
Average	12.5
Standard deviation	10.7
Maximum	29
Minimum	0
Total	113

Table 6.4: Statistics on discussion threads (EUC course)

As indicated in Table 6.1, the data collected by WebCT can be used to draw conclusions about the submission of tasks, marks obtained and time spent on WebCT. This will be discussed in Chapter 7.

6.3 Course Marks

Since the EUC course used in the experiment (WRU102) had a prerequisite course (WRU101), final marks were available for the first course, as well as test marks and final marks for the second course. UPE has a policy of Duly Performed Certificates, which implies that students, who have not displayed adequate levels of performance, are not allowed to write the final examination. Therefore courses often have more students at the beginning of the course, than the number writing the final examination. All the students had class marks, which were calculated as an average of their two semester test results.

A table containing the class and final examination marks of the EUC experimental and control groups in the first semester (WRU101) can be found in Appendix B. A summary of the data can

be found in Table 6.5. The mean first semester mark was very similar for the two groups, namely 61.3% for the experimental group and 62.3% for the control group. The class marks for the second semester showed some variation, with the experimental group obtaining a mean class mark of 39.9% and the control group, a mean of 46.1%. The mean final mark for the students who were allowed to write the examination was again very similar in the two groups, being 54.0% for the experimental group, and 54.9% for the control group. The pass rate for the control group was higher than that of the experimental group, namely 50.8% compared to 39.3%.

	Semester 1 (WRU101)		Semester 2 (WRU102)			
	Initial n	**Final mark**	**Final n**	**Class mark**	**Final mark**	**Pass rate**
Experimental group	61	61.3%	35	39.9%	54.0%	39.3%
Control group	61	62.3%	42	46.1%	54.9%	50.8%

Table 6.5: Marks for the EUC control and experimental groups in 2001

6.4 Course Evaluation

Students in the Department of Computer Science and Information Systems are required at the end of each semester to evaluate the lecturer and the course. A standardised course evaluation questionnaire is used for this purpose, where students are required to complete the applicable sections. A copy of this course evaluation questionnaire can be found in Appendix C.

Unfortunately course evaluation must be anonymous, which implies that no correlations could be made between the results of the experimental group and their course evaluation results, except where they specifically commented on WebCT in the open-ended questions. These comments will be discussed in Chapter 7, to indicate students' satisfaction with the course.

Means for each section were calculated for all the EUC students who completed the course evaluation questionnaire. The author also taught one of the other (traditional style) groups. Section means were also calculated for this lecturer. The EUC second semester course results are given in Table 6.6. For all the sections, the means were very similar, with the values ranging between 3.31 and 3.74.

Section	All lecturers (n = 115)	Specific lecturer (n = 58)	Difference
Lecturer evaluation	3.62	3.74	-0.12
Course evaluation	3.34	3.31	-0.03
Practical Evaluation	3.62	3.62	0
Lesson Evaluation	3.61	3.68	-0.08

Table 6.6: Results of EUC course evaluation in 2001

6.5 Questionnaire for User Interaction Satisfaction

At the end of the semester, the EUC group were asked to complete a modified version of the Questionnaire for User-Interaction Satisfaction (Section 5.3.8). 32 Students completed the questionnaire. A copy of this questionnaire can be found in Appendix D. The results of this questionnaire were used to determine whether WebCT satisfied the requirements of the users ($H_{2.3}$). A number of questions were asked under each topic, and students had to select a response based on a 5-point Likert scale. For the purpose of analysing the results, 1-3 was regarded as a Negative response, while 4-5 was regarded as a Positive response. Results obtained can be found in Appendix F.

The means per section were all above 3, indicating a positive response from the students (Table 6.7). The students were quite positive about the Display (3.96) and the WebCT tasks (3.93). This was followed by Learning (3.77), System capabilities (3.60) and Terminology (3.5). The mean response for User reactions was 3.35.

Section	Mean
User Reactions	3.35
Display	3.96
Terminology	3.50
Learning	3.77
System Capabilities	3.60
WebCT Tasks	3.93

Table 6.7: Means per section for user-interaction satisfaction (EUC group, n = 32)

6.6 Focus Group Interviews

Focus group interviews were held to address the issues that were not addressed by the quantitative methods. In the interviews, students were asked how this experience affected their learning styles ($H_{2.5}$), their time ($H_{2.6}$), peer collaboration ($H_{2.2}$), attendance ($H_{2.4}$) and performance ($H_{3.1}$). They were also asked about any perceived benefit, their attitude to E-learning, feedback received as well as the level of support provided by WebCT. These questions can be found in Appendix E.

To ensure that the students would give their true opinions, an impartial person was used to facilitate these interviews. This person was a senior lecturer in the CS&IS department, Mr N.L.O. Cowley, who had experience in the focus group methodology. Four focus group interviews were held, three for the EUC experimental group, and one for the HCI group. The participants in the focus groups were selected randomly, within certain parameters. For the EUC focus groups, the experimental group was divided into different groupings, based on their levels of participation in WebCT. The three EUC focus groups therefore comprised students with levels of good participation, medium participation and very little participation. Each group consisted of six participants, who signed an informed consent form, agreeing that their comments could be used in a research report.

The feedback from the focus group interviews was organised into themes and categories and the results will be given in the next chapter. From the data collected the themes and categories given in Appendix G.1 were compiled. The main categories were Management or Organisation of Learning, Changes in the Learning Process and Course Evaluation. Under Management the themes addressed whether students regarded the E-learning environment as integrated with the course, additional or as a replacement. The changes in the Learning Process could imply changes in learning style, interest, time spent, the use of the communication tools and attendance. The Course Evaluation category did not have any themes.

The students' responses were transcribed, collated and analysed using the themes and categories in Appendix G.1. Extracts from these responses are given in Appendix G.2. These results will be combined with the analysis of the quantitative data in Chapter 7.

6.7 Conclusions

In order to determine the impact of using E-learning to support IT education at UPE, a number of different methods were used to collect data during the project. Quantitative data was collected by means of two sets of questionnaires. One questionnaire was used to determine usability problems and user interaction satisfaction, while the other questionnaire was used to determine course satisfaction. Marks were collected to determine the relevant impact on student performance. Data was also recorded in WebCT, in order to report on the frequency of use as well as level of student participation in WebCT activities.

Focus group interviews were held to measure aspects like impact on learning style and time spent on the course. These aspects are difficult to indicate on questionnaires and therefore need to be determined by qualitative measures.

The analysis of this data, in terms of the hypotheses identified in Section 5.2, will be explained in Chapter 7.

C h a p t e r 7 Analysis of Results

7.1 Introduction

Chapter 6 reported on the data collected during and at the end of the research experiment. This chapter will describe the analysis of the results given in Chapter 6. Where applicable, quotes from the focus group interviews will be given in italics.

7.2 Learning Parameters

Since the overall goal of the project was to investigate the use of E-learning to support IT education at UPE, several parameters were investigated to determine the success of the project. These parameters were described in the research hypotheses given in Section 5.2.

7.2.1 Impact on Student Performance ($H_{2.1}$)

For the EUC group the marks of the control and experimental groups (n=61 for both groups) were compared. In order to compare the groups, the progress percentage between the first semester and second semester marks was calculated, and this percentage was used for further analysis by means of a t-test. As explained in Section 6.3, some students were not allowed to write the second semester examination. It was not possible, however, to compare the results in the individual strata (e.g. 50 – 59 range), since the resulting sample sizes were too small to indicate possible significance (For the different strata, the initial sample sizes were: n = 29, n = 21, n = 8 and n = 3 respectively) (Berenson and Levine 1999).

In the experimental group, marks had to be predicted for 26 students (42%), while only 19 students (31%) in the control group were not allowed to write the exam. Two possible reasons exist for this, namely unsatisfactory performance during the course, as well as the fact that students might have cancelled the course. It is therefore possible that the dropout rate was increased due to the use of E-learning.

The result of the t-test, shown in Table 7.1, does not indicate a significant difference between the progress of the control and experimental groups. The control group had a mean of 9.9% less in the second semester, while the experimental group had a mean of 10.7% less. This leads us to

conclude that using an E-learning environment does not affect student performance, and to reject hypothesis $H_{2.1}$.

Variable	Mean Control (n = 42) (Std. Dev. 8.102)	Mean Experimental (n = 35) (Std.Dev. 8.954)	t-value	p
Progress %	-9.9	-10.7	0.445	0.657

Table 7.1: EUC student performance

The HCI group (n=23) showed a significant increase in final marks (Table 7.2). In June 2001 they obtained a mean mark of 56.6%, while in November 2001, the mean was 67.3%. Even though this seems very positive, this increase might be due to other factors as well. Because of the small sample size, the significance cannot be statistically accepted (Berenson and Levine 1999). Table 7.2 is therefore included only as anecdotal information, but no conclusions should be made from the contents of this table.

MeanSem 1 (Std.Dev. 6.5)	Mean Sem 2 (Std.Dev. 11.6)	t-value	p
56.6	67.3	-3.839	0.000391

Table 7.2: HCI student performance (n = 23)

7.2.2 Degree of Student Collaboration ($H_{2.2}$)

In an on-campus only situation, both groups of students did not really see the need for using asynchronous communication tools, as they were in daily contact with each other, and therefore preferred to use verbal communication. Some students indicated that they preferred to work in a group, while others did not, but the E-learning environment did not have an effect on their preference or style. This leads us to reject hypothesis $H_{2.2}$, since the degree of student collaboration did not increase.

As a possible oversight by the instructor, no specific group tasks were created in the weekly assignments. In this case, students might have been forced to work together, but they might still have done so off-line, rather than on-line.

7.2.3 User Satisfaction

Satisfaction with the learning environment ($H_{2.3}$)

The overall satisfaction of the EUC students was determined at a top level, by looking at the means per section. This is shown in Figure 7.1. The detailed results can be found in Appendix F. The results indicate that the students were very satisfied with the system display (mean = 3.96), as well as the specific tasks in WebCT (mean = 3.93), but were less positive about their overall reactions (mean = 3.35).

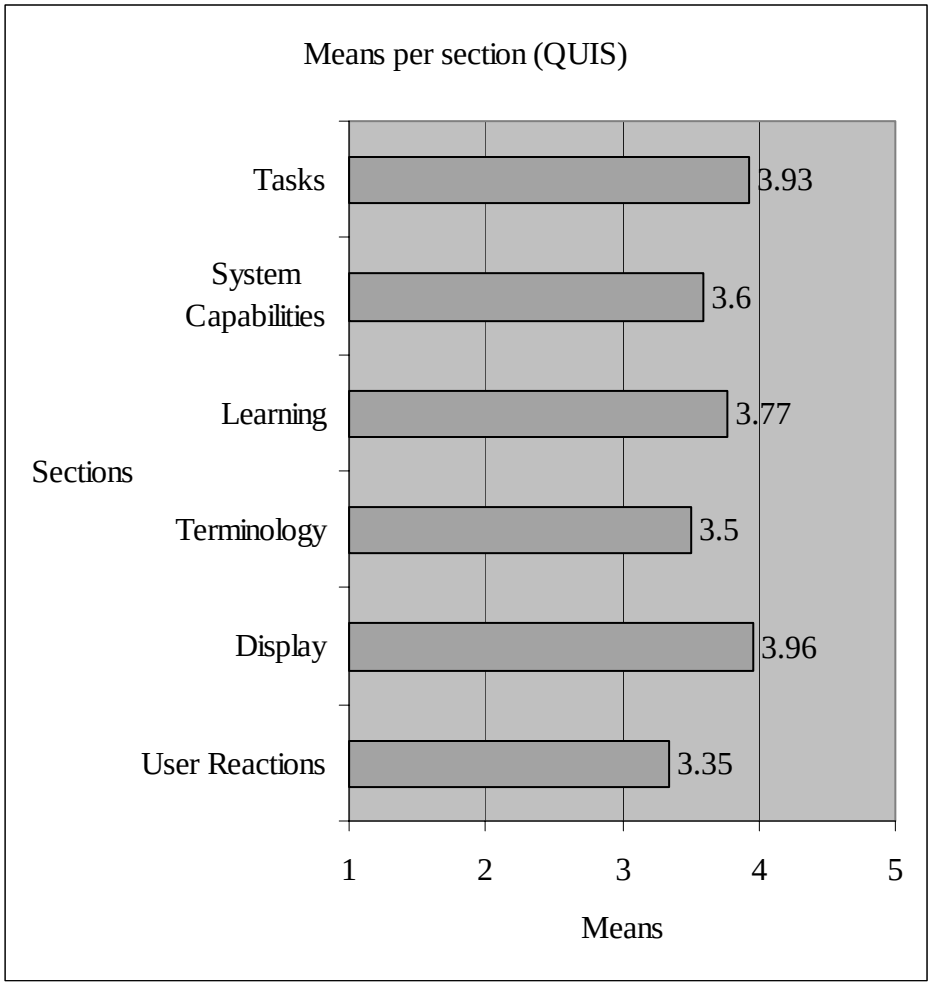

Figure 7.1: Top-level analysis of user-interaction satisfaction (EUC group)

The results of the questionnaire for user interaction satisfaction (Appendix F) were used to identify the strengths and weaknesses of WebCT. Table 7.3 indicates the 5 best and 5 worst features of the system, based on the mean ratings. As can be seen in Table 7.3, the students found

WebCT easy to use and the screens easy to read. However, they did not feel very positive about WebCT, and found it dull and frustrating.

The five best features of the system	Mean	Std.Dev.
Completing a quiz: Often used	4.55	0.89
Characters on the computer screen: Easy to read	4.47	0.92
Reading discussion topics: Always worked	4.45	0.74
Reading e-mail messages: Easy to do	4.43	1.00
Completing a quiz: Easy to do	4.42	0.81
The five worst features of the system	**Mean**	**Std.Dev.**
Error messages clarify the problem: Never	2.97	1.27
Submitting assignment answers: Gave problems	3.09	1.15
Overall reactions to the system: Dull	3.13	1.13
Overall reactions to the system: Inadequate power	3.13	0.90
Overall reactions to the system: Frustrating	3.19	1.05

Table 7.3: Five best and five worst features of WebCT (EUC group)

To determine the satisfaction of the users at a more detailed level, the QUIS data was analysed using Chi^2 analysis and t-tests. From the initial group of 61, 32 students completed the questionnaire. These respondents were divided into two groups, based on the time they spent per week on WebCT. The one group spent less than one hour per week, while the other group spent between one and four hours per week.

Chi^2 analysis was done on all the questions of the questionnaire to determine whether the students indicated a significant positive or negative response. This was done for all the respondents together, as well as for the two groups separately. The results were very similar to the results obtained from looking at the mean ratings, for both the sections as well as the issues indicated in Table 7.3. When the questionnaires of the two groups of respondents were analysed by means of t-tests, some significant differences were found (Table 7.4).

Group 1: 0 – 1 hour per week (n = 17) **Group 2: 1 – 4 hours per week (n = 15)**					
Question	**Topic**	**Group 1**	**Group 2**	**t-value**	**p**
8.1.4	Consulting Syllabus	2.62	3.42	-2.08	0.046
8.2.4	Reading material online	2.71	3.71	-2.08	0.046
8.10.1	Posting Discussion Topics: Easy	3.53	4.66	-2.94	0.006
8.10.2	Posting Discussion Topics: Always worked	3.57	4.57	-2.42	0.022
8.10.4	Posting Discussion Topics: Often used	2.53	3.85	-2.40	0.023
8.11.2	Reading Discussion Topics: Easy	4.13	4.78	-2.62	0.014
8.11.4	Reading Discussion Topics: Always worked	3.00	4.14	-2.49	0.018

Table 7.4: Significant differences between EUC groups based on frequency of use

The questions given in Table 7.4 were the only ones where there were significant differences between the responses of the two groups. The first two questions referred to Consulting the syllabus (Question 8.1.4) and Reading study material on-line (Question 8.2.4). Group 1 seldom used these features, while group 2 used these more regularly. Question 8.10 referred to the Posting of discussion topics. Here the respondents in group 1 indicated that this was difficult to do, that it gave problems, and that they seldom used it. Group 2 had a more positive response. Lastly Question 8.11 referred to the Reading of discussion topics. Group 1 indicated that this was difficult to do and that it gave problems, while group 2 said that it was easy to do and always worked. The focus group interviews also highlighted the problem of uploading of answer files to assignments, which sometimes did not work correctly, and did not give adequate feedback.

Figure 7.2 illustrates that the user reactions for students in group 2 (who used WebCT more), were more positive than those of students in group 1. The satisfaction of students regarding completing tasks in WebCT can be seen in Figure 7.3, which confirms that there was a definite correlation between frequency of use and overall user reaction and level of difficulty experienced with WebCT. In the box and whisker plots, the central point indicates central tendency, the box indicates variability around this central tendency and the whiskers indicates the range of the variable.

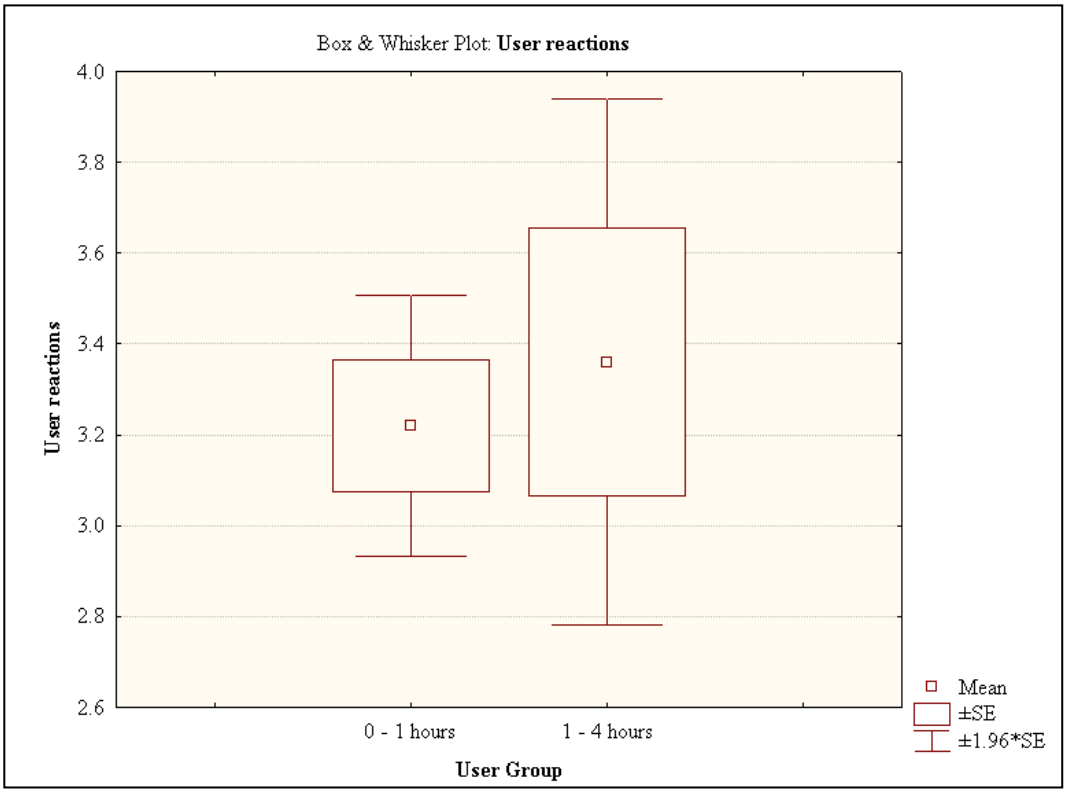

Figure 7.2: Overall user reaction with regard to WebCT (EUC course).

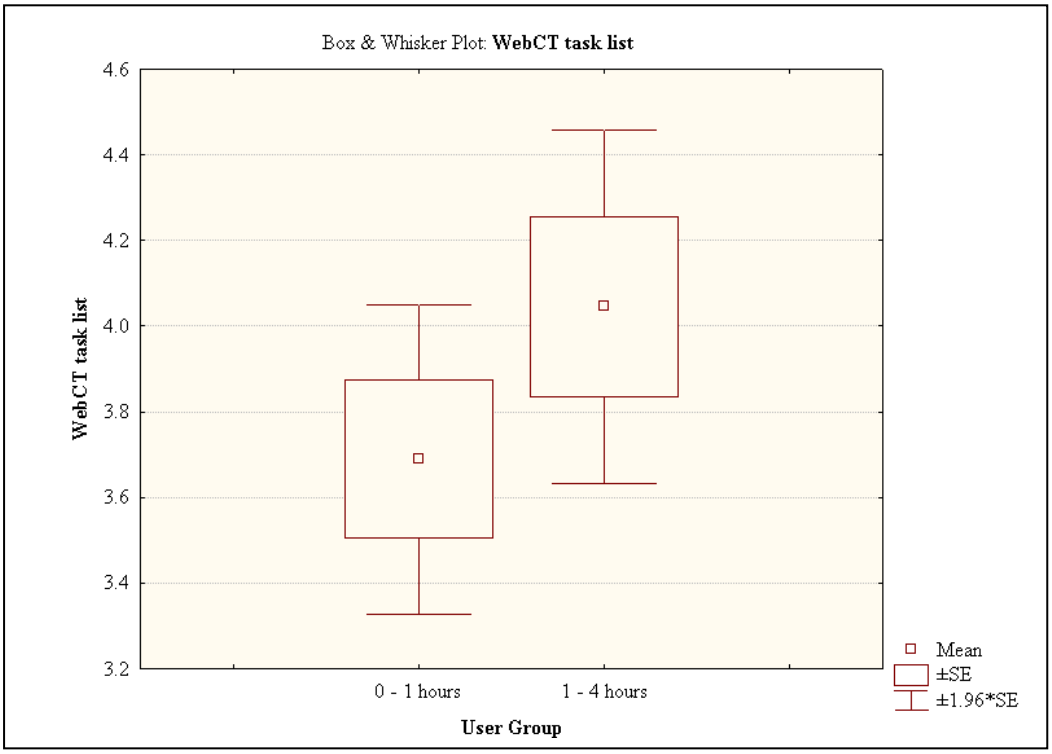

Figure 7.3: Satisfaction of students in group 1 and group 2 with WebCT tasks (EUC course).

From Table 7.3 and Figure 7.1, it can be seen that there appears to be no severe usability problems with WebCT. In the focus group interviews, the HCI group was very positive about the quizzes and the fact that they could get immediate feedback. They also said that because WebCT enforced due dates for assignments and quizzes, it meant that they had to keep up to date.

About the software accessibility (Section 5.3.3.), both groups of students said:

"Yes, I would very much like if one could have remote access."

"I agree, so you could go home and work on your computer."

Course Satisfaction ($H_{2.3}$)

As indicated in Chapter 6, information was collected from all the EUC students, but their course evaluation questionnaires were filled in anonymously (Section 6.4). The following positive comment came from the open-ended questions:

"The fact that I did WebCT made the course more interesting and better."

For the question on "How could the course be improved" the following comments were given:

"Letting all the lecture groups work on WebCT."
"Encouraging more students to join WebCT."

One student even wrote:

"Giving more tasks, for the week, so students can be more familiar with WebCT."

From this we can accept $H_{2.3}$, and state that the E-learning environment had a positive effect on the students' satisfaction with the course.

7.2.4 Effect on Attendance ($H_{2.4}$)

A number of EUC students stated that, by making attendance to the contact sessions voluntary, they were inclined to skip them.

"No, as soon as they made it optional. They have to make it compulsory."

In the HCI class, students seem to have a greater realisation of the importance of the contact sessions, and even though they sometimes skipped a session, they would usually be there.

"Because it's not so much a lecture, it's more participation, it is to your benefit definitely to go because you get the information that you need to properly prepare your assignment before you upload it, but you probably could get away with it."

It is therefore difficult to accept or reject $H_{2.4}$, as different results were found with the EUC and HCI groups.

7.2.5 Effect on Learning Style ($H_{2.5}$)

Both groups of students indicated that using WebCT did not have an impact on their learning style.

> *"It did not change my learning style, but changed the nature of the lectures, and by changing the lectures, it added value. It became participative."*

From this, we can therefore reject $H_{2.5}$. It is possible, however, that students might not be aware of changes in their learning styles.

7.2.6 Effect on Time Spent by Students ($H_{2.6}$) and Effect on Preparation ($H_{2.7}$)

It was very difficult to separate these two issues in the analysis of the data, and therefore they are discussed together. The EUC students said that most of them probably spent the same amount of time or less, some admitting that they guessed their way though the preparation exercises, and would then attend the contact session. Because of the lack of preparation, however, they would not necessarily understand all of the aspects of the lecture content.

> *"Less, far less, that is why I concentrate more on my lessons and applications, at the moment"*

> "*In the past, yes, when you used to go to the lecture, then you come home, and you go over what they did, it is more like a theory study of it, where you make notes and everything. Now it is more practical, and there is nothing that you can actually look at and remember."*

The HCI group felt that they had to spend more time on the course than in the first semester, because the JITT methodology expects preparation from students.

> *"Little quizzes on-line sort of made you actually go and read your work, read through the assignment work, through the lecture notes and do the assignment. It made you do a bit more."*

> *"Definitely up the amount of time I spent on HCI, but online time is still very limited. It's basically the prep off-line and do the work and then just go online for those couple of minutes to do the test."*

It is therefore difficult to decide whether to accept or reject $H_{2.6}$ and $H_{2.7}$ as different results were found with the EUC and HCI groups.

7.2.7 Resource Implications

Instructor skills and knowledge needed ($H_{2.8}$)

The designers of a WebCT learning environment do not need HTML knowledge, as learning material can be created in web authoring software, and then uploaded to the server. All the components needed in the E-learning environment can be created by selecting these from menus, or working through wizards. It is therefore possible to reject $H_{2.8}$, provided that instructors already possess sufficient levels of computer literacy.

Total time spent by instructors ($H_{2.9}$)

From a lecturer point of view, considerable time was required to create and maintain the E-learning environment in WebCT. To create the E-learning environment with the necessary course material for both courses took approximately one month's intensive work. This may be because the WebCT environment was new to the lecturers, and we had to determine the best way to do things. The weekly maintenance was much less, but because of the use of the JITT methodology the instructors would easily spend at least four hours each per week setting up the assignment tasks and quiz questions. In addition, four to six hours of marking were involved each week, since feedback forms one of the cornerstones of the JITT methodology. Making use of tutors for the marking of assignments could lessen this impact. It is also possible that once an E-learning environment, with study material, quizzes and assignments, has been created for a specific course, it could reduce the time requirements in the future. From these results, however, $H_{2.9}$ must be accepted in that the time spent by the instructor will initially be increased.

7.2.8 Level of Participation

Quantitative data exists here only for the EUC groups, and the results are given below. Both groups consisted of 61 students, as explained in Section 5.3.2.

Student Performance ($H_{3.1}$)

For both the experimental and control EUC groups, attendance registers were signed in the contact sessions. The experimental group knew that the contact sessions were voluntary, and that the attendance registers were just for record keeping. In the case of the experimental group, WebCT recorded their marks for the assignments and quizzes that they submitted. These marks were used to determine the submission percentage (mean percentage obtained for assignments

and quizzes submitted). When comparing (with t-tests) the attendance percentage with the final mark of the students, the following results were found.

There was a significant difference between the submission percentage and the final marks, with the mean submission percentage for the experimental group being 24.2%, and the mean final mark being 43.8% (see Table 7.5). There was no significant difference between the attendance percentage and the final mark. The mean attendance percentage was 50.8 %, with the mean final mark being 43.8% (Table 7.6). The significant difference between the mean submission percentage and the mean final mark may be the result of the students' attitude as supported by the following statement:

> *"The easy part was the multiple choice. Yes, because you did not even think what the answer was, you just put anything down, and you submit it."*

Mean submission %	Mean final mark	t-value	p
24.2	43.8	-5.719	0.000

Table 7.5: T-test for experimental group (submission % vs. final mark)

Mean attendance %	Mean final mark	t-value	p
50.8	43.8	1.403	0.163

Table 7.6: T-test for experimental group (attendance % vs. final mark)

For the control group, the mean attendance percentage was 71.8% with a mean final mark of 47% (Table 7.7). This represents a significant difference, indicating that just attending contact sessions, did not really influence final marks.

Mean attendance %	Mean final mark	t-value	p
71.8	47.0	7.000	0.000

Table 7.7: T-test for control group (attendance % vs. final mark)

There was a significant difference between the attendance percentage of the experimental and control groups (Table 7.8). This could be expected, however, because of the fact that contact sessions were compulsory for the control group. The mean attendance percentage was 71.8 % for the control group, and 50.8 % for the experimental group.

Mean attendance% (control group)	Mean attendance% (experimental group)	t-value	p
71.8	50.8	3.896	0.000

Table 7.8: T-test for EUC groups (attendance %)

From these results, $H_{3.1}$ can be rejected, indicating that the level of participation did not influence student performance.

User Satisfaction ($H_{3.2}$)

As indicated in Table 7.4, students who spent between one to four hours per week on the system were more positive than those students who spent less than one hour per week. The students who spent more time on the system, felt that certain tasks were easy to do, while the other students complained that these tasks were difficult to do, and gave problems. This leads us to accept $H_{3.2}$, i.e. that the level of participation of the students does have a positive effect on the level of user satisfaction.

7.3 Conclusions

The analysis of the experimental results discussed in this chapter showed that it was possible to accept the following hypotheses: $H_{2.3}$, $H_{2.9}$ and $H_{3.2}$. This implies that the use of an E-learning environment had an effect on student satisfaction, time spent by instructors and that the level of participation influenced user satisfaction. The hypotheses that were rejected were: $H_{2.1}$, $H_{2.2}$, $H_{2.5}$, $H_{2.8}$ and $H_{3.1}$. We can therefore conclude that using the E-learning environment did not have an effect on student performance, student collaboration, learning style and instructor skills and knowledge needed.

It was not possible to accept or reject $H_{2.4}$, $H_{2.6}$ or $H_{2.7}$, as the two groups of students indicated different results. These hypotheses related to student attendance, student time spent on course work and student's level of preparation. It may be conjectured, however, that the reason for this was that the postgraduate students were more motivated and willing to do preparation, while the first-year students did the minimum amount of work that they could.

Chapter 8 Conclusions

8.1 Introduction

The goal of this research project was to investigate the use of E-learning to support IT education at UPE. This chapter will highlight the achievements of the project and report on the hypotheses. It will further identify the problems encountered throughout the project and finally it will discuss research ideas which flow from this project and might warrant further investigation.

8.2 Achievements

A literature survey was done to determine the definition, components and possible benefits of E-learning (Chapter 2). Different methods and important issues to consider when evaluating E-learning were investigated. A literature review, review of several HE institutions' web sites in South Africa and personal communication were used to determine the current E-learning situation in South Africa (Section 2.5). A draft framework for E-learning was created and circulated to academics in Southern Africa in order to validate this framework (Chapter 3).

The framework for E-learning was created to provide a checklist which could be used to determine whether software supports the essential components required for an E-learning environment. The framework identifies the essential, important and critical components of an E-learning environment (Section 3.4, Table 3.3 and Table 3.4).

Two examples of Course Management Software were identified as possible tools with which an E-learning environment could be created. These tools were compared using two different methods. The methods used were a heuristic evaluation (Section 4.3) and a comparison of available features (Section 4.4) and cost (Section 4.5). Based on this evaluation, WebCT was selected as the most suitable tool to create an E-learning environment at UPE. Experimental design was used to design and implement an experiment to determine the impact of using E-learning to support IT education at UPE. In order to do this, several hypotheses were constructed and evaluated (Section 5.2). These hypotheses are repeated in Table 8.1, together with an indication of whether they were accepted, rejected or not determined.

Research Hypothesis		Result
H_0:	An E-learning environment cannot be used to support IT education at a tertiary level (null hypothesis)	Rejected
H_1:	Course Management Software can be used to create an E-learning environment for IT students at UPE	Accepted
H_2:	Using a E-learning environment will have an effect on:	
	$H_{2.1}$: Student performance	Rejected
	$H_{2.2}$: Student collaboration	Rejected
	$H_{2.3}$: Student satisfaction	Accepted
	$H_{2.4}$: Student attendance	?
	$H_{2.5}$: Learning style	Rejected
	$H_{2.6}$: Student time spent on course work	?
	$H_{2.7}$: Student's level of preparation	?
	$H_{2.8}$: Instructor skills and knowledge needed	Rejected
	$H_{2.9}$: Total time spent by instructors	Accepted
H_3:	The level of participation of students in an E-learning environment will have an effect on:	
	$H_{3.1}$: Student performance	Rejected
	$H_{3.2}$: User satisfaction	Accepted

Table 8.1: Research Hypotheses Results

Courses were presented to two different groups of IT students (one undergraduate and one postgraduate) using the E-learning environment during the second semester of 2001. The Just-in-Time-Teaching (JITT) methodology was followed with both groups of students (Section 5.3.2). The JITT methodology consists of a carefully orchestrated blend of learning activities, combining contact sessions and E-learning. Students performed some of these activities at their own pace and in their own time. The preparatory exercises were delivered via the E-learning environment and the classroom activities were closely linked to the preparatory activities. A control group was created for the EUC (undergraduate course) experimental group (Section 5.3.2). Because of the nature of the HCI (postgraduate course) it was not possible to create a control group for this course. Data was collected during and after the duration of these courses (Section 5.3.8).

WebCT recorded the marks obtained by students for quizzes and assignments as well as the history of pages visited and discussion threads (Section 6.2). Course marks were determined for all students (Section 6.3). The students in the EUC course completed a course evaluation questionnaire, which was used to determine students' satisfaction with the course (Section 6.4). The EUC experimental group completed a questionnaire for user interaction satisfaction in order to give feedback on the use of WebCT (Section 6.5). Focus group interviews were held with both groups, in order to gain more information (Section 6.6).

The data collected was analysed (Chapter 7). Based on this analysis some hypotheses were accepted, some rejected and some could not be accepted or rejected (Table 8.1). The use of an E-learning environment was determined to have an effect on student satisfaction, time spent by instructors and the level of participation influenced user satisfaction ($H_{2.3}$, $H_{2.9}$ and $H_{3.2}$ were accepted). The E-learning environment did not have an effect on student performance, student collaboration, learning style and instructor skills and knowledge needed ($H_{2.1}$, $H_{2.2}$, $H_{2.5,}$ $H_{2.8}$ and $H_{3.1}$ were rejected). Since different results were obtained from the two groups, it was not possible to accept or reject some of the hypotheses ($H_{2.4}$, $H_{2.6}$ and $H_{2.7}$). These hypotheses related to student attendance, student time spent on course work and student's level of preparation.

8.3 Problems Encountered

Problems were encountered with implementing WebCT, as no manuals were available with the software. Manuals were then bought from another company, but these were still in the development stage (for version 3.0), and were not necessarily available when needed.

From a lecturer point of view, considerable human resources were required to create and maintain the E-learning environment in WebCT (Section 7.2.8). This may be because the WebCT environment was new to the lecturers, and we had to determine the best methods to use. It may also be because of the use of the JITT methodology, since due dates and feedback to students were very important. Making use of tutors for the marking of assignments could lessen this impact. It is also possible that once an E-learning environment, with study material, quizzes and assignments, has been created for a specific course, it could reduce the time requirements in the future.

Instructors and students had to be logged on to the department's network to use WebCT, because of the problems with the firewall (Section 5.3.4). This was not always convenient. The HCI group stated that they would have liked to be able to have off-campus access to WebCT (Section 7.2.3). In an off-campus situation, students may want to communicate with one another and with the lecturer asynchronously, which could drastically improve the perceived benefit of E-learning to the student.

The cost implications of continuing this research was a problem, since the WebCT licensing fees were increased drastically, and it would have cost about R16 000 for 100 licences in 2002.

8.4 Future Research

The E-learning framework developed in Chapter 3 can be used to determine the suitability of software for creating an E-learning environment (Table 3.3). If a HE institution wants to create their own software, the framework could also be used as a checklist to ensure that all the essential and critical components are incorporated.

Some authors maintain that E-learning has a positive affect on student performance. This was not evident in this study at UPE. Even though this study showed that the use of E-learning did not have an effect (positive or negative) on the performance of students, this may be due to the hybrid E-learning approach followed. A no contact teaching approach might give a significantly different result.

There seemed to be a difference in opinion between the HCI (postgraduate) and EUC (first year) students, particularly in the areas of attendance, time spent and preparation (Section 7.2). This may be because the selected first year course is seen as less important (students are compelled by most curricula to pass this course). It would be interesting to obtain the opinions of second or third year students, who should be more motivated than the first year students. The perceived importance of a course may influence the amount of preparation that students are willing to do. Alternatively, first year students may not be ready for the JITT methodology (Section 5.3.2), but maybe another E-learning methodology could be used successfully instead. An investigation into using alternate E-learning methodologies could be done.

This project has investigated the impact of E-learning on several factors (Section 5.2). An investigation into additional factors could be done, in order to more fully determine the impact of E-learning. This might include obtaining a separate phone line and server, and providing remote access to the E-learning environment (Section 5.3.4). This, together with the incorporation of some group projects, might give a different response to the use of the CMC component of an E-learning environment.

E-learning could also be introduced in other departments at UPE, as it might be very suitable for use in other subjects.

With new versions of software constantly being developed, other examples of CMS could be more appropriate than WebCT. An investigation into different software packages available to create E-learning environments could also be conducted.

Finally, the evaluation measures used in this research project might need adjustment or refinement. It might even be that some additional measures should also be used. For example, teacher satisfaction was never evaluated in this research experiment.

8.5 Conclusions

E-learning can be used to support traditional IT education at UPE at both undergraduate and postgraduate level (Section 7.2). WebCT can be used successfully to create an E-learning environment for IT education in a university (Section 7.3). WebCT was a good choice to create the E-learning environment, since the heuristic and empirical evaluations revealed no severe usability problems (Section 7.2.3). It is necessary, however, to ensure that students are sufficiently computer literate, and are familiar with the browser paradigm.

Positive effects of E-learning included an increase in student satisfaction (Section 7.2.3). No significant negative effects were determined. Several additional benefits also exist, for example, it is possible to give students immediate feedback (e.g. the quizzes). The JITT methodology can be used to ensure that lecture content is based on answers to questions provided by students and that lecture time is specifically focussed on problem areas.

We can conclude therefore that using E-learning as a support tool for IT education has more advantages than disadvantages. E-learning provides students and lecturers with more freedom, promotes active learning, while not losing the social interaction from contact sessions (Appendix G.2). It can be used to support IT education in a traditional university environment, but experienced users may find it dull. It is important to include motivational aspects like online quizzes and assignments in the learning environment (Section 7.2.3).

References

ABRAMS, G. and HAEFNER, J. (2002): Blending Online and Traditional Instruction in the Mathematics Classroom. *Technology Source* **2002**(September/October 2002) http://ts.mivu.org/default.asp

ALESSI, S.M. and TROLLIP, S.R. (2001): *Multimedia for Learning. Methods and Development.* Third Edn, Allyn & Bacon.

ALLEN, M. (1998): To be or not to be? Questions of computer-mediated learning and distance education. http://www.curtin.edu.au/learn/DSM/examples/4.html

ALLEN, R. (1998): The Web: interactive and multimedia education. *Computer Networks and ISDN Systems* **30**:1717 - 1727.1998.

BERENSON, M.L. and LEVINE, D.M. (1999): *Basic Business Statistics. Concepts and Applications.* New Jersey, Seventh Edition Edn, Prentice-Hall, Inc.

BLOOM, B.S. (1972): *Taxonomy of Educational Objectives.* London, Longman.

BROADBENT, B. (2000): Championing e-Learning. **2002**(22 April 2002). http://www.e-learninghub.com/championing.html

BROERE, I., GEYSER, H.C. and KRUGER, M. (2002): The Introduction of Multi-Modal Education: A Strategy in Process. *Proc. South African Association for Research and Development in Higher Education Congress.*, Cape Town, South Africa.8 - 10 July 2002.

BROOMES CONSULTING, I. (ed) (2001): *The Teaching Space: e-Learning and Distant Education* **2001**, Broomes Consulting, Inc. http://www.TeachingSpace.com.

CALITZ, A.P., TALJAARD, M. (2000): An Investigation into the use of Multimedia Technologies to Develop a Virtual Classroom. *Proc. CITTE'2000*, Port Elizabeth.28-30 June 2000. http://www.upe.ac.za/citte2000/papers.asp

CERVINO, D.J. (1997): The Virtual Classroom. **2000**(31 May 2000). http://www.ils.unc.edu/disted/distint.html

DEBOURGH, G.A. (2002): Simple Elegance: Course Management Systems As Pedagogical Infrastructure to Enhance Science Learning. *Technology Source*(May/June 2002) http://ts.mivu.org/default.asp

DENZIN, N., K and LINCOLN, Y., S (eds) (1998a): *Collecting and Interpreting Qualutative Materials.*, Sage Publications, Inc.

DENZIN, N., K and LINCOLN, Y., S (1998b): *The Landscape of Qualitative Research. Theories and Issues.* California, Sage Publications, Inc.

DIX, A., FINLAY, J., ABOWD, G., BEALE, R. (1998): *Human-Computer Interaction.* Europe, Second Edition Edn, Prentice Hall.

DRINGUS, L.P. (2002): From Both Sides Now. *ELearn Magazine: Education and Technology in Perspective.* http://elearnmag.org

DRYSDALE, E. (2002): Challenges in implementing E-learning. *Proc. International Conference on Technology and Education (ICTE Africa) 2002*, Potchefstroom, South Africa.,

EDELSON, P. (2001): E-learning in the USA: the storm after the storm. *Proc. Annual conference of the University Association for Continuing Education.*, Glasgow, Scotland.9 - 11 April 2001.

EIFFEL-INC.COM (2000): *Activate Course Design.*

EU (1997): European Employment Strategy. **2003**. http://europa.eu.int/comm/employment_social/employment_strategy/index_en.htm

FAULKNER, X. (2000): *Usability Engeneering*. MacMillan Press Ltd.

FELDSTEIN, M. (2002a): What is "Usable" E-learning? *E-learn Magazine*. http://www.elearnmag.org

FELDSTEIN, M. (2002b): What's Important in a Learning Content Management System? *ELearn Magazine: Education and Technology in Perspective.* http://elearnmag.org

FORMAN, D., NYATANGA, L. and RICH, T. (2002): E-learning and Educational Diversity. *Nurse Education Today*(22):76 - 82

FURNELL, S., EVANS, M., PHIPPEN, A.D. and ABU-RGHEFFI, M.N.A. (1999): Online Distance Learning: Expectations, Requirements and Barriers. **2000**(11 May 2000). http://www.fae.plym.ac.uk/tele/odl-1.html

GAL-EZER, J. and LUPO, D. (2002): Integrating internet tools into traditional CS distance education: students' attitudes. *Computers and Education* **38**:319 - 329.2002.

GOVINDASAMY, T. (2002): Successful implementation of E-learning. Pedagogical considerations. *Internet and Higher Education* **4**:287 - 299.2002.

HANNAFIN, M.J. (1989): Interaction Strategies and Emerging Instructionaltechnologies: Psychological perspectives. *Canadian Journal of Educational Communication* **18**(3):167 - 179

HENKE, H. (1997): Evaluating Web-Based Instructional Design.

HORTON, W. (2000): *Designing Web-Based Training*. John Wiley & Sons.

ISO9241 (1997): ISO 9241-1: Ergonomic requirements for office work with visual display terminals.

KEATS, D. (2000): Lessons from three years of online learning: moving from supplemental resources to generic software. *Proc. SATNAC'2000 3rd Annual South African Telecommunications Networks Applications Conference*, Somerset West, South Africa.11 to 13 September 2000.

KING, F.B. (2002): A virtual student. Not an ordinary Joe. *Internet and Higher Education* **5**:157 - 166.2002.

KIRKPATRICK, D. (1998): *Evaluating Training Programs: The four levels.* San Francisco, Berrett-Kohler.

LE ROUX, I. (2002): E-learning at the University of Pretoria. Has the Plateau of Productivity been reached. *Proc. Conference of Communication and Information Technology in Tertiary Education (CITTE 2002)*, Durban, South Africa.25 - 27 September 2002.

MARTIN, M. and TAYLOR, S.A. (1997): The Virtual Classroom: The next steps. *Educational Technology*(September-October 1997)

MASIE, E. (1999a): Special Report: Learning Portal Watching Guide. **2002**(2002/04/25). http://www.masie.com/masie/default.cfm

MASIE, E. (1999b): Special Report: The "e" in e-learning stands for "E"xperience. **2002**(2002/04/25). http://www.masie.com/masie/default.cfm

MASIE, E. (2002): Elliot Masie's TechLearn Trends #232. **2002**(2002/04/25). http://www.masie.com/masie/default.cfm

MAY, K. (2000): E-learning: Improving Quality through Assessment and Evaluation. **2002**. http://www.eduport.com/community/kiosk/20004/eval.htm

MCLEAN, M. and JACKSON, C. (2002): Implementing WebCT in a new Problem-based Learning Curriculum: From buffet to a la carte. *Proc. Conference of Communication and Information Technology in Tertiary Education (CITTE 2002)*, Durban, South Africa.25 - 27 September.

MEHLENBACHER, B., MILLER, C.R., COVINGTON, D. and LARSEN, J.S. (2000): Active and Interactive Learning Online: A Comparison of Web-based and Conventional writing classes. *IEEE Transactions of Professional Communication* **43**(2):166-184

MILNER-BOLOTIN, M. and SVINICKI, M.D. (2001): Using Online Resources to Promote Active Learning in Physics Teaching. *Technology Source*(November/December 2001) http://ts.mivu.org/default.asp

MÖLLER, J.J. (2000): Reality Back in Virtuality. *Proc. CITTE'2000*, Port Elizabeth, South Africa.28 - 30 June 2000.

NCSA (2000): E-learning - A Review of Literature. University of Illinois at Urbana-Champaign.

NEWMAN, W.M. and LAMMING, M.G. (1995): *Interactive Systems Design*. Addison-Wesley.

NIELSEN, J. (1993): *Usability Engineering*. San Diego, Academic Press.

NIELSEN, J. (2002): Severity Ratings for Usability Problems. **2003**. http://www.useit.com/papers/heuristic/severityrating.html

NORMAN, K., SHNEIDERMAN, B., HARPER, B. (1995): QUIS: The Questionnaire for User Interaction Satisfaction. http://www.cs.umd.edu/hcil/quis/

NOVAK, G.M., PATTERSON, E.T., GAVRIN, A.D., CHRISTIAN, W. (1999): *Just-in-Time Teaching: Blending Active Learning with Web Technology.* New Jersey, Prentice-Hall.

OLIVER, R., OMARI, A.,HERRINGTON, J. (1997): Exploring Student Interactions in Collaborative world Wide Web Learning Environments. *Proc. Ed-Media 1997*.

PARLANGELI, O., MARCHIGIANI, E. and BAGNARA, S. (1999): Multimedia systems in distance education: effects of usability on learning. *Interacting with Computers* **12**:37 - 49.1999.

PRETORIUS, B. (2002): Implementation of a no-contact 1st yesr ICT course on the Varsite LMS. *Proc. Conference of Communication and Information Technology in Tertiary Education (CITTE 2002)*, Durban, South Africa.25 - 27 September 2002.

QUINN, A. (2001): Why People can't Use E-learning. (2002). http://infocentre.frontend.com

RAVAGLIA, R. (2001): The case for blending E-learning. *Education West*(August/September 2001):12,13.August/September 2001.

SALMON, G. (2000): *E-Moderating. The Key to Teaching and Learning Online.* London, Kogan Page Limited.

SHEREMETOV, L. and ARENAS, A.G. (2002): EVA: An Integrated Web-Based Collaborative Learning Environment. *Computers & Education.* **39**:161 - 182.2002.

SHNEIDERMAN, B. (1998): *Designing the User Interface: Strategies for Effective Human-Computer Interactions. Third edition.* Addison-Wesley.

SMULDERS, D. (2001): Web Course Usability. **2002**. http://www.learningcircuits.org/2001/aug2001/elearn.html

STOREY, M.A., PHILLIPS, B., MACZEWSKI, M. and WANG, M. (2000): Evaluating the Usability of Web-based Learning Tools. *Educational Technology & Society* **5**(3).4-5 May 2000.

TALJAARD, M., WESSON, J.L. (2000): An Effective Framework for Successfully Implementing a Virtual Classroom. *Proc. SATNAC'2000 3rd Annual South African Telecommunications Networks Applications Conference*, Somerset West.11 to 13 September 2000.

TSAI, S. and MACHADO, P. (2002): E-learning, Online Learning, Web-based Learning, or Distance Learning. *ELearn Magazine: Education and Technology in Perspective.* http://elearnmag.org

VAN DER MERWE, A. (2002): Web-based E-learning as part of the E-campus Initiative. *Proc. Conference of Communication and Information Technology in Tertiary Education (CITTE 2002)*, Durban, South Africa.25 - 27 September 2002.

WESSON, J. (2002): Usability Evaluation of Web-based Learning: An Essential Ingredient for Success. *Proc. World Computer Congress (WCC) 2002: Stream 3: Tele-Learning*, Montreal, Canada.25 - 30 August 2002.

WHEELER, S. and MAGEE, R. (1999): Distance education & convergent technologies: the Internet and World Wide Web. **2000**(11 May 2000). http://www.fae.plym.ac.uk/tele/bcs4.html

Appendices

Appendix A E-learning Framework Survey

1. Goal

To gather information to refine the E-learning environment framework, to get an indication of the relative importance of the issues named in the framework and to get a subjective indication of the usability of software tools.

2. Biographical Data

2.1 Please indicate the type of institution where you work.

University 1	Technikon 2	☐ 1

2.2 What is the name of your institution? _____ ☐ 2

2.3 What is the name of your Department / School / Unit? _____ ☐ 3

2.4 What is your professional position? (e.g. Lecturer) _____ ☐ 4

2.5 Please select the years you have been involved in virtual classrooms?

0 – 1 1	2 – 5 2	6 – 10 3	+10 4	years ☐ 5

2.6 Please select the years you have been involved in development of web-based material.

0 – 1 1	2 – 5 2	6 – 10 3	+10 4	years ☐ 6

3. Are you currently involved in / planning to be involved in E-learning?

Yes 1	No 2	☐ 7

4. **If yes, which tool was / will be used in the creation of the E-learning environment?**

WebCt 1	TopClass 2	In house program 3	Other: 4	_____ ☐ 8

5. **Why was that particular tool selected?**

_____

_____ ☐ 9

6. **For what subject do you have your E-learning environment?**

_____ ☐ 10

7. **What year level students do you have using your E-learning environment?**

_____ ☐ 11

8. **How would you describe the average computer literacy level of your students?**

None 1	Basic 2	Intermediate 3	Advanced 4

☐ 8

9. **List the advantages you have observed (or any thoughts you might have) in the use of an E-learning environment.**

_____

_____

_____

_____ ☐ 12

10. List the disadvantages you have observed (or any thoughts you might have) in the use of an E-learning environment.

_____

_____

_____ ☐ 13

11. **Framework components / features of an E-learning environment**

Please indicate whether you think each aspect is ***Not required, Optional*** *or* ***Essential*** *for an E-learning environment, by clicking on the relevant option. If it is a* nice-to-know *but not a* necessary *aspect– select the* ***Not required*** *option. If you are* ***Unsure****, please indicate that in the last option.*

A Learning Environment	Not required	Optional	Essential	Unsure	
1. Access to course material					☐14
Keyword search					☐15
Course download / off-line working					☐16
Course can be printed					☐17
CD-ROM support					☐18
Ergonomic user interface (easy to use)					☐19
2. Private space and customisation					
Student can make private annotations of course material					☐20
Student can make bookmarks					☐21
Individual choice of learning sequence					☐22
Interrupt and resume learning session					☐23
Username and password security					☐24
3. Asynchronous student-student communication					
One-to-one email					☐25
One-to-many email					☐26
Discussion forums					☐27
Teamwork tools (support for collaborative work)					☐28
File upload capability / submission of work					☐29
4. Synchronous student-student communication					
Chat room					☐30
Shared Whiteboard					☐31
5. Pedagogical tools / Student tools					
Quiz					☐32
Self-assessment					☐33
Progress tracking					☐34
B Author's environment / Support tools					
1. Production of Course Material					
No technical knowledge required to develop course material					☐35
Web interface for course development					☐36
Support to convert existing material					☐37
Multiple authors support					☐38
Index creation support					☐39

Glossary support					☐ 40
Ergonomic development interface (learnability)					☐ 41
Support for multimedia (graphics, video, sound)					☐ 42
2. Module management					
Course structure editor / course planning (learning modules and other resources can be managed and arranged in a flexible way)					☐ 43
Course managing (enables instructors to collect information from or about students)					
Course customizing					☐ 44
3. Quizzing features / Assessment					
No HTML knowledge required to develop quizzes					☐ 45
Quiz editor/manager included					☐ 46
Self-assessment (data not stored)					☐ 47
Multiple choice questions					☐ 48
Image map questions (graphics can be used in the questions)					☐ 49
Short Answer Questions					☐ 50
Essay Questions					☐ 51
Randomised and calculated questions					☐ 52
Actions based on test results					☐ 53
4. Data					
Marking on-line,					☐ 54
Managing records					☐ 55
Analysing and tracking					☐ 56
C Teacher's Environment / Pedagogical Tools					
1. General					
Multiple teachers support					☐ 57
2. Team working					
Teacher can set up group of students					☐ 58
Group file upload capability					☐ 59
3. Tutoring					
Asynchronous tutoring (i.e. by email)					☐ 60
Synchronous tutoring (i.e. Audio-, Videoconference)					☐ 61
Teachers can assign specific material to group of students					☐ 62
4. Course evaluation					
Trace of student's paths through modules					☐ 63
Statistical/graphical reports					☐ 64
Grade management					☐ 65

D Administration					
1. General					
Registration and follow-up of students					☐ 66
Management of student files					☐ 67
Access rights					☐ 68
Crash recovery					☐ 69
E Technical requirements					
1. Client platform					
Standard Web browser (entirely platform independent)					☐ 70
Win 9x, NT (software or plugins)					☐ 71
MacOS (software or plugins)					☐ 72
UNIX, Linux (software or plugins)					☐ 73
2. Server platform					
Win 9x, NT					☐ 74
UNIX, Linux					☐ 75
MacOS					☐ 76
F General Properties	**Not Important**	**Important**	**Critical**	**Unsure**	
1. Support					
Technical support (Student and Instructor Help desk)					☐ 77
Pedagogical support (Instructional design)					☐ 78
System documentation					☐ 79
2. Cost					
Start-up costs					☐ 80
On-going costs					☐ 81
Technical Support					☐ 82
3. Limitations of package					
Number of courses					☐ 83
Number of students					☐ 84

12. Rate the support provided by the tool in terms of the following criteria

	Bad	**Average**	**Good**	**Unsure**	
1. Functionality					☐ 85
2. Usability					
Ease of use (learnability)					☐ 86
Customer satisfaction					☐ 87
Effectiveness in meeting needs					☐ 88

13. How do students rate your E-learning environment?

Hard to use 1	Limited 2	Average 3	Excellent 4	☐ 89

14. **If you had to select a new tool to use to design an E-learning environment, how long would you be prepared to spend learning the tool?**

1-4 Hours 1	1 Day 2	Days 3	A week 4	☐ 90

15. How would you describe your level of computer literacy?

None 1	Basic 2	Intermediate 3	Advanced 4	☐ 91

16. How long would you be prepared to have your students spend learning how to use an E-learning environment?

1-4 Hours 1	1 Day 2	Days 3	A week 4	☐ 92

17. General Comments

Please add any further comments you may have regarding E-learning environment.

_____

_____

_____

_____ ☐ 90

18. Would you like to see the result of this research?

Yes	No
1	2

19. Submit

Please complete and submit the completed survey by **September 30, 2000.**

If you would like to contact me, please write, call or email me at:

Mrs M Taljaard
Department of Computer Science & Information Systems
University of Port Elizabeth
P O Box 1600
Port Elizabeth
6000

Queries: call (041) 504 2668 or email csamt@upe.ac.za

Thank you for your co-operation.

Appendix B EUC marks in Semester 2 2001

B.1 Control Group

	Semester 1	Semester 2		
St No	WRU101 Mark	Class Mark (Rounded)	Final Mark (Rounded)	Attendance %
199225257	53	43	41	10
200311042	59	52	45	70
201317443	57	48	51	90
197438560	50	23		30
198036950	53	77	59	60
201302934	59	55	61	70
200307576	54	43	53	90
201301547	57	62	55	90
199221669	57	11		30
199235635	55	57	55	100
200340859	59	41	41	60
200340565	55	44	41	70
201324032	55	47	47	70
201318121	57	45	40	100
201317176	52	28		90
200347888	55	25		40
201314592	55	29		100
200309749	52	33		80
200340557	50	18		80
199204292	56	23		70
201341697	55	30		70
201301768	56	36		100
201301946	54	51	40	70
201318962	58	35		40
201345536	55	50	39	100
200323113	50	28		60
201344912	56	46	50	80
199211329	54	6		40
200330330	55	30		90
201303086	68	58	69	100
200327097	65	49	60	20
201319896	69	73	72	100
201315386	62	46	52	70
199239789	62	23		30
201315327	66	58	51	90
200325914	64	31		50
201327740	63	48	50	70
199224285	60	34		70
201325020	64	45	52	70
201322382	66	50	43	90

St No	Semester 1	Semester 2		
	WRU101 Mark	Class Mark (Rounded)	Final Mark (Rounded)	Attendance %
200310038	66	62	59	40
201303795	69	56	59	60
200306588	63	57	52	50
201329328	68	53	65	100
201330172	64	48	34	80
201312166	66	53	42	100
201302128	69	51	52	100
200313584	62	12		50
201323575	68	72	58	70
200318551	63	45	52	70
201329077	75	21		50
201338882	76	66	64	80
201314428	73	72	71	70
201300508	72	47	52	70
201305232	72	67	67	90
201318806	72	63	71	70
201302969	73	61	58	100
201302594	71	62	56	60
201319462	87	92	90	80
201303612	88	73	75	100
201320622	80	51	61	80
Number of students (n)	**61**	**61**	**42**	**61**
Mean	**62.3%**	**46.1%**	**54.9%**	**71.8%**
Standard deviation	**8.7%**	**17.6%**	**11.5%**	**22.8%**

B.2 Experimental Group

	Semester 1	Semester 2			
St No	WRU101 mark	Class mark (Rounded)	Final mark (Rounded)	Attendance %	Mean Submission %
198438870	50	3		0	0%
198059650	50	40	52	70	29%
201319152	50	37		50	36%
199204462	50	0		30	6%
201338513	51	5		30	23%
199220093	51	33		0	0%
201341816	51	0		0	0%
201329220	52	40	53	10	0%
201319608	52	46	50	60	32%
199223718	53	0		0	0%
199212155	53	28		50	24%
200308300	53	24		70	10%
201319837	53	25		60	39%
198340110	54	37		0	0%
199234647	54	58	59	90	47%
200306812	54	24		0	0%
201314622	55	3		10	2%
201321238	56	33		60	17%
199240000	56	43	42	90	52%
200308165	56	17		0	0%
200310305	56	48	45	70	31%
198164090	56	15		0	0%
201315890	56	34		60	23%
200334727	57	49	42	60	15%
200320750	57	37		60	24%
201326108	58	40	45	90	22%
200302507	59	49	53	70	40%
199237085	59	10		0	0%
201339951	59	58	64	90	55%
201330539	60	50	54	0	0%
201320630	60	40	36	30	10%
200321749	60	44	45	70	15%
200324411	61	38		50	18%
199223904	61	35		100	30%
201318881	62	49	47	60	28%
201328429	62	53	61	50	40%
201300516	63	31		60	30%
199225850	63	16		10	0%
201342952	63	29		70	0%
199214360	63	63	63	0	0%
201300567	64	44	43	100	62%
201349973	64	40	51	60	20%

	Semester 1	Semester 2			
St No	WRU101 mark	Class mark (Rounded)	Final mark (Rounded)	Attendance %	Mean Submission %
201321084	65	61	51	80	45%
200324276	65	48	47	100	28%
200305646	65	40	41	10	1%
201313472	66	48	45	60	24%
201320460	66	58	59	90	38%
201317583	68	64	69	100	65%
201304139	68	54	50	60	34%
200308041	69	63	52	80	34%
201317095	72	61	53	0	0%
197149470	72	14		10	0%
201300427	72	23		40	17%
201321955	73	41	50	10	0%
201319624	73	74	71	100	56%
201317400	73	59	58	80	52%
201330458	78	63	64	90	62%
201312077	78	81	80	90	67%
201312093	80	78	73	80	44%
201301180	80	68	58	80	52%
201315467	81	68	65	100	81%
Number of students (n)	**61**	**61**	**35**	**61**	**61**
Mean	**61.3%**	**39.9%**	**54.0%**	**50.8%**	**20%**
Standard deviation	**8.5%**	**20.3%**	**10.1%**	**35.4%**	**20%**

Appendix C Course Evaluation Questionnaire

Lecturer: ..... Course Code: ..... | | 2 |
|---|---|
| | 4 |
| | 5 |

Language:

English	Afrikaans	Xhosa	Other: .....

Instructions
1. Fill in only those sections specified by the lecturer.
2. Please answer the following questions thoughtfully, accurately and fairly. Give your own opinion, indicating whether you agree or disagree with each statement. Use the following key:
1. Strongly disagree 2. Disagree 3. Undecided 4. Agree 5. Strongly agree

A	Lecturer evaluation	1	2	3	4	5	
1.	The lecturer is enthusiastic about his/her subject and continuously stresses its basic principles and recent developments.	1	2	3	4	5	6
2.	The lecturer is well prepared for each lecture.	1	2	3	4	5	7
3.	The lecturer has an interesting style of presentation.	1	2	3	4	5	8
4.	The lecturer adds to the understanding of the required reading material, rather than merely repeating it.	1	2	3	4	5	9
5.	The workload required of me is in accordance with the level of the course.	1	2	3	4	5	10
6.	The lecturer speaks clearly in class.	1	2	3	4	5	11
7.	The lecturer is in control of the class and maintains discipline in a tactful way.	1	2	3	4	5	12
8.	The lecturer stimulates creative ability and encourages me to think for myself.	1	2	3	4	5	13
9.	The lecturer provides ample opportunity for class discussion and questions.	1	2	3	4	5	14
10.	The lecturer gives explanations which are clear and to the point.	1	2	3	4	5	15
11.	The lecturer is aware when I have difficulty in understanding a topic and offers additional explanations.	1	2	3	4	5	16
12.	The lecturer is able to go beyond the textbook and supply useful examples and applications from his own experience and/or from practice.	1	2	3	4	5	17
13.	The lecturer clearly indicates what material the tests will cover, so that I know what is expected of me.	1	2	3	4	5	18
14.	The lecturer is available during consulting hours for consultation and individual help.	1	2	3	4	5	19
15.	Compared to my other courses, the standard of lecturing in this course was above average.	1	2	3	4	5	20
16.	The lecturer inspires me to think about/discuss the subject beyond the course requirements.	1	2	3	4	5	21
17.	The lecturer inspires me to do my best in the course.	1	2	3	4	5	22
18.	The lecturer makes the course interesting and challenging.	1	2	3	4	5	23
19.	The lecturer encourages me to want to study this subject further.	1	2	3	4	5	24
20.	I can talk freely to my lecturer if I have problems.	1	2	3	4	5	25
21.	My lecturer tries to ensure that I do my best in this course.	1	2	3	4	5	26

B	Course evaluation	1	2	3	4	5	
1.	The objectives of the course and assignments are clearly stated in the course guide.	1	2	3	4	5	27
2.	The course stimulates creative ability and encourages me to think for myself.	1	2	3	4	5	28
3.	The workload expected is in accordance with the level of the course.	1	2	3	4	5	29
4.	The class work adequately prepared me for practicals, tutorials and tests.	1	2	3	4	5	30
5.	The text book and notes complement the work covered.	1	2	3	4	5	31
6.	The class mark was a fair assessment of my effort.	1	2	3	4	5	32
7.	The course was well structured and organized.	1	2	3	4	5	33
8.	The department sets enough tests to assess my progress properly.	1	2	3	4	5	34
9.	I gained a good understanding of concepts and principles in the course.	1	2	3	4	5	35
10.	I feel that I can manage the level of difficulty of this course.	1	2	3	4	5	36
11.	The prescribed textbook helps me to understand the contents of the course.	1	2	3	4	5	37
12.	The textbook is well written, understandable and enjoyable to work with.	1	2	3	4	5	38
13.	The textbook is worth the money I paid for it.	1	2	3	4	5	39
14.	Tests are promptly marked and returned.	1	2	3	4	5	40
15.	Sufficient feedback concerning my progress is provided to me.	1	2	3	4	5	41
16.	It is important to attend lectures as relevant, additional information is given in lectures.	1	2	3	4	5	42
17.	Assessment methods are used that accurately assess my knowledge of the course.	1	2	3	4	5	43
18.	Assessment methods are used that require me to apply the subject matter to problems.	1	2	3	4	5	44
19.	Marks are awarded fairly for tests.	1	2	3	4	5	45
20.	Comments on tests are provided that show me how I can improve.	1	2	3	4	5	46
21.	Sufficient time is allowed in tests for the amount of work required.	1	2	3	4	5	47

C	Practical evaluation	1	2	3	4	5	
1.	The practicals demand a workload from me which is in accordance with the level of the course.	1	2	3	4	5	48
2.	The practicals stimulate creative ability and encourage me to think for myself.	1	2	3	4	5	49
3.	The practicals are clear and to the point.	1	2	3	4	5	50
4.	The practicals assisted in understanding the work covered in class.	1	2	3	4	5	51
5.	The class work adequately prepared me so that I could complete the practicals.	1	2	3	4	5	52
6.	Practicals prepared me adequately for tests.	1	2	3	4	5	53
7.	Practicals can be completed in the time provided.	1	2	3	4	5	54
8.	Practical exercises contributed to a sense of achievement.	1	2	3	4	5	55
9.	There were enough student assistants to provide me with adequate assistance.	1	2	3	4	5	56

D	Lesson evaluation	1	2	3	4	5	
1.	The lessons demand a workload from me which is in accordance with the level of the course.	1	2	3	4	5	67
2.	The lessons stimulate creative ability and encourage me to think for myself.	1	2	3	4	5	68
3.	The lessons are clear and to the point.	1	2	3	4	5	69
4.	The lessons assisted in understanding the work covered in class.	1	2	3	4	5	70
5.	The class work adequately prepared you for completing the lessons.	1	2	3	4	5	71
6.	Lessons can be completed in the time provided.	1	2	3	4	5	72
7.	Lessons prepared students for tests and practicals.	1	2	3	4	5	73
8.	Lesson exercises contributed to a sense of achievement.	1	2	3	4	5	74
9.	There were enough student assistants to provide adequate help to me.	1	2	3	4	5	75

E	Student Assistant evaluation	1	2	3	4	5	
1.	The student assistants are enthusiastic about their subject.	1	2	3	4	5	76
2.	The student assistants are well prepared for each session.	1	2	3	4	5	77
3.	The student assistants add to the understanding of the required material through clear explanations.	1	2	3	4	5	78
4.	The student assistants speak clearly.	1	2	3	4	5	79
5.	The student assistants are in full control of their session and maintain discipline in a tactful way.	1	2	3	4	5	80
6.	The student assistants stimulate creative ability and encourage me to think for myself.	1	2	3	4	5	81
7.	The student assistants provided ample opportunity for questions.	1	2	3	4	5	82
8.	The student assistants gave explanations which were clear and to the point.	1	2	3	4	5	83
9.	The student assistants are aware when I am having difficulty in understanding a topic and offer additional explanations.	1	2	3	4	5	84
10.	The standard of student assistance was above average.	1	2	3	4	5	85
	Write your student assistant's name(s) :						

F	Practical Test evaluation	1	2	3	4	5	
1.	Practical tests can be completed in the time provided.	1	2	3	4	5	86
2.	My marks in the practical tests are a fair reflection of my knowledge of the course contents.	1	2	3	4	5	87
3.	I was aware that cheating occurred during a practical test.	Yes		No			88

G	Laboratory evaluation	1	2	3	4	5	
1.	There were enough PC's (machines) available in the laboratories.	1	2	3	4	5	89
2.	There was enough free time available for additional practice.	1	2	3	4	5	90
3.	The software used on the network was adequate.	1	2	3	4	5	91

H. *Open Ended Questions*

1. What were your course expectations?

.....

2. Were your course expectations realised? Explain.

.....

3. What topics would you have liked to be included in the course?

.....

4. Which topics did you not enjoy?

.....

5. Which topics did you enjoy and find useful?

.....

6. Which sections did you have difficulty with?

.....

7. Do you feel that you put enough effort into the course? Explain.

.....

8. How could the course be improved?

.....

9. How could the lecturer improve his/her presentations?

.....

10. Would you recommend the course to a fellow student? Yes/No (Comment)

.....

11. If you attended SI, did you find it useful?

.....

12. On average, how many hours per week did you spend in the laboratories working on course related work.

0	1 - 4	5 - 10	more than 10

Thank you for your co-operation.

Please return this completed form to your lecturer.

Appendix D Questionnaire for User-Interaction Satisfaction of WebCT

Questionnaire No: _____ **Date: _____**

Gender: **____ male** **____ female**

PART 1: System Experience

1.1 How long have you used this system for?

__ less than 1 hour
__ 1 hour to less than 1 day
__ 1 day to less than 1 week
__ 1 week to less than 1 month
__ 1 month to less than 6 months

1.2 On the average, how much time do you spend per week on this system?

__ Never used it.
__ less than one hour
__ one to less than 4 hours
__ 4 to less than 10 hours
__ over 10 hours

PART 2: Past Experience

2.1 How many different operating systems have you used?

__ none
__ 1
__ 2
__ more than 2
__ Don't know

PART 3: Overall User Reactions

Please circle the numbers which most appropriately reflect your impressions about using this computer system. Not Applicable = NA.

3.1	Overall reactions to the system	terrible wonderful 1 2 3 4 5	NA
3.2		frustrating satisfying 1 2 3 4 5	NA
3.3		dull stimulating 1 2 3 4 5	NA
3.4		difficult easy 1 2 3 4 5	NA
3.5		inadequate power adequate power 1 2 3 4 5	NA

Please write any comments about your overall reactions to the system here:

_____
_____
_____
_____

PART 4: Screen Displays

4.1	Characters on the computer screen	hard to read easy to read 1 2 3 4 5	NA
4.2	Highlighting on the screen	unhelpful helpful 1 2 3 4 5	NA
4.3	Screen layouts were helpful	never always 1 2 3 4 5	NA
4.3.1	Amount of information that can be displayed on screen	inadequate adequate 1 2 3 4 5	NA
4.3.2	Arrangement of information on screen	illogical logical 1 2 3 4 5	NA

Please write any comments about the screens here:

_____

_____

PART 5: Terminology and System Information

5.1	Use of terminology throughout system	inconsistent consistent 1 2 3 4 5	NA
5.2	Terminology relates well to the work you are doing?	always never 1 2 3 4 5	NA
5.3	Messages which appear on screen	unhelpful helpful 1 2 3 4 5	NA
5.3.1	Position of instructions on the screen	never in same place always in same place 1 2 3 4 5	NA
5.4	Program keeps you informed about what it is doing	never always 1 2 3 4 5	NA
5.4.1	Animated cursors keep you informed	never always 1 2 3 4 5	NA
5.4. 2	Performing an operation leads to a predictable result	never always 1 2 3 4 5	NA
5.4.3	Controlling amount of feedback	impossible easy 1 2 3 4 5	NA
5.4.4	Length of delay between operation	unacceptable acceptable 1 2 3 4 5	NA
5.5	Error messages	unhelpful helpful 1 2 3 4 5	NA

5.5.1	Error messages clarify the problem	never	always	
			1 2 3 4 5	NA
5.5.2	Phrasing of error messages	hostile	friendly	
			1 2 3 4 5	NA

Please write any comments about terminology and system information here:

_____
_____
_____
_____

PART 6: Learning

6.1	Learning to operate the system	difficult	easy	
			1 2 3 4 5	NA
6.1.1	Getting started	difficult	easy	
			1 2 3 4 5	NA
6.1.2	Learning advanced features	difficult	easy	
			1 2 3 4 5	NA
6.1.3	Time to learn to use the system	slow	fast	
			1 2 3 4 5	NA
6.2	Exploration of features by trial and error	discouraging	encouraging	
			1 2 3 4 5	NA
6.2.1	Exploration of features	risky	safe	
			1 2 3 4 5	NA
6.2.2	Discovering new features	difficult	easy	
			1 2 3 4 5	NA

When answering the following questions, note that a task can consist of a number of steps, e.g. to send mail to your lecturer, involves clicking on the *mail* icon, selecting to *compose a message*, typing the name in the *send to* textbox, typing the message, and clicking on the send button.

6.3	Tasks can be performed in a straight-forward manner	never	always	
			1 2 3 4 5	NA
6.3.1	Number of steps per task	too many	just right	
			1 2 3 4 5	NA
6.3.2	Steps to complete a task follow a logical sequence	never	always	
			1 2 3 4 5	NA
6.3.3	Feedback on the completion of sequence of steps	clear	unclear	
			1 2 3 4 5	NA

Please write any comments about learning here:

_____
_____

PART 7: System Capabilities

7.1	System speed	too slow	1	2	3	4	5	fast enough	NA
7.1.1	Response time for most operations	too slow	1	2	3	4	5	fast enough	NA
7.1.2	Rate information is displayed	too slow	1	2	3	4	5	fast enough	NA
7.2	The system is reliable	never	1	2	3	4	5	always	NA
7.2.1	System failures occur	frequently	1	2	3	4	5	seldom	NA
7.2.2	System warns you about potential problems	never	1	2	3	4	5	always	NA
7.3	Correcting your mistakes	difficult	1	2	3	4	5	easy	NA
7.3.1	Correcting typos	complex	1	2	3	4	5	simple	NA
7.3.2	Ability to undo operations	inadequate	1	2	3	4	5	adequate	NA
7.4	Ease of operation depends on your level of experience	never	1	2	3	4	5	always	NA

Please write any comments about system capabilities here:

_____
_____
_____
_____

PART 8: Tasks list of the WebCT E-learning environment

8.1	Consulting syllabus	difficult to do	1 2 3 4 5	easy to do NA
		gave problems	1 2 3 4 5	always worked NA
		not useful	1 2 3 4 5	very useful NA
		seldom used	1 2 3 4 5	often used NA
8.2	Reading study material on-line	difficult to do	1 2 3 4 5	easy to do NA
		gave problems	1 2 3 4 5	always worked NA
		not useful	1 2 3 4 5	very useful NA
		seldom used	1 2 3 4 5	often used NA
8.3	Accessing assignment tasks	difficult to do	1 2 3 4 5	easy to do NA
		gave problems	1 2 3 4 5	always worked NA
		not useful	1 2 3 4 5	very useful NA
		seldom used	1 2 3 4 5	often used NA
8.4	Submitting assignment answers	difficult to do	1 2 3 4 5	easy to do NA
		gave problems	1 2 3 4 5	always worked NA
		not useful	1 2 3 4 5	very useful NA
		seldom used	1 2 3 4 5	often used NA

8.5	Checking grades for assignments	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA
8.6	Completing a quiz	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA
8.7	Checking grades for quizzes	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA
8.8	Writing e-mail messages	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA

8.9	Reading e-mail messages	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA
8.10	Posting discussion topics	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA
8.11	Reading discussion topics	difficult to do	easy to do 1 2 3 4 5	NA
		gave problems	always worked 1 2 3 4 5	NA
		not useful	very useful 1 2 3 4 5	NA
		seldom used	often used 1 2 3 4 5	NA

Please write any comments about the WebCT E-learning environment:

_____
_____
_____
_____
_____

Appendix E Questions used in Focus Group Interviews

Issues:

Impact on learning style

- Would you describe yourself as a social/extrovert person, or as an introvert?
- Would you normally be actively involved in the learning process or not?
- Did doing Wru102, using on-line learning, influence your learning style?

Impact on time required

- How much time did you have to spend on a weekly basis?
- How does this compare to the time spent in a traditional style of learning and interaction?
- What did you have to do off-line (at home) to be able to participate?
- When did you work on the WebCT system, e.g. during practicals, or in your free time?
- Would you have liked being able to dial in from home – would you have participated more?

Impact on peer collaboration

- Did you interact with your peers on-line?
- Which tools did you use to do this?
- Did you work collaboratively on assignments?

Perceived benefit to student

Did you

- Submit the required tasks / answers regularly
- Attend the contact session regularly

- Did doing this help you to understand the content?

- Were you able to apply the knowledge at the end of a topic (study guide)?

- What would encourage you to participate in the discussion process, or get you to submit the answers to exercises?

Reaction of student

Did you

- Read and contribute to the discussions
- Only read the discussions
- Neither read or contributed to the discussions

(This could apply to discussions or e-mail).
Why, or why not?

Impact on student performance

- What did you learn from the active learning activities?
- What did you learn from the collaborative activities?

Support provided by course management software (WebCT)

- To what degree were you actively involved in the learning process, by doing WRU102 using on-line learning?

How did the WebCT environment (tasks and activities) support and actively promote active learning?

- How did you use the environment to be actively involved?

Did you find the tools in WebCT useful? Give your feelings on

- Using the e-mail
- Using the discussion lists

Amount of feedback received

- Do you feel that you received enough feedback to know whether you are on track with the content?

Problems encountered

- What problems would you like to bring under our attention??

General

- Did you enjoy being part of the e-learning experience? Why or why not?
- What do you think should be done differently, if this experiment / experience is repeated next year?

Any other comments / suggestions

Appendix F Results of the Questionnaire for User Interaction Satisfaction

F.1 Results of the Chi^2 analysis

For the purpose of analysing the results, 1-3 was regarded as a Negative response, while 4-5 was regarded as a Positive response. Not Applicable (NA) values and missing values were not taken into account, and n adjusted accordingly.

In the significance column:

*** Indicates 99% significance

** Indicates 95%significance

		n	Mean	Std Dev	Positive	Negative	p	Chi^2	Significance
Overall User Reactions to the system									
3.1	Terrible vs wonderful	31	3.58	1.09	16	15	1.000	0.00	
3.2	Frustrating vs satisfying	31	3.19	1.05	11	20	0.072	3.23	
3.3	Dull vs stimulating	32	3.13	1.13	10	22	0.033	4.50	**
3.4	Difficult vs easy	30	3.73	1.08	20	10	0.067	3.33	
3.5	Inadequate power vs adequate power	30	3.13	0.90	10	20	0.067	3.33	
Screen Displays									
4.1	Characters on the computer screen: Hard to read vs easy to read	32	4.47	0.92	28	4	0.000	18.00	***
4.2	Highlighting on the screen: Unhelpful vs helpful	32	4.38	0.75	27	5	0.000	15.13	***
4.3	Screen layouts were helpful : Never vs Always	32	3.69	0.90	19	13	0.288	1.13	
4.3.1	Amount of information on the screen: Inadequate vs adequate	32	3.53	1.14	16	16	1.000	0.00	
4.3.2	Arrangement of information on screen: Illogical vs logical	32	3.75	0.84	22	10	0.033	4.50	**
Terminology and System Information									
5.1	se of terminology throughout system: Inconsistent vs Consistent	31	4.16	0.73	25	6	0.001	10.46	***
5.2	Terminology relates well to the work you are doing? Always vs Never	31	2.10	1.08	4	27	0.000	18.60	***
5.3	Messages which appear on screen: Unhelpful vs Helpful	31	4.13	0.76	26	5	0.000	12.92	***
5.3.1	Position of instructions: Never in same place vs Always in same place	32	4.06	0.98	24	8	0.004	8.00	***
5.4	rogram keeps you informed about what it is doing: Never vs Always	32	3.59	0.98	14	18	0.479	0.50	
5.4.1	Animated cursors keep you informed: Never vs Always	30	3.37	1.22	14	16	0.715	0.13	
5.4. 2	Performing an operation leads to a predictable result: Never vs Always	30	3.63	0.85	18	12	0.273	1.20	
5.4.3	Controlling amount of feedback: Impossible vs Easy	30	3.70	0.88	17	13	0.465	0.53	
5.4.4	Length of delay between operation: Unacceptable vs Acceptable	31	3.35	0.98	14	17	0.472	0.52	
5.5	Error messages: Unhelpful vs Helpful	26	3.50	1.30	14	12	0.694	0.15	
5.5.1	Error messages clarify the problem: Never vs Always	30	2.97	1.27	9	21	0.028	4.80	**
5.5.2	Phrasing of error messages: Hostile vs Friendly	29	3.52	1.06	14	15	0.710	0.14	

		n	Mean	Std Dev	Positive	Negative	p	Chi^2	Significance
Learning									
6.1	Learning to operate the system: Difficult vs Easy	31	3.94	1.18	22	9	0.031	4.65	**
6.1.1	Getting started: Difficult vs Easy	31	3.77	1.28	20	11	0.150	2.07	
6.1.2	Learning advanced features: Difficult vs Easy	29	3.86	0.88	20	9	0.063	3.45	
6.1.3	Time to learn to use the system: Slow vs Fast	32	4.00	1.02	22	10	0.033	4.50	**
6.2	xploration of features by trial and error: Discouraging vs Encouraging	29	3.76	1.09	17	12	0.457	0.55	
6.2.1	Exploration of features: Risky vs Safe	29	4.00	0.96	20	9	0.063	3.45	
6.2.2	Discovering new features: Difficult vs Easy	29	3.90	1.08	19	10	0.137	2.21	
6.3	Tasks can be performed in a straight-forward manner: Never vs Always	30	3.77	1.04	19	11	0.144	2.13	
6.3.1	Number of steps per task: Too many vs Just right	31	3.74	0.93	17	14	0.719	0.13	
6.3.2	Steps to complete a task follow a logical sequence: Never vs Always	30	3.93	1.01	22	8	0.010	6.53	**
6.3.3	Feedback on the completion of sequence of steps: Clear vs Unclear	30	2.80	1.32	9	21	0.028	4.80	**
System Capabilities									
7.1	ystem speed: Too slow vs Fast enough	32	3.44	0.95	17	15	0.723	0.13	
7.1.1	Response time for most operations: Too slow vs Fast enough	32	3.53	0.92	19	13	0.288	1.13	
7.1.2	Rate information is displayed: vs Too slow vs Fast enough	31	3.81	0.75	21	10	0.072	3.23	
7.2	The system is reliable: Never vs Always	29	3.79	0.94	18	11	0.264	1.24	
7.2.1	System failures occur: Frequently vs Seldom	31	3.87	1.26	22	9	0.031	4.65	**
7.2.2	System warns you about potential problems: Never vs Always	30	3.20	1.27	14	16	0.715	0.13	
7.3	Correcting your mistakes: Difficult vs Easy	31	3.58	1.18	17	14	0.719	0.13	
7.3.1	Correcting typos: Complex vs Simple	32	3.78	1.07	18	14	0.479	0.50	
7.3.2	Ability to undo operations: Inadequate vs Adequate	32	3.69	1.40	20	12	0.157	2.00	
7.4	Ease of operation depends on your: Never vs Always	32	3.41	1.07	15	17	0.723	0.13	

		n	Mean	Std Dev	Positive	Negative	p	Chi^2	Significance
Tasks list of the WebCT virtual classroom environment									
8.1.1	Consulting syllabus: Difficult to do vs Easy to do	28	3.54	1.10	15	13	0.705	0.14	
8.1.2	Gave problems vs Always worked	28	3.61	1.10	14	14	1.000	0.00	
8.1.3	Not useful vs Very useful	28	3.61	1.07	15	13	0.705	0.14	
8.1.4	Seldom used vs Often used	30	3.00	1.11	9	21	0.028	4.80	**
8.2.1	Reading study material on-line: Difficult to do vs Easy to do	26	4.08	1.26	21	5	0.001	9.85	***
8.2.2	Gave problems vs Always worked	28	3.79	1.20	19	9	0.058	3.57	
8.2.3	Not useful vs Very useful	27	3.52	1.19	14	13	1.000	0.00	
8.2.4	Seldom used vs Often used	28	3.21	1.34	12	16	0.449	0.57	
8.3.1	Accessing assignment tasks: Difficult to do vs Easy to do	31	4.00	1.21	21	10	0.072	3.23	
8.3.2	Gave problems vs Always worked	31	3.81	1.14	20	11	0.150	2.07	
8.3.3	Not useful vs Very useful	30	3.87	1.11	19	11	0.144	2.13	
8.4.4	Seldom used vs Often used	30	4.07	1.11	23	7	0.003	8.53	***
8.4.1	Submitting assignment answers: Difficult to do vs Easy to do	32	3.50	1.30	17	15	0.723	0.13	
8.4.2	Gave problems vs Always worked	32	3.09	1.15	11	21	0.077	3.13	
8.4.3	Not useful vs Very useful	31	3.77	1.09	20	11	0.150	2.07	
8.4.4	Seldom used vs Often used	31	4.00	1.13	24	7	0.004	8.27	***
8.5.1	Checking grades for assignments: Difficult to do vs Easy to do	31	4.16	1.13	23	8	0.011	6.33	**
8.5.2	Gave problems vs Always worked	31	3.90	1.16	20	11	0.150	2.07	
8.5.3	Not useful vs Very useful	30	4.13	1.04	23	7	0.003	8.53	***
8.5.4	Seldom used vs Often used	31	3.74	1.32	19	12	0.280	1.16	

		n	Mean	Std Dev	Positive	Negative	p	Chi^2	Significance
8.6.1	Completing a quiz: Difficult to do vs Easy to do	31	4.42	0.81	25	6	0.001	10.46	***
8.6.2	Gave problems vs Always worked	32	4.06	1.22	22	10	0.033	4.50	**
8.6.3	Not useful vs Very useful	31	4.29	0.94	26	5	0.000	12.92	***
8.6.4	Seldom used vs Often used	31	4.55	0.89	27	4	0.000	15.63	***
8.7.1	Checking grades for quizzes: Difficult to do vs Easy to do	31	4.39	0.95	28	3	0.000	18.60	***
8.7.2	Gave problems vs Always worked	30	4.20	0.81	23	7	0.003	8.53	***
8.7.3	Not useful vs Very useful	30	4.13	1.01	21	9	0.028	4.80	**
8.7.4	Seldom used vs Often used	30	4.23	0.94	24	6	0.001	10.80	***
8.8.1	Writing e-mail messages: Difficult to do vs Easy to do	28	4.29	1.15	24	4	0.000	14.29	***
8.8.2	Gave problems vs Always worked	27	4.19	1.14	23	4	0.000	12.02	***
8.8.3	Not useful vs Very useful	27	4.30	1.03	22	5	0.002	9.49	***
8.8.4	Seldom used vs Often used	29	3.28	1.65	13	16	0.457	0.55	
8.9.1	Reading e-mail messages: Difficult to do vs Easy to do	28	4.43	1.00	23	5	0.000	11.57	***
8.9.2	Gave problems vs Always worked	28	4.50	0.79	25	3	0.000	17.29	***
8.9.3	Not useful vs Very useful	28	4.32	0.98	22	6	0.002	9.14	***
8.9.4	Seldom used vs Often used	30	3.30	1.58	14	16	0.715	0.13	
8.10.1	Posting discussion topics: Difficult to do vs Easy to do	30	4.10	1.18	23	7	0.003	8.53	***
8.10.2	Gave problems vs Always worked	28	4.07	1.18	22	6	0.002	9.14	***
8.10.3	Not useful vs Very useful	28	4.00	1.12	19	9	0.058	3.57	
8.10.4	Seldom used vs Often used	29	3.17	1.61	13	16	0.457	0.55	
8.11.1	Reading discussion topics: Difficult to do vs Easy to do	31	4.35	1.08	26	5	0.000	12.92	***
8.11.2	Gave problems vs Always worked	29	4.45	0.74	27	2	0.000	19.89	***
8.11.3	Not useful vs Very useful	29	4.03	0.94	19	10	0.137	2.21	
8.11.4	Seldom used vs Often used	30	3.53	1.36	16	14	0.715	0.13	

F.2 Results of the T-tests

Variable	Group 1: 0 – 1 hours			Group 2: 1 – 4 hours				
	Valid n	Mean	Std.Dev.	Valid n	Mean	Std.Dev	t-value	p
User Reactions								
Q3.1	17	3.35	0.86	14	3.85	1.29	-1.29	0.204
Q3.2	17	2.88	0.85	14	3.57	1.15	-1.90	0.067
Q3.3	17	2.94	0.82	15	3.33	1.39	-0.98	0.334
Q3.4	16	3.93	0.85	14	3.50	1.28	1.11	0.276
Q3.5	16	3.06	0.85	14	3.21	0.97	-0.45	0.652
Screen Display								
Q4.1	17	4.41	1.12	15	4.53	0.63	-0.36	0.714
Q4.2	17	4.47	0.71	15	4.26	0.79	0.76	0.452
Q4.3	17	3.47	0.71	15	3.93	1.03	-1.48	0.147
Q4.3.1	17	3.47	1.06	15	3.60	1.24	-0.31	0.753
Q4.3.2	17	3.76	0.66	15	3.73	1.03	0.10	0.918
Terminology								
Q5.1	16	4.18	0.75	15	4.13	0.74	0.20	0.841
Q5.2	16	2.18	1.04	15	2.00	1.13	0.47	0.635
Q5.3	17	4.00	0.70	14	4.28	0.82	-1.03	0.307
Q5.3.1	17	3.88	0.99	15	4.26	0.96	-1.10	0.276
Q5.4	17	3.35	0.78	15	3.86	1.12	-1.51	0.141
Q5.4.1	16	3.18	1.04	14	3.57	1.39	-0.85	0.398
Q5.4.2	16	3.75	0.85	14	3.50	0.85	0.79	0.431
Q5.4.3	16	3.68	0.87	14	3.71	0.91	-0.08	0.935
Q5.4.4	17	3.47	0.79	14	3.21	1.18	0.71	0.480
Q5.5	12	3.33	1.15	14	3.64	1.44	-0.59	0.557
Q5.5.1	15	2.53	1.06	15	3.40	1.35	-1.95	0.060
Q5.5.2	15	3.40	1.12	14	3.64	1.00	-0.61	0.545
Learning								
Q6.1	17	3.82	1.07	14	4.07	1.32	-0.57	0.569
Q6.1.1	17	3.52	1.37	14	4.07	1.14	-1.17	0.248
Q6.1.2	14	3.57	0.93	15	4.13	0.74	-1.79	0.083
Q6.1.3	17	3.82	1.01	15	4.20	1.01	-1.04	0.303
Q6.2	14	3.64	1.08	15	3.86	1.12	-0.54	0.590
Q6.2.1	14	4.00	1.03	15	4.00	0.92	-0.00	1.000
Q6.2.2	14	3.85	1.02	15	3.93	1.16	-0.18	0.853
Q6.3	17	3.58	0.87	13	4.00	1.22	-1.07	0.290
Q6.3.1	16	3.43	0.89	15	4.06	0.88	-1.97	0.058
Q6.3.2	16	3.75	1.00	14	4.14	1.02	-1.06	0.298
Q6.3.3	16	3.12	1.14	14	2.42	1.45	1.46	0.153

Variable	Group 1: 0 – 1 hours			Group 2: 1 – 4 hours				
	Valid n	Mean	Std.Dev.	Valid n	Mean	Std.Dev.	t-value	p
System Capabilities								
Q7.1	17	3.29	1.98	15	3.60	0.91	-0.90	0.371
Q7.1.1	17	3.58	1.00	15	3.46	0.83	0.36	0.714
Q7.1.2	17	3.76	0.75	14	3.85	0.77	-0.33	0.738
Q7.2	14	3.71	0.72	15	3.86	1.12	-0.42	0.670
Q7.2.1	16	4.06	0.85	15	3.66	1.58	0.87	0.390
Q7.2.2	16	2.93	1.06	14	3.50	1.45	-1.22	0.232
Q7.3	17	3.64	0.78	14	3.50	1.55	0.34	0.735
Q7.3.1	17	4.00	0.93	15	3.53	1.18	1.24	0.223
Q7.3.2	17	4.00	1.17	15	3.33	1.58	1.36	0.183
Q7.4	17	3.11	0.85	15	3.73	1.22	-1.66	0.106
WebCT Task List								
Q8.1.1	15	3.20	1.14	13	3.92	0.95	-1.79	0.083
Q8.1.2	15	3.46	0.99	13	3.76	1.23	-0.71	0.478
Q8.1.3	15	3.33	0.89	13	3.92	1.18	-1.49	0.147
Q8.1.4	16	2.62	0.88	14	3.42	1.22	-2.08	0.046
Q8.2.1	13	3.84	1.57	13	4.30	0.85	-0.92	0.361
Q8.2.2	13	3.53	1.05	15	4.00	1.30	-1.01	0.318
Q8.2.3	13	3.38	1.19	14	3.64	1.21	-0.55	0.582
Q8.2.4	14	2.71	1.38	14	3.71	1.13	-2.08	0.046
Q8.3.1	17	3.76	1.14	14	4.28	1.26	-1.20	0.239
Q8.3.2	17	3.64	1.05	14	4.00	1.24	-0.85	0.399
Q8.3.3	17	3.76	1.20	13	4.00	1.00	-0.57	0.572
Q8.3.4	17	3.76	1.30	13	4.46	0.66	-1.76	0.089
Q8.4.1	17	3.52	1.28	15	3.46	1.35	0.13	0.893
Q8.4.2	17	3.17	1.01	15	3.00	1.30	0.42	0.671
Q8.4.3	16	3.68	1.07	15	3.86	1.12	-0.45	0.654
Q8.4.4	17	3.70	1.21	14	4.35	0.92	-1.64	0.110
Q8.5.1	16	4.37	0.80	15	3.93	1.38	1.09	0.283
Q8.5.2	16	3.93	0.99	15	3.86	1.35	0.16	0.868
Q8.5.3	16	4.06	0.92	14	4.21	1.18	-0.39	0.697
Q8.5.4	17	3.35	1.45	14	4.21	0.97	-1.89	0.068
Q8.6.1	17	4.47	0.71	14	4.35	0.92	0.38	0.703
Q8.6.2	17	4.29	0.84	15	3.80	1.52	1.15	0.258
Q8.6.3	17	4.17	1.01	14	4.42	0.85	-0.73	0.465
Q8.6.4	17	4.70	0.77	14	4.35	1.00	1.09	0.284
Q8.7.1	16	4.43	0.81	15	4.33	1.11	0.29	0.767
Q8.7.2	16	4.12	0.71	14	4.28	0.91	-0.53	0.594
Q8.7.3	16	3.93	0.99	14	4.35	1.00	-1.14	0.262
Q8.7.4	16	4.12	0.95	14	4.35	0.92	-0.67	0.507

Variable	Group 1: 0 –1 hours			Group 2: 1 – 4 hours				
	Valid n	Mean	Std.Dev.	Valid n	Mean	Std.Dev.	t-value	p
Q8.8.1	15	4.26	1.22	13	4.30	1.10	-0.09	0.927
Q8.8.2	14	4.14	1.02	13	4.23	1.30	-0.19	0.846
Q8.8.3	14	4.21	1.12	13	4.38	0.96	-0.42	0.676
Q8.8.4	15	2.86	1.68	14	3.71	1.54	-1.41	0.169
Q8.9.1	16	4.18	1.16	12	4.75	0.62	-1.51	0.142
Q8.9.2	15	4.40	0.91	13	1.61	0.65	-0.70	0.484
Q8.9.3	15	4.13	1.06	13	4.53	0.87	-1.09	0.285
Q8.9.4	16	3.06	1.61	14	3.57	1.55	-0.87	0.387
Q8.10.1	15	3.53	1.40	15	4.66	0.48	-2.94	0.006
Q8.10.2	14	3.57	1.08	14	4.57	1.08	-2.42	0.022
Q8.10.3	14	3.71	1.06	14	4.28	1.13	-1.36	0.182
Q8.10.4	15	2.53	1.47	14	3.85	1.51	-2.40	0.023
Q8.11.1	16	4.06	1.23	15	4.66	0.81	-1.59	0.121
Q8.11.2	15	4.13	0.83	14	4.78	0.42	-2.62	0.014
Q8.11.3	16	3.73	0.96	14	4.35	0.84	-1.85	0.074
Q8.11.4	16	3.00	1.46	14	4.14	0.94	-2.49	0.018

Appendix G Focus Group Interviews

G.1 Categories and Themes – Coding scheme

Category	Code	Theme	Code	Sub theme	Code
Management or Organisation of learning	**A**	Seen as Integrated	**1**		
		Seen as extra / add on	**2**		
		Replacement	**3**		
Changes in learning process	**B**	Learning styles	**1**	Deadlines more in your face	**a**
				Increased time management necessary	**b**
				Lazy	**c**
				No change	**d**
				Active learning	**e**
		Interest changed	**2**	Increased	**a**
				Decreased	**b**
				No change	**c**
		Time Spent	**3**	More	**a**
				Less	**b**
				No change	**c**
		E-communication	**4**	Feedback	**a**
				None due to proximity	**b**
				Assignments uploaded	**c**
				Necessity (usefulness) for contact lectures / clarity	**d**
				None due to lack of interest	**e**
				None due to lack of friends in group	**f**
				None due to lack of knowledge	**g**
				Problems with submission	**h**
				Quizzes	**I**
		Attendance	**5**	Increase	**a**
				Decrease	**b**
Benefits	**C**	Consistently work	**1**		
		Self management	**2**		
Neutral	**D**	No impact	**1**		
Disadvantages	**E**	Accessibility problems	**1**		
		Self management	**2**		
Course evaluation	**F**				

G.2 Extracts from the Focus Group Interviews

These responses are a selection of those made during the interviews.

1. Management or Organisation of Learning

Category	Theme	Response
A	1	"The concept of WebCT is good, everything is there. It puts it on your desk, it puts it on Janet's desk."(HCI) "You access WebCT, print the information and then go home, trying to fathom out what is happening in the lecture, and then trying to actually do the assignment because during the lecture often one had the opportunity to ask Janet it you were on the right track."(HCI)
	2	"Now they take your time for the WebCT, and a lecture, it is like taking more of your time."(EUC) "It is more like a leisure, doing this discussions, if we have free time, then you partake in things like this. But at the moment there is no free time." (EUC)

2. Changes in Learning process

2.1 Learning styles

Category	Theme	Response
B	1a	"You pretty much had a deadline so you had to do your quiz and assignment before the deadline other wise you don't get the marks."(HCI) "Even if a person is very strict they do not keep time like WebCT. WebCT is ruthless – down to the last second."(HCI)
	1b	"You have to structure it very well so you can get your information through on time."(HCI) "It forces you to prepare."(HCI)
	1c	"In the past, I always used to learn about what happened in the lecture, but now that here is like an optional lecture, you tend to get lazy and not attend these lectures, and just do what you have to do." (EUC)
	1d	"I tried to change it, but I always come back to the same." (EUC) "I don't think it did actually influence my learning style. It was the same as in the first semester."(HCI)

Category	Theme	Response
	1e	"It was sometimes more of an active nature."(HCI) "It does keep you active. You participate every week because you have so much stuff to do and the quizzes software does not allow you to submit after a certain date. So that way it was definitely a benefit to use."(HCI)

2.2 Interest Changed

Category	Theme	Response
B	2a	"What I enjoy is when a lecturer actually gives you more than what's in the textbook. They actually provide some application or some general knowledge of what is currently happening in the real world with regards to what you are meant to be doing."(HCI)
	2b	"I do the work, I don't think it is that interesting, although it is very practical and easy to use." (EUC)

2.3 Time Spent

Category	Theme	Response
B	3a	"I think it is more time, when compared to the lectures." (EUC) "Yes, I'll say it forced me to spend a lot of time on HCI because I had to prepare before the time to complete assignments and do the quizzes as well."(HCI) "Definitely up the amount of time I spent on HCI."(HCI)
	3b	"I think I actually spent a bit less time this semester, because now the lecture is optional…."(EUC) "Less, far less, I concentrate more on my lessons and applications at the moment." (EUC)

2.4 E-communication

Category	Theme	Response
B	4a	"Well, with the quizzes you do get feedback." (EUC) "I think the quizzes being marked and getting your results there and then on the spot, getting feedback immediately."(HCI)
	4b	"It is just much quicker to go to your friend in the group, and talk to them. You get your answer straight away." (EUC) "I think we felt a little bit stupid to use the discussions."(HCI)
	4c	"Most of the time I submitted." (EUC)
	4d	"It adds value, but I am just lazy." (EUC) "I think I agree on that because there were times once or twice where actually just looking at the lecture notes I was still a bit lost and vague when it came to the assignments, so yes, I definitely needed the contact session to ask."(HCI)
	4e	"Does WebCT have email?"(HCI)
	4f	"All my close friends, they either do 131, or they are not doing computers." (EUC)
	4g	"I don't know how to use the stuff. I struggled with submitted, so I never even bothered with discussions." (EUC)
	4h	"Even when I submitted my work, it either never went through or I struggled." (EUC) "Quite a few of us in general had difficulties first finding out how to upload an assignment."(HCI) "Sometimes it frustrated me actually, it did not want to upload, and especially when you are trying to meet the deadline."(HCI)
	4i	"The easy part was the multiple choice. Yes, because you did not even think what the answer was, you just put anything down." (EUC) "I think the quizzes being marked and getting your results there and then on the spot, getting feedback immediately."(HCI)

2.5 Attendance

Category	Theme	Response
B	5a	"Yes, I attended all the lectures". (EUC) "Yes, I think I attended all of the lectures because I found that during the lectures you go through the assignments that you have to submit, the problems that we find with the assignment."(HCI)
	5b	"No, as soon as they made it optional. They have to make it compulsory."(EUC)

3. Benefits

Category	Theme	Response
C	1	"It does keep you active. You participate every week because you have so much stuff to do and the quizzes software does not allow you to submit after a certain date. So that way it was definitely a benefit to use."(HCI)
	2	"It forced me to do the work, it forced me to be on time."(HCI)
	3	"It makes it easy for us to submit an assignment. It puts the information right at our computer. So it provides this kind of link that allows an establishment of this virtual class room."(HCI) "It changed the nature of the lectures, and so added value. It became participative."(HCI)

4. Neutral

Category	Theme	Response
D	1	"I think personally it did not make a very big difference to me because coming from a different discipline I had to read the textbook anyway. So first semester and second semester was much the same."(HCI)

5. Disadvantages

Category	Theme	Response
E	1	"I would very much like if one could have remote access."(HCI) "Home access would have been much appreciated."(HCI) "You can't even download some of the assignments because the network is down."(HCI)
	2	"I prefer the lectures, because then they explain everything." (EUC)