

**The Design, Implementation And Evaluation Of An  
On-Line, Internet-based, Distance Education Information  
System: A Case Study  
(The Creation Of A Virtual Classroom at  
ML Sultan Technikon)**

P Naidoo

Research Report Submitted In Partial Fulfillment of the Requirements for  
the Master of Education Degree (Educational Technology)

Department of Educational Technology  
Faculty of Humanities  
University of Durban-Westville

Supervisor: Dr C Kistan

December 2000

(i) Abstract

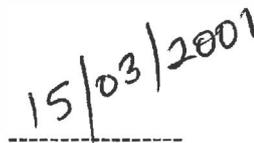
*The purpose of the study was to determine, to what extent a “ Virtual Classroom” could be simulated at ML Sultan Technikon and how effective it would be in solving the many challenges the Institution faces. This involved the design, implementation and evaluation of an on-line, Internet-based, distance- education Information system. The study focused on five key areas: “**Technical challenges**”, “**Interaction**”, “**On-line subject matter**”, “**On-line research**” and “**Assessment**”. The study was, to determine the technical challenges in setting up an on-line information system. Once the system was set up, it was used to ascertain how learners interacted with other course participants and how learners responded to the presentation of on-line subject matter. It also assisted in determining how learners went about performing on-line research and helped in finding out the nature of on-line assessments.*

(ii) Declaration

I, Pregalathan Naidoo, declare that this dissertation is my own work, and has not been submitted previously for any degree in any University.



-----  
Researcher



-----  
Date

(iii) Contents

	<b>Section</b>	<b>Page</b>
	<b>Chapter One: Introduction</b>	
1.1	Definition of terms	2
1.2	Critical research questions	3
1.3	The need for the study	4
1.4	Theoretical framework used in the process	6
	<b>Chapter Two: Literature Review</b>	
2.1	On-line literature – review	8
2.1.1	A review of the web sites of all fifteen technikons in South Africa	10
2.1.2	A review of the web sites of all twenty-one universities in South Africa	12
2.1.3	A review of a sample of the web sites of formal school systems, government educational departments and non-governmental organizations in South Africa.	18
2.1.4	A review of South African educational institutions, making use of the Lotus Notes or LearningSpace software	20
2.1.5	A review of a sample of international educational institutions making use of the LearningSpace software.	21
2.1.6	A review of a sample of international business institutions making use of the LearningSpace software	23
2.2	Text-based literature review	27
2.2.1	“Interactive Internet” (Johannes Cronje - University of Pretoria)	27
2.2.2	“Online instruction at Technikon SA” – (JF van Koller – Technikon South Africa)	29
2.2.3	“The Internet and Distance Education” (Eunice Ivala)	31

	<b>Chapter Three: Methodology</b>	
3.1	The research design of the study	34
3.2	The setting: an overview of ML Sultan Technikon	34
3.3	The on-line distance education course (OLDEC)	35
3.3.1	Reasons for integrating the OLDEC into the Information Processing II subject	35
3.3.2	The OLDEC curriculum	36
3.4	The student participants	39
3.5	The OLDEC instructor	41
3.6	The implementation of the OLDEC information system	41
3.6.1	The “OLDEC Server” set-up phase	41
3.6.2	The “Instructor PC” set-up phase	43
3.6.3	The Student PC’s set-up phase	45
3.6.4	Student e-mail accounts set-up phase	46
3.6.5	The telecommunications system set-up phase	46
3.6.6	Setting up of the OLDEC learning programme	49
3.7	Data collection plan and instruments used	57
3.8	Issues of validity	58
3.9	Control procedures	58
3.10	Planned process versus the actual process	59
	<b>Chapter Four: Findings</b>	
4.1	Findings associated with the technical challenges in the setting up and maintenance of the computer hardware	62
4.2	Findings associated with the technical challenges in the setting up and maintenance of the computer software	64
4.3	Findings associated with the technical challenges in the setting up and maintenance of the telecommunications links	69
4.4	Findings related to how learners interacted with fellow learners and the instructor in the on-line classroom	71

4.5	Findings related to how learners responded to the on-line presentation of subject matter	74
4.6	Finding related to how learners went about performing research using on-line sources	78
4.7	Findings related to the new and modified assessment strategies that were implemented to suit on-line education	79
4.8	Findings related to the security measures that were put in place to make on-line assessments secure	86
4.9	Findings related to how learners responded to taking the on-line assessments	87
4.10	Findings related to a comparison of learners' performance in on-line assessments with their previous performance in traditional classroom assessments	87
4.11	General findings	90
	<b>Chapter Five: Recommendations and Conclusion</b>	
5.1	Recommendations	92
5.2	Evaluation of the study and conclusion	98
	<b>References</b>	105
	<b>Annexure A</b>	109
	<b>Annexure B</b>	110
	<b>Annexure C</b>	113
	<b>Annexure D</b>	118

(iv) List of Tables

	<b>Title</b>	<b>Page</b>
Table 1	Summary of the six categories of the on-line literature review	9
Table 2	A list of the duration, specific outcomes and assessment criteria for each module	37
Table 3	Differences in the three electronic modes of interaction	71

(v) List of Figures

	<b>Title</b>	<b>Page</b>
Figure 1	Layers of the OLDEC Server	43
Figure 2	Layers of the Instructor PC	44
Figure 3	Summary of the Student PCs set up	45
Figure 4	Illustrations of the Telecommunications Infrastructure	48
Figure 5	User Authentication Screen	49
Figure 6	Home Page Screen	50
Figure 7	Schedule Web Page	51
Figure 8	Media Center Web Page	52
Figure 9	Course Room Web Page	53
Figure 10	Profiles Web Page	54
Figure 11	Assessment Web Page	55
Figure 12	Chat Room Web Page	56
Figure 13	End-User Computing % vs OLDEC %	88
Figure 14	First-year aggregate % vs OLDEC %	89
Figure 15	Matriculation aggregate % vs OLDEC %	89

(vi) List of Acronyms

AGN	Africa Growth Network
CAL	Computer Aided Learning
CBE	Computer Based Education
COLISA	Confederation of Open Learning Institutions of South Africa
CPU	Central Processing Unit
FAQ	Frequently Asked Questions
FTP	File Transfer Protocol
GDP	Gross Domestic Product
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
IBM	International Business Machines
ICD	Interactive Course Development
ICT	Information and Communication Technologies
IDRC	Integrated Development Research Centre
IRC	Internet Relay Chat
ITU	International Telecommunications Union
LAN	Local Area Network
MBPS	Megabits Per Second
MEG	Multimedia Education Group
MIS	Management Information Services
MODEM	Modulator - Demodulator
MRG	Multimedia Research Group
NGO	Non-Governmental Organizations
NIC	Network Interface Card
OBE	Outcomes Based Education
OLC	Open Learning Centre
OLDEC	On-line Distance Education Course
PLATO	Programmed Logic for Automatic Teaching

RAM	Random Access Memory
ROSS	Rhodes On-line Student Server
SDLC	Systems Development Life Cycle
SOL	Students On-line
SRC	Students Representative Council
TCP/IP	Transmission Control Protocol / Internet Protocol
TWR	Technikon Witwatersrand
UCT	University of Cape Town
UNINET	Universities Network
UNISA	University of South Africa
UPS	Uninterruptible Power Supply
URL	Unique Resource Locator
UTP	Unshielded Twisted Pair
VGA	Video Graphics Array
WAN	Wide Area Network
WCSN	Western Cape Schools Network
WEBCT	Web Course Tools
WWW	World Wide Web

## CHAPTER ONE

### INTRODUCTION

The purpose of the study was to determine, to what extent a “ *Virtual Classroom*” could be simulated at ML Sultan Technikon and how effective it would be in solving the many challenges the institution and the higher education sector in general faces.

The higher education sector nationally and globally is facing an increase in the number of learners wanting to undertake further education. This increasing demand on education is outstripping the funding allocated to education. Among the increasing population of learners is a significant population of mature students who are studying part-time while working. Due to the pressure of work and personal responsibilities, they may not be free to attend classes at fixed times and in a certain location. For most students today, education represents a considerable investment in time and money, and like most consumers, students are now demanding a service equivalent to the cost. As a result, many students want more feedback, more attention and more resources to help them learn. Higher education faces increased competition, resulting in the need to improve the quality of the courses and services. It is hoped that the creation of “Virtual Classrooms” will assist in solving some of these challenges.

The study involved the *design, implementation and evaluation* of an *on-line, Internet-based, distance- education information system*. The researcher chose a case-study approach, to study the characteristics of a group of learners that were subjected to an on-line, distance education, Internet-based course at ML Sultan Technikon. The premise being, that the group under study was typical of many other groups within the Technikon and at other higher educational institutions in South Africa that provide or are in the process of providing on-line distance education. The researcher attempted to study the life cycle of this group, with a view of establishing generalizations about a wider population to which the group belonged.

The study focussed on five key areas: “**Technical challenges**”, “**Interaction**”, “**On-line subject matter**”, “**On-line research**” and “**Assessment**”. The study was used to determine the technical challenges in setting up an on-line information system. Once the system was set

up, it was used to ascertain how learners interacted with other course participants and how learners responded to the presentation of on-line subject matter. It also assisted in determining how learners went about performing on-line research and helped in finding out the nature of on-line assessments.

## 1.1 Definition of terms

The key terms and concepts used in the context of this study are clarified below:

A ***Virtual Classroom*** is an educational institution that only exists in cyberspace. Cyberspace refers to the environment created by computer hardware, software and telecommunications. There may be no real campus. The instructors or consultants affiliated with the virtual institution may be located within other businesses or academic institutions and may be working from their home or office. Learners taking courses through a virtual institution can perceive that institution in any way they like as long as they receive the education they need.

***Distance Education*** is education offered to learners who are in different locations to that of the source or provider of the instruction. Although the learner and provider are geographically isolated, technology is used to mediate and bridge the instructional gap.

Education being ***On-Line*** refers to the notion that there is a direct two- way communication link from the learner's computer and the remote Server computer that manages the educational programme. Changes or updates made to the information on the Server will be immediately accessible and noticeable on the learner's computer. In other words communication takes place in "real-time", ensuring that there is minimal delay in the transferring of information from one point to another.

Being ***Internet-based*** means that Internet- technology is used to close the instructional distance between learners and providers. The Internet being an international WAN (Wide Area Network) that connects many LANs (Local Area Networks) and individual computers using routers and public telecommunication systems. The Internet runs on a set of software rules known as TCP/IP (Transmission Control Protocol – Internet Protocol).

For the purpose of this study the *Information System* is an arrangement of five building blocks **People, Activities, Data, Networks** and **Technology** which were integrated for the purposes of supporting the On-line Distance Education Programme. **People**, refers to those that interact with the information system such as programmers, technicians, instructors and learners. **Activities** refers to the functionality and processes that support the purpose, mission, goals and objectives of the system such as providing learners with time-tabling information, course notes, e-mail and administering of tests. **Data** refers to the files and databases of the system. For example, when a student submits an assignment on-line it has to be saved as a file within the system's database. **Networks** refer to the technical arrangement that interconnects computers and peripherals such as, cabling, hubs, interface cards, modems, telephone links that make up the Internet. **Technology** refers to the computer hardware such as learners' personal computers, servers and printers and the computer software such as browsers, Windows programmes and server software (Whitten, Bentley & Barlow 1994).

The *design* phase involved planning and analysis such as deciding what hardware and software were to be used, designing and planning of the curriculum, the syllabus outline, time frames, determining learning aims, objectives, outcomes and selecting course content and assessment tasks.

*Implementation* involved the building of the networks, software installation, system testing and correcting errors (debugging).

The *evaluation* phase determine whether the project meets its intended goals and needs adequately. It also served a formative purpose providing information for the improvement of the project for future use.

## 1.2 Critical research questions

The study attempted to answer the following critical questions:

- 1.2.1 What were the technical challenges related to the setting up and maintenance of the computer hardware?

- 1.2.2 What were the technical challenges related to the setting up and maintenance of the computer software?
  - 1.2.3 What were the technical challenges related to the setting up and maintenance of the telecommunications links?
  - 1.2.4 How did learners interact with fellow learners and the Instructor in an on-line classroom?
  - 1.2.5 How did learners respond to on-line presentation of subject matter?
  - 1.2.6 How did learners go about performing research using on-line sources?
  - 1.2.7 What new or modified assessment strategies needed to be implemented to suit on-line education?
  - 1.2.8 What security measures need to be introduced to make on-line assessments secure?
  - 1.2.9 How did learners respond to taking the on-line assessments?
  - 1.2.10 Are the learners' performance in on-line assessments, consistent with their previous performance in traditional classroom assessments?
- 1.3 The need for the study

The study will assist in addressing the following problems and challenges facing the ML Sultan Technikon community:

- The system will assist in providing access for learners who are geographically isolated from the Technikon. Many students, after qualifying, find employment in remote areas, in other provinces or even overseas, will now have the opportunity to continue their academic career with the institution. Prospective students who live in remote rural areas will have an opportunity to study at the Technikon using computers available at Telecentres, libraries and community resource centres.
- A large percentage of the student population, study part-time. These students often do not have the time to travel to the Technikon due to their demanding work or personal schedules. The system will allow learners to study in their own time or asynchronously.

- Learners have different abilities. Some learners grasp concepts in a shorter space of time while others take much longer. This system will allow learners to work at their own pace.
- The Technikon has many learners with physical disabilities or who suffer from illnesses and conditions that prevent them from participating in traditional classroom-based programmes. This system will assist in incorporating these students into the Technikon.
- There is a lack of expertise at the Technikon in the areas of web-design and using the Internet as a means of instruction. This project will help to build capacity among personnel in these areas.
- It will put learners in touch with a large amount of multimedia resources available on the Internet. The resources can be incorporated into the normal curriculum. Learners will have the opportunity to experience a wide range of Internet applications such as e-mail, newsgroups, chat-rooms, teleconferencing, World Wide Web and Telnet.
- The project will allow learners to direct their own learning. With the Instructor merely playing a facilitating role, learners can take the responsibility for participating in programmes, completing assignments, gathering information and developing computer skills.
- This project can be adapted from being Internet-based to being Intranet-based. The Intranet-based system uses the same technology as the Internet-based system except that only users within the organization or local area network have access to the learning programmes. The learning programmes will not be accessible from outside the organization. The Intranet-based system can be used to complement the existing classroom-based instruction. Lecturers can use it to administer tests, dispense course notes and integrate the World Wide Web into normal lessons.

#### 1.4 Theoretical framework used in the process

Through the entire process, the “Constructivist” theoretical framework was used.

The following are examples of how the basic principles of the theoretical framework were adhered to (Bruner 1990, Merrill 1991)

- Learning was made to be an “active process” by urging learners to develop their problem-solving and critical thinking skills. They were given opportunities to “construct” their own knowledge by testing ideas and approaches based on their prior knowledge and experience and applying this to new situations.
- Learning was made whole, authentic and real. It involved learners in real world situations. For example, if the learners were thought the advantages of using e-mail or Chat-rooms they were given the opportunity to immerse themselves into the actual application thus learning from their own experiences. Authentic tasks in meaningful contexts were emphasized.
- Learners were exposed to multiple representations of reality. Multiple representations avoided oversimplifications and represented the complexity of the real world. This was done, by giving learners collaborative projects to complete, thus accommodating various viewpoints. The environment supported collaborative construction of knowledge through social negotiation.
- The process emphasized learning and not teaching. Learners were encouraged to work autonomously and show initiative. This was done by not allowing students to have face-to-face communication with course participants.
- The process encouraged learner inquiry and nurtured learners’ natural curiosity. For example, learners were given research tasks to perform using Search Engines.

- Performance and understanding were emphasised when learning was assessed. For example, e-mail, chat- room and research assessment tasks were performance- based tasks.

## CHAPTER TWO

### LITERATURE REVIEW

Two methods were used to perform the literature review. Firstly an on-line literature review, using the Internet was done. This was followed by a text-based review of books, journal articles and conference papers. The results of the two methods will be discussed in separate sections.

#### 2.1 On-line literature - review

In this review one searched for websites (South African and International) that provided some form of on-line distance education using the Internet. This search yielded thousands of websites; therefore one had to delimit the search to concentrate on those websites that were relevant to the parameters of the study. The following are the six categories that were reviewed:

Table 1 provides a summary of the six categories of the on-line literature review, which is then followed by a more detailed analysis.

**TABLE 1****Summary of the six categories of the on-line literature review**

<b>Categories</b>	<b>Organizations</b>
A review of the web sites of all fifteen Technikons in South Africa	Eastern Cape, North West, Cape, Mangosuthu, Northern Gauteng, Peninsula, Pretoria, Vaal Triangle, Border, Free State, ML Sultan, Natal, Port Elizabeth, South Africa, Witwatersrand.
A review of the web sites of all twenty-one Universities in South Africa	North West, North, Venda, Medunsa, Rand Afrikaans, Zululand, Durban Westville, Fort Hare, Orange Free State, Port Elizabeth, Potchefstroom, Rhodes, Stellenbosch, Transkei, Vista, Witwatersrand, Cape Town, Natal, South Africa, Western Cape, Pretoria
A review of a sample of the web sites of schools, Government educational departments and Non-governmental organizations in South Africa.	Cyberschool, Schoolnet, Yenza, Western Cape Schools' Network, Acacia, Edu-Tech Puisano,
A review of the South African educational institutions, making use of the Lotus Notes or LearningSpace software.	Potchefstroom, University of South Africa
A review of a sample of international educational institutions making use of the LearningSpace software	Kennesaw State, Georgia, Russian Ministry of Education, Wisconsin.
A review of a sample of the international business institutions making use of the LearningSpace software	Rouse, Sinopac Bank, IBM, Herman Miller, American Express, Siemens, ACER, World Bank

### 2.1.1 A review of the web sites of all fifteen Technikons in South Africa

The following Technikon web-sites were not available or accessible:

- Eastern Cape Technikon (<http://www.tktech.ac.za>)
- North West Technikon (<http://www.tnw.ac.za>)

The following Technikon web sites were accessible, but did not contain any form of on-line or distance education information:

- Cape Technikon (<http://www.ctech.ac.za>)
- Mangosuthu Technikon (<http://www.mantec.ac.za>)
- Technikon Northern Gauteng (<http://www.tng.ac.za>)
- Peninsula Technikon (<http://www.pentech.ac.za>)
- Technikon Pretoria (<http://www.techpta.ac.za>)
- Vaal Triangle Technikon (<http://www.tritek.ac.za>)
- Border Technikon (<http://www.bortech.ac.za>)

The following web sites did contain some form of on-line or distance education information:

#### Technikon Free State

This site offers various on-line courses using the software called WEBCT (Web Course Tools). Types of courses include agriculture, education, engineering, human sciences and management. These courses are not accessible to the general public and only registered users are authorized to take them. The courses are presented through “TFS On-line” and contain syllabi, schedules, announcements and lecture notes. Discussion groups, live chats, on-line assessments, white boarding and e-mail are also made available to students (<Http://www.tofs.ac.za/onlinecourses/index.htm>).

### ML Sultan Technikon

This site is hosted by the Department of Chemistry and provides course notes, past examination papers and general information on diploma and degree courses. The notes are available in "html format" or in downloadable WordPerfect files or in Microsoft Word format via the "FTP" server. The site was installed and funded by the University of Brighton. Graphics are viewed using the CHIME plug-in for Netscape. The site also presents current research done by the Department ([Http://www.chem.mlsultan.ac.za](http://www.chem.mlsultan.ac.za)).

### Technikon Natal

Technikon Natal has an "Open Learning Centre" (OLC). It serves as a Virtual Classroom and supports on-line Telematic learning. The "COP SHOP" is a resource for the operating systems course offered at Natal Technikon. It was designed by Mari Pete and is an example of an on-line classroom, designed to complement the face-to-face contact ([Http://olc.ntech.ac.za](http://olc.ntech.ac.za)).

### Port Elizabeth Technikon

Although this site does not provide on-line or distance education, it does provide a wide range of information like FTP servers for downloads, news servers and student servers where students can host their own web pages. The "Internet Virtual Library", bulletin-board services, FAQs, guides, tutorials and encyclopaedias are also available (<http://www.petech.ac.za>).

### Technikon South Africa

Technikon South Africa boasts a "COOL Virtual Students Campus". This is a brief summary of the numerous facilities that are available to students via this website. **Biographical information**, lists all the information that was captured when the student was registered at the institution. **Financial records**, lists all the financial transactions that have been made against the students' accounts. **Academic record**, lists the subjects enrolled for, year mark, examination mark and the final mark. **Academic calendar**, lists events and examination

dates. **Assignment information**, lists the assignment and submission dates and the marks awarded. **Track and Trace**, lists the numbers that were given by the Post Office to track posted student assignments. **Feedback and forms** are used for students to change information or contact the lecturer. **Your Studies** contains courseware, academic guidance, on-line self-assessments, discussion groups, frequently asked questions, academic contact details, book lists, student lists and feedback to lecturers and notes (<http://cool.tsa.ac.za>).

### Technikon Witwatersrand

Technikon Witwatersrand in connection with CYBER Connections has set up the “ TWR Cyber Centre” with 50 computers. TWR students have to access information technology, the World- Wide Web, e-mail and educational software. Cyber Connections supplied the computer terminals, software, networking, technical services and furniture. TWR supplied the venue and gave Cyber Connections, whose business is marketing and research, electronic access to more than 12000 TWR students for its business purposes This is a good example of an Education/ Business symbiotic relationship (<http://www.twr.ac.za>).

#### 2.1.2 A review of the web sites of all twenty-one universities in South Africa

The following university web sites were not available or accessible:

- University of the North West (address could not be found)
- University of the North (<http://www.unorth.ac.za>)
- University of Venda (<http://www.univen.ac.za>)

The following university web sites were accessible, but did not contain any form of on-line or distance education information:

- Medical University of Southern Africa (<http://www.medunsa.ac.za>)
- Rand Afrikaans University (<http://www.rau.ac.za>)
- University of Zululand (<http://www.uzulu.ac.za>)

The following University web sites did contain some form of on-line or distance education:

#### University of Durban Westville

This web site was set up by the Computer Science Department, which contains some course notes on assembly language programming and sample programmes. It also lists the contact details of students doing particular computer courses in the Department (<http://yoda.cs.udw.ac.za>).

#### University of Fort-Hare

This site known as “Campus On-line” provides an on-line chat forum, an events calendar, a notice board, classifieds, SRC forms, free Internet mail, search capabilities, student web pages and COMTALK, a communication students’ paper (<http://www.ufh.ac.za>).

#### University of the Orange Free State

This web site contains facilities for students to access timetable-information, examination results, account queries, and access to South African media information. Residence, sporting activities and bursary information are also available (<Http://uovsvm1.uvos.ac.za/index.htm>).

#### University of Port Elizabeth

Although this site does not have any form of on-line distance education, it does contain interesting information like an on-line electronic newsletter called “ONSE ANGELTJIE” (<http://www.upe.ac.za/afned/angel.htm>).

#### University of Potchefstroom

At this University “Telematic Learning Systems” was established in 1996 as a strategic plan to apply appropriate technologies to the learning process. It has enabled over 4000 learners in more than 50 study centres to take part in this initiative in South Africa and around the world.

A wide range of courses, from engineering to theology, are offered using this system (<http://www.puk.ac.za/tls/index.html>).

### Rhodes University

“Rhodes On-line Student Service” ROSS, is an on-line student information site that is only accessible to registered students (<https://www.sec.ru.ac.za/ross>).

### University of Stellenbosch

At Stellenbosch, distance education takes place in two modes. **Internet- driven distance education** is mainly aimed at more advanced students and **Interactive television broadcasts**. These are one-way images with interactive audio, which are independent of landlines that facilitate electronic classrooms in Pietersburg, Midrand, Bloemfontein, Durban, Port Elizabeth, East London, Stellenbosch and Bellville. A wide range of courses are offered in distance mode, ranging from gynaecology to mathematics (<http://www.sun.ac.za>).

### Universit of Transkei

This site contains information about the PLATO system that is installed at “The Centre for Technological Education”. PLATO is an acronym that stands for “Programmed Logic for Automatic Teaching”. The PLATO system contains self- instructional lessons for high school and university students ranging from mathematics to social studies (<Http://www/utr.ac.za/plato/platowp.html>).

UCR-FM is a community radio- station that has bridged the gap between University of Transkei and the wider community. Broadcasting in Xhosa, Zulu, Sesothu and English, it provides information and educational programmes on current affairs, health and welfare issues, as well as science and technology which has had enormous success with the community (<http://www.utr.ac.za/ucrfm/index.htm>).

## Vista University

COLISA (Confederation of Open Learning Institutions of South Africa) is an alliance of three higher education institutions, UNISA, VISTA University and Technikon SA. COLISA supports an integrated and flexible learning system with regional nodal points within which quality distance education is supported by quality study material, face-to-face tutorials and interactive information technology (<http://www.colisa.ac.za>).

## University of Witwatersrand

“Witsplus” is a web site that provides information for students attending part-time studies. Course notes are placed on web pages that are accessible via the Internet (<http://www.witsplus.wits.ac.za>).

## University of Cape Town

The Multimedia Education Group (MEG) was established at the University of Cape Town in March 1997. It is an experimental pilot project with the central focus being the development and implementation of computer- based teaching resources for selected disciplines. The following are some of the projects being undertaken. “**Africa 1300AD**” is a tour of archaeological sites. “**Deep foundations**” enhances students’ basic learning skills in the historical knowledge context. The “**Isiseko Referencing Project**” teaches essay writing skills. “**News-frames**” introduces the conventions of news reporting. The “**Online writing course**”, centres around the word processor and the WWW. “**Images of Africa**” is a course on the perceptions of Africa’s past. “**Reading the World Wide Web**” is a course on practical web authoring. “**Starting blocks**” are on-line resources for software literacy in UCT laboratories (<http://www.meg.uct.ac.za/mission.htm>).

The following are some of the Computer- Based Education (CBE) projects being undertaken at the University of Cape Town. The “**ADP/HR/ITS WEBCAL**” project uses NETG material to teach staff and students Windows, Word and Excel. The Department of Chemistry’s has implemented a computer- based tutorial project. There is also a computer based education programme for high school science. The Department of Construction

Economics teaches construction technologies using computer-based education. The “**Internet Open University**” is lecturer Peter Dunsby’s vision of a South African electronic open-university. The Mathematics department has on-line courses on General Relativity and calculus. The Medical and Microbiology departments also have computer based learning programmes (<http://www.uct.ac.za/projects/cbe/cbeuct.html>).

### University of Natal

This “ Interactive Instructional Material Research and Resources” site, set up by lecturer Kathy Murrell, contains some interesting resources. “**Classroom tutorials**” contain information on “Human Computer Interface” and designing computer- based educational material for Education Masters students. “**Developmental Resources**” contain links to Clipart, Management Tools, Evaluation Issues and facilities available at the University. “**Issues and Debates**” include Interface Design of Web Pages, Copyright Material information and articles on CAL information. There are also links to **live on-line courses** and syllabi (<http://www.und.ac.za/users/murrell/classrm>).

There is also a website set up by lecturer Patsy Clarke that contain some of the following on-line projects like “Boys and Girls Compute to Play”, “Reflections of an online learner”, “The Internet as a medium of qualitative research” and “WWW as a medium of adult learning”( <http://www.und.ac.za/users/clarke/>).

The Multimedia Research Group (MRG) was formed at the University of Natal to investigate alternative computer-based, teaching methods that could play a role in addressing the educational challenges facing students and academic staff at the University. MRG has successfully done the following. It has implemented courses in medicine, biology, economics and computer science. It has developed a number of multimedia packages and spearheaded the development of a HTML tutor and courseware design software. It has also proposed the creation of ICD (Interactive Course Development) (<http://www.und.ac.za /und/icd/mrgmission.html>).

### University of South Africa

“Students on line” (SOL) is UNISA’s Internet-based distance education website. The following is a list of some of the features. “**My courses and assignments**” contains a list of course codes that the student is registered for, e-mail access to the respective lecturers, a list of submitted assignments and credits received, and a discussion forum for that subject. “**Administration**” contains students’ personal biographical records and a facility for students to cancel examination entries, cancel study units and change addresses or examination centres. “**Prescribed books**” give a list of prescribed books for the courses registered. There is also “**Examination timetables**”, “**Library**” that provides access to library catalogues, “**Examination results**” and a “**FAQ**” (frequently asked questions) (<http://sol.unisa.ac.za>).

### University of Western Cape

This web page contains a variety of on-line courses for undergraduate and postgraduate biology students (<http://www.botany.uwc.ac.za>).

This website also hosts the “Internet Biology Education Project” site that has the primary aim of creating a network for better teaching and learning of biology. A vast array of biological resources has been compiled, new resources developed and existing ones converted for the use in the web-based environment. These resources are aimed at improving literacy at secondary school level ([http://www.botany.uwc.ac.za/sci\\_ed/](http://www.botany.uwc.ac.za/sci_ed/)).

### University of Pretoria

This is the home page of Johannes Cronje, who coordinates the Masters Degree in Computer Integrated Education at the University of Pretoria. He has a web-based on-line classroom that is highly graphical and contains amongst others the **Poster Wall**, **Learners Desks**, and **Chalkboard**. The current course contains several facilities.

“**Schedule for 2000**” contains the modules, description, lecturers dates and times. “**Tasks and outcomes**” are listed for each module. “**Students groups**” is a list of class photos and contact details. “**Curriculum**” details what each module comprises of and the credit

weighting. “**Student professional development portfolios**” contain students’ biographical information and qualification, professional experience and affiliations, awards and grants and current projects that students are involved with. “**Lecturers**” contains photographs of the lecturers, biographic and academic information. “**Alumni**” contains information on past students. There are also “**On-line registration forms**”, FAQs, links to various references and resources on the Web (<http://hagar.up.ac.za/catts/abchome.html>).

“C@TTS” (computer assisted teaching and training society of the University of Pretoria), which is also hosted on this site, has numerous resources on web-based learning (<http://hagar.up.ac.za/catts/medhome.html>).

### 2.1.3 A review of a sample of the web sites of formal school systems, government educational departments and non-governmental organizations in South Africa.

#### CyberSchool Africa

CyberSchool Africa was founded in January 1997 and originally offered a web-based exam revision guide for matriculant learners. The interactive curriculum-based tutorials and a range of communication and collaboration features facilitated a unique style of learning and teaching. With a re-launch in July 1999 CyberSchool Africa has proven to be a valuable educational resource for the South African secondary school community. This organization is a major role player in educational hypermedia in South Africa with high-level contacts in government, NGOs, school networking bodies, public and private schools and the corporate sector (<http://www.cyberschool.co.za/register/history/>).

#### SchoolNet SA

SchoolNet SA is a national NGO that develops and expands the use of the Internet in South African schools. SchoolNet SA seeks to support educators and learners in transforming education through the application of Information and Communication Technologies (ICTs) by providing leadership, expertise and developing effective partnerships in the areas of “Internet connectivity and appropriate technology”, “Human resource development and

capacity building”, “Content and curriculum management and development” and “Advocacy and marketing”. SchoolNet SA and its partners hope to meet the challenge of transforming South Africa’s education system from an industrial to a knowledge-based model, contributing to South Africa’s global competitiveness (<http://www.school.za>).

### Yenza

“Yenza” is a word that means, “do it” in Isizulu and IsiXhosa. It is a guide to using the Internet for research and teaching in the Social Sciences and Humanities. The site is a project of the National Research Foundation in partnership with the InfoLit Project of the Adamastor Trust. The main Yenza themes are as follows: “**Learn to use the Internet**” is a section that covers e-mail, discussion lists, searching for information, evaluating information and provides links to a selection of introductory Internet resources. “**Start your research**” contains links to resources on a variety of research- related topics aimed at new and more experienced researchers. “**Yenza for trainers**” contains suggestions for trainers on running courses using Yenza. “**The Internet for teaching**” offers annotated links to resources on integrating the Internet into teaching. “**Subject links**” contains pages of discipline specific links covering a wide range from Education to Home Economics. “**Building a Website**” assists in the technicalities of constructing and managing a website (<http://www.frd.ac.za/yenza/>).

### The Western Cape Schools’ Network

The Western Cape Schools’ Network is an educational networking organization, which supplies Internet services to primary and secondary schools in the Western Cape and promotes the use of the Internet in education. The WCSN was founded in 1993 and is totally self- funded with more than 900 schools connected. Members of the WCSN have started local projects using the Internet, e.g. I\*EARN (International Education and Resource Network) and have developed much experience and knowledge about using the Internet for educational ends and how to integrate it into the curriculum (<http://www.wcape.school.za>).

## Acacia

The Acacia initiative is an International effort led by the International Development Research Centre (IDRC) to empower sub-Saharan African communities with the ability to apply information and communication technologies to their own social and economic development. Acacia has been designed and is being led by Canada's International Development Research Centre (<http://www.idrc.ca/acacia/>).

## EduTech Puisano

EduTech Puisano is a joint venture between the Department of Education and the "Teacher" magazine and the "Daily Mail and Guardian" newspaper. It provides guides to establishing media centres at schools and encourages teachers and learners to use the media resources in this centre. There is a wide range of topics including community radio stations and the use of television as a medium of instruction. It provides useful information on the selection and licensing of software and provides several links to educational resources available on the Internet (<Http://www.teacher.co.za/edutech.html>).

### 2.1.4 A review of South African educational institutions. making use of the Lotus Notes or LearningSpace software.

It was decided to use the Lotus Suite of software packages (Domino, Notes and LearningSpace) in this research project. It was therefore necessary to find out whether other educational institutions in South Africa were also making use of the same products. It was difficult to track down whether any South African Educational Institutions were using the LearningSpace software, but only the following two educational institutions were found using the Lotus Notes platform.

## University of Potchefstroom

The University of Potchefstroom recently deployed an interactive computer system driven by Lotus Notes to run its distance- learning MBA course offered by the Graduate School of Management. This on-line education environment is hosted by Africa Growth Network

(AGN), which is an independent subsidiary of the ABSA banking group and was co-developed by Computer Software Solutions (A Lotus premium business partner). It is currently serving over 300 students. Students have quick and easy access to courseware, can submit completed assignments securely, reference sections of background information and have on-line discussions between themselves. Students are supplied with a CD containing the Lotus Notes software and the framework databases. To update information or assignments, they connect via the Internet or dial directly into AGN's Notes Server. A Video CD is also part of the package. The main benefit of this is that the students can view the supporting video course content without leaving the Notes environment (<http://www.itweb.co.za/office/lotus/>).

### University of South Africa

In order to improve the efficiency and management of its remote academic programmes, the University of South Africa has initiated a project, which calls for the eventual installation of 2500 seats of the Lotus NotesSuite. The product currently forms an integral part of courses run by the Graduate School of Business Leadership and is soon to be extended to other faculties in the university. The necessary course information is stored in a common database accessible to all students who can dial in at a convenient time to download information relevant to particular assignments. In the Notes workflow environment, students are guaranteed secure, efficient store and forward facilities for assignments round the clock. Notes groupware facilities allow students to collaborate on common projects (<http://www.itweb.co.za/office/lotus/>).

#### 2.1.5 A review of a sample of international educational institutions making use of the LearningSpace software.

It was found that many international educational institutions were using the Lotus LearningSpace software. The following are some of the selected sites:

### Kennesaw State University

Kennesaw State University (USA), which has the Southeast's second largest executive MBA programme, has trained executives in the traditional classroom situation for years. But in 1996, officials at the Atlanta University, began to explore distributed learning solutions. In 1998 the MBA distance education programme was introduced and LearningSpace was implemented as the communication and management platform. Now with 250 enrolled students residing in locations from New Jersey to the Bahamas, Kennesaw is using LearningSpace to expand its reach into new geographical and niche markets that were previously impenetrable. Using LearningSpace, Kennesaw students can access a diverse range of educational materials, from print to video, audio, and web pages. They can now interact with fellow students and instructors in a way that fits their busy schedule. Since adopting LearningSpace, Kennesaw State has been able to reduce the number of face-to face meetings required of its MBA students and has allowed the expansion of the programme without a proportionate expansion in teaching staff (<http://www.lotus.com/products/learnspace>).

### University of Georgia

The Terry College of Business at the University of Georgia in Athens, Georgia (USA) recently ran an MBA programme for students who were consultants for PriceWaterhouse Coopers (which is a management consulting practice that is the second largest global consulting organization worldwide). The course used a combination of face-to-face contact and a virtual classroom using LearningSpace (<http://www.lotus.com/products/learnspace/>).

### Russian Ministry of Education

Lotus Development Corporation has concluded an agreement between Lotus and the Ministry of Higher and Professional Education of the Russian Federation for the implementation of Internet, Intranet and distance learning software throughout the Russian schools and universities. The agreement states the intention of both parties to implement a new information and communication technology infrastructure for the Russian education system. Under the agreement, the Ministry permitted and approved the purchase of up to 500000

licences of Lotus Notes and Lotus LearningSpace by state-financed primary, secondary or tertiary institutions in Russia (<http://www.lotus.com/lotus/press.nsf/>).

### University of Wisconsin

As more students entered its international internship programmes, the University of Wisconsin Department of Hospitality and Tourism Management (USA) found that traditional classroom instruction was insufficient. Using LearningSpace, the University now provides specialized instruction in a variety of courses to thousands of students globally via its newly formed Learning Innovations (<http://www.lotus.com/products/learnspace/>).

### 2.1.6 A review of a sample of international business institutions making use of the LearningSpace software.

#### The Rouse Company

The Rouse Company (headquarters in Columbia, Maryland) is one of the largest research and development and management companies in the United States of America. The company needed to train approximately 700 employees in 70 regions across the United States of America on a customized software solution that was in the process of being developed and tested to address budgeting and prospective reporting needs. With the assistance of Lotus business partners, Rouse installed Lotus LearningSpace to assist in generating a six-hour, three module course including simulations to be delivered over the corporate Intranet. Currently training comprises approximately 70% instructor-based and 30% on-line training using LearningSpace (<http://www.lotus.com/home.nsf/welcome/learnspace/>).

#### Bank Sinopac

Established in 1992 in Taiwan, Bank SinoPac provides commercial and investment resources and information to both national and international markets. To ensure that all staff was equipped to represent the bank and market its products, Sinopac delivers training to its approximately 1500 employees. Not only the bank's lecturers had to travel from one location to conduct classroom-based training but the trainees had also to travel to the classroom.

Incurring costs were extremely high and it was difficult to deliver just-in-time training. Faced with this challenge, the bank consulted with Lotus to provide LearningSpace as the single platform, which could define, configure and manage multiple training courses that can be offered to its employees worldwide simultaneously (<http://www.lotus.com/home.nsf/welcome/learningspace/>).

## IBM

IBM creates, develops and manufactures computer systems, software, networking systems, storage devices and microelectronics. It also provides value to its customers through its professional solutions and services business worldwide. In 1995, IBM acquired Lotus Development Corporation. In 2000, they launched IBM Mindspan Solutions, which is a complete family of services and technologies designed to bring customized e-learning solutions to organizations. IBM's Management Development group needs to reach more than 30 000 managers in more than 50 countries. IBM's challenge was to create a rich, learning experience for its managers, while still ensuring that its approach was practical, cost effective and engaging to all participants. IBM tapped into its own technologies and expertise and devised the Basic Blue programme, which was launched in 1999. The twelve-month programme, based on IBM's proven e-learning model and Lotus LearningSpace 4.0, is a blended solution that combines Web-based learning, simulations and collaboration with traditional face-to face learning laboratories (<http://www.lotus.com/home.nsf/welcome/learningspace/>).

## Herman Miller

Herman Miller (Based in Zeeland, Michigan) is one of the world's premier designers and manufacturers of office furniture and systems and relies on LearningSpace 4.0 as the core of its extensive e-learning programme. LearningSpace 4.0 provides a comprehensive solution that meets all of the company's learning needs, from effective course delivery and collaborative learning to seamless management of the entire programme. While its initial focus is training more than 5000 dealer representatives, the company is moving towards adopting Learning 4.0 as the e-learning solution for all of its 7000 employees (<http://www.lotus.com/home.nsf/welcome/learningspace/>).

### American Express

American Express, which provides training worldwide to over 70 000 people has selected Lotus LearningSpace as its primary delivery mechanism for on-line distributed learning programmes. Beginning with key courses in the Human Resource Development Department, the company plans to provide up to 70% of all corporate training via distributed learning within five years. American Express selected LearningSpace on the basis of its collaborative learning platform as well as the tight integration of real-time and asynchronous learning experiences. They plan to make extensive use of the interoperability of LearningSpace with other Lotus Notes knowledge repositories (<http://www.lotus.com/products/learnspace/>).

### Siemens

The Siemens Virtual University (SVU) has been using the LearningSpace software as part of its training programmes for almost two years and has seen a marked increase in the use of the product for virtual team projects as well as training applications. In addition to field technical training, the SVU now delivers classes on new product and service offerings and enables a variety of organizations to hold group meetings on-line. Field employees, business partners, and departmental workgroups all look to LearningSpace as the desired means of sharing information (<http://www.lotus.com/products/learnspace/>).

### ACER

Founded in 1976, Hung Chi Computers (ACER) is the world's third largest PC manufacturer. With over 28 000 employees in 120 affiliates in 37 countries, ACER found that planning and implementing high quality enterprise-wide training for its employees was critical to its success. In a single year, the company offers more than 600 internal training courses across its various business units throughout the world. Turning to LearningSpace, the company was able to effectively plan and implement on-line training, enterprise wide. As the courses are delivered through the use of multimedia technology, they are both lively and interactive. Employees can easily gain access to these courses anywhere, anytime through the Internet to acquire new skills or upgrade existing ones (<http://www.lotus.com/products/learnspace/>).

## World Bank

The World Bank, a public, non-governmental provider of loans and economic development resources and services worldwide, trains its clients and staff often in locations where the telecommunications infrastructure is undeveloped and network connections are slow or intermittent. Together with videoconferencing and printed coursework, the World Bank uses LearningSpace's asynchronous learning technology in its on-line learning courses (<http://www.lotus.com/lotus/press.nsf/>).

## 2.2 Text-based literature review

### 2.2.1 “Interactive Internet” (Johannes Cronje - University of Pretoria )

The following is a summary of a research paper titled “Interactive Internet -using the Internet to facilitate co-operative distance learning” by Prof Johannes Cronjé from the Department of Didactics: University of Pretoria (South Africa).

The University of Pretoria presented a two-year course-driven Master’s degree in Computer-Assisted Education. The course was of a modular design to allow students from geographically distant areas to attend four full- day workshops per month. Early in the second year a course was presented in computer-based communication and distance learning. In the past it was necessary for students to attend the module on campus, as that was the only place where they could gain affordable access to the Internet. With the development of the commercial Internet, the situation arose in 1996, where it was, in fact, cheaper for the students to purchase their own Internet connections, than it would have been for them to travel to class. This provided an opportunity for the presentation model to be reversed. Instead of the students coming to campus to explore the Internet, they were now encouraged to stay at home and treat the campus as just one of the sites for exploration. The idea was to use the Internet to teach about the Internet and in that way to facilitate situated learning at a distance. The students following the course had attended lectures together for eighteen months and thus knew each other well. The classes had relied strongly on co-operative learning principles and students were familiar with this way of working.

The aim of the research project was to determine the feasibility of using the Internet for co-operative, constructivist, distance learning. The following research questions were asked:

- Can a "virtual classroom" be successfully simulated on the Internet?
- Will students who have been used to contact teaching adapt to the virtual classroom?
- To what extent could co-operative work be done over the Internet?

- To what extent will technology and technological literacy affect the learning process?

The following is a summary of the findings, conclusions and recommendations.

- It is essential that students be **familiar with the basics** of their own mailers and browsers. It may be an idea to start the course with a number of exercises in this respect.
- The **remote network MUST be stable**. It is highly disconcerting for students who are concerned about learning as much as possible, to find themselves, let down by technology.
- The same goes for the Home network. Moreover, should maintenance or other eventualities render the **Home network off line, students should be informed in advance**.
- **Deadlines** must be given for every task, and **progress should be monitored**.
- **Co-operative learning works well**, particularly in instances where students have had time to build a relationship of trust in the past.
- **Allowing students to define the scope of their own projects** works well. Comments from their peers are valuable. It may be necessary for the mentor to shape the project in terms of the size, as some students overestimate what can be done in three months.
- **A web site is a good place to store large quantities of information** for non-interactive purposes, while creating ownership by allowing students to add their own URLs contributes to the interactivity of a usually passive site.
- **An on-line discussion group works well**, particularly when this is augmented by a lively forum, such as *ITforum*. Students may not wish to air their views in public, but they might be prepared to discuss it with their classmates.

## 2.2.2 “On-line instruction at Technikon SA” – (JF van Koller – Technikon South Africa)

Technikon South Africa realised that it was of crucial importance to equip their academic staff with the required instructional technology skills in order to implement technology-based instruction effectively. That is the reason why the TELES Dweb Course was introduced. This course was aimed at training and equipping educators and trainers in the skills of on-line web-based instruction.

The following is a summary of the general aims, structure and findings of the study:

The course consisted of the following eight modules:

**Module 1:** Your On-line Classroom, The Technology and Network Learning

**Module 2:** Instructional Design and Network Pedagogies

**Module 3:** Web Multimedia Attributes and Their Use for Learning

**Module 4:** Teaching and Moderation in the On-line Classroom

**Module 5:** Assessment and Evaluation of On-line Students

**Module 6:** Developing the Course: Producing and Assembling Course Components

**Module 7:** Class Presentation of Instructional Design Templates Projects

**Module 8:** Presentation of Instructional Design Templates, Formative and Summative Evaluation, Conclusion

The on-line campus consisted of the following main sections or components:

**The conference section:** This was the main and most important section of the campus since most of the discussions, exercises and activities took place here. Participants were required to read the first message of the instructor, which provided an introductory discussion of the lesson/module and the tasks or assignments for the week. Participants also read and commented on the messages of other participants. The conference section also provided a facility for the submission of assignments.

**The workspace section:** This section was mainly used for the activities and exercises that required a lot of practice and experimentation. Participants used this section to practice and overcome any difficulties that they might have had. There was also a submission box for assignments and tasks in addition to a similar facility in the conference section.

**The information section:** This section provided participants with basic information on the campus, the course(s) offered and where to find different sources of information.

**The courses section:** This section provided information on: the different courses offered; the syllabus of each course; the grades each participant obtained at every stage of the course and a section where participants could evaluate the past week's session and activities.

**The library:** The library provided different references and also allowed access to different sources in a direct fashion (e.g. by including web-addresses or direct links to certain sources). The library also allowed direct access to different search engines on the world –wide- web.

**The U-Chat section:** This section was used mainly for real time (synchronous) communications or chats. Participants were required to utilize this facility at a predetermined time when everyone could participate simultaneously.

**The café section:** This section allowed for the initial introduction of each participant in the course. It also allowed opportunities for informal chats and requests for assistance. However, the café communications were also asynchronous.

**The administration section:** This section was used for the setting of participants' own profiles on aspects such as password, e-mail address, language preference and so forth. Participants could change any of the above aspects if the need arose. They could also use this section to send feedback on the campus structure to the system developers.

**The gallery section:** This section contained some examples of multimedia and other images and could be visited by participants for interest sake.

### 2.2.3 “The Internet and Distance Education” ( Eunice Ivala – University of Natal)

It is often taken for granted that the Internet provides all the solutions in delivering on-line distance education. The author of this paper provides some interesting thoughts on the constraints, which hinder the use of the Internet in distance education in South Africa and the rest of Africa.

The following is a brief summary of the main points:

#### Inadequate telecommunication infrastructure

Many underdeveloped countries have limited telecommunication networks and the Internet is totally dependent on minimum levels of telecommunication infrastructure for their existence. The number of telephone lines per 100 people, a measure known as "teledensity " is perhaps the largest constraint. The average teledensity among developing countries is just 1.5. In very low-income countries like Afghanistan, Guinea, Liberia, Niger and Somalia, the figure is 0.0002 or one telephone for every 500, 000 people. In Cambodia, Chad and Zaire there is one for every 1,000 (International Telecommunications Union, 1995; Aleobua, 1999). At global level, at least 80% of the world's population still lacks the most basic telecommunication. Africa has the lowest number of telephone lines per capita in the world and the existing telecommunication infrastructure is in very poor condition. In a world where information technology has become the engine of economic growth and power, this places Africa at a serious comparative disadvantage. According to a recent BBC broadcast dealing with the Internet in Africa (Wilson, <http://journ.ru.ac.za/review/11/dave.html>), a figure of one telephone per 100 people was given as being an average for the African continent. The teledensity in Sub-Saharan Africa is currently estimated at 0.5. This equates to approximately one phone line for every 200 people. By comparison, the teledensity in United States of America is 65 (equivalent of one phone line for every two people) and 45 in Europe (the rate of Zimbabwe was estimated at 1.2 in 1994). Viewed in this context, terms like the 'information superhighway' become meaningless, and any form of Internet connection appears to be an attainable dream for the majority of African countries.

### Internet access and telephone charges

It is estimated that the average cost of a low volume Internet account in Africa is about US\$ 50 per month, using the lowest-priced services available in each country (in most cases just e-mail). When the cost of the telephone call is added to this, the total cost of access is probably more than US \$75 per month on average (Jensen, 1998). The average cost of a dial-up Internet connection in Africa is US\$75 per month compared to US\$10 in the United States of America and US\$15 in England. Further, local telephone connection charges in Africa can be very significant whereas in the United States of America local calls are free. The service is beyond the reach of all but the wealthy. Another factor limiting the growth of the Internet is the bandwidth (the high capacity international connections that make Internet use possible.) This is associated with the poor telecommunication infrastructure and prohibitive regulatory environments.

### Computer hardware and telecommunications equipment costs

According to the International Telecommunication Union (ITU, 1995), "an inhabitant of a high income country is four times more likely to have access to a television set than an inhabitant of a low-income country; 25 times more likely to have access to a telephone, but 8,000 times more likely to have access to an Internet host computer". More basic still, one in three people globally lack access to electricity. Analysts agree that the cost of putting a computer in every home, of establishing the necessary infrastructure or, merely of providing electricity to every house is prohibitive (Mannisto, Kelly and Petrazzine, 1998). Business and educational institutions in Africa face substantially higher cost for computer and telecommunications equipment than their counterparts in developed economies. For example, a basic PC is at least 50 percent more expensive in Africa than in United States of America after government duties and taxes are applied. This makes computers a very expensive proposition for business and educational institutions in Africa, especially when one compares the relative cost of wages between the two countries. Adjusting for wage rates, a computer in Africa is approximately 6 times more expensive than in the United States of America. Looking at this from a different perspective, and computer in Zimbabwe is about 10 times the Zimbabwean per capita GDP, a computer is 15 times the per capita GDP of Ethiopia (Mannisto, Kelly and Petrazzine, 1998), whereas in the United States of America, it is approximately 1/10 of the per capita GDP.

### Skills Shortage

The development of the Internet is seriously constrained by the shortage of skilled human resources. According to International Telecommunications Union (ITU, 1997), "if one excludes China and India, the number of people in developing countries with no access to secondary education rises to three quarters of the population. In high income economies by contrast, more than 97% of the population have access to secondary education". Most IT and related companies in the African continent face huge shortages of skilled personnel. Universities and technical colleges in Africa are often ill equipped to provide training on current technological developments and consequently provide training unsuited to the needs of the market.

The skills shortage results in high turnover of staff in technology- related companies as staff are poached from one company to the next. This results in a significant loss of productivity. Further, companies are reluctant to invest in training of staff due to the likelihood that trained personnel will be poached by other companies. This further limits the amount of skills available on the continent.

### Political restrictions and tariffs

Political restrictions are common in many developing countries and several countries have a politically motivated policy of making the Internet access unaffordable to all but commercial users. Access to the Internet in China, which is subject to tight regulations, cost around US\$70 a month (ITU, 1995). Tariffs on imported computers can also make Internet access far more expensive. In India, for example, tariffs on computers reach 120 percent.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 The research design of the study

The “Case-Study approach” was used to study the characteristics of a group of learners at ML Sultan Technikon, who took an On-line Distance Education Internet-based course. The reason for choosing this approach was based on the premise that this group under study at the Technikon is typical of many other groups within the Technikon and at other higher educational institutions in South Africa that provide or are hoping to provide on-line distance education. The researcher attempted to study the life cycle of this group, with a view of establishing generalisations about a wider population to which the group belonged.

The “Participant Observation” strategy was used. The researcher, apart from being the observer, also participated in the development of the On-line Information System and participated as the Instructor of the group. The researcher therefore had “Participant and Observer” status.

The researcher made use of mainly qualitative methods and the research report is largely a descriptive one, while in a few instances, quantitative methods were used such as statistical correlation analysis of the assessment scores of the learners.

#### 3.2 The setting: an overview of ML Sultan Technikon

ML Sultan Technikon is a tertiary institution, being one of fifteen Technikons in the Republic of South Africa. It is situated in Ritson Road in Durban in the province of Kwa-Zulu Natal. The vision of the Technikon is to be a world-class educational institution of technology for entrepreneurial leadership. In its quest to train leaders of tomorrow, ML Sultan Technikon strives for the transformation of Higher Education through sustainable, quality teaching, learning, research and development programmes in participation with industry and the wider community (ML Sultan Technikon, General Handbook, 2000).

The Technikon has twenty-six academic departments, which make up the four faculties of Arts, Commerce, Engineering and Science. Besides a wide range of courses up to Diploma level, the Technikon also offers programmes that lead to the award of the Bachelor of Technology (B.Tech), Masters of Technology (M.Tech) and the Doctor of Technology (D.Tech) degrees.

It also serves the community by offering intensive short courses in various high level industrial and commercial skills, both in response to requests from individual companies and from the public in general. It presently employs 900 staff members and has a student population of about 8800.

The research took place in the Department of Commercial Administration, which is one of six academic departments in the Faculty of Commerce. The On-line Distance Education component of the research was integrated into the National Diploma in Office Management, which is one of two full-time programmes offered by the Department. The purpose of this diploma is to produce future Office-Managers with the necessary knowledge, techniques and technology, to be able to work in the fast changing office environment.

### 3.3 The on-line distance education course (OLDEC)

The OLDEC was integrated into the subject Information Processing II , a second-year subject in the National Diploma in Office Management.

#### 3.3.1 Reasons for integrating the OLDEC into the Information Processing II subject

It was administratively difficult to initiate and run a new “stand-alone” distance education course. It would have taken too long for the Technikon structures (Faculty Boards and Council) to approve and grant permission to run a new course. It was easier to integrate the OLDEC into an existing, pre-approved subject. The credit obtained from doing the OLDEC contributed to the final credit of the subject Information Processing II.

The specific outcome of the OLDEC formed part of the broad overall outcome of the Information Processing II, making integration easier. The learners that enrolled for

Information Processing II were better prepared for taking the OLDEC, since it was assumed that they had the necessary pre-requisite computer knowledge and skills required to undertake such a course.

Information Processing II formed part of the researcher's normal time- tabled lecture load, making it easier to conduct the research during normal lecture times, as computer facilities and venues were made available during these times.

It was the first time that the Lecturer (researcher) made contact with these Information Processing II students, thus preventing past interaction with these students from affecting the findings of the study.

### 3.3.2 The OLDEC curriculum

The OLDEC was titled "Experiencing the Internet". The broad educational outcome of the course, was to provide learners with knowledge and practical experience, in important Internet Applications (e.g. E-mail, World Wide Web, Chat-rooms and Discussion Forums). The idea was to use the Internet to teach the Internet.

The first term of 2000, from the period 7 February 2000 to 24 March 2000 was used to conduct the study. The course comprised of six modules, with each module designed to take one week to complete.

Four forty-minute periods per week were allocated for practical lessons in the computer laboratory and one forty-minute period per week was allocated for discussion in a normal classroom venue.

The timetable was as follows:

Monday 10:15 to 10:55 (Discussion session)

Monday 12:25 to 13:05 (Practical session)

Wednesday 11:00 to 11:40 (Practical session)

Thursday 8:00 to 8:40 (Practical session)

Friday 8:00 to 8:40 (Practical session)

Table 2 lists the duration, specific outcomes and assessment criteria for each module.

**TABLE 2**

**A list of the Duration, Specific Outcomes and Assessment Criteria for each Module**

<b>Module</b>	<b>Specific Outcomes</b> <i>After the completion of this module the Learners would have achieved the following:</i>	<b>Assessment Criteria</b>
Module One (Orientation Module) from 7/02/ 2000 to 11/02/2000	<ul style="list-style-type: none"> <li>• Understood the objectives and rationale for the research.</li> <li>• Understood the ground rules and procedures that would be followed during the research.</li> <li>• Logged-in and entered passwords successfully.</li> <li>• Used the basics of the Web Browser environment.</li> <li>• Navigated through the Lotus LearningSpace environment.</li> <li>• Accessed time-table information.</li> </ul>	There were no assessments for this module
Module Two From 14/02/2000 to 18/02/2000	<ul style="list-style-type: none"> <li>• Understood the definition and advantages of a Computer Network.</li> <li>• Understood the term Communication Media and the different types of Communication Media</li> <li>• Understood the meaning of the word Topology and the different</li> </ul>	The learner was required to take an on-line assessment test based on the work covered in the module. The test consisted of multiple- choice single answer, multiple- choice multiple answer and true or false type questions.

	<p>types of Topologies</p> <ul style="list-style-type: none"> <li>• Understood the definition of LAN and WAN and some examples</li> <li>• Understood the definition, its uses and a brief history of the Internet.</li> </ul>	<p>There were twenty questions worth one credit each.</p>
<p>Module Three From 28/02/2000 to 3/03/2000</p>	<ul style="list-style-type: none"> <li>• Understood the definition and advantages of e-mail</li> <li>• Used the principles of e-mail etiquette when sending e-mail</li> <li>• Understood the structure of an e-mail address.</li> <li>• Read and sent e-mail using the Free South African Service Webmail.co.za</li> <li>• Read and sent e-mail using the free American Service Hotmail.com</li> </ul>	<p>The learner was required to log into Webmail or Hotmail and access the test question that was posted via e-mail. The learner was then required to submit the answer by sending an e-mail to the Instructor. Marks were allocated for the actual content of the answer, language usage and use of e-mail rules and etiquette.</p>
<p>Module Four From 6/03/2000 to 10/03/2000</p>	<ul style="list-style-type: none"> <li>• Understood the basics of the Domain Naming Service</li> <li>• Understood the e-mail address of people and domain names</li> <li>• Understood the Web Server Computers and domain names</li> <li>• Used the different capabilities of the Web Browser</li> <li>• Understood the difference between Hypertext and Hyperlinks</li> <li>• Accessed various Web Sites</li> </ul>	<p>The learner was required to undertake an on-line test. The assessment consisted of short open-ended questions. The test consisted of twelve questions with a total of thirty credits.</p>

<p>Module Five From 13/03/2000 to 17/03/2000</p>	<ul style="list-style-type: none"> <li>• Understood the purpose of Search Engines</li> <li>• Used Yahoo, HotBot, Excite and other International Search Engines</li> <li>• Used Ananzi, Mweb, ZaZoo and other South African Search Engines</li> <li>• Performed on-line research on the Internet</li> </ul>	<p>Each learner was given a topic to research using the Internet and was required to summarise the information and write a three hundred-word essay comprising, the title, body and bibliography. The task was worth thirty credits</p>
<p>Module six From 20/03/2000 to 24/03/2000</p>	<ul style="list-style-type: none"> <li>• Understood the purpose of IRC</li> <li>• Used chat-rooms to communicate with fellow course participants</li> <li>• Created own chat-rooms and had private conversations</li> </ul>	<p>Learners were allocated chat -room groups and were given a collaborative, problem- solving task. Credits were allocated according to the level of interaction and contribution to solving the task using the chat-rooms</p>

### 3.4 The student participants

The class consisting of twenty-two, who had registered for Information Processing II, participated in the research project. Prior to the students taking the OLDEC, an on-line survey questionnaire was administered (see Annexure A – Questionnaire A). Only sixteen of the twenty-two students were present on the day the survey was conducted. The purpose of the survey was to gain the following information about the students:

- Biographical Details
- Past Academic Record
- Computer Literacy Level
- Pre – knowledge of the Content of the OLDEC
- Written English Communication Skills

The information gained from the survey assisted the researcher in designing the OLDEC at the appropriate level, taking into account the limitations and pre-requisite knowledge of the students. The survey revealed the following background information about the students:

- 100% of the students came from the Black African race group.
- 75% of the students completed their schooling career in under-resourced, rural schools.
- 88% of the students did not have access to computers at secondary school level.
- Of the 12% that did have access to computers at secondary school level, most of them used it only to work on commercial software packages, e.g. Microsoft Word, WordPerfect.
- Most of the students who were accepted for this diploma did commercial subjects, e.g. accountancy, business economics and typing at matriculation level, although students with good grades in non-commercial subjects were also accepted.
- 94% of the students do not have access to computers outside the Technikon.
- 100% of the students had not used the Internet before, and very few had pre-requisite knowledge required for the OLDEC.
- 63% of the students did not frequently read topics related to computers (i.e. consulting books and magazines).
- The basic computer literacy level of students were very low, since the only exposure that they had had on computers, was at the Technikon in 1999, doing the first-year subject, End-User Computing.
- The written English communication, of students was very poor (e.g. spelling, grammar, expression). This could be attributed to the fact that all of them used English as their second language.

### 3.5 The OLDEC instructor

The Instructor of the course played the following additional roles:

- Designer and Developer of the Curriculum.
- Implementer of the Information System.
- Researcher.

The Instructor has had eight years of tertiary lecturing experience and eight years of work experience in Commerce and Industry and holds qualifications in Electronic Engineering, Computer Science and Education and is also the Programme Co-ordinator for the Diploma and belongs to various Technikon committees dealing with Quality Assurance and Curriculum Development.

### 3.6 The implementation of the OLDEC information system

The implementation of the OLDEC information system took place during the period December 1999 to January 2000. This included several phases, which will be detailed below.

#### 3.6.1 The “OLDEC Server” set-up phase

The Server is the main computer that manages and disseminates the OLDEC. To save on costs, an existing personal computer was made available from the Department. It had the following hardware specifications: a Laser Platinum PC with an INTEL Pentium II processor running at 233 Mhz. having 64MB of RAM, 4 GB of hard drive space, a 44-speed CD-ROM drive and a VGA monitor. These hardware specifications were adequate, considering that, at any given time, a maximum of twenty-two users would have access to the Server.

The next step was to install an operating system onto the Server. It was a choice between Windows 95, Windows 98, Windows NT and Windows 2000. Windows NT 4.0 Workstation was chosen due to its reputation for reliability, stability and security features, which has a proven record in the corporate sector. Windows 95 and Windows 98 were not suited to the

“high-traffic” networking environment and Windows 2000 was a fairly new product with several bugs and had not been fully tested.

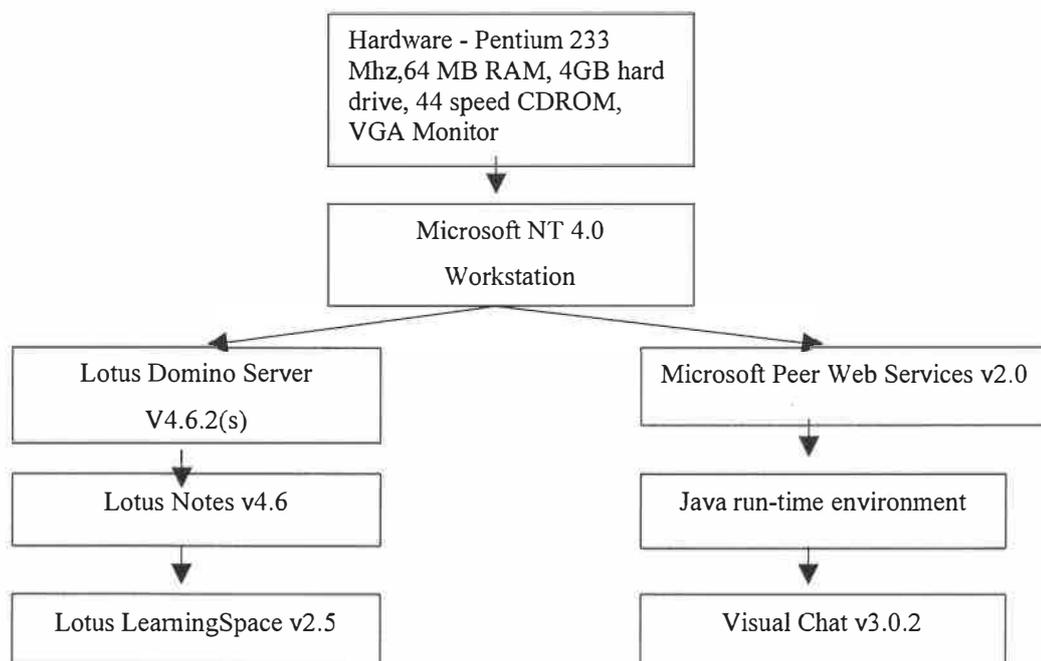
Next, a suite of packages had to be chosen, that could manage and help create the OLDEC. The Lotus suite of packages was chosen, since it was the only available package that met the needs of the OLDEC. It provided all the necessary building blocks (integrated components) and was easy to install and operate. It was purchased from IBM South Africa and paid for by the Technikon. It consisted of the following components:

- Lotus Domino Server version 4.6.2(a) with integrated components that included a Database Server, HTTP Server, NNTP Server, LDAP Server, SMTP Server, POP3 Server and IMAP Server.
- Lotus Notes version 4.6 (e-mail client software package).
- Lotus LearningSpace version 2.5, which was a software package that allows one to create, conduct and administer on-line distance education courses. LearningSpace is a distributed- collaborative learning environment, which allows one to form an on-line community of learners, instructors and course participants.

The next step was to set up the software that provided an on-line Chat Room. The following suite of packages was chosen to accomplish this:

- Microsoft Internet Information Server (Peer Web Services) version 2.0, which was a software -package that delivered Web pages.
- Java Run-time Environment version 1.1 which allowed Internet applications written in the Java programming language to execute on the Server.
- Visual Chat version 3.0.2 allowed Internet uses to engage in conversations using private and public Chat-rooms.

Figure 1 shows the layers of the OLDEC server.



**Figure 1: Layers of the OLDEC Server**

### 3.6.2 The “Instructor PC” set-up phase

It is not good practice to work directly on the Server console, to create courses and maintain databases once the software has been installed. If this were done, it would have used up valuable resources on the Server, which would have resulted in slower access times to users connecting to the Server. This could have also caused the Server to unexpectedly freeze or shut down. To prevent this from happening a second computer, called the Instructor PC was connected to the Server that served the following functions:

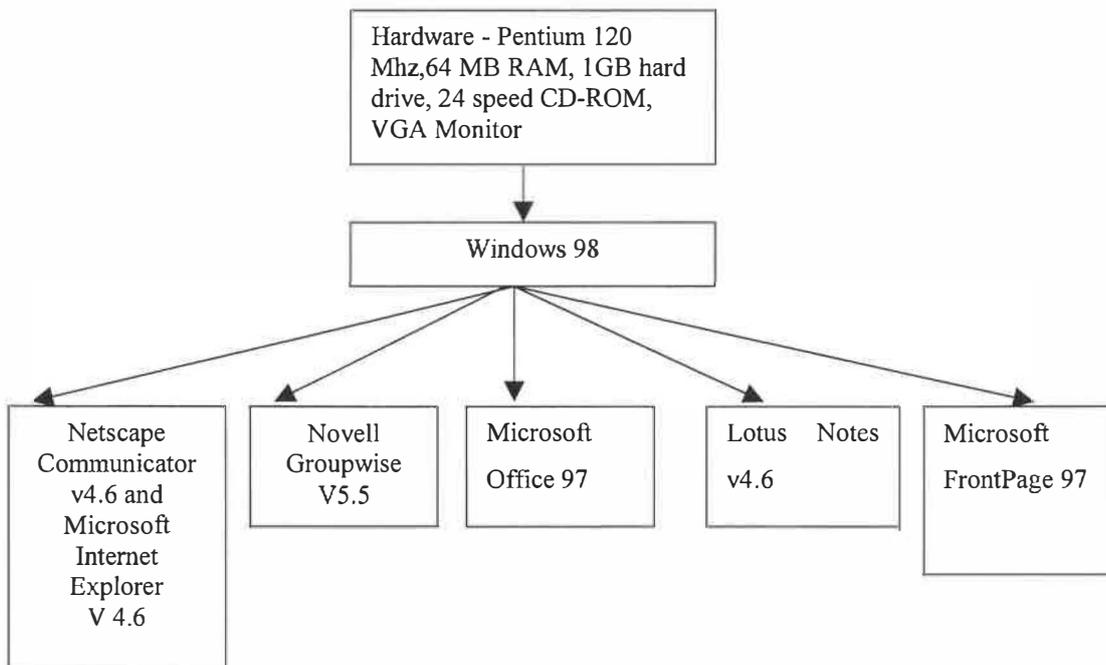
- All programming, creation of courses and maintenance of the Server was done via the Instructor PC. The Server could be controlled remotely.
- The Instructor PC was used to test the OLDEC. Before students were allowed to work on the course, the Instructor could preview the course to check for accuracy and “bugs”.
- The Instructor PC was used to send and receive e-mail from students
- The Instructor PC was used for backup and replication purposes. A copy of all the data present on the Server was made and placed on the Instructor PC. If the data on the Server was corrupt or was destroyed, it could easily be restored, by copying it back from the Instructor PC onto the Server.

The Instructor PC had the following hardware specifications. It was a VTECH computer with an Intel Pentium running at 120 MHZ. It had 64MB RAM, 1GB of hard disk space, a 24-speed CD-ROM drive and a VGA monitor.

The following software packages were installed on the Instructor PC:

- Microsoft Windows 98 operating system
- Lotus Notes Version 4.6 was installed to allow connectivity to the Server for maintenance and backup purposes.
- Microsoft FrontPage 97 was used to create some of the web pages for the OLDEC.
- Microsoft Office 97 was used to create some of the text and graphics for the web pages of the OLDEC.
- Novell GroupWise version 5.5 the e-mail client was used to send and receive messages from students
- Web Browsers, Microsoft Internet Explorer Version 5 and Netscape Communicator Version 4.6 was used to test and preview the OLDEC.

Figure 2 shows the layers on the Instructor PC



**Figure 2: Layers of the Instructor PC**

### 3.6.3 The Student PCs set-up phase

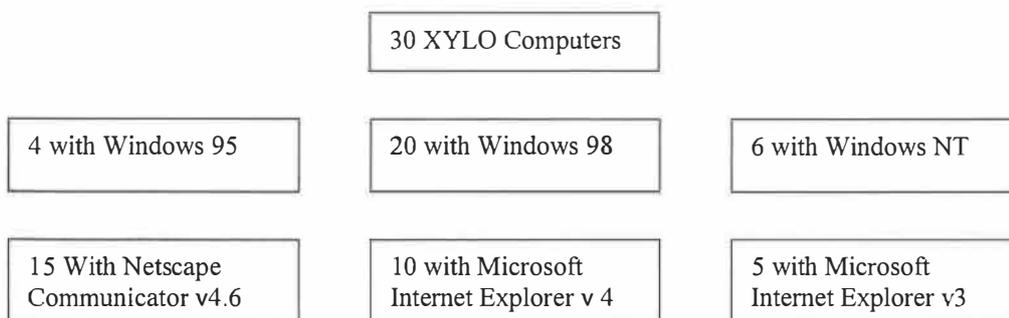
An existing computer laboratory with thirty computers belonging to the Department of Commercial Administration was made available to students, which provided access to the OLDEC Server and the Internet.

The student PCs had the following hardware specifications. They were XYLO computers with Intel Pentium 133 MHZ processors with 32 MB RAM, 2 GB hard drive space and VGA monitors.

It was decided to install three operating systems in the Student PCs, to study, which were the most reliable. Six computers had Microsoft Windows NT 4.0 Workstation installed. Four computers had Microsoft Windows 95 installed and twenty computers had Microsoft Windows 98 installed.

Students accessed the OLDEC Server via the Internet using Web Browsers. It was decided to install three versions of Web Browsers, to study, which were the most reliable and provided the most features. Fifteen computers had the Netscape Communicator Web Browser V4.6, ten had Microsoft Internet Explorer Version 4 and five computers had Microsoft Internet Explorer Version 3 installed.

Figure 3 shows a summary of the Student PCs set-up



**Figure 3: Summary of the Student PCs set-up**

#### 3.6.4 Student e-mail accounts set-up phase

It was decided that e-mail accounts for each student be set-up with external Service Providers that offered free Internet e-mail services. This was necessary, since the Technikon's MIS (Management Information Services) Department, refused to set up accounts for the students on the internal campus GroupWise network. The reasons given for this refusal was that if they acceded to this request, it would compromise security and increase the network traffic, causing slow, campus network access.

The Instructor applied for e-mail accounts for each student from Webmail, a South African company and Hotmail, an American company. The reason for applying for two e-mail addresses was that if access to Webmail was not available, then Hotmail could be used, and vice-versa. Therefore each student had two e-mail addresses that took the following format:

- Shezi@Hotmail.com
- Shezi@Webmail.co.za

#### 3.6.5 The telecommunications system set-up phase

The telecommunications system provides the connectivity between the Server, the Instructor PC, the Student computers, the existing networking infrastructure at the Technikon and the Internet.

The following steps were followed:

- NICs (network interface cards) and their corresponding software drivers were installed on the Server, the Instructors PC and the Student computers.
- The TCP/IP protocol software with unique IP addresses had to be installed on all PCs.
- UTP (unshielded twisted pair) Ethernet cabling had to be connected to all NICs, via Active Distribution Hubs. This allowed complete connectivity to the existing Technikon network infrastructure and the Internet.

It was decided that the OLDEC Server be accessed only from within the Technikon, i.e. it will operate only within the Intranet. This implied that learners from outside the Technikon

and the rest of the world would not have access to the OLDEC Server. The reasons for operating the OLDEC Server on the Intranet was as follows:

- Since the project was still in its infancy stages and many “bugs” were present, it was not advisable to allow the outside community, access to it.
- The Intranet is more secure than the Internet, which makes it difficult for hackers to pose a security risk.

Although the OLDEC Server was only accessible from within the Technikon, students had access to the rest of the global Internet. The Intranet feature was made possible by changing the configurations on the Proxy/Firewall Server that was situated at the Technikon’s MIS Department.

The connectivity to the outside world was made possible by a Router, connected to a Modem with a 64 kbps Telkom Diginet line connected to the UNINET Hubs located at the University of Natal-Durban campus.

Figure 4 illustrates the telecommunications infrastructure:

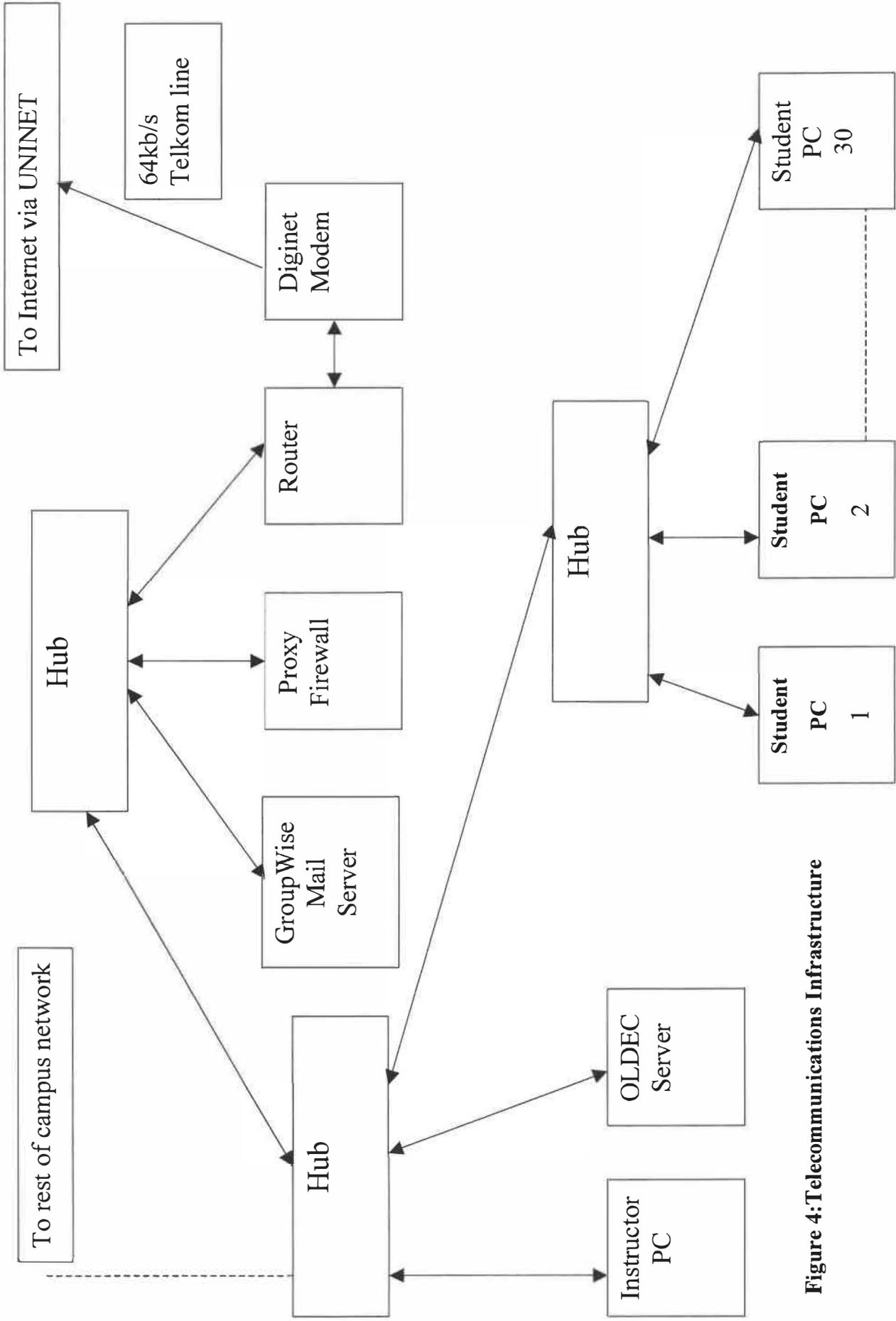


Figure 4: Telecommunications Infrastructure

### 3.6.6 Setting up of the OLDEC learning programme

#### 3.6.6.1 The user authentication screen

The first web page that the student encountered was the user authentication screen. The student was prompted to enter a user name and password. The system then authenticated whether the Student was a valid registered student by comparing what was entered, to that present in the system's databases. User accounts for all twenty-two students were created with their surname as their user name and their registration number as their password. The system then used this login information to track all activities of the student as they navigated through the system. Figure 5 shows the user authentication screen.

**Figure 5: User authentication screen**

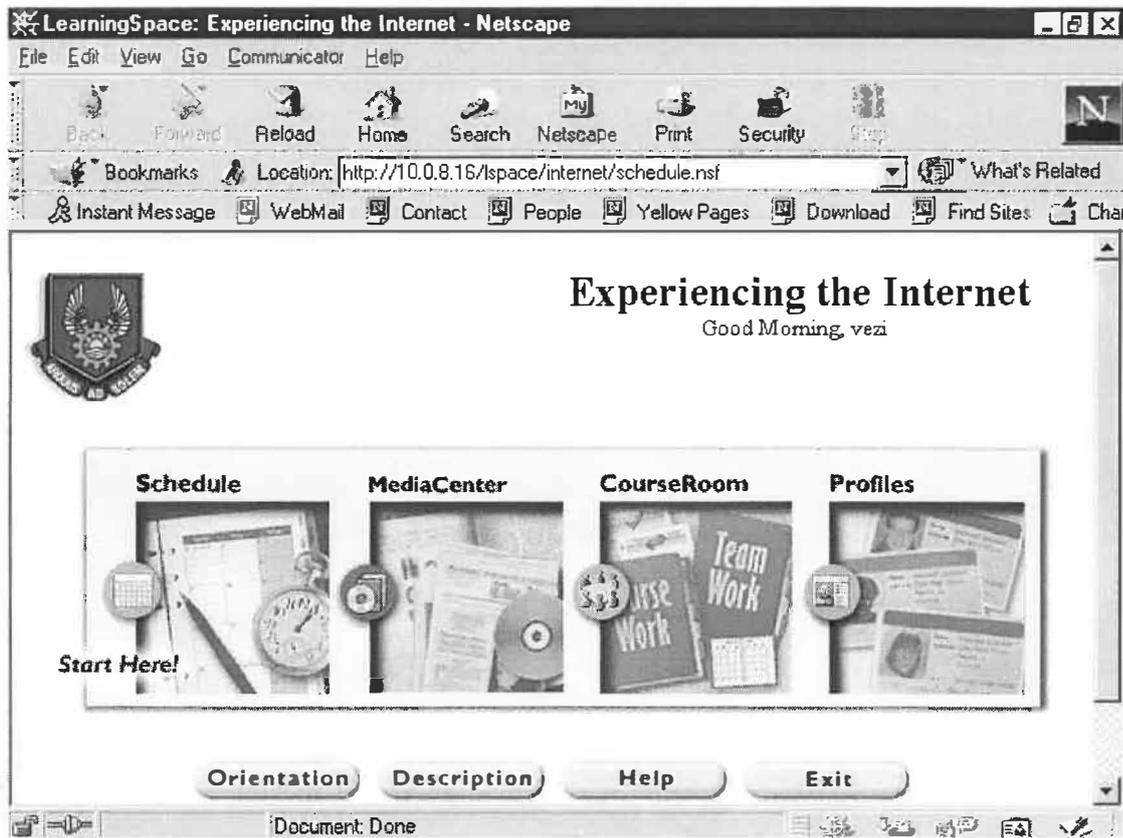


The image shows a standard Windows-style dialog box with a title bar that reads "Username and Password Required" and a close button (X) in the top right corner. The main text inside the dialog says "Enter username for /lspace at 10.0.8.16:". Below this text are two input fields. The first field is labeled "User Name:" and contains the text "vezi". The second field is labeled "Password:" and contains seven asterisks "xxxxxxx". At the bottom of the dialog, there are two buttons: "OK" on the left and "Cancel" on the right.

### 3.6.6.2 The home page screen

Once the student was successfully logged-in and authenticated by the system, the student was presented with the home page. The home page consisted of four main functional areas, viz. Schedule, Media Centre, Course-Room and Profiles that the student could navigate through. The Orientation, Description and Help buttons provided more information and assistance for first- time users. Figure 6 shows home page screen.

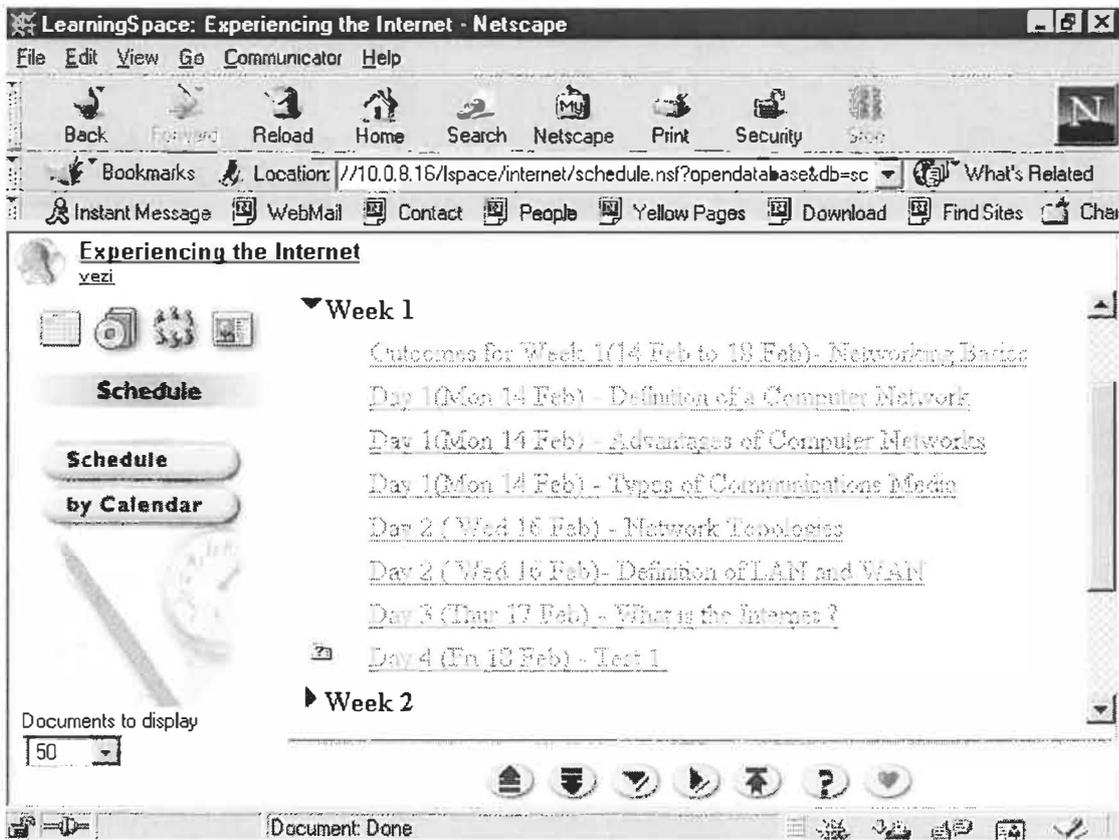
**Figure 6: Home page screen**



### 3.6.6.3 The schedule web page

The schedule served as a road map to the course, similar to a syllabus, guiding the student through tasks and the materials that were needed to complete their work. It linked directly to the content. The schedule presented the structure and details of the course, such as assignment resources, learning objectives, overviews, reading materials, exercises, surveys and tests. The schedule could have been organized for self-paced learning, with no specified due dates, or mapped to a particular time- frame that used dates for completion. Depending on the design of the assignments, one could directly start a discussion or assignment from a schedule document. Figure 7 shows schedule web page.

**Figure 7: The schedule web page**



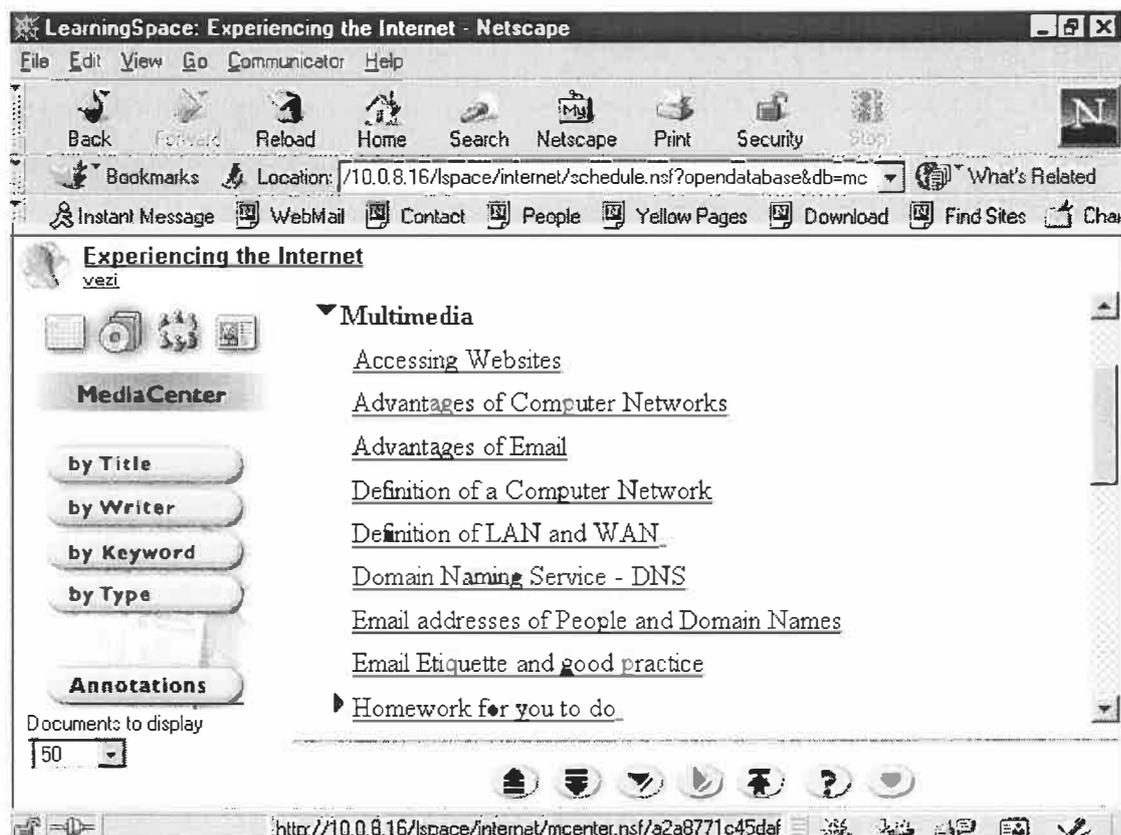
### 3.6.6.4 The media centre web page

The purpose of the media centre was to provide the following:

- It acted as a repository or store for all resources
- It contained all the reference materials for the course, similar to a library
- It had full Multimedia capabilities, e.g. text (articles, book excerpts), graphics, sound files, video clips and URL links to other sources on the Internet.
- It also had the ability to launch applications that resided on CD-ROM, allowing one to integrate materials on CDs, such as dictionaries, computer- based training programmes, etc.
- It allowed one to view documents in various ways, similar to card catalogues in the library. One could view by title, type, writer or keyword.
- It could be used to create a list of FAQs (frequently asked questions)

Figure 8 shows the media centre web page

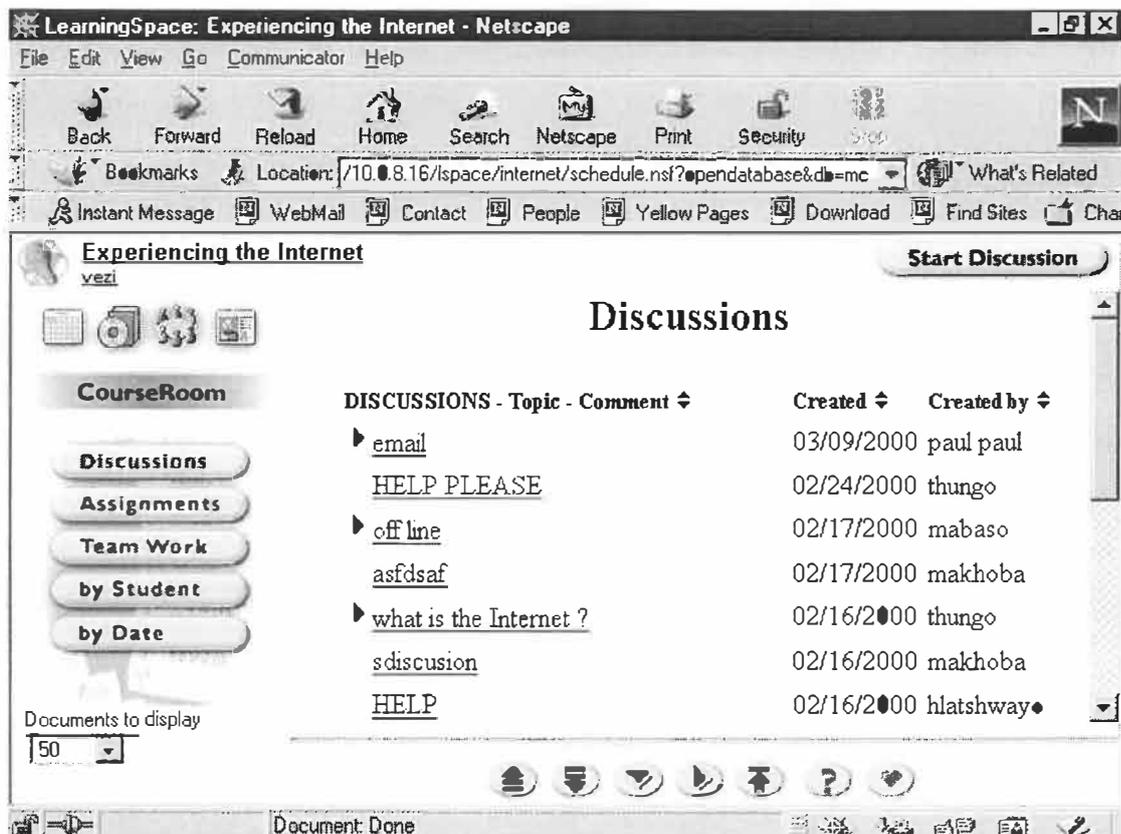
**Figure 8: The media centre web page**



### 3.6.6.5 The course-room web page

The course room was the interactive, on-line classroom. One could discuss topics among fellow participants, share information and complete projects and assignments. The course-room allowed one to work in assigned teams and facilitated collaboration with the instructor(s) and other classmates. The multiple levels of communication enabled public and private levels of interaction. One could enter topics for the entire class to read, or make it private between the student and the instructor(s), or for team members only. Sophisticated course-room views separated discussions and assignments, making it easy for the student to identify tasks. The instructor facilitated the course- room, by helping the student with assignments and discussions, providing general feedback and answering questions to promote student success. Figure 9 shows the course-room web page

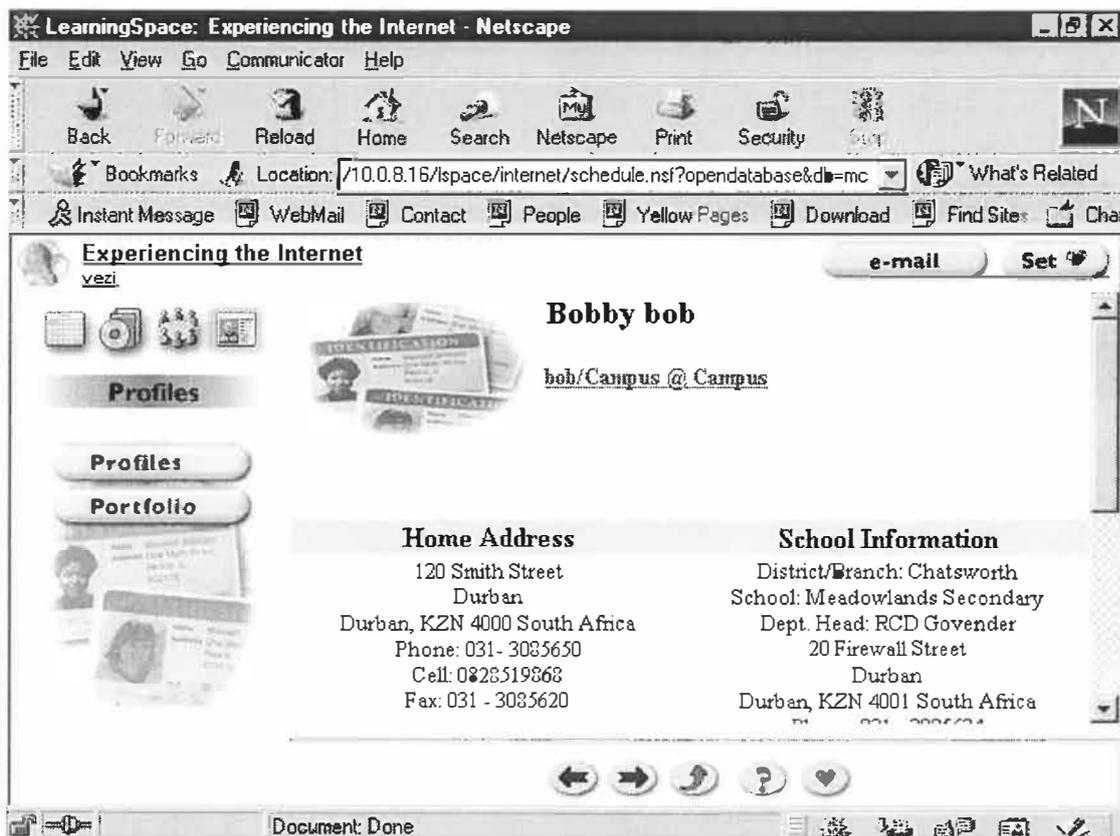
**Figure 9: The course- room web page**



### 3.6.6.6 The profiles home page

The profiles contained information on fellow course participants and instructor(s). The students could provide information about themselves, by editing the profile so that it contained the picture, nickname, interests and depending on the course, educational and work background information. This database enabled the student and their classmates to get to know each other since one may not have the opportunity to meet face-to-face. In addition, one could access a private portfolio of graded class assessments and assignments. Figure 10 shows the profiles web page.

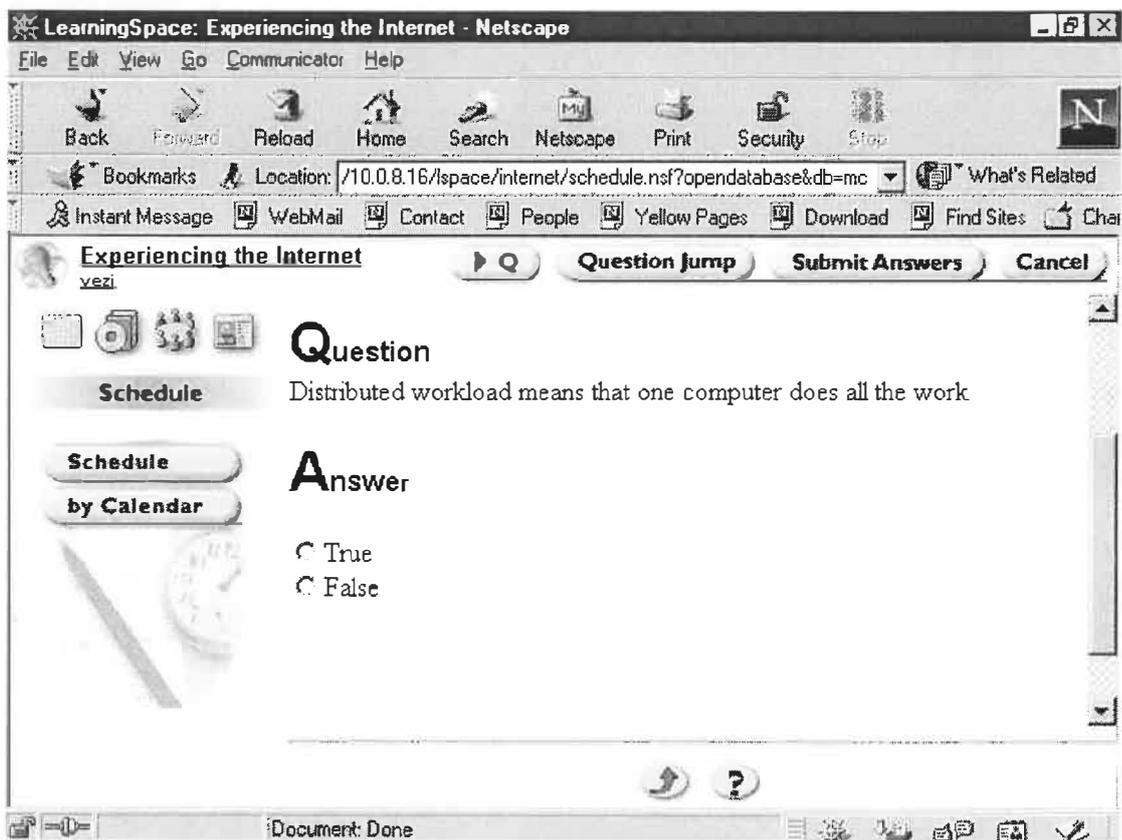
Figure 10: The profiles web page



### 3.6.6.7 The assessments web page

The system also had the functionality of allowing the Instructor to create quizzes, examinations, surveys and self-assessments. The computer could automatically grade true or false type questions and multiple choice type questions, while the instructor graded open-ended questions. Due dates were set for each assignment and the student was limited to the number of times that an assessment could be taken. Figure 11 shows a typical assessment web page.

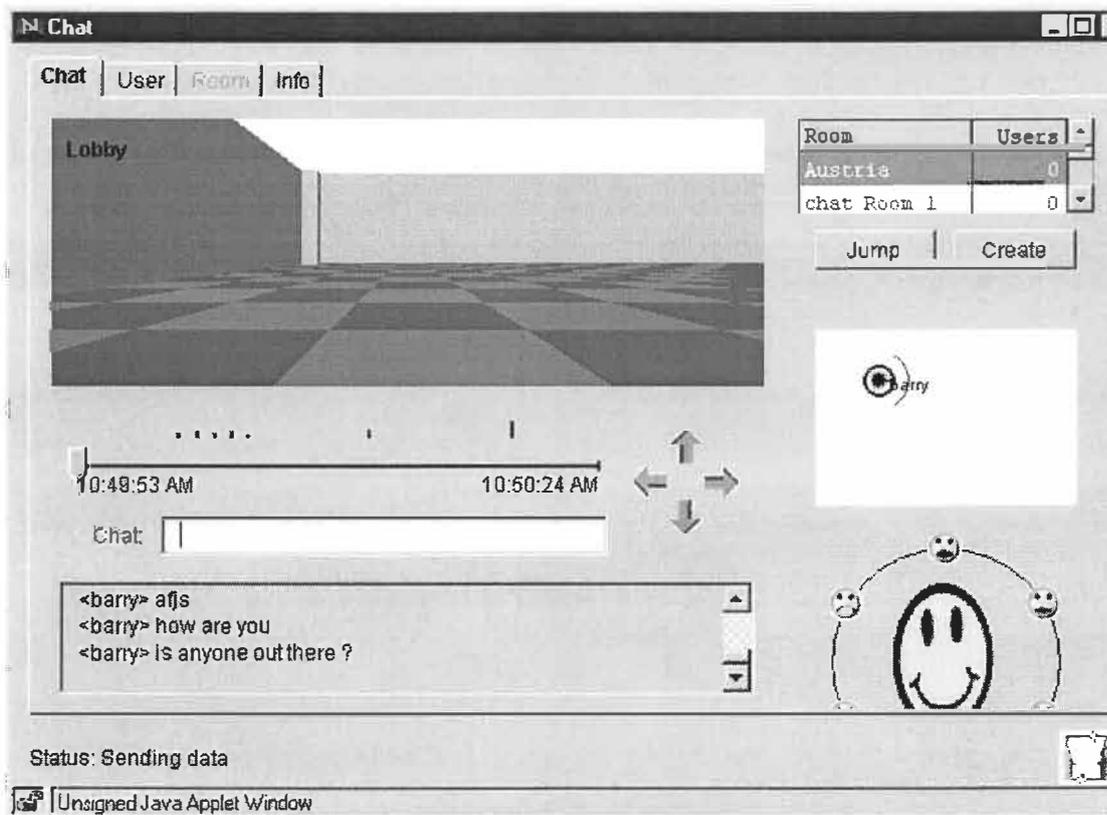
**Figure 11: The assessments web page**



### 3.6.6.8 The chat- room web page

IRC (Internet Relay Chat) allowed students to have conversations with fellow course participants and people anywhere around the world using the Internet. This was done, by typing messages on the keyboard. This type of conversation is also called real-time chat since there is very little delay in the messages getting from one point to another. Unlike e-mail this is a much quicker way of communicating with people. When the student wanted to begin chatting he or she entered a specific chat-room or channel. A chat-room is a place where a specific subject or theme is being discussed. public chat-rooms, where anybody on the Internet could join in and have a conversation and private chat-rooms, where two people could have a private conversation could be created. Figure 12 shows the chat room web page.

**Figure 12: The chat room web page**



### 3.7 Data collection plan and instruments used

The following data collection strategies and instruments were used:

- Students worked on the OLDEC for four forty-minute periods per week for six weeks. This was done in the Department's computer laboratory. While students were busy with the OLDEC, the Researcher observed students at random while they were interacting with the computer. Observation notes were kept in a book called the "**OBSERVATION LOG**" and its contents were later analysed.
- Students were allocated one forty-minute period per week for six weeks in a classroom venue, which was originally scheduled as a theory lecture period. The Researcher used this period to conduct informal interviews with the class. The learners were prompted to provide feedback of their experiences with the system. The interview questions were open-ended and semi-structured. Interview notes were kept in a book called the "**INTERVIEW LOG**" which was later analysed.
- The design of the curriculum and the implementation of the Information System were done by the Researcher. In order to record and track the progress of the project, the Researcher kept notes in a book called the "**CRITICAL INCIDENT LOG**". This book was also used to record the overall thoughts of the Researcher through the project. The contents of this log were later analysed.
- During every practical lesson, each student was given a notebook called the "**STUDENT LOG**". All students were urged to record their experiences and any other problems they experienced with the OLDEC and were later analysed.
- The stored data (**electronic records**) on the Server provided a rich source of information. It stored learners' test answers, assignment and project submissions and e-mail and discussion forum interactions. A content analysis of this was done.

- Prior to the students taking the OLDEC, an on-line survey questionnaire was administered (See Annexure A – **Questionnaire A**). The purpose of the survey was to gain information about the students such as biographical details, past academic record, computer literacy level, pre-knowledge of the content of the OLDEC and written English communication abilities. The responses from the survey, were collated by the computer, and the contents of this electronic data were later analysed. The findings of this survey are detailed in this chapter under the heading “The Student Participants”.
- After the students completed the course, another on-line survey questionnaire was administered (See Annexure B – **Questionnaire B**). This questionnaire served an evaluative function. Students were prompted to give their overall comments on the way the course was designed and presented and to determine whether it met its intended objectives. The computer collated the responses from this survey and the content of this electronic data was analysed.

### 3.8 Issues of validity

By using the process of triangulation, all seven data sources mentioned above were used to verify the occurrence of certain phenomena and findings. This helped in strengthening the validity of the research.

### 3.9 Control procedures

The following control procedures were used:

- In order to simulate a true distance education environment, students were not allowed to communicate verbally with fellow course participants and the instructor in the laboratory while working on the OLDEC. Students were only allowed to communicate via e-mail, chat-room, or discussion- forum. If students experienced problems or needed clarity on an issue, they would write it down in the “Student Log” or bring it up during the weekly feedback sessions.

- Strict time limits were placed during lessons and tests. For example, if a lesson was designed to take forty minutes, students were compelled to complete taking the lesson within this time period. The purpose of stipulating a fixed time period was to gauge whether the time allocated for each lesson was sufficient.

### 3.10 Planned process versus the actual process

It is often the case in research projects that unusual and unforeseen problems arise. So one had to deviate slightly from what was originally planned in the research proposal.

The following is a list of modifications that had to be made in order to accommodate these unusual occurrences and unforeseen problems.

- It was originally envisaged that the OLDEC would comprise of eight modules spanning a period of eight weeks, which would cover the entire first term of 2000. Technikon management's decision to shorten the term resulted in only time being available to complete six modules, spanning a period of six weeks.
- During the first module (Orientation) from 7 February 2000 to 11 February 2000, only 20% of the students had registered for the course. During the second module from 14 February 2000 to 18 February 2000, only 80% of the students had registered for the course. Due to this late registration, some students lagged behind, not having time to catch up on work already covered.
- On the day the on-line survey Questionnaire A was administered, only sixteen out of a possible twenty-two students took the survey. This may have affected the validity of the findings.
- As a control procedure to simulate a distance education scenario, it was decided that students were not allowed to communicate verbally with fellow course participants and the lecturer during the laboratory sessions while working on the OLDEC. This was not always the case. Some students were found secretly chatting with their friends or looking at each other's computer monitors. On some

occasions, the Researcher found it unavoidable and had to communicate critical instructions verbally to the students. This may have affected the findings of the distance education simulation scenario.

- During the running of the OLDEC, it was decided to include an additional data source, which was not originally planned for. Students were given a notebook called the “STUDENT LOG” to record their experiences and any other problems that they had experienced with the OLDEC.
- It was originally envisaged that students would only be allocated four forty-minute periods per week to complete the OLDEC. The allocated time was insufficient and additional afternoon and Saturday morning sessions had to be arranged in order for students to complete their work. Students who were absent from some sessions, used this additional time to bring themselves up to date with the current lessons.
- During the week of 13 March 2000, there was widespread student unrest on the Technikon campus. Some lecture days had to be cancelled and re-scheduled. This caused confusion among many students, resulting in some students not attending module five and module six. Due to this problem, only 80% of the students took the on-line evaluation Questionnaire B. This may have affected its validity.
- It was originally planned that students would not be given a second chance to complete tests. But in some instances, hardware and software problems prevented students from taking tests. In some instances students were absent from tests. In these instances, students were given a second chance to complete the same test that they missed. Since a new test was not set, this could have affected the validity of the assessment results.
- In some instances, students were reluctant to give the researcher feedback on the OLDEC, especially in filling in of the “STUDENT LOG” and during the interview sessions. The reasons for this reluctance was probably due to them being

scared or shy to voice their opinions and fear of being victimized if they were to disagree with certain points of view.

## **CHAPTER FOUR**

### **FINDINGS**

The study produced the following findings that are categorized according to their significance in answering the critical questions.

#### **4.1 Findings associated with the technical challenges in the setting up and maintenance of the computer hardware**

##### Server reliability

The server hardware was found to be very reliable with no breakdowns, considering, that it was switched on twenty-four hours a day for the duration of the course.

##### Low server component specifications

Although high quality components were used, the server had low component specifications. The CPU type and speed was too low. It lacked sufficient RAM and the hard-drive capacity. When students tried to access the assessment databases, simultaneously during the on-line tests, students complained that it took too long to access the next question in the test. Since strict time limits were set for tests, these delays resulted in students not having enough time to complete tests and so were unfairly disadvantaged.

##### Lack of uninterruptible power supply (UPS)

On several weekends, interruptions in the Technikon and Durban Metro electricity supply caused the server to switch off and reboot itself. In an on-line distance education scenario, this is not acceptable, since students should have access to the server at all times. The server was not equipped with any uninterruptible power supplies.

### Lack of backup devices

The Server was not equipped with any “backup devices”. Backup devices would have allowed one to copy the entire data content of the server. If data on the server was lost or corrupted, the backup copy could have been used to restore the original content.

### Lack of digital input devices

Effective multimedia production equipment, such as scanners and digital cameras are essential in the design of any OLDEC. Due to the lack of these facilities, creating illustrations and drawings were time consuming, and one often found it difficult to search for suitable graphics.

### Faulty Workstations

The computers in the laboratory were used daily from 8:00 to 16:00 by all students in the department. Due to this high usage factor, some computers broke down or were vandalized by students. These problems ranged from “sticky mice”, monitors not displaying graphics, computers rebooting and problems with power wiring.

Faulty computers did not pose a problem, since students were relocated to spare computers in the laboratory.

Computers ending up faulty were also due to the Technikon not providing sufficient technical personnel to service the equipment. Also suppliers of computers did not keep their warranty agreements, resulting in spares not being available to repair faulty components.

### Lack of Internet facilities

There were approximately twenty, fully equipped computer laboratories at the Technikon. It was found that only a few of these laboratories had Internet access and were made available to students after hours and during breaks. With a student

population of over 8800, these facilities were inadequate. Students that did not have access to the Internet after hours found it difficult to cope and revise certain modules of the OLDEC.

#### Lack of printing facilities

No printing facilities were made available to students in the laboratory. Students without after-hours access to the Internet could not make hard copies of the Web pages for revision purposes. Printers were also essential in printing out sequential instructions given in the web pages, which were too long to memorize.

#### **4.2 Findings associated with the technical challenges in the setting up and maintenance of the computer software.**

#### Lack of technical support

The Domino Server software was purchased from IBM South Africa. Apart from an orientation seminar lasting one-hour, no technical support was available from IBM on the installation and maintenance of the software. When telephonic support was requested, it was found that some of the software engineers had moved to other positions in the company, or had resigned or were not available. No technical support was available from the MIS Department at the Technikon, since none of the personnel were familiar or had worked with the LearningSpace software before.

The Instructor was forced to install and maintain the software without external technical support. It was both a frustrating and challenging experience for the Instructor to figure things out from first principles and taking approximately two months to get the software working.

#### Incorrect server operating system

The server was loaded with the Microsoft NT Workstation version 4.0, operating system. Although this did not present any major problems associated with reliability and stability, it did cause slow access, when many users tried to access the Server

simultaneously. NT Workstation 4.0 is normally installed on student PC's or "client" computers. The correct software should have been Microsoft NT Server version 4.0, but this piece of software was not available at the Technikon and was too expensive to purchase.

#### Problems experienced during the creation of student e-mail accounts

"Notes" is a propriety e-mail system designed by Lotus that forms part of the Lotus Domino package. Ideally, the Lotus Notes software should have been installed on the Campus network with user accounts created for all twenty-two students, thus allowing them the full benefit of all the features of the package. This was not possible since the Campus was set up with a legacy, Novell GroupWise e-mail system. The MIS department refused to have two different e-mail systems running concurrently i.e. Lotus Notes and Novell GroupWise, as it would pose a lot of technical problems to configure both these systems to communicate with each other. This would have required additional hardware and software such as mail gateways. This limited the users from experiencing the full benefit of the package.

The MIS department was approached to create e-mail accounts for the twenty-two students on the existing Novell GroupWise e-mail system. This request was turned down. The reason given was that it would compromise the Campus network security and would increase the network traffic causing a slow down in access speeds. The instructor had to therefore create e-mail accounts for the students, using the free e-mail Internet service providers HotMail and WebMail. Although this served the purpose, it was not the preferred solution.

## Lotus LearningSpace problems

The following “bugs” and inadequacies were found with Lotus LearningSpace:

### **Authentication Problems**

User-names and passwords were created for all students. On a few occasions, some students had problems logging into the course i.e. the system failed to verify and authenticate them properly, thus denying them access to the course. This was an intermittent problem. The problem was temporarily solved, by allowing them to login with “dummy” user-names and passwords. The source of this problem was not found.

### **Internal Assessment errors**

On a few occasions, while students were busy taking on-line tests and submitting answers, the computer would freeze and not allow them to continue with the test. It would come up with the following error message:

*“LearningSpace encountered an Internal Assessment error (Error no. 4091.141)”*

The cause of this error could not be traced and students had to re-do the tests.

### **Incorrect number of test questions**

In some instances, the incorrect number of test questions was displayed while students were taking the on-line assessments e.g. if a test contained fifteen questions, the computer would only display twelve out of the possible fifteen questions. The reason for this error was inexplicable and students had to redo the test.

### **Portfolio limitations**

The purpose of the “portfolio” web- page which was part of the “profiles” web- page was to display the assessment status of the student i.e. it should have displayed the credits obtained for each test, assignment or project, in web-page format. The

“portfolio” should have also displayed the marked tests, assignments and projects that were returned to the student. This was not so. Students could not gain electronic feedback of credits, marked assessments and Instructors comments. Therefore, hard copies of these had to be made and handed to students. This defeated the purpose of having a true “paperless” environment. This was partially due to not installing the Lotus E-mail system.

### **Importing HTML code**

The “Media-Centre” was used to store the web pages for the OLDEC. When HTML code was imported from other external sources, into the Media-Centre web-page, it could not display the page properly on the Web Browser i.e. only HTML code written specifically in the Media-Centre environment could be displayed correctly. This was probably due to LearningSpace not being fully compatible with the entire HTML standard.

### **Limitations of the Lotus Http Server**

The Http Server is a programme that hosts and disseminates web pages to be viewed on a web browser. The Lotus Http Server could only display web pages that were specifically created in the Lotus LearningSpace environment. Therefore web pages created in other environments such as Microsoft FrontPage could not be hosted and displayed. To solve this problem, another web server programme (Microsoft Peer Web Services) had to be installed on the same machine and was used to host and display third party web pages. This resulted in conflicts between the existing Lotus Http Server and the Microsoft Peer Web Server. The problem was solved, by placing the Http Server on Port 80 and the Microsoft Peer Web Server on Port 1080.

### **Limited Java extensions**

Java is a programming language that allows one to create Internet applications. When the Java Chat programme was installed in the Server, the Java Domino extensions could not support this application. Therefore a third party Java Run-time environment version 1.1 had to be installed to support the Java Chat programme i.e. Domino Java

extensions could only support Domino and Lotus Java applications and not third party Java applications.

### **Inadequate functionality**

This version of LearningSpace did not have any form of real-time chat facility. This is an important component in on-line distance education, allowing synchronous communication. One had to therefore install a third party Java Chat programme on a separate Web Server (Microsoft Peer Web Server). It also lacked other functionality such as “White-boarding” which could allow students to graphically collaborate on projects. It also did not have any facilities that could support teleconferencing and video-conferencing, that allow students to speak, hear and see other students via digital cameras and microphones.

### Security risks

It was found that students posed many security threats to the software installed on the workstations. Students often deleted or modified certain important system and programme files on the workstations. Students modified and experimented with important configuration information on their computers such as altering screen properties, changing network settings and introducing their own screen saver passwords. Students also brought in viruses on disks that infected the network.

### Operating system reliability

It was found that of the three operating systems installed, Windows NT was the most stable and reliable (in terms of having superior features and functionality with less “downtime” and fewer “system crashes”), followed by Windows 98 and lastly, Windows 95.

### Browser reliability

Of the three browsers installed, it was found that Microsoft Internet Explorer 4 and Netscape Communicator 4.6 performed equally well while Microsoft Internet Explorer 3 performed poorly.

### **4.3 Findings associated with the technical challenges in the setting up and maintenance of the telecommunications links**

#### Low speed Diginet line

The Technikon used one 64Kbps (Kilo Bits Per Second) Diginet line that connected the Technikon to the UNINET (Higher Education Internet Service Provider) hub that it situated at the University of Natal- Durban. With over 900 staff members and a small proportion of the student-population accessing the Internet, this bandwidth was grossly insufficient.

#### UNINET's poor Internet infrastructure

The Technikon used UNINET as its service provider. Initially UNINET was designed to accommodate a few Universities and Technikons. With the growth of the Internet, it now services over fifteen Technikons, 21 Universities and a large number of schools, colleges and government educational departments. It therefore cannot support the large data traffic volumes required today.

#### Low Intranet - bandwidth

The Technikon used network hardware such as hubs and network interface cards that operated at a speed of 10 Mbps within the local Intranet network. With large amounts of data traffic created due to large multimedia file transfer required in on-line distance education, this speed was found to be too slow.

## **16 bit network interface cards (NICs)**

Most of the computers in the laboratory use 16-bit NIC's, resulting in a limited amount of data being transmitted and received.

### Internet disruptions

There were constant interruptions to Internet access. This resulted in extreme frustration and de-motivation among students. On one occasion a practical session had to be cancelled. The problem manifested itself in the following way. The Browser would fail to connect to the web site and would come up with the following error:

*FW-1 at Fw : Failed to connect to WWW Server*

The MIS department offered the following explanation, that the problem had been isolated to Checkpoint in the USA. The above problem illustrates that we are constantly dependent on third party services for our content and connections.

### Firewall configurations

A Firewall is a computer that resides inside the Technikon network and is responsible for the security of the Technikon's Campus network. It prevents unauthorized access such as hackers breaking into the network. It determines whether outside users have access to Servers within the campus (Internet Servers), allowing only users within the Technikon access to the Servers (Intranet Servers). The MIS department refused to configure the Firewall so as to make the OLDEC Server accessible from the outside. Only users from within the Intranet could have access.

### Free e-mail service providers

Initially students were signed up with the free Internet e-mail South African service provider called WebMail. This service was found to be unreliable. Although the

access speeds were fast (being a local site) it was sometimes offline and students could not read and send e-mail. A backup service was necessary. Therefore students were signed up with a second free Internet e-mail American Service Provider called Hotmail. Although Hotmail was slower to access, it was much more reliable than WebMail. Students therefore had a choice between the two.

#### 4.4 Findings related to how learners interacted with fellow learners and the instructor in the on-line classroom

##### Differences found in the three electronic modes of interaction

Learners used three electronic modes of interaction viz. **E-mail**, **Internet Relay Chat (IRC)** and **Discussion forums** (Newsgroups). Table 3 shows a summary of the essential differences that were found between these three modes.

**Table 3 Differences in the three electronic modes of interaction**

	<b>e-mail</b>	<b>IRC</b>	<b>Discussion Forums</b>
<b>Communication Speed</b>	<b>Slowest</b> , since mail needed to be deposited and retrieved from many intermediate post boxes and mail servers.	<b>Fastest</b> , since a single IRC Server coordinated the simultaneous transfer of messages and messages were not saved or temporarily stored.	<b>Faster than E-mail</b> , since messages, were handled by a single News Server and were not deposited in various post boxes. <b>Slower than IRC</b> , since messages were saved and categorized by the News Server.
<b>Mode of Communication</b>	<b>Asynchronous.</b> Users did not need to be simultaneously on-line. Communication did not take place in real-time.	<b>Synchronous.</b> Users had to be simultaneously on-line. Communication took place in real-time.	<b>Asynchronous.</b> Users did not need to be simultaneously on-line. Communication did not take place in real-time.

	<b>e-mail</b>	<b>IRC</b>	<b>Discussion Forums</b>
<b>User Identity</b>	Identity of users and originating computers were normally <b>traced</b> from e-mail addresses or from computer's IP address.	Total <b>anonymity</b> was maintained with the use of nicknames.	Users <b>remained anonymous</b> or <b>revealed</b> their identity.
<b>File Transfer</b>	File attachment was <b>possible</b> e.g. programme, audio, video and graphics files.	File transfer was <b>not possible</b> .	File transfer was <b>not possible</b> .
<b>Storage capabilities</b>	<b>Messages could be saved</b> on disk either on the local computer or on the mail server for later reference.	<b>Messages could not be saved</b> on the IRC Server. Reference to "communication history" was not possible	<b>Messages could be saved</b> on disk either on the local computer or on the News Server for later reference.
<b>Level of Message Categorization</b>	<b>Lowest</b> Was difficult to group e-mail messages into topic categories.	<b>Had a higher level than E-mail but a lower level than Discussion forums.</b> This was made possible by allocating specific chat-rooms (Channels) to users with similar topics	<b>Highest level of categorization.</b> Messages were categorized according to their discussion topic.

### Discussion Forums – The least used mode

It was found that Discussion Forums were the least used mode of interaction.

### Face-to – face interaction was unavoidable

In order to simulate an on-line distance education scenario, the original intention was to only allow students to communicate using the three electronic modes of interaction, viz. e-mail, IRC and discussion forums. This was not the case and could not be effectively enforced. Participants therefore used a fourth mode, “face-to-face” interaction. This occurred on the following levels.

#### **Interaction during “orientation” lectures**

Although a distance education scenario was to be simulated it was necessary on the first few days to deliver a normal lecture to brief students on the purpose of the research, ground rules and to give them time-table information. This orientation was necessary since students were not given timeous notification of the project implementation. Students were also taught how to log-on and test their passwords and how to navigate through the browser.

#### **Normal lectures had to be held during technical problems**

On two occasions, normal lectures had to be held, due to problems with the Internet connections.

#### **Communication during practical sessions**

Although it was against the rules, some students still looked at the screens of other students and communicated with them verbally and non-verbally, in the laboratory.

### **Assistance given by the Instructor**

Although it was against the rules to offer assistance to students while they were working on the OLDEC, the Instructor had to intervene, at times when it was found that the students were making blatant errors.

### **Unsupervised sessions**

When students used the laboratory after hours to practice on the OLDEC, the Instructor was not present to control the environment to simulate a distance education scenario, and face-to-face communication could have occurred.

### **Interaction during feedback sessions**

Once a week, one session was dedicated to interviewing students to gain feedback on the course.

## **4.5 Findings related to how Learners responded to the on-line presentation of subject matter**

Shortcomings inherent in the way the content was presented.

### **Lack of clear definitions**

It was found that certain terms used in the content such as “peripherals”, “images”, “junk-mail”, “lap-top computer” and “desk-top computer” were not understood by students. The Instructor wrongly assumed that learners had the knowledge to understand these terms.

### **Lack of clear explanation of conventions used**

Students questioned the reason why certain conventions were used, which at times seemed illogical and foreign to them. For example, one student worked through a section on “conventions used when writing e-mail messages”. He did not understand

why one should not use all uppercase letters when typing out messages. It was not mentioned to the student that, using all capital letters was the equivalent of “shouting”

### **Ambiguity**

It was found that in certain instances, students were confused with ambiguous statements. For Example instead of giving the instruction “click on home” the instruction “go to home” was given which could have implied that the student was required to go back to the home page.

### **Content errors**

It was found that in some instances there were spelling and grammatical errors in the content. In a few instances there were technical errors. For example, when one was giving instructions on “how to access e-mail”, some of the instructions were insufficient or incorrect. This tended to confuse and annoy students.

### **Incorrect sequence of lessons**

It was found that in one instance, the lesson on “e-mail” should have come after the lesson on “web-browsers”, since knowledge of web-browsers were necessary in accessing web-based e-mail.

### **Lack of focus**

It was found that when students were presented with large amounts of content, they were overwhelmed (Information overload) and found it difficult to identify content that was important for assessment purposes. The Instructor failed to indicate to students what was relevant for the test.

### **Insufficient development of critical thinking skills**

In a traditional classroom setup, students are not normally given an opportunity to consult their notes when taking assessments. In an on-line distance education scenario

students will have access to the content while taking assessments (the equivalent of “open-book” examinations), resulting in test questions being made more complex, requiring students to apply their critical and analytical skills. The Instructor did not encourage students to engage with the content in a critical manner, eventually preparing them for “open-book” assessments.

### **Failure to adapt content to the language level of students**

It was found that in some instances, the Instructor copied whole chunks of content from web sites on the Internet and directly imported it into the OLDEC web pages. The Instructor did not modify the language and complexity level in any way to suit the needs of the students, resulting in confusion among students.

### **Failure to acknowledge copyrighted content**

It was found that in certain instances, where content was imported from other web sites on the Internet, no copyright acknowledgements, citations or reference information was provided

### Lack of sufficient computer literacy

Although most students completed End-User Computing, a pre-requisite subject for the OLDEC, some of them had problems accomplishing simple tasks, like double - clicking on icons. It was therefore wrongly assumed that all students had the necessary computer skills such as keyboarding skills, operating system procedures, and knowledge of web browser features. Students were asked whether they had enough background information and computer literacy given to them in first year to handle this course. 83% of the responses were “no” and 17% were “yes”.

### Insufficient time allocation

Most students complained that the forty-minutes allocated for each lesson was not sufficient to complete the lesson. The Instructor found it difficult to gauge the amount

of content that needed to be put into a lesson, since students' abilities varied so widely.

#### Problems adapting to on-line content

Students had problems adapting to this new method of content delivery (viewing information on the screen). Students found it difficult to adapt to studying from the computer without having the content in their note- books or textbooks. Some students even went to the extent of copying all the contents from their computer screens into their notebooks. Students had to be reminded that the content was to be made available to them during the assessments.

Students were asked what were their experiences in a “Normal Traditional Classroom” and a “Virtual Classroom”. The following is a summary of their experiences.

- One can obtain much more information from the Internet than from a textbook.
- If you have a problem, one can get a solution quicker from the lecturer than from the computer.
- The computers are not available to us after hours and at home, but textbooks are for revision and memorizing.
- During classroom lectures, we are given exercises to do to measure our progress, but with the on-line system we were not given tasks because we don't have access to computers at home, so we cannot gauge our progress.
- In the classroom if you miss out a certain point, you can ask the lecturer at the same time, thus getting immediate feedback.

#### The use of OBE principles proved to be advantageous

OBE principles were used in the design of the content. It was found that this had positive effects. By stating the broad overall and specific outcomes prior to each lesson, students were informed from the outset on what skills, competencies, knowledge and values they were expected to achieve after completing each lesson. By

specifying the assessment criteria prior to attempting the lesson, students were motivated, since they knew what was expected of them during the assessment tasks.

#### The need for preparing lessons in advance

It was found that some students after completing the tasks scheduled for the day, experimented with other parts of the system. Therefore one had to prepare a few lessons in advance to cater for those students that worked at an accelerated pace.

#### The need for making content portable

Although some students had after- hours access to computers with Browser software, not all of them had Internet facilities to gain access to the OLDEC. There was therefore a need for facilities for students to save the web pages on diskette or CD – re-writable media, thus allowing them the opportunity to view the OLDEC offline.

#### **4.6 Finding related to how learners went about performing research using on-line sources.**

##### Students lacked the ability to use the Internet effectively to perform on-line research

It was found that students performed very badly on On-line research tasks. Possible reasons for this being the case will be discussed in the recommendations and conclusion chapter.

#### 4.7 Findings related to the new and modified assessment strategies that were implemented to suit on-line education

The researcher experimented with the following five assessment strategies, which were administered as five separate tests:

##### Findings related to test 1

The instructor experimented with the following three types of questions in test1. The server graded these questions automatically. (Annexure C contains a complete list of the questions)

- **True or false type questions.**
- **Multiple choice- single answer type questions.** These questions allowed students to choose a single answer from a list of possible answers.
- **Multiple choice – multiple answer type questions.** These questions allowed students to choose one or more answers from a list of possible answers.

The following were the findings related to test 1:

- Since the computer graded the test automatically, one had to manually verify that the computer performed the process correctly. It was found that in all instances the computer graded the tests correctly. Automatic grading saves time, but needs to be manually verified.
- It was found that one had to set a relatively challenging test (since students had access to the content) to test students' critical thinking and logical reasoning abilities.
- The time allocation was sufficient for this test, but some students tried to cancel the assessment and tried to refer to the content for answers. When they

got back to taking the test, the test started right back from question one, thus wasting time.

- Students preferred this type of testing since they were not good in articulating their thoughts in written English.
- Nineteen of the twenty-two students successfully completed the test on the first attempt. Three students were given the opportunity to redo the same test due to computer malfunction or they being absent. This could have affected the reliability of their assessments, since a new test was not set.
- One had to set due dates, randomize the questions and restrict the number of times the test could be taken to maintain reliability of the test scores.
- The class average for this test was ten credits out of a possible twenty credits.

#### Findings related to test2

The following were the objectives of test 2:

- To check whether students could successfully access the two e-mail websites <http://www.hotmail.com> and <http://www.webmail.co.za>.
- To check whether students could successfully login to the websites and. Enter their Usernames and Passwords.
- To check whether students could read E-mail such as read friendly letters, assignments, tasks or test questions.
- To check whether students could reply to E-mail such as sending a reply to their friends or submitting their test answers.
- To test whether students could use the proper formats, conventions and etiquette when sending e-mail.
- To test whether students could communicate properly using the English language (grammar and spelling)

The following test question was sent to all students

**From:** Mr. P.Naidoo

**To:** IP2 students

**Date:** 2/27/00

**Subject:** E-mail Assignment

*Hello there Information Processing 2 Student. I hope you are enjoying the course so far.  
Answer the following question by sending me a message using E-mail*

**Question:**

*What are some of the disadvantages that E-mail has when compared to normal postal mail?  
Due date Friday March 3. 20 marks*

*Marks will be allocated according to the following criteria*

*12 marks for answering the actual question*

*4 marks for use of language eg. Grammar and spelling*

*4 marks for proper use of e-mail etiquette*

*answers should be e-mailed to the following address [naidoob@wpo.mlsultan.ac.za](mailto:naidoob@wpo.mlsultan.ac.za)*

The following are the findings related to test 2:

- The due date was initially set to be Friday March 3. Due to technical problems the due date was extended to Saturday March 4. Fourteen students submitted their answers on the new due date. Four students submitted their answers two days late. One student submitted the answer three days late. Two students submitted the answer seven days late. One student did not submit at all. On the whole this test was handled quite well and students were quite confident in sending e-mail. The class average for this test was thirteen out of a possible twenty credits.
- The spelling and grammar used in the e-mail communication was very poor.
- Some students did not use the proper e-mail conventions e.g. some students were still using all CAPITAL LETTERS (the equivalent of “shouting” when sending e-mail)

- Students were also encouraged to find the e-mail addresses of friends, family and popular personalities and correspond with them. A large number of students used the e-mail facility successfully for this purpose. The Instructor received a fair amount of friendly e-mail from students.
- Students also experimented with sending e-mail to cell phones using the SMS capabilities.

### Findings related to test 3

The purpose of test 3 was to test how well students understood the work for module 4. The Instructor experimented with short open-ended questions. Annexure D contains the complete list of questions. The test consisted of 12 questions with a total of 30 credits. The credits assigned to each question were different according to the complexity of the questions. The level of complexity of the questions, was made relatively high (application type questions). This was necessary since the content was made available to students during the test.

The following are the findings related to test 3:

- Nineteen out of a possible twenty students successfully completed the test, with three students having to redo the same test due to technical problems or being absent on the day the test was administered.
- The class average for this test was eleven out of a possible thirty credits. The mark is relatively low. This was possibly due to the questions being complex and requiring the application of knowledge. The allocated time was also insufficient to answer the questions.

#### Findings related to test 4

The purpose of this test was to gauge the students' ability to use Search Engines to find information, summarize it and write a paper on the topic.

Each of the twenty-two students was given a different topic. Assigning different topics prevented students from seeking assistance from fellow students, thus maintained reliability. The twenty-two topics and the test question is listed below

*Computer printers, computer monitors, computer hard drives, computer viruses, computer security, multimedia, word processing, spreadsheets, databases, microprocessors, random access memory, read only memory, digital versatile disk, modem, video conferencing, Windows 2000, virtual reality, computer hacking, satellites, mainframe computers, cell phones, CD-Rom.*

*Question:*

*Summarize the information that you collected on your research topic and write an essay into the space provided. The essay should not be more than 300 words (i.e. 30 lines of text)*

*The essay should have three sections:*

*Section A: The title of your research topic*

*Section B: Content ( i.e. the actual essay of 30 lines) – 25 marks*

*Section C: Bibliography (i.e. the website address of where you obtained the information from – 5 marks*

The above topics were chosen since they dealt with important areas in the computer science syllabus.

The students were given three forty-minute periods during the week and one three hour session on a Saturday morning to do the research.

Students were required to use international search engines such as Yahoo, Hotbot and Excite and South African search engines such as ZaZoo, Ananzi and Mweb to find information on their topic. They were not allowed to consult any print media (e.g. textbooks or magazines) for their research.

The following are the findings related to test 4

- Seventeen of the twenty- two students successfully completed the test the first time. Five students had to redo the test due to technical difficulties or they being absent.
- The Instructor failed to give clarity on what information the content should consist of such as Definition of topic, Advantages, Uses, Purposes, Applications, etc.
- The Instructor also failed to provide students with a method to cite web site addresses for reference purposes and how to construct the bibliography.
- Students performed very badly in this test. The class average for this test was thirteen out of a possible thirty credits. The spelling and grammar were very poor. Most students just copied everything directly of the screen without checking whether it was relevant to the topic. In most cases the bibliography was done very poorly or was non-existent.

#### Findings related to test 5

The purpose of this test was to ascertain whether students could use chat-rooms effectively and test whether students could collaborate on team projects and tasks.

Students were grouped into four teams. Four separate chat-rooms were created on the IRC Server. The following four topics were allocated to each Chat Room:

**Chat room 1:**

*Topic: In 20 years time, what influence do you think computers will have on our lives?*

**Chat room 2:**

*Topic: What steps can be taken at the Technikon to make students more computer literate?*

**Chat room 3:**

*Topic: The Internet has many benefits, but has it got any bad or negative points?*

**Chat room 4:**

*Topic: if you were the Lecturer teaching computer subjects at the Technikon, what would you do differently, in the way the subject is being taught?*

Students were given approximately an hour to discuss their relevant topic. The students were then required to take the following test.

**Question 1:**

*Use your notes and type out your answer to your particular chat room topic. (20 credits)*

**Question 2:**

*From your experience what are some of the advantages of using chat-rooms? (5 credits)*

**Question 3:**

*From your experience, what were some of the problems you encountered when using chat-rooms? (5 credits)*

The following are the findings related to test 5

- Students enjoyed this type of assessment very much. They displayed an ability to collaborate effectively on team projects and tasks.
- The class average for this test was eighteen out of a possible thirty credits.
- It was found that the normal group-dynamics that exist in normal face-to-face communication was present in On-line Chatting such as some users dominating the discussion or some users being shy and remain as observers.

#### **4.8 Findings related to the security measures that were introduced to make on-line assessments secure**

##### The use of user names and passwords

Only registered users of the system were permitted to take the tests.

##### Limiting the number of times the test could be taken

The system ensured that the number of times a student was allowed to take a test was controlled. Normally the system only allowed the student to take each test only once. If the student attempted to take the test more than once an error message was displayed. In some instances, due to technical failure, some students were permitted to take the same test for the second time.

##### The “Randomize” option

The “Randomize” option caused the system to produce a different sequence of test questions for each student, i.e. each student answered the tests in a different sequence. Students were discouraged from peeking into their neighbors’ computer monitors to copy answers.

##### Setting due dates

Additional security was provided with the inclusion of the “due date” feature. One could set the due dates for the assessments. Due dates could either be an “end date only”, or a “start date” and an “end date”. If a start date and an end date were specified, students could not take the assessments before the start date or after the end date. If dates were not appropriate to the course, an assessment could be designated as “ongoing”, which allowed students to take that assessment at any time.

#### 4.9 Findings related to how learners responded to taking the on-line assessments

- Students needed time to adapt to an “open-book” type of test. They needed time to adapt to the idea that the content will be available to them when writing the test, and be prepared to tackle challenging and application type questions.
- Students complained, across the board that the time allocation for the five tests were too short.
- One advantage of doing on-line assessments is that all communication were typed onto the computer. This improved the students’ keyboarding skills.
- Students were asked which type of testing mode they preferred. 66% preferred using computers to do On-line assessments, 17% preferred using the normal hard copy answer book and 17% preferred both.
- Students were asked which of the five tests they liked most and which they disliked. Most of them preferred the “multiple- choice test” and the “e-mail test”. The most disliked test was the “research test”

#### 4.10 Findings related to a comparison of learners’ performance in on-line assessments with their previous performance in traditional classroom assessments

In an attempt to answer this question, it was first decided to extract information from the Technikon’s computer records on students’ past performance in the following “traditional classroom assessments”:

- **End-User Computing subject percentage** – this was a first year subject that was a pre-requisite for the OLDEC and was completed in 1998.
- **First year aggregate percentage** – this was the average of the percentages of all six subjects that were taken by students in their first year. These subjects were pre-requisites for second year subjects and were completed in 1998.
- **Matriculation aggregate percentage** – this was the average of the percentages of all six subjects that were taken by students in their last

schooling year (Grade12). These subjects were pre-requisites for first year subjects and were completed in 1997.

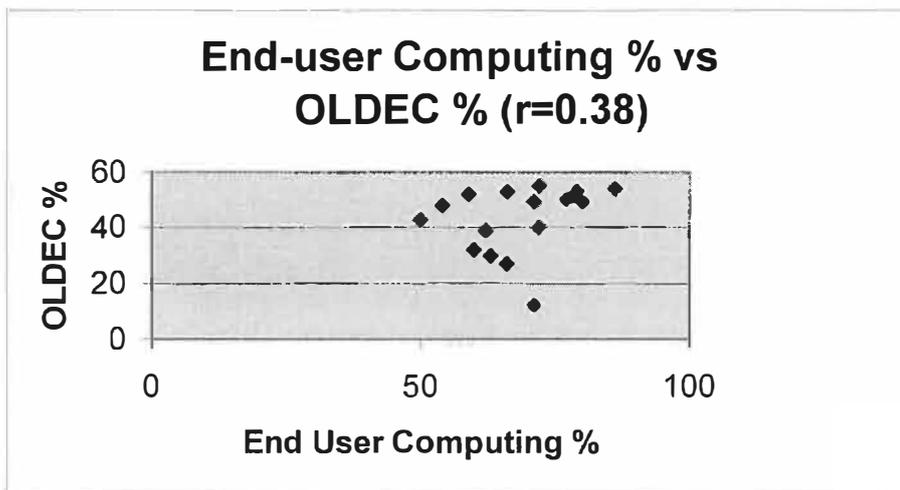
Secondly, it was decided to extract information from the Server on students' performance in the OLDEC "On-line assessments". This was done as follows:

- **OLDEC percentage** – this was the average of the percentages of all five on-line tests that were written in 1999.

It was then decided to check if there was a correlation between students' performance in "traditional classroom assessments" and "on-line assessments". The following computations were done:

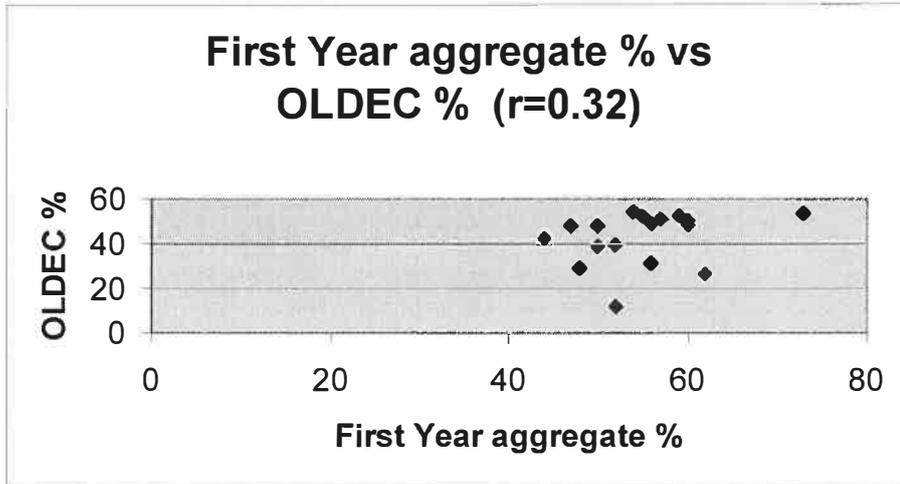
- **End-User Computing % vs. OLDEC %** - Scatter diagram shown in Figure 13 yielded a correlation coefficient of  $r = 0.38$ .

Figure 13



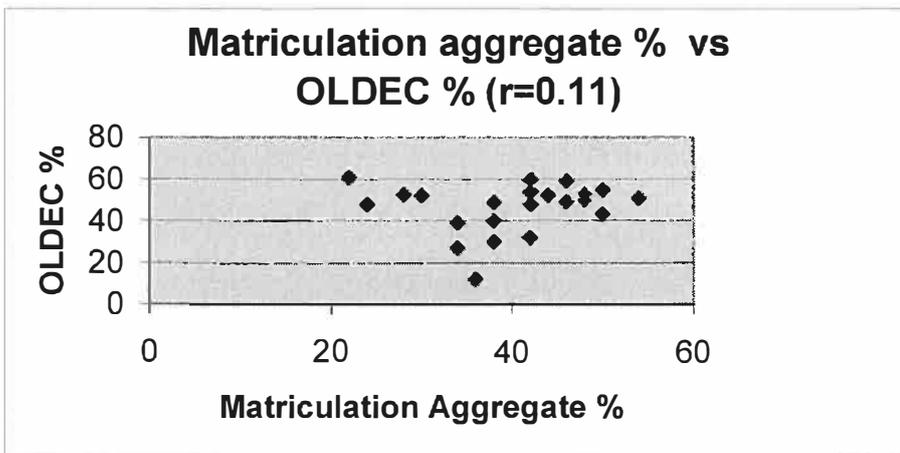
- **First- Year aggregate % vs. OLDEC %** - Scatter diagram shown in Figure 14 yielded a correlation coefficient of  $r = 0.32$ .

Figure 14



- **Matriculation aggregate % vs. OLDEC %** - Scatter diagram shown in Figure 15 yielded a correlation coefficient of  $r = 0.11$ .

Figure 15



This seems to suggest that the standards maintained in the on-line assessments were consistent with the standards that were present in traditional assessments. In other words whether an assessment is done on-line or by traditional means, the results should be consistent with the students' abilities.

#### 4.11 **General findings**

##### Comparison of the three modes of teaching

Students were asked which of the following modes of teaching they preferred:

Mode 1 – face to face traditional teaching

Mode 2 – on-line teaching

Mode 3 – combination of Mode 1 and Mode 2

67% preferred mode 3, 25% preferred mode 1 and 8% preferred mode 2

##### Students impressions of the instructor

Students were asked what they liked and disliked most about the Instructor. Generally, very positive sentiments were expressed. The following is a summary of the responses:

- He teaches quite well and is an understanding man.
- He did not scold and yell at us if we are late.
- He explained instructions to those who registered late.
- He gave clear instructions and was very helpful.
- He asked us if we had any problems.
- He was always available in the afternoons and on weekends.
- He gave us time to ask questions.
- He maintained good discipline.
- We would have liked to be left alone in class.
- The lecturer did not talk to us when we needed him (this was so, since it was one of the control measures to simulate a distance education scenario)

## Students overall impressions of the OLDEC

The following is a summary of the students' responses on their overall impressions on the course and the way it was run.

- It was very informative.
- There was lot of information about the Internet.
- We learnt a lot about e-mail, chatting and accessing websites.
- We had a lot of practical and hands-on experience that could be applied to the work situation.
- We learnt how to communicate and share views with others.
- We learnt a lot of new concepts.
- We were not allowed to communicate directly with the lecturer and the people next to us.
- We did not like coming to Saturday lectures.
- There were always errors on the computers.

## CHAPTER FIVE

### RECOMMENDATIONS AND CONCLUSION

This chapter offers some recommendations, based on some of the findings. This is followed by a final evaluation and conclusion of the study.

#### 5.1 Recommendations

##### 5.1.1 High quality components can improve the reliability of the Server

The reliability of the Server was probably due to, high quality components being used in its manufacture. This is a critical factor in any on-line distance education setting, since the Server has to be up and running for twenty-four hours, seven days a week.

##### 5.1.2 High component specifications can improve the performance of the Server

Although high quality components were used in the manufacture of the Server, it had low component specifications. It is recommended that any on-line distance education Server should have the best specifications available at that time. For example the Server should have had at least, the following system unit specifications:

- Two Intel Pentium III Xeon Processors running at 800mhz
- 32 kb level 1 cache and 256 kb level 2 cache
- 256 Mb ECC 133mhz SDRAM memory
- 36 Gb Ultra3 SCSI hard drive

##### 5.1.3 A low-cost UPS can provide sufficient backup power

To provide sufficient power protection, a low cost UPS that will have a power output of about 600VA is needed. A UPS with a backup time of about 20 minutes is sufficient to allow for the downloading or uploading of large files or graphics, therefore preventing the loss of data.

#### 5.1.4 The need for backup devices

Any OLDEC Server needs to have at least one of the following backup devices:

- A ZIP drive capable of storing 120MB on each disk
- A CD-rewritable drive capable of storing up to 650MB per CD
- A Tape drive that is capable of storing at least 8GB
- A RAID (redundant array of inexpensive disk) system or a “cluster” system

#### 5.1.5 The need for digital input devices

Scanners and digital cameras are essential in effective Internet multimedia production. Cost effective possibilities are the HP Scanjet 4300C scanner and the HP Photosmart 912 Digital camera that provides a resolution of 2.24 megapixels and a colour depth of 36 bits.

#### 5.1.6 The need for effective maintenance of student workstations

It is suggested that the following be done to prevent the deterioration of the workstations present in the student computer laboratories:

- Taking higher security measures (e.g. the introduction of visible security personnel or the installation of security cameras)
- Computer equipment needs to be serviced regularly
- Increase the number of laboratory staff (technicians and operators)
- Purchasing computer equipment from reputable dealers that honour their warranty agreements.

#### 5.1.7 The need for more Internet facilities for students

It is suggested that students should have free and unlimited Internet access in all computer laboratories during normal Technikon hours and a reasonable amount of

access after hours. The cost of this service should be included in their annual registration fees with the assumption being that all students will use the Internet.

#### 5.1.8 The need for printing facilities for students

It is recommended that at least one high-speed laser printer be installed in each one of the 60 seater computer laboratories.

#### 5.1.9 The need for sufficient technical and project management support

Any on-line distance education project cannot be undertaken single handedly. One needs to establish a web-based training team consisting of the following personnel:

- **Project manager** - to lead the overall effort, set milestones, negotiate for resources and communicate changes to the team.
- **Instructional designers** – to conduct needs assessment, design lessons and develop the blueprints.
- **System managers** – to provide technical guidance and support
- **Graphic artists** – to create the web pages
- **Programmers** – to code and create modules that cannot be obtained commercially
- **Instructors** – to facilitate the teaching and learning process

In addition to the above, it is recommended that when purchasing software, it be obtained from a reputable dealer that is willing to provide some after sales support and training.

#### 5.1.10 Use the correct Server operating system

In a project like this it is important to choose the correct Server operating system. It is recommended that Microsoft's Windows 2000 Server be used, due to it having an array of features. These include Web and Application Services, Directory Services, Clustering, Security Services, Communication and Networking capabilities,

Management Services, Cross platform integration, Terminal Services and File and Print Services.

5.1.11 The OLDEC software must be compatible with existing organizational software

It is important to choose OLDEC software that will be compatible and will integrate easily with existing legacy systems. One should not be locked into proprietary software but rather go for software that support “Open” standards.

5.1.12 Shop around for the OLDEC software that best suits the needs

It is recommended that the choice of the OLDEC software be done after a complete needs analysis is done. If the software is chosen before the analysis, one ends up with numerous inadequacies and functionality problems with the software. Listed below are alternative “off the shelf” software that could have been used:

- CLASSNET (from Iowa State University)
- FLAX (from FLAX Interactive Courseware)
- TOP Class (from WBT Systems)
- Virtual – U (from Virtual Learning Environments)
- WEBCT (from WEBCT Educational Technologies)
- WEBFUSE (from Central Queensland University)
- WEBTEACH (from the Professional Development Centre – Sydney Australia)
- WEB Course in a BOX (from Mad Duck Technologies)
- ZEBU (from MC2 Learning Systems)

One could also opt to develop “in-house” software, which has the advantage of being tailored to the institution’s specific needs. Examples of institutions that have developed such systems are the University of South Africa and Technikon South Africa.

#### 5.1.13 Reduce the security risks

It is important to reduce the security risks and threats to the software installations in the students' computer laboratory. This could be achieved in the following ways:

- Installing effective anti-virus protection software on all machines. For example one could use Symantec's Norton Antivirus 2000.
- Installing effective policy editing tools such as Microsoft POLEDIT to limit access to certain functions on the desktop.
- Having an efficient method of restoring and cloning machines in a short space of time. For example, one could use Symantec's GHOST software.

#### 5.1.14 The need for a high bandwidth connection from the Technikon to the service provider

The present 64kbps Diginet line has a bandwidth that is grossly insufficient. It is recommended that the following alternatives be considered.

Diginet is Telkom's dedicated, synchronous, data transfer service. It provides round-the-clock, secure, high quality, point-to-point services over a digital transmission network. **Diginet Plus** offers speeds from 128 kbps up to 2048 kbps in 64 bit/s aggregates, and is aimed at medium to large organizations, which have higher bandwidth needs. It is recommended that the Technikon install at least a, 1024 kbps line.

#### 5.1.15 The need for a new ISP (Internet Service Provider)

UNINET is clearly incapable of providing the necessary support for the Technikon Internet requirements. It is recommended that an alternative ISP be sought. Some suggestions are ION, UUNET, MWEB or Internet Africa.

#### 5.1.16 The need for the Intranet infrastructure upgrade

The Intranet bandwidth of 10mbps is clearly too slow. This could be upgraded by making the following changes:

- Changing the 10mbps Hubs to 100mbps Hubs
- Upgrading the cabling to the CAT5 standard
- Changing the network interface cards from 10mbps to Fast Ethernet
- Upgrading the network interface cards from 16 bit to 32 bit

#### 5.1.17 The need for an analysis of students' abilities

A proper assessment of students' abilities need to be done prior to the offering of any On-line Distance education course and if need be, sufficient training needs to be given to students that lack basic computer literacy.

## 5.2 Evaluation of the study and conclusion

This section provides a discussion on whether the project met its intended goals adequately and provides a summary of the findings and closing remarks.

The study involved the design, implementation and evaluation of an on-line distance education information system. Since the study involved the entire process of the *Systems Development Life Cycle (SDLC)* and included the critical phases of design, implementation and evaluation, the researcher gained much experience in managing a project in its entirety and not treating it in a piecemeal fashion. By following the project from its inception to its completion, much experience was gained on the workings of each of the parts and how the different phases integrated with each other.

In this project the concept of a “Virtual Classroom” did not exist in the true sense of the word. At the outset a virtual classroom was defined as an environment that existed in cyberspace and one that could be created by using computer hardware, software and telecommunications. In this instance, this was not strictly the case since learners took the course at the Technikon’s computer laboratory and in some instances received instruction using traditional lecture methods. In general, the concept of a virtual classroom was simulated and could easily be extended and offered to students outside the Technikon.

The concept of “Distance Education” did not strictly exist, since there was no geographical isolation between the learners and the institution, but the technology was used to mediate and bridge the instructional gap. In this instance a distance education system was simulated and could easily be implemented to cater for learners that were physically distant from the Technikon campus.

The course proved to be a true “On-line” system, in that communication took place in “real-time”. Changes and updates that were made to the information on the Server were immediately noticeable on the learners’ computers.

The OLDEC was a true “Internet-based” system. Although the course was run from within the confines of the Technikon (operated as an Intranet), it still used Internet technology and could easily be accessed globally, with the correct “firewall” and security settings.

In retrospect, instead of choosing ten critical questions, the researcher should have been more selective and chosen fewer questions that could be analysed more closely. In some instances, the data collected produced very little information and findings to answer the critical questions adequately.

The project did cater for learners with differing abilities, by allowing them to work at their own pace and “asynchronously”.

One of the aims of the project was to build capacity among the Technikon staff in the areas of web-design and Internet usage as a means of instruction. Unfortunately, this was not the case, since the project was not handled by a team of staff members and the researcher had to assume all the roles such as developer and instructor.

The project did put learners in touch with a large amount of multimedia resources and gave them the opportunity to experience a wide range of Internet applications such as e-mail, newsgroups and chat-rooms.

The project, to a reasonable extent, allowed learners to direct their own learning and take responsibility for participating in the programme, but in some instances the instructor had to motivate learners to produce the expected results.

The “Constructivist” theoretical framework used, proved to be very valuable in directing the project. Learning was made to be authentic, real and an active process. Learners were exposed to multiple representations of reality. The project emphasized learning (working autonomously) and not teaching. The process encouraged learners’ natural curiosity and, performance and understanding were emphasized.

Two methods were used to perform the literature review, an on-line literature review using the Internet and a text- based review of books, journal articles and conference

papers. The on-line literature review seemed to produce better results, since it is updated more frequently and was better suited to the topic under study. In some instances the researcher was prevented from evaluating the web sites of institutions that provided on-line distance education, since it required user identities and passwords.

With respect to the research design of the study, the “Case-study” approach was effective in producing the desired result, but lacked in one aspect. The researcher, apart from being the observer, also participated in the development of the system and participated as the instructor of the group. Assuming too many roles, may have introduced a few subjective viewpoints in the findings.

Twenty-two full-time students were selected to undertake the course at the Technikon premises. A much better situation would have been to select part-time students that took the course from home or from their places of work. This would have simulated a true on-line distance education setting.

The period of six weeks allocated to conduct the course was insufficient time for students to adapt to the new conditions, produce sufficient feedback and produce accurate results. Given this short period of time, sufficient data was collected and analysed to produce meaningful results.

The group of twenty-two students chosen seemed to be a manageable number, but at times, an increase in the absenteeism rate, may have had an effect on the reliability of some of the results.

Of the group of twenty-two students chosen, 100% of the students came from the Black African race group. 75% of the students completed their schooling career in under-resourced rural schools and 88% of the students did not have access to computers after school hours. The group did not represent a cross-section of the South African population such as Blacks, Coloureds, Indians and Whites. If this was the case, it could have produced different findings in the assessment results, since other population groups did come from well- resourced schools and in many instances do have access to computers after school hours.

The seven data sources produced sufficient data to produce meaningful findings. By using the process of triangulation, the validity of the research was strengthened. Also sufficient control procedures were introduced to simulate a distance education scenario.

It is often the case in research projects where unusual and unforeseen problems arise. The researcher took sufficient steps to modify and adapt the project to accommodate these unusual occurrences.

In general, the type of computer hardware used was adequate in running the project successfully. Setting up and maintaining the hardware was manageable except for the following minor problems. For example the Server that was used had low component specifications. There was a lack of uninterruptible power supply services to provide backup power. There was a lack of backup storage and digital input devices. Student workstations often broke down due to the high usage factor or vandalism. There was a lack of Internet facilities for students to use after hours and a lack of printing facilities in the laboratories. In order for quality on-line distance education to take place, the above technical challenges relating to hardware need to be addressed.

The technical challenges in setting up and maintenance of the computer software was by far the biggest stumbling block in the project. Some of the problems included the lack of sufficient technical support and using the incorrect Server operating system. Problems were also experienced during the creation of students' e-mail accounts. The Lotus suite of packages (Notes, Domino and LearningSpace) was relatively easy to install but contained numerous "bugs" and inadequacies. In future one should consider using the later versions of Lotus or opt for software from other vendors such as WEBCT. "Virtual Classrooms" are built using software programmes, therefore software security risks and threats need to be assessed and minimized otherwise the entire virtual classroom structure is bound to collapse. The software used is the heart of the system and careful consideration needs to be given before one commits to a specific software platform.

For any OLDEC to be successful, there needs to be adequate telecommunications infrastructure. Internet bandwidths of 64kbps are clearly insufficient and needs to be

increased to at least 2048 kbps. Intranet bandwidths are also important. 10mbps speeds need to be increased to 100mbps and 16-bit NIC's need to be upgraded to 32-bit. One of the biggest threats to providing a successful OLDEC is that the Internet is not owned and managed by one single entity, but the responsibility is distributed to numerous global organizations. Too much dependence is placed on third party organizations. System failure at these organizations could lead to Internet disruptions causing the entire OLDEC to collapse. It is therefore important to choose and subscribe to reliable Internet Service Providers (ISP).

The researcher experimented with three electronic modes of interaction, viz. e-mail, Internet relay chat and discussion forums. The findings seem to suggest that learners preferred communicating via e-mail and IRC rather than using discussion forums. It was intended that students only communicate using these three electronic modes in order to simulate a distance education scenario. Since the situation was not a true distance education scenario, face-to-face contact was unavoidable. For example normal lessons had to be held due to technical problems.

In general the quality and the way the on-line content was presented was of an acceptable standard, it however did have certain shortcomings. For example in some instances there was a lack of clear definitions, lack of clear explanations and conventions used. In other instances, the content contained errors and was ambiguous. Also some of the lessons were not arranged in a logical sequence. The designer of the content failed to adapt the content to the language level of the students and failed to acknowledge copyrighted content. Since this was a pilot project, these problems were expected, and serve as a learning experience for future course development.

It is important to assess the computer literacy of students prior to subjecting them to any on-line distance education. In this instance students were not fully prepared to undertake such a course. It is important to equip students with the necessary skills to allow them to undertake such a course.

In general students found that there wasn't sufficient time allocated for the lessons and for revision. This was understandable, since there were insufficient Internet

facilities available after hours and this pilot programme had to be timetabled into the already constrained lecture schedule.

In general students had difficulties in adapting to this new method of content delivery i.e. viewing information on the computer screens. Given more time and access to computers, students will be able to adapt to studying from computers without having to refer to content in notebooks and textbooks.

Learners found it difficult to effectively perform on-line research using the Internet. Possible reasons could have been that insufficient time was allocated for the research tasks or the students had problems adapting to this new method or they lacked general researching skills, which should have been acquired at secondary school level.

The researcher experimented with five on-line assessment strategies in five tests. Test1 involved true or false and multiple-choice questions. Test2 involved receiving and submitting assignments via e-mail. Test3 contained open-ended questions. Test4 required students to perform on-line research on a specific topic. Test5 was used to ascertain whether students could use chat-rooms to effectively collaborate on team projects. True or false and multiple-choice questions had the advantage of being automatically graded by the computer, saving the instructor lots of time. Receiving and submitting assignments via e-mail and using chat-rooms to work on team projects seemed to be very popular among students. Open-ended questions did not offer any real advantage in that they still had to be manually marked by the instructor. Students need more time and skills to perform effective on-line research.

It is important when choosing software that allows assessments to be done on-line, that there is sufficient security built into the system. For example, there needs to be secure user and password authentication and features for setting due-dates and options for randomising test questions.

In the study, a comparison was done of the learners' performance in on-line assessments with their previous performance in traditional classroom assessments. Correlation coefficients of 0.38, 0.32 and 0.11 seemed to suggest that the standards

maintained in the on-line assessments were consistent with the standards present in traditional assessments.

In general learners were pleased with the way the instructor ran the course and expressed positive sentiments about their overall impression of the course.

The findings of the study seemed to suggest that more learners preferred a combination of face-to-face traditional teaching and on-line education.

In conclusion, on-line distance education is not a panacea for all education and training ills, but it does offer additional possibilities for educating and training more people and can be easily and efficiently implemented on a wider scale at ML Sultan Technikon and at other institutions of higher learning.

-----oOo-----

## REFERENCES

- Acacia. "Communities and the Information Society in Africa: Programme Overview". <http://www.idrc.ca/acacia>
- ACER. "LearningSpace helps ACER to plan and implement on-line training enterprise-wide". <http://www.lotus.com/products/learnspace>
- Aleobua, Boniface. 1999. African Internet Status.  
<http://www.dejanews.com>
- American Express. "American Express Selects LearningSpace for Delivery of On-Line Learning". <http://www.lotus.com/products/learnspace>
- Bank SinoPac. "Bank SinoPac on LearningSpace".  
<http://www.lotus.com/home.nsf/welcome/learningspace>
- Biodiversity and Conservation Biology. University of Western Cape.  
<http://www.botany.uwc.ac.za>
- Bisetty, Vincent. "Department of Chemistry Intranet". ML Sultan Technikon.  
<http://www.chem.mlsultan.ac.za>
- Bruner, J. 1990. Acts of Meaning. Cambridge, MA: Harvard University Press.  
(available on-line)
- Campus On-line. University of Fort- Hare. <http://www.ufh.ac.za>
- CBE projects at UCT. University of Cape Town.  
<http://www.uct.ac.za/projects/cbe/cbeuct.html>
- Centre for Technological Information. University of Transkei.  
<http://www.utr.ac.za/plato/platowp.html>
- Clarke, Patsy. "Patsy Clark's Home Page". University of Natal.  
<http://www.und.ac.za/users/clarke>
- COLISA. Confederation of Open Learning Institutions of South Africa. Vista University. <http://www.colisa.ac.za>
- Computer Science 2. University of Durban-Westville. <http://yoda.cs.udw.ac.za>
- Cronjé J. 1996. "Interactive Internet -Using the Internet to facilitate co-operative distance learning". Department of Didactics: University of Pretoria (South Africa).
- Cronje, Johannes. "Department of teaching and training studies". University of Pretoria. <http://hagar.up.ac.za/catts/abchome.html>

- Cronje, Johannes. C@tts Home Page. University of Pretoria.  
<http://hagar.up.ac.za/catts/medhome.html>
- CyberSchool Africa. "Cyberschool Africa's History". Cyberschool Africa.  
<http://www.cyberschool.co.za/register/history>
- Distance Education. University of Stellenbosch. <http://www.sun.ac.za>
- EduTech Puisano. <Http://www.teacher.co.za/edutech.html>
- Herman Miller. "Herman Miller turns to Lotus LearningSpace 4.0 to train its dealer network". <http://www.lotus.com/home.nsf/welcome/learnspace>
- IBM WorldWide. "Rouse Company Receives Tremendous ROI with LearningSpace".  
<http://www.lotus.com/home.nsf/welcome/learningspace>
- IBM. "IBM Builds its manager training programme with LearninSpace 4.0".  
<http://www.lotus.com/home.nsf/welcome/learnspace>
- ITU. 1995. In: *Panos Media Briefing* No.28 April 1998
- ITU. 1997. Challenges to the Network: Telecomms and the Internet.  
 In: *Panos Briefing* No. 28, April 1999
- Internet BIO-ED Project. University of Western Cape.  
[http://www.botany.uwc.ac.za/sci\\_ed](http://www.botany.uwc.ac.za/sci_ed)
- Ivala Eunice. 2000. "The Internet and Distance Education". Faculty of Human Sciences, University of Natal.
- Jensen, Mike. 1998. The expansion of African Webspaces.  
<http://www.mg.co.za/mg/pc/9805/06may-wiredafrica03.htm>
- Kennesaw State. "Kennesaw State and LearningSpace Go Long Distance".  
<http://www.lotus.com/products/learnspace>
- Lotus Development SA. "Potch academics take MBA Notes".  
<http://www.itweb.co.za/office/lotus>
- Lotus Press Release. "Lotus announces strategic partnership with Russian Ministry of Education". <http://www.lotus.com/lotus/press.nsf>
- Mannisto, Kelly, Petrazzine. 1998. Internet and Global Information Infrastructure in Africa, ITU.
- MEG. "Multimedia Education Group". University of Cape Town.  
<http://www.meg.uct.ac.za/mission.htm>
- Merrill, D. 1991. Constructivism and instructional design. *Educational Technology* (available on-line)
- ML Sultan Technikon, 2000. General Handbook.

Multimedia Research Group. University of Natal.

<http://www.und.ac.za/und/icd/mrgmission.html>

Murrell, Kathy. "Interactive Instructional Material Research and Resources".

University of Natal Durban. <http://www.und.ac.za/users/murrell/classrm>

ONSE ANGELTJIE. "Afrikaanse elektroniese tydskrif". University of Port Elizabeth.

<http://www.upe.ac.za/afned/angel.htm>

Pete, Mari. "Open Learning Centre". Technikon Natal. <Http://olc.ntech.ac.za>

PricewaterhouseCoopers. "Incorporating face-to-face understanding in distance education". <http://www.lotus.com/products/learnspace>

Programme for the transformation of higher education, Education white Paper 3.

Department of Education, Pretoria July 1997.

[http://www.polity.org.za/govdocs/white\\_papers/](http://www.polity.org.za/govdocs/white_papers/)

ROSS. "Rhodes on-line Student Service". <https://www.sec.ru.ac.za/ross/>

SchoolNet SA. "About SchoolNet SA". SchoolNet SA. <http://www.school.za>

Siemens. "Siemens saves \$2000 per employee per week".

<http://www.lotus.com/products/learnspace>

SOL. "Students on-line". University of South Africa. <http://sol.unisa.ac.za>

Technikon Witwatersrand <http://www.twr.ac.za>

Telematic Learning Systems. University of Potchefstroom.

<http://www.puk.ac.za/tls/index.html>

UFS Mainframe. University of the Free State.

<http://uovsvm1.uvos.ac.za/index.htm>

UNISA. "UNISA Students Keep In Touch With NotesSuite".

<http://www.itweb.co.za/office/lotus>

Unitra Community Radio. University of Transkei.

<http://www.utr.ac.za/ucrfm/index.htm>

University of Wisconsin. <http://www.lotus.com/products/learnspace>

Van Koller JF. "Online instruction at Technikon SA: An evaluation of a course in on-line instruction offered to TSA academic Staff members". Technikon SA

WCSN. "Western Cape Schools' Network". <http://www.wcape.school.za>

WEBCTADMIN. "TFS Online Courses". Technikon Free State.

<http://www.tofs.ac.za/onlinecourses/index.htm>

Webmaster. "COOL Virtual Students Campus". Technikon South Africa.

<http://cool.tsa.ac.za>

Webmaster. "Web Services". PE Technikon. <http://www.petech.ac.za>

Whitten J L, Bentley LD, Barlow V M. System Analysis and Design. 3<sup>rd</sup> edition.

Richard d Irwin, Inc . 1994. Boston Massachusetts.

Wilson D. Rhodes University. "Growing the Internet in Africa".

<Http://journ.ru.ac.za/review/11/dave.html>.

Witsplus. Centre for Part-time Studies. University of Witwatersrand.

<http://www.witsplus.wits.ac.za>

World Bank. " World Bank selects Lotus LearningSpace to deliver knowledge and training Worldwide". <http://www.lotus.com/lotus/press.nsf>

Yenza. "Welcome to Yenza". <http://www.frd.ac.za/yenza/>

## Annexure A

Questionnaire A (On-line – Survey Questionnaire). The questions that appear below are not in their original Web Page format but in a simplified text format.

Enter your Surname.....

Enter your First Names.....

Enter your Registration Number.....

Enter your Age.....

Are you male or female?.....

Enter the Name of your Secondary School.....

Enter the Physical address of your Secondary School.....

Enter your Matric subjects, grade and symbols.....

Did you obtain a Matric exemption?.....

Enter your first year subjects and the percentages .....

Did you have access to computers in school?.....

If you had access to computers in school, what programmes did you work on?.....

Do you have access to a computer outside the technikon eg. at home , at friends or family?.....

If you have access to computers outside the technikon, what programmes do you work on?.....

Do you frequently read books and magazines on computers?.....

Briefly explain what the INTERNET is .....

Have you used the INTERNET before?.....

If you have used the INTERNET before , state for what purposes.....

What are the advantages of using the INTERNET?.....

In 100 years time, what do you see computers being capable of doing?.....

## Annexure B

Questionnaire B (On-line – Survey Questionnaire). The questions that appear below are not in their original Web Page format but in a simplified text format.

Explain in detail all the problems you experienced with your computer while doing the course.....

Give some suggestions on how we could improve our computer system that we have in our computer labs.....

During normal classroom lectures, you get your information from the Lecturer, your notes and your textbooks. How is this different from getting your lessons and information from the computer screen?.....

Explain what problems you experienced with the language that was used in the computer lessons?.....

Explain what problems you experienced with the layout, colour and illustrations used in the computer lessons?.....

Explain if you experienced any problems with the instructions that were given to you in the computer lessons?.....

Explain if there was sufficient time to complete each lesson in the 40 minute period?.....

You did five lessons:

Week 1 : Networking Basics

Week 2 : E-mail

Week 3 : Using Web Browsers and accessing Websites

Week 4 : Using Search Engines and doing research on the Internet

Week 5 : Internet Chatting

Which lesson did you like the most and which lesson did you dislike the most. Give reasons for your choices.....

Give some suggestions on how we could improve the way we write up your notes for you on the Computer Screen.....

You used E-mail to communicate with your friends and the Lecturer. Explain why E-mail was useful to you and explain any problems you experienced with it.....

You used Internet Chatting to communicate with your friends and the Lecturer. Explain why Internet Chatting was useful to you and explain any problems you experienced with it.....

You used the Course room to start discussions with your friends and the Lecturer. Explain why the Course room discussions were useful to you and explain any problems you experienced with it.....

You used Three ways to communicate:

1. E-mail
2. Internet Chatting
3. Course Room Discussions

Which one did you like the most and which one did you dislike the most. Give reasons for your choice.....

The Lecturer was not available to give you help during the lessons. Explain if this was a problem to you and why?.....

Normally you used books and magazines from the library to do assignments and projects. How is this different from getting information using Search Engines on the Internet?.....

Explain the problems you experienced when you used Search Engines to find information on the Internet.....

In your opinion, which is a better, faster and easier way of getting information. From books or from the Internet? Give reasons for your answer.....

Give reasons why most of you performed very badly in test 4 (Test 4 was on researching your topic on the Internet using Search Engines).....

In what ways could you have done better in Test 4?.....

Were there any differences in doing your tests on the computer, compared to writing tests normally in an answer book. Explain?.....

Which type of test do you prefer. Doing it on the computer or writing it in an answer book?. Give reasons for your answer.....

In which type of test can students cheat more easily. Doing it on the computer or writing it in an answer book? Give reasons for your answer.....

You wrote 5 different types of tests:

Test 1 : was a multiple choice and true or false type test

Test 2 : was short questions

Test 3 : was on reading and sending E-mail

Test 4 : was on doing research on the Internet

Test 5 : was on Internet Chatting

Which type of test did you like the most and which type of test did you dislike the most. Give reasons for your choices.....

Give reasons why you were not well prepared for some of the tests?.....

Can you give some suggestions on how the Lecturer could improve the way he conducts tests on the computer. ....

What did you like most about the way the lecturer conducted and ran the course?...

What did you dislike most about the way the lecturer conducted and ran the course?...

There are three ways that you could do your studies

- 1: You could attend normal classroom lectures at the Technikon
2. You could work only from home on your computer connected to the Internet
3. You could attend some lessons at the Technikon and work on some lessons from home on your computer connected to the Internet.

Which one of the three ways would you prefer? Give reasons for your choice.....

What did you like the most about attending this subject?.....

What did you dislike most about attending this subject ?.....

If you were the lecturer, what would you have done differently in running this course?.....

Did you find that you had enough background information and computer literacy given to you in first year to handle this course? Explain.....

Do you have any other comments to make about the course?.....

## Annexure C

Test 1 (on-line test). The questions that appear below are not in their original Web Page format but in a simplified text format.

### **Question**

Which of the following are not computer networks?

### **Choices**

- 2 computers connected together
- 1 computer standing alone
- 10 computers connected together
- 2 separate computers with no link between them

### **Question**

Which of the following does not describe the word "Topology"

### **Choices**

- the way we physically connect computers
- the way we arrange computers
- the pattern we use to connect computers
- the way computers are repaired

### **Question**

In a Totally Connected Network, not all computers have a link or connection to each other

### **Answer Key**

False

### **Question**

In a Hierarchical Network which one of the following statements is true

### **Choices**

- Each computer is linked to 4 other computers
- Each computer is linked to one other computer
- Each computer is linked to three other computers

None of the above

**Question**

Which statements are not true about STAR networks?

**Choices**

The network is hierarchical

The Network is in the shape of a STAR

All computers are connected to a central computer

The computers are connected in a ring

**Question**

Another word for BUS is TRUNK

**Answer Key**

True

**Question**

Which of the following is not true about LANs?

**Choices**

LAN stands for Linear Area Network

LAN's cover a large area

LAN's stretches across the whole world

An example of a LAN is the INTERNET

**Question**

Examples of WANs are

**Choices**

The network in the computer LAB

The INTERNET

TELKOM's Network

The staff computer network at the Technikon

**Question**

Which of the following are not true about the INTERNET

**Choices**

The INTERNET is a LAN

The INTERNET is a WAN consisting of LAN's

The INTERNET covers only South Africa

The INTERNET is an International Network

**Question**

The INTERNET is run and owned by the United States of America Government

**Answer Key**

False

**Question**

The INTERNET was called by the following name 30 years ago

**Choices**

UUNET

ARPANET

MNET

**Question**

Networks facilitate communication in which of the following ways

**Choices**

By allowing you to send e-mail

By allowing you to do Word Processing

By allowing you to do Video Conferencing

By allowing you to draw pictures

**Question**

Who founded the World Wide Web?

**Choices**

The National Science Foundation

Bill Gates

Tim Berners-Lee

National Aeronautics and Space Administration

**Question**

Which of the following computer devices cannot be shared among each computer in a computer network

**Choices**

Hard disk  
Mouse  
CD-ROMS  
screen

Question

Distributed workload means that one computer does all the work

**Answer Key**

False

**Question**

Which of the following are not similar words for "Communication Media"

**Choices**

Radiation  
Channel  
Vacuum  
Link

**Question**

Coaxial Cable is similar to telephone cable

**Answer Key**

False

**Question**

Which of the following describes Fibre Optic Cable

**Choices**

It is sometimes made of glass  
It is sometimes made of plastic

It uses light pulses  
it uses a laser beam

**Question**

Which of the following Communication Media uses the atmosphere (air) to send signals?

**Choices**

coaxial cable  
microwave dish  
radio transmitter  
twisted pair cable

**Question**

Which one of the following are not true about satellites?

**Choices**

the signals travel through the earths atmosphere  
you need a satellite disk  
satellites rotate around the sun  
MNET's DSTV uses satellites

## Annexure D

On-line Test 3 Questions. The questions that appear below are not in their original Web Page format but in a simplified text format.

What is the difference between a Web Browser and a Web Page?

What is the difference between HTML and HTTP? Don't give me what it stands for.

What is the difference between hypertext and hyperlinks?

Give reasons why you think that the following E-mail Address is incorrect.

paul@ac.uk.telkom

Write down all the information you can gather from the following E-mail address.

bobby@durban.org.za

Give reasons to why you think that the following E-mail address is incorrect.

http://naidoob@wpo.mlsultan.ac.za

If only one-quarter of your web page is visible to you, which button would you press on the Web Browser to get the full page back again?

Can you write down the Web site addresses of five South African organisations

If UDW (University of Durban Westville) is an academic institution in South Africa, what do you think its web site address is?

Is the Web site address an example of a URL?

What is the name of the Web Browser that you are using?

Why is it important for a company to have a web server?