Asynchronous web-based technologies to support learning

by

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Abstract

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This dissertation reports on an investigation into three web-based technologies to determine their usefulness and the extent to which they support learning. The study comprises three case studies, each examining a separate web-based technology, suitable for diverse groups of learners in terms of age group and background. The main contribution is to determine for whom and how these technologies could be used, with the intention of providing a systematic structure of web-learning possibilities for learners of different ages (children, undergraduates and postgraduates) and types of teaching (contact teaching and distance learning).

It was found that web-based technologies could support learning. Their usefulness depends on how the instructional design addresses the different aspects of web-based learning, and whether or not the course and web-based material match the characteristics/needs of the target group.

Key words: web-based learning; web-based technologies; collaborative learning; educational web sites; course management systems; web-based classrooms; learners' characteristics; children; undergraduates; postgraduates; adult learning.

Samevatting

Kandidaat: Gabrielle Joy de Villiers
Promotor: Prof. Dr J.C. Cronjé
Departement: Inligtingkunde
Graad: MA (Inligtingkunde)
Titel: Asinkroniseerde webgebaseerde tegnologieë om leer te ondersteun

In hierdie verhandeling word verslag gedoen oor ‘n ondersoek na drie webgebaseerde tegnologieë, om hul bruikbaarheid te bepaal asook die mate waarin hulle leer ondersteun. Die studie bestaan uit drie afsonderlike gevallestudies waarin ‘n webgebaseerde tegnologie ondersoek word wat geskik is vir diverse groepe leerders in terme van ouderdomsgroep en agtergrond. Die hoofbydrae is om vas te stel vir wie, en hoe hierdie tegnologieë gebruik kan word, met die doel om ‘n sistematiese struktuur van web-leermoontlikhede te voorsien vir leerders van verskillende ouderdomme (kinders, voorgraadse en nagraadse studente) en verskillende tipes onderrig (kontakonderrig en afstandsonderrig).

Daar is bevind dat webgebaseerde tegnologieë leer kon ondersteun. Hul bruikbaarheid is afhanklik van hoe die instruksionele ontwerp verskillende aspekte van webgebaseerde leer aanspreek, en of die kursus en webgebaseerde materiaal aan die eienskappe/behoeftes van die teikengroep voldoen of nie.

Sleutelwoorde: webgebaseerde leer; webgebaseerde tegnologieë; samewerkende leer; onderwys-webwerwe; kursusbestuursisteme; webgebaseerde klaskamers; leerders se kenmerke; kinders; voorgraadse studente; nagraadse studente; volwasse leer.

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List of Abbreviations

CGI	Common Gateway Interface
CIE	Computer-Integrated Education
CMC	Computer-Mediated Communication
CMS	Course Management System
FTP	File Transfer Protocol
HCI	Human-Computer Interaction
HOTS	Higher order thinking skills
HTML	Hypertext Mark-up Language
ID	Instructional Design
NCTM	National Council of Teachers of Mathematics
OBE	Outcomes-Based Education
SAQA	South African Qualifications Authority
WBI	Web-based instruction
WWW/Web	World Wide Web

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Definitions of Terms

Asynchronous communication

Where the transmitting and receiving of messages takes place at different times.

Baby Boomers

Adults born between 1941 and 1960.

Bulletin Board

An electronic area for posting, displaying and receiving information.

Collaborative learning

A learning process which emphasises group or co-operative efforts among academic staff and learners, and which stresses active participation and interaction on the part of both learners and instructors. Knowledge is viewed as a social construct and therefore the educational process is facilitated by social interaction in an environment that facilitates peer interaction, evaluation and collaboration (Hiltz, 1995).

Computer-Mediated Communication (CMC)

Any form of interpersonal communication that uses some form of computer technology to transmit, store, annotate, or present information created by one or more participants. It can help to achieve fundamental educational objectives such as: focusing on active learning, placing the responsibility for learning with learners, and encouraging peer review and teamwork (Wolz, 1997 in: Edwards and Clear, 2001).

Contact teaching

Traditional class teaching, supplemented by computer lab sessions.

Course Management System (CMS)

CMSs refer to tools that support the design, delivery and management of online courses (Firdyiwek, 1999).

Curriculum 2005

A curriculum based on the ideal of lifelong learning for all South Africans. It aims at equipping learners with the knowledge, competencies and orientations needed for success after they leave school or have completed their training. Its guiding vision is that of a thinking, competent future citizen (South Africa, 1997a).

Curriculum 21

A new, revised and streamlined curriculum, to replace Curriculum 2005 (Pretorius, 2000).

Discussion list

Uses list-processing software and distributes e-mail to all subscribed users on the list. It is useful for one-to-many communication. A moderator is optional (Clarke, 1998).

Distance learning

Distance learning is an instructional delivery system that connects learners with educational resources. Distance learning provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current students. The implementation of distance learning is a process that uses available resources and will evolve to incorporate emerging technologies (Porter and Lane, 2000).

Educational web sites

Educational web sites, in this specific context, refer to web-based tutorial and practice environments.

File Transfer Protocol (FTP)

Standard method of moving files across the Internet.

Flaming

A "flame" refers to any message or article that contains strong criticisms, usually irrational or highly emotional.

Generation X

Generation X refers to people born between 1961 and 1981. They are the generation after the Baby Boomers, currently in their twenties.

Human-Computer Interaction (HCI)

The discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and the study of major phenomena surrounding them (Dix *et al*, 1998).

Hypertext Mark-up Language (HTML)

The language used to create Web documents (Kennedy, 1997).

Internet

A co-operatively run global collection of computer networks with a common addressing scheme (Kennedy, 1997). The Internet includes the World Wide Web

(Web), communication technologies (including e-mail, discussion lists, bulletin boards, newsgroups, and real time chat), File Transfer Protocol (FTP), Gopher, Telnet, and Usenet.

Instructional Design

Instructional design is the systematic design of teaching and learning environments (Liaw and Huang, 2000).

ITFORUM

An electronic discussion forum where people from around the world discuss theories, research, new paradigms, and practices in the field of Instructional Technology. The list is open to anyone interested in Instructional Technology, including postgraduate learners in the field. Leaders in the field are invited to write a short paper, which is posted on the list prior to discussion. This guest discussant remains available electronically on the list for a period of one week to discuss, debate, or answer questions from subscribers (Surry, 1994).

Lurking

The practice, particularly of "newbies" (newcomers to the Internet), of reading messages and information posted on interest newsgroups and discussion lists without posting or participating themselves (Clarke, 1998).

Millenial Generation

People born since the early 1980s (Zoba, 1997).

Open learning

Open learning strives to provide unhindered access to learning resources so that technologically-supported freedom of information may be turned into freedom of education for people pursuing their own learning needs. It emphasizes personal autonomy over studies (Kirkup and Jones, 1996 in: Edwards and Clear, 2001).

Outcomes-Based Education (OBE)

An approach which requires learners and lecturers to focus their attention on the desired end results of learning, and the teaching and learning processes that will guide learners to these end results (Geyser, 1999).

Web-based classroom

An online learning environment attached to the Web, that supports collaboration between learners through Computer-Mediated Communication, within the context of

constructivist learning. It delivers material to adult learners at locations other than the course delivery centre, and simulates aspects of a physical environment.

Web-based technologies

Technologies that run on the Internet or the Web, including web sites, web-based course management systems (CMSs), web-based classrooms, discussion lists, e-mail, etc.

World Wide Web (Web)

Graphic and text documents published on the Internet that are interconnected through clickable “hypertext” links (Kennedy, 1997).

Chapter 1

Introduction

1.1 Introduction

Worldwide, there is a shift away from traditional learning towards open learning. The aim of open learning is to provide unhindered access to learning resources, so that technologically supported freedom of information may be turned into freedom of education for people pursuing their own learning needs (Virtual Campus, 1998a). The way to achieve this is through a flexible learning system.

A flexible learning system encompasses a range of distance and face-to-face delivery mechanisms and support systems, using appropriate, cost-effective combinations of technologies. In the context of such tendencies, universities and schools are increasingly making use of Internet and web-based technologies, telematic education, and web-based course management systems, using some of these technologies successfully and others less so.

This dissertation reports on an investigation into three asynchronous web-based technologies to determine their usefulness and the extent to which they support learning. The study comprises three case studies, each examining a separate web-based technology, suitable for diverse groups of learners in terms of age groups and backgrounds. In each case study, the research questions are subdivided into various aspects related to web-based learning, namely pedagogical, affective/emotional, communicative and technological aspects. The way in which these aspects are designed and implemented determines the usefulness of web-based technologies.

1.2 Research problem

There are numerous web-based technologies currently available, each with different applications. There is, however, no systematised structure stating which should be used for whom, and how the technologies should be used. This research attempts to describe the possibilities of web-based technologies for different age groups of learners (children, undergraduates and postgraduates), and types of teaching (contact teaching and distance learning).

1.3 Aim of research

The purpose of this study is to determine for whom and how these technologies could be used, with the intention of providing a systematic structure of web-learning possibilities for different learners and types of teaching. Educators and trainers can use this structure as a point of departure in future teaching experiences.

1.4 Objectives of the research

The specific objectives of the research are to assess:

- The usefulness of specific web-based technologies, as they relate to the four main aspects investigated in this study, namely:
  - Pedagogical/andragogical;
  - affective/emotional;
  - communicative; and
  - technological.
- The extent to which learners' responses to various web-based technologies vary between different groups of learners.

1.5 Research questions

The major research questions to be explored in this study are given in Table 1.1.

Table 1.1 Major research questions

1. What role do the following aspects play in web-based technologies:
   - Pedagogical/andragogical;
   - affective/emotional;
   - communicative; and
   - technological aspects?
2. What are the distinguishing characteristics of learners of different age groups, and what are the differences and similarities between these age groups in the context of web-based technologies?
3. What are the learning possibilities for:
   - Children;
   - undergraduates; and
   - postgraduates

   in the context of web-based technologies?
4. What are the web-learning possibilities for:
   - Contact teaching; and
   - distance learning?

These questions will be answered by investigating three case studies. In each case study, the target population is divided into two groups, for the purpose of comparison and contrast. Although the tendency is to use the generic term "learner", for the sake of clarity and to increase readability, the terms "**children**", "**undergraduates**" and "**postgraduates**" will also be used. When a combination of any of these terms is used, the word "learner" is used.

The target populations of the three case studies are discussed below.

Case Study 1: An investigation of *Plane Math* (a web-based tutorial and practice environment). The target population is primary school children and the investigation was performed in two different schools, one in an urban city context and the other in a rural town context.

Case Study 2: An investigation of a web-based course management system (CMS)

delivered by *WebCT*. The target population is tertiary-level learners, and the investigation was performed on a group of undergraduate Multimedia learners doing their Bachelor of Arts in Multimedia, and a group of postgraduate Engineering learners (adult learners) doing their Masters in Engineering. Both groups were using *WebCT* for the first time shortly after it was implemented by the Virtual Campus of the University of Pretoria. The investigation is therefore performed on groups of learners from both kinds of sciences, i.e. the "soft" and the "hard" respectively.

Case Study 3: An investigation of *RBO*, a fully online postgraduate course presented via a web-based classroom. The target population is tertiary-level adult learners. The investigation was performed on learners doing the course on a formal basis (i.e. as part of the Masters degree in Computer-Integrated Education (CIE)), and learners who did the course on an informal basis (i.e. in a continuing-education context).

In each case study the following aspects are considered:

- Pedagogical/andragogical aspects;
- affective/emotional aspects;
- communicative aspects; and
- technological aspects.

Figure 1.1 gives an overview of the study, showing the aspects investigated in each case study. The case studies are divided, in turn, into their constituent target populations. The web-based technologies under investigation employed different types of teaching, the educational web site being used in a physical classroom, while the web-based CMS was used to augment contact. The web-based classroom ran entirely on the Web with no physical contact.

Figure 1.1 Overview of the study

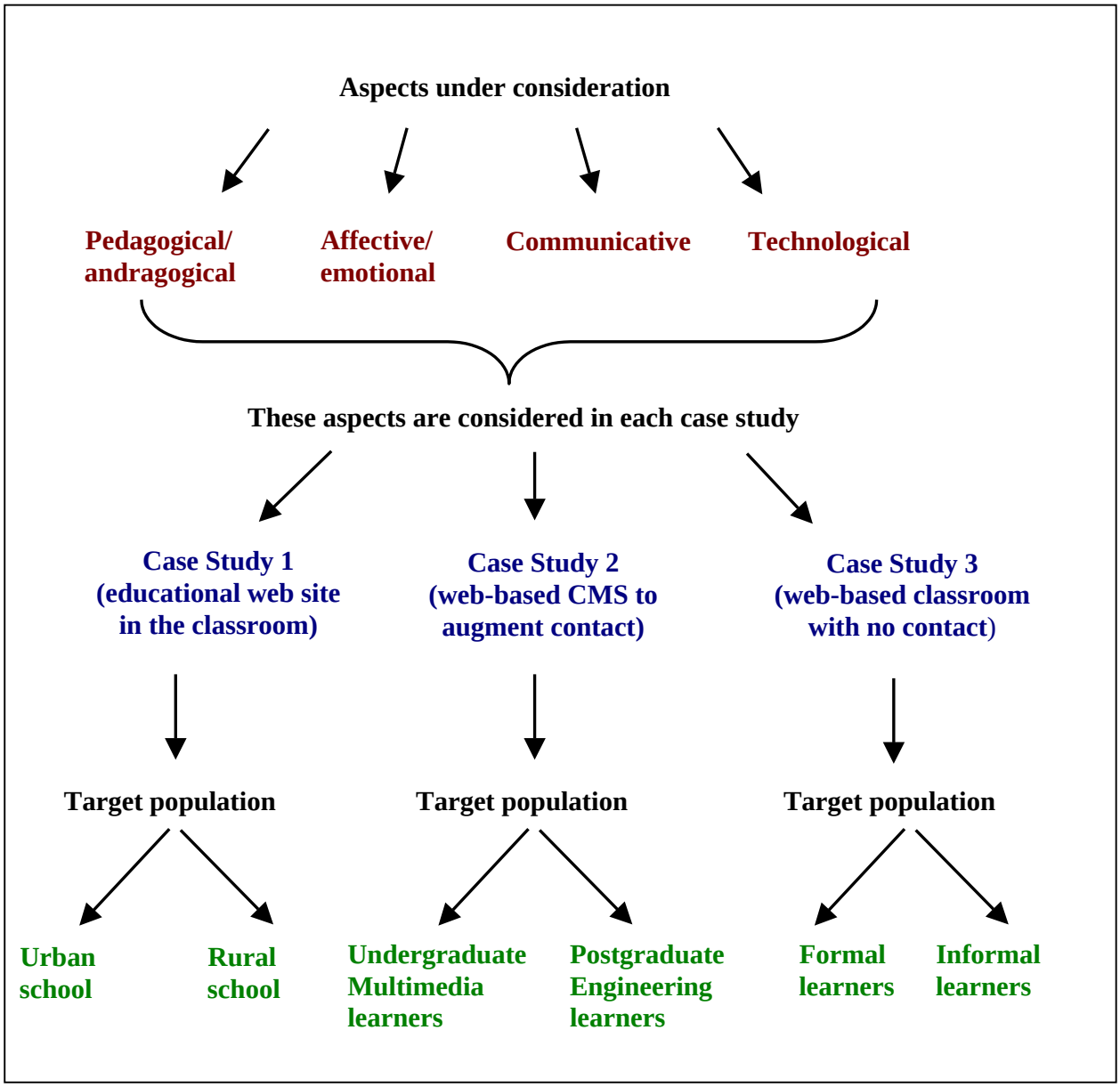


Table 1.2 gives the subquestions that arise in each case study, as they relate to the various aspects under investigation.

Table 1.2 Subquestions relating to the aspects under investigation in the various case studies

Case study	Aspects	Research subquestions
Case Study 1	Pedagogical	▪ What was the response of the children with regard to their own learning? ▪ How relevant is *Plane Math* to the school curriculum?
	Affective/emotional	▪ Did the children enjoy their learning experience?
	Communicative	▪ To what extent does the site employ adequate Instructional Design (ID) principles? ▪ To what extent does the Human-Computer Interaction (HCI) promote learning or hinder it?
	Technological	▪ To what extent does the technology support effective use?
Case Study 2	Andragogical	▪ To what extent is *WebCT* an aid/obstacle to learners' learning? ▪ Were learners satisfied with the nature of the feedback they received from their instructors via *WebCT*? ▪ To what extent can collaborative learning be stimulated effectively on *WebCT*, using the bulletin board feature?
	Affective/emotional	▪ What are learners' first impressions of *WebCT*? ▪ What emotions, likes and dislikes do learners experience when using *WebCT*?
	Communicative	▪ To what extent is *WebCT* user-friendly? ▪ To what extent is *WebCT* an effective means of delivery? ▪ What method of communication (face-to face/virtual) do learners prefer? ▪ To what extent do learners value a bulletin board?
	Technological	▪ What technological problems did learners/instructors encounter when using *WebCT*?
Case Study 3	Andragogical	▪ To what extent was the course, with no face-to-face contact, effective in supporting the needs and learning of postgraduate learners? ▪ To what extent can collaborative learning be effectively stimulated on the Internet?
	Affective/emotional	▪ What emotions, likes and dislikes do postgraduates learners experience in a fully online course?
	Communicative	▪ How effective was the design of the web-based material in facilitating learning? ▪ What features characterised the human-human interaction?
	Technological	▪ What technological problems are encountered in a fully online course?

The rationale behind investigating each of these cases will now be discussed.

Rationale for Case Study 1

The rationale behind this case study is to determine where web-based technologies can be used to supplement traditional contact teaching, and to conduct research on the effectiveness of educational web sites. The field of web-tutorials is a rapidly growing and dynamic one that is making a significant demand on evaluators to keep pace. Due to their currency, few have been evaluated thus far. If the feedback generated by such an evaluation is positive, it would be worthwhile to introduce web sites/tutorials as supportive tools in the appropriate educational curricula. Such information would be useful for instructional designers and educators as a way of evaluating the usefulness of children's web sites for enhancement or modification, and in the development of new web sites.

The purpose of taking a sample group from each of two schools in two different contexts is to see whether responses to the *Plane Math* web site varied, and to evaluate whether or not educational equality was achieved among diverse populations of learners.

Rationale for Case Study 2

The rationale behind investigating *WebCT* is to determine learners' responses to web-based CMSs. A further purpose is to investigate whether or not the interface of *WebCT* is intuitive and appropriate, and whether or not learners were challenged and engaged by the learning experience. It is also necessary to discuss the problems related to the development and implementation of courses of this kind, in order to avoid potential pitfalls.

WebCT was designed with a view to supporting interactive educational communication and to offering enhanced support to teachers and learners in using the Internet as a medium for learning. However, the true test of such a tool, apart from its contribution to learning outcomes, is the actual use to which it is put, the development of skills and method that it supports and the satisfaction learners gain from using it.

Rationale for Case Study 3

This case study investigates the extent to which one can work solely on the Internet and the Web. This issue is of particular significance as Internet-based learning is increasingly attractive for adults who work full-time but seek continuous education, and many adult learners attempt to achieve their goal of adult learning via distance learning options (Chyung, 1999). It also seeks to examine the extent to which collaborative learning can be stimulated on the Internet, with no face-to-face contact.

In Case Studies 1 and 2 the Web acts as a supplement to traditional contact teaching, while Case Study 3 reports on a fully online course.

1.6 Previous research

In order to place this research project in the context of research conducted in South Africa, a review of the NEXUS database was undertaken. According to this review, conducted in November 2000, eight related studies were identified. These are detailed in Table 1.3 and show the context of the problem, with regard to the existing body of literature.

Table 1.3 Related research topics

Researcher	Title	Year	Degree
Brown, S	A framework for internet-supported collaborative learning in South Africa	1998	MTech
Butcher, N and Roberts, N	The Internet, satellite and the professional development of educators: building appropriate teaching and learning models	1998	Non-qualification
Clarke, P.A	Telematic teaching of adults via the World Wide Web: a case study	1998	MEd
de Bruyn, A.M	Guidelines for the use of the Internet in teaching	1999	D Ed
de Jager, A	The use of the Internet as a constructivistic tool when teaching the mole concept	1995	MEd
Dickson, M	Superhighway or cul de sac: the Internet as a tool for learning school mathematics	1998	MEd
Peté, M.M	The design and development of a resource-based, open learning system on the World Wide Web	1998	MEd
Voster, B	Possibilities and constraints of teaching adults on the World Wide Web.	1998	MEd

From Table 1.3 it can be seen that this research is relevant to research conducted by the authors de Bruyn, Peté and Voster, but at the same time it is unique, because it seeks primarily to investigate learners' responses to web-based technologies and, based on these responses, propose the way forward. The study is also highly integrated in that it investigates three case studies, where web-based technologies are investigated on learners from various age groups, giving a wide picture of for whom and how web-based technologies can be used to support learning. The research is thus both relevant and unique.

1.7 Value of research

Kinshuk (2000) comments:

> *Rather than jump from one technology fad to another or leap to conclusions that new technologies require new planning and design processes or radically different learning paradigms, it appears reasonable to consolidate what we know works best in which various learning and work environments, and to identify known gaps in our knowledge and areas where new technologies simply do not fit well into existing frameworks.*

The main contribution the dissertation will make to research is to provide educators with possibilities for using web-based technologies for learners of different ages (children, undergraduates and postgraduates) and for different types of teaching (contact teaching and distance learning). Its ultimate purpose is to

expand educators' abilities to provide effective training and education via these media, so as to attain greater success in future teaching experiences.

1.8 Methodology

The research design for both the proposed study and the separate case studies is discussed in this section, as well as the data collection methods used. An evaluation matrix is presented in Table 1.5, which correlates the major research questions with the main research methods used in each case study.

1.8.1 Research design

The study commences with a literature review on the fundamentals of web-based technologies. Three case studies were undertaken to illustrate how theory derived from the literature is applied in practice. The overall research design is eclectic, as separate research designs were used in each case study.

The study follows an opportunist model, in that the researcher used the events that came her way and which were available to her to test the success of various web-based technologies.

The individual case studies follow similar research designs, in that each case study follows a quantitative non-experimental survey design. In such designs, data is collected through questionnaires/interviews and statistically analysed (McMillan and Schumacher, 1993). According to McMillan and Schumacher (1993), designs of this nature have a wide range of applications.

Due to the small group sizes in each case study, statistical analysis of the data has not been conducted, as this would have little value. Consequently the results from each case study provide only initial support. Case Studies 2 and 3 rely on a combination of two research designs, namely, a quantitative non-experimental survey design and a qualitative ethnographic design. A qualitative ethnographic design relies on observation and interviews to gain an in-depth understanding of the situation at hand, and relies on rich descriptions of data (McMillan and Schumacher, 1993).
The researcher intends to discover, through both qualitative and quantitative research, how learners of different age groups respond to and experience different web-based technologies, and whether or not these technologies support learning.

1.8.2 Data collection methods

Table 1.4 shows the various data collection methods used in the individual case studies.

Table 1.4 Data collection methods

Case studies	Data collection methods
Case Study 1	Questionnaire, observation, expert review checklist
Case Study 2	Questionnaire, interviews, analysis of messages sent to the bulletin board
Case Study 3	Questionnaire, participant observation, interviews, analysis of messages sent to the discussion list

In Case Study 1, data was collected primarily by means of a questionnaire, but also by using observation and an expert review checklist. In Case Study 2, a questionnaire was once again the primary data collection method. Other data collection methods used were interviews with the two instructors responsible for using *WebCT* in their courses, as well as an analysis of the messages sent to the bulletin board. The data collection methods used in Case Study 3 were similar to those used in Case Study 2, except that participant observation was also used. The methods used in Case Study 3 were a questionnaire, participant observation and interviews, as well as an analysis of the messages sent to the discussion list. Multiple methodologies were used in each case study to validate the results generated from the questionnaire, i.e. to apply triangulation.

The various data collection methods are elaborated on in the context of the three case studies, as given in Chapters 3, 4 and 5 respectively. The results derived from each case study will be integrated in Chapter 6, in order to answer the main research questions.

Reeves (in: de Lisle, 1997) recommends an evaluation matrix for research into multimedia. Table 1.5 presents such a matrix which, in this instance, correlates the major research questions with the main research methods implemented in each case study.

Table 1.5 Matrix of research questions and methods

Method / Questions	Case Studies	Literature review	Question-naires	Interviews	Observation	Analysis of messages
What role do pedagogical/ andragogical, affective/emotional, communicative and technological aspects play in web-based technologies?	1	✓	✓			
	2	✓	✓	✓	✓	✓
	3	✓	✓		✓	✓
What are the distinguishing characteristics of learners of different age groups, and what are the differences and similarities between these age groups in the context of web-based technologies?	1	✓	✓		✓	
	2	✓	✓			✓
	3	✓	✓		✓	✓
What are the learning possibilities for children, undergraduates and postgraduates in the context of web-based technologies?	1	✓	✓		✓	
	2	✓	✓		✓	
	3	✓	✓	✓	✓	✓
What are the web-learning possibilities for contact teaching and distance learning?	1	✓	✓		✓	
	2	✓	✓	✓		✓
	3	✓	✓	✓	✓	✓

1.9 Limitations of this study

Certain limitations were experienced in the study, namely:

- Limited time available for the investigation;
- the studies dealt with small segments of subject areas; and
- small group sizes are used.

The small group sizes mean that while there were some commonalities among learners, these findings are not generalisable. Consequently, the results from each case study provide only initial support.

1.10 Specific exclusion from this study

The researcher accepts Clark's contention that media do not influence learning (Clark, 1994), and Russell's conclusion that there are no significant differences in performance between individual delivery media (Russell, 1999). The researcher will therefore not be measuring learning gain through pre-tests (before the training), and post-tests alike (after training), to determine the extent of learning.

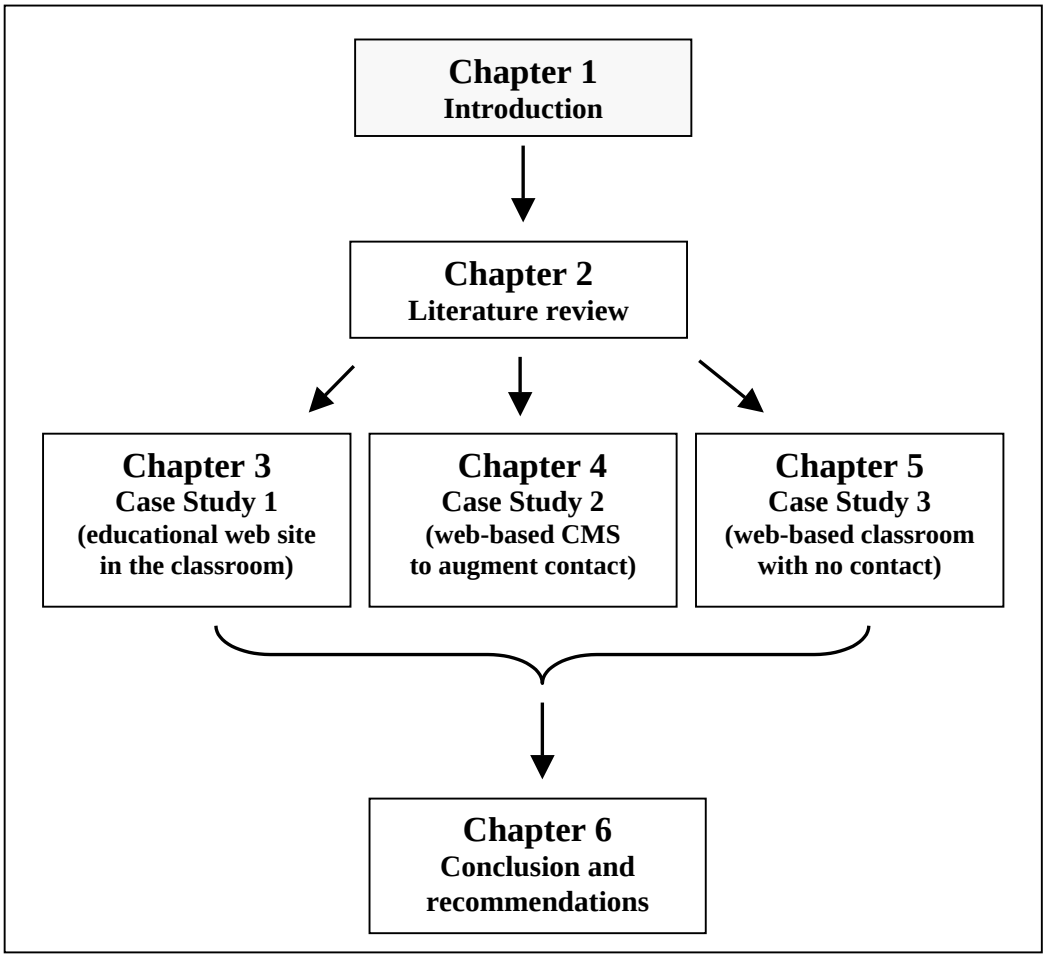
1.11 Outline of the dissertation

This dissertation is comprised of six chapters, of which an outline is given in Table 1.6. This is followed by a diagrammatic illustration of the outline of the dissertation, as depicted in Figure 1.2. This figure is shown at the beginning of each chapter, where the current chapter is blocked in blue, for the purpose of orientating the reader.

Table 1.6 Outline of dissertation

Chapter	Name of chapter	Description
Chapter 1	Introduction	The framework within which the problem is situated. It outlines the main points of the study and provides a general overview.
Chapter 2	Literature review	A review of relevant literature on aspects related to web-based technologies. The characteristics of learners are presented, as well as the web-learning possibilities for learners of different age groups, and types of teaching.
Chapter 3	Case Study 1	Description and investigation of *Plane Math* – an educational web site used in the classroom.
Chapter 4	Case Study 2	Description and investigation of *WebCT* – a web-based CMS used to augment contact.
Chapter 5	Case Study 3	Description and investigation of *RBO* – a fully online course, presented via a web-based classroom.
Chapter 6	Conclusions and recommendations	Integration of the results of the three case studies, and conclusions and recommendations regarding the way forward.

Figure 1.2 Diagrammatic illustration of the outline of the dissertation

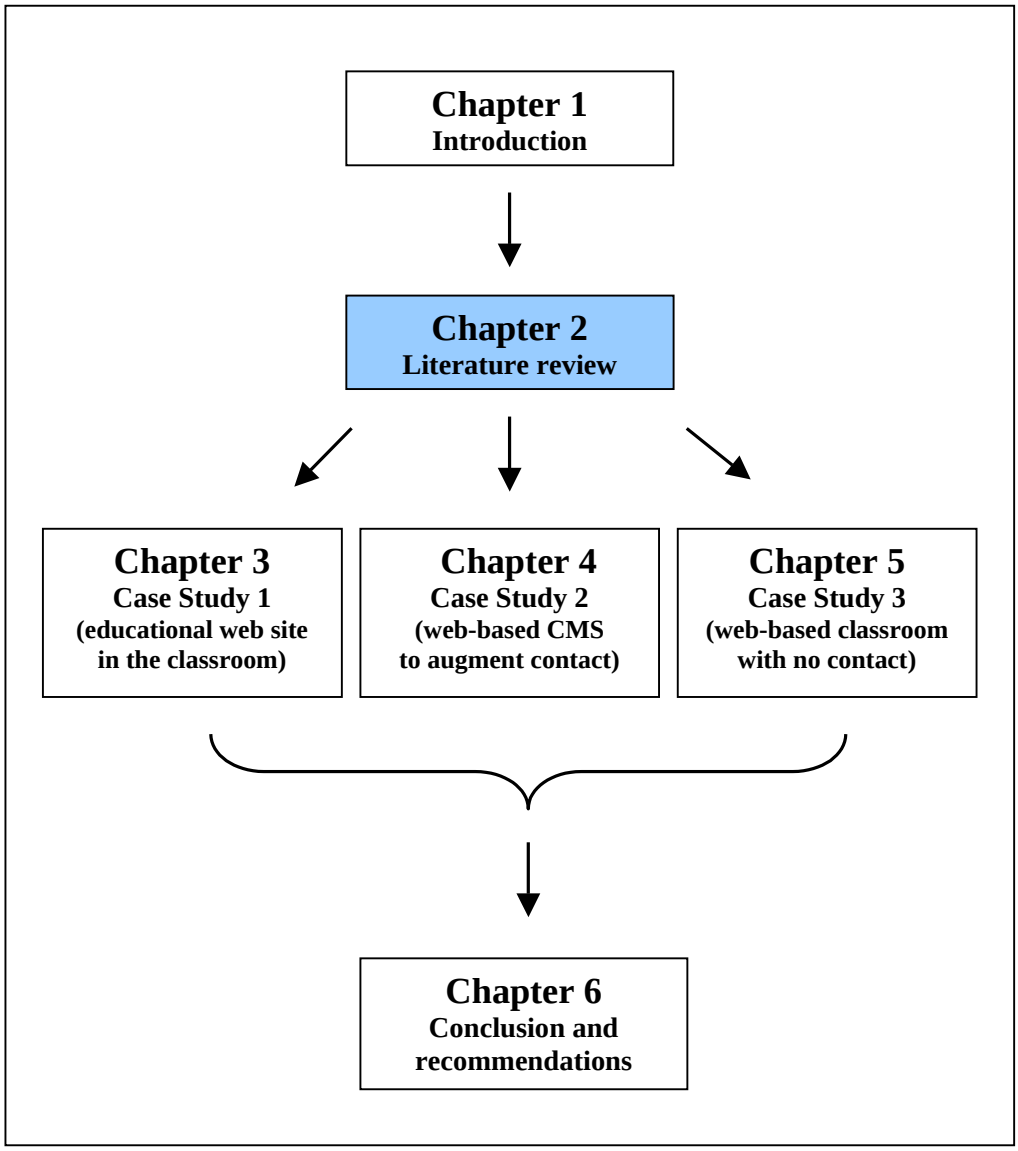


1.12 Summary

The dissertation reports on an investigation of three web-based technologies to investigate learners' responses to, and experience of, them. This chapter has provided a framework within which the problem is situated. Chapter 2 sets out to answer the research questions by undertaking a literature review, in order to contextualise the research.

Chapter 2

Literature review



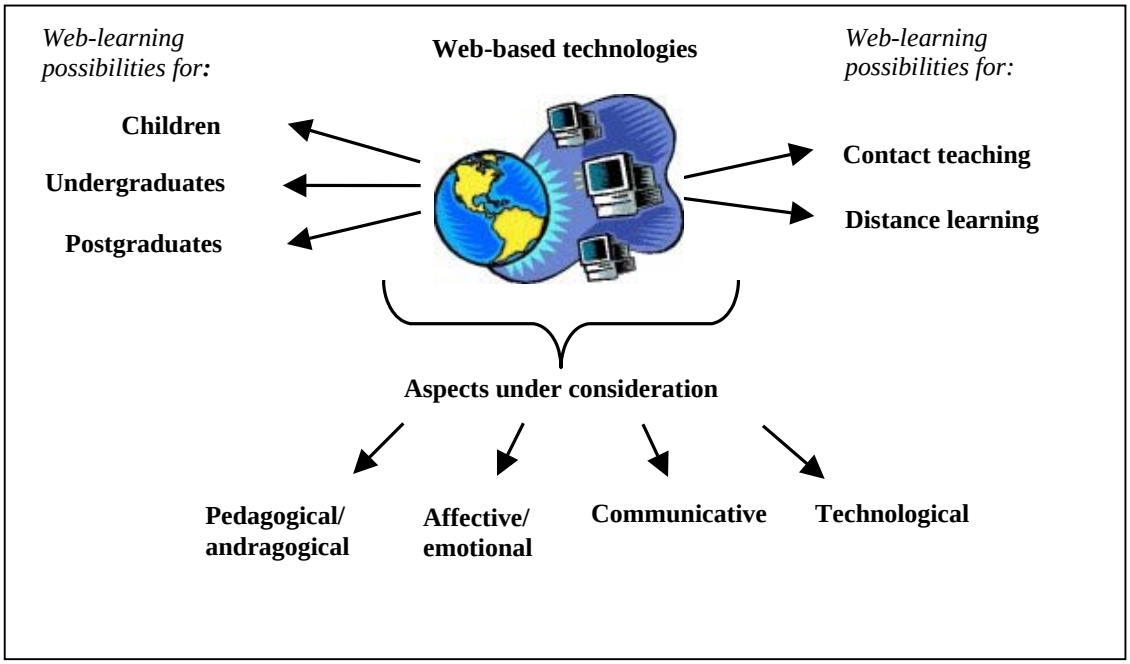
2.1 Introduction

Following the previous chapter which provided a framework for the study, this chapter reviews relevant literature covering the research questions in Chapter 1, Table 1.1. The following points are discussed in this chapter:

- Aspects to consider when using web-based technologies.
- The distinguishing characteristics of learners of different age groups, and the differences and similarities between these age groups in the context of web-based technologies.
- Learning possibilities for children, undergraduates and postgraduates in the context of web-based technologies.
- Web-learning possibilities for contact teaching and distance learning.

These points are discussed in turn in the sections that follow, and are illustrated diagrammatically in Figure 2.1.

Figure 2.1 Application of web-based technologies for different age groups and types of teaching



2.2 Aspects to consider when using web-based technologies

> *Nothing before has captured the imagination and interest of educators simultaneously around the globe more than the World Wide Web* (Owston, 1997).

A wide range of technological options are currently available to educators and instructors (Huang, 2000). Web-based instruction (WBI) has been widely applied in both contact teaching and distance learning (Huang, 2000; Harmon and Jones, 1999; Trentin, 1999; Liaw and Huang, 2000), and there is a current rush in academia toward implementing it (Harmon and Jones, 1999). However, the rush to conduct education and training on the Web is at best ill-devised, and at worst will fail to deliver the magic everyone expects (Harmon and Jones, 1999). Harmon and Jones (1999) argue that the Web will be of great value for education in the near and distant future, if used appropriately.

Richie and Hoffman (1997) define web-based instruction (WBI) as "a hypermedia-based instructional program which utilises the attributes and resources of the Web to create a meaningful learning environment wherein learning is supported and fostered". According to Sherry and Wilson (1997), a WBI learning environment should include many resources, support collaboration, implement web-based activities as part of the learning framework, and support both novices and experts. A WBI environment is also able to provide a wealth of information to learners that is not readily available in textbooks or in lectures (Daugherty and Funke, 1998).

Harmon and Jones (1999) present five levels of web use. Table 2.1 presents these levels and gives a description of what each entails. These levels are commonly used in schools, colleges and universities, and in corporate training. Each case study in this dissertation investigates the use of a different level of web use, as indicated in italics in Table 2.1. In Case Study 1, the Web was used as a **supplement** to traditional contact teaching, while Case Study 2 considered **communal** use of the Web. In Case Study 3, the level of web use was **immersive**, i.e. the course was run entirely on the Web.

Table 2.1 Five levels of web use in education

Level of web use		Description
1.	Informational	▪ Provides stable information to the learner. ▪ Administrative in nature ▪ Consists of the instructor placing items such as the syllabus, course schedules and contact information on the Web for learners to review. ▪ Requires little or no daily maintenance, and takes up minimal space and bandwidth.
2.	Supplemental ***Case Study 1 (educational web site)***	▪ Provides course content information for the learner, functioning as an addendum to the core content. ▪ Main part of educational experience is provided in a classroom setting. ▪ Instructor places course notes on the Web. This should be done after class, otherwise class attendance will drop. ▪ Requires more technical know-how by the instructor, daily or weekly maintenance, and low to moderate space and bandwidth.
3.	Essential	▪ Requires the instructor to have HTML skills, and information literacy skills along with ample course development time. ▪ Learner obtains most, if not all, of the course content information on the Web. ▪ Classes still meet face-to-face, but learners are expected to use the web-based course materials extensively. ▪ Requires learners to take a more proactive approach to ensure their own learning.
4.	Communal ***Case Study 2 (web-based CMS)***	▪ Classes meet both face-to-face and online. ▪ Learners generate course content themselves. ▪ Requires the use of other online tools, such as chat rooms, bulletin boards, e-mail, and video. ▪ Requires both instructor and learners to have good HTML skills as well as effective technology skills in general. ▪ Online group collaboration tools are not as user-friendly and "bug-free" as one might hope and novice technology users might not be able to get past the frustrations of imperfect tools to get to meaningful interaction about the course content.
5.	Immersive ***Case Study 3 (web-based classroom)***	▪ All of the course content and interactions occur online. ▪ This level should be seen as a sophisticated, constructivist virtual learning community. ▪ Comprised of learner-centred, constructivist pedagogies. ▪ Instructor and learners must have a high level of technical expertise and sophisticated learning strategies.

(summarised from Harmon and Jones, 1999)

Various aspects play an important role in different web-based technologies. These aspects need to be considered as they influence the effectiveness of learning or the degree to which learning is supported. These aspects are pedagogical/andragogical, affective/emotional, communicative, and technological aspects, and are discussed in turn in the sections that follow.

2.2.1 Pedagogical/andragogical aspects

Pedagogical/andragogical aspects emphasise how learning domains are to be represented, and affordances provided to support learning (Hannafin *et al*, 1997).

In this section the following are discussed:

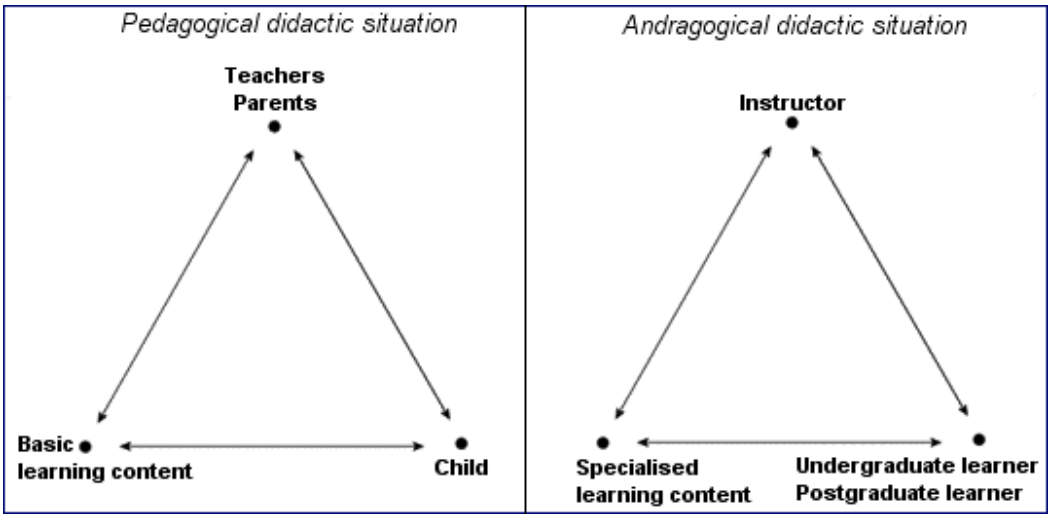
- Pedagogical and andragogical didactic situations;
- objectivist and constructivst epistemology; and
- collaborative learning.

2.2.1.1 Pedagogical and andragogical didactic situations

The term "andragogy" is used to distinguish the teaching and learning of adults from "pedagogy", the teaching and learning of children. "Andragogical" in this study includes both undergraduate and postgraduate learners.

Fraser (*et al*, 1993) presents two didactic situations, namely: the pedagogical didactic situation and the andragogical didactic situation. They define a didactic situation as a coherent set of circumstances in which people find themselves at a particular time, in which he/she is in a specific relationship with other people or objects (aspects of reality) and which demand or suggest particular activities. Figure 2.2 gives a schematic representation of these two situations (Fraser *et al*, 1993).

Figure 2.2 Pedagogical and andragogical didactic situations (adapted from Fraser *et al*, 1993)



In the **pedagogical didactic situation**, teachers and parents teach basic learning content to immature children in order to lead them to adulthood, while in the **andragogical didactic situation**, instructors function as tutors who teach and guide students, apprentices and other adult persons, by means of specialised learning content, to become more mature (Fraser *et al*, 1993).

2.2.1.2 Objectivist and constructivist epistemology

The application of technology to teaching and learning has undergone a paradigm shift in terms of the learning strategies which should be embedded in web-based instruction. This paradigm shift has been the move from an objectivist epistemology to a constructivist epistemology (Sims, 1998) – the former and the latter are two of the main approaches, or epistemologies of learning.

According to objectivist epistmemology, knowledge has an objective and separate existence, the attributes, relationships and structure of which can be known (Cronin, 1997). As a knowledge expert, the instructor (and/or appropriately designed content in the case of web-based instruction) embodies an accurate representation of this structure. Teaching involves presenting knowledge and modelling its structure in such a way that it can be accurately acquired and reproduced, while learning involves the accurate acquisition and replication of

this external knowledge (Cronin, 1997; Jonassen *et al*, 1995). The instructor is therefore the transmitter of knowledge and the learner is a receiver (Jonassen *et al*, 1995).

According to Miller and Miller (1999), the fundamental goal of the objectivist epistemology is the accurate transmission and reception of knowledge. This epistemology not only drives strategies which determine the communication between learner and content, but also drives communication between instructor and learners, and among learners. Communication is therefore a means (i.e. strategy) to an end (acquisition of knowledge).

In contrast to objectivist epistemology, the constructivist epistemology reflects a position that knowledge is not independent of the learner, but is internally constructed by the learner as a way of attaching meaning to experiences (Cronin, 1997; Jonassen *et al*, 1995). It is a specific strategy of instruction that facilitates cognitive learning, in contrast to didactic, authoritarian teaching as evidenced in the objectivist epistemology, and is a learner-centred, rather than an instructor-centred approach.

According to Jonassen (*et al*, 1995), learning involves the interpretation of experiences and therefore the knowledge constructed by each learner is unique. Constructivist aspects include real-world situated learning, anchored instruction, discovery-learning, integrated testing, and transfer (i.e. applying known skills to new tasks) (de Villiers, 1999; Miller and Miller, 1999). The active learner participation required in constructivist models can lead to long-term results and real-world performance. Web-based teaching and training facilitate learner initiative, knowledge construction and real-world exposure via browsing (de Villiers, 1999).

A dominant characteristic of constructivist learning is collaboration among learners. In contrast to objectivist instructional theories, constructivist theories posit that it is through communication with others that learners construct meaning from their experiences (Miller and Miller, 1999). The importance of social negotiation in the learning process makes communication critical, hence the need for constructivist instructional environments to be designed and implemented with social negotiation in mind.

Constructivism is increasingly attractive in the public learning system, with its critical need to motivate and engage diverse learners. Constructivists object to pre-specified objectives

and criterion-referenced testing, preferring contextualised learning experiences where learners explore and set their own goals (Dick, 1996). Table 2.2 sets out some key terms associated with constructivism (Dick, 1991; Duffy and Jonassen, 1991; Merrill, 1991), together with corresponding descriptions.

Table 2.2 Terms associated with constructivism

Key terms	Description
Active participation	Learning is an active experience.
Situated/anchored instruction	Learning is anchored in contexts which stimulate apprenticeship learning.
Real-world applications	Problem-solving situations are practical and represent the real-world.
Transfer	Learners transfer skills to other problem-solving situations.
Integrated testing	Testing is integrated into the task, i.e. less emphasis on formal testing and scoring.
Collaborative learning	Emphasis on teamwork (collaboration) to promote multiple perspectives.

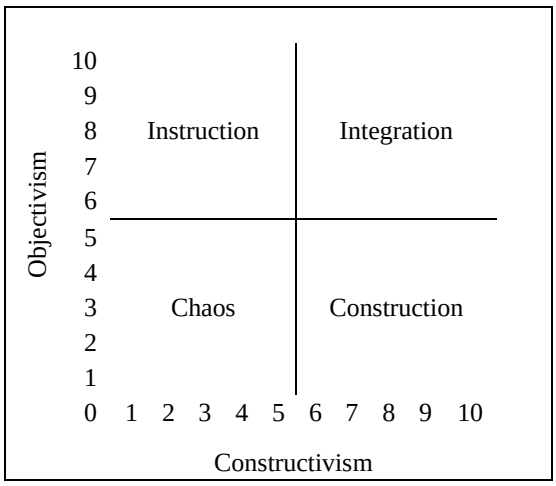
To facilitate a deeper understanding of constructivism, the constructivist epistemology is compared to the objectivist epistemology. Table 2.3 shows certain differences between these two approaches, based on the works of the following authors: Duffy and Jonassen, 1991; Jonassen *et al*, 1995; Runes, 1962:217; and Tam, 2000.

Table 2.3 Differences in learning between the objectivist and constructivist epistemology

Objectivist epistemology	Constructivist epistemology
▪ Knowledge and truth exist outside the mind of the individual and are therefore objective.	▪ Knowledge and truth are constructed by individuals and do not exist outside the human mind.
▪ Learning is viewed as the acquisition and accumulation of a finite set of skills and facts.	▪ Learning is a change in meaning constructed from experience.
▪ Learning is objective.	▪ Learning is personal and relevant to the learner.
▪ Mainly concerned with the object to be known/learned.	▪ Emphasises personal construction of knowledge.

Educational software, course management systems (CMSs), and web sites usually fall into one of these approaches, however, they can and do sometimes overlap. Cronjé (2000c) proposed that the two approaches can be seen as complementary rather than opposing. He proposes that the two can be juxtaposed with each other at 90° instead of at 180° on a continuum. Figure 2.3 depicts these two approaches, with four quadrants that emerge between the two epistemologies.

Figure 2.3 Four quadrants of teaching and learning



Each of the four quadrants represents a particular kind of teaching or learning, as indicated in the following descriptions:

- The *chaos* quadrant is the domain of serendipitous and incidental learning;
- *Instruction* is the domain of programmed learning, tutorials, lectures, and drill-and-practice;
- *Construction* corresponds closely to what is traditionally written about constructivism, constructionism and cognitivism; and
- *Integration* is the combination, under appropriate conditions, of instruction and construction. It is typically the domain of the instructional designer, and learning in this quadrant depends on a goal analysis to determine the learning outcome (Cronjé, 2000c). The designer would then select both objectivist/instructionist and constructivist/cognitive learning events to achieve the desired outcome (Cronjé, 2000c).

2.2.1.3 Collaborative learning

Collaborative learning is strongly associated with constructivism. This section examines collaborative learning in more detail, discussing its features and giving guidelines for its use.

Hiltz (1995) defines collaborative learning as a learning process that emphasises group or co-operative efforts among faculty and learners, and stresses active participation and interaction on the part of both learners and instructors. Knowledge is viewed as a social construct, and therefore the educational process is facilitated by social interaction in an environment that facilitates peer interaction, evaluation and collaboration.

In collaborative learning, the instructor and learners adopt certain roles, and certain features characterise the learning process. Features of collaborative learning, given in Table 2.4, are based on the works of Clarke, 1998; Cronjé, 1999; Hiltz, 1995; Johnson and Johnson, 1999; Jonassen and Reeves, 1996; Kafai and Resnick, 1996; Tam, 2000; and Watson and Rossett, 1999.

Table 2.4 Features of collaborative learning

Role	Description of role
Role of the learner	▪ Assess, sequence and derive meaning from information. ▪ Construct and generate their own knowledge. ▪ Collaborate with other learners. ▪ Act as planner, manager, guide, facilitator and participant.
Role of the instructor/ teacher	▪ Act as mentor and guide. ▪ Encourage learners to work together to build a common body of knowledge, and accomplish shared goals. ▪ Structure learning opportunities (act as planner, manager, guide, facilitator and participant). ▪ Serve as a resource. ▪ Create and maintain a collaborative problem-solving environment. ▪ Assure assessment.
Characteristics of the learning process.	▪ Encourage and accept learner autonomy and initiative. ▪ Use a wide variety of materials, including raw data, primary sources and interactive materials, and encourage learners to use them. ▪ Inquire about learners' understandings of concepts before sharing his/her own understanding of those concepts. ▪ Encourage learners to engage in dialogue with other learners and with the instructor. ▪ Engage learners in experiences that show contradictions to initial understandings and then encourage discussion. ▪ Provide time for learners to construct relationships and create metaphors. ▪ Assess learners' understanding through application and performance of open-structured tasks.

Johnson and Johnson (1999) identify five prerequisites for effective collaborative learning, namely: positive interdependence, individual accountability, a mutual goal, face-to-face promotive interaction and social skills. These prerequisites are discussed in turn.

- *Positive interdependence* relates to the perception that we are linked with others in such a way that we cannot succeed unless they do.
- *Individual accountability* exists when the performance of each individual learner is assessed and the results returned to the group and the individual. The purpose of collaborative learning groups is to make each member a stronger individual.
- *A mutual goal* exists when group members discuss how well they are achieving their goals and maintaining effective working relationships.
- *Face-to-face promotive interaction* is when individuals promote each other's success by helping, assisting, supporting, encouraging and praising each other's efforts to achieve.
- *Social skills* are the interpersonal and small group skills (that need to be taught to learners), which contribute to the success of a collaborative effort.

According to Trentin (1999), learning to collaborate is a prime educational goal as well as an indispensable prerequisite when the aim is to co-develop something. However, this scenario becomes more intricate when learners live away from their educational institution and have to engage in a collaborative exercise.

2.2.2 Affective/emotional aspects

> *What has received relatively little attention by instructional technologists and designers is the development of instruction that incorporates affective goals, objectives, and strategies into educational programs and practices* (Martin and Briggs, 1986:11).

The Virtual Campus of the University of Pretoria states that an engaged learner is a motivated learner, and that it is generally agreed that motivation can make more of a difference between success and failure than any other factor (Virtual Campus, 1998a). According to Fleming and Levie (1993), variation, curiosity, relevance, challenge and control are general intrinsic motivational principles. Malone (1981) states that one of the powers of interactive electronic instruction is the capability to engage by providing rapid, compelling interaction and feedback to the learner.

Malone (1981) emphasises the importance of designing instruction using metaphors with which learners are familiar. Malone (1981) identifies four aspects that foster intrinsic motivation, namely:

- Create **challenge**;
- hand **control** over to learners;
- encourage **curiosity**; and
- meet the **fantasy** needs of individuals.

Web-based technologies should also be designed with creativity embedded, adhering to the Keller ARCS motivational model (Keller and Kopp, 1987), which strives to:

- Gain the **attention** of learners;
- demonstrate **relevance**;
- instil **confidence**; and
- provide **satisfaction**.

Emotional responses are not all positive, however. The combination of technologies designed to motivate learners, and the way humans communicate on the Internet, can result in certain emotional responses which may not be expressed in traditional face-to-face contact. Holland (1996) mentions that "talking on the Internet, people regress …. people regress, expressing love and aggression to a degree that they never would face-to-face". Holland (1996) states that there are three symptoms of this regression, namely:

- Flaming;
- sexual harassment; and
- generosity.

The first and most common symptom is flaming. King (1995) states that flame wars often erupt among strangers, that is, newcomers to Internet discussion groups, and new members of a particular group are often the source of, or the target of, inflammatory messages. He states that people who have never seen or heard each other take the anonymity of cyberspace as an excuse to be rude in ways that one does not see in real life. They are more blunt and uninhibited than they would be in traditional face-to-face contact (King, 1995).

A second symptom of regression on the Internet is sexual harassment. This occurs when crude invitations are made to people about whom one knows no more than their online signature (these may well be "gender-benders" that hide the sex of the speaker).

The third symptom of regression, which may not necessarily be considered a regression at all – is the extraordinary generosity one sees on the Internet. Features of online communication are openness, a sense of sharing and mostly tolerance. Total strangers may devote extensive time to helping one by, for example, sharing information.

2.2.3 Communicative aspects

In web-based courses, as in any learning environment, instructional interactions include "interactions that take place between learners and the content they are trying to master" (Moore, in: Wagner, 1997:21). Instructional strategies used to sequence the delivery of course content as well as the strategies used to present content are communication tools that determine the manner in which the learner interacts with the content. The pedagogical/andragogical design "communicates" information that shapes learners' experiences, including expectations about the purpose of learning, depth of reflection and understanding, level of participation, degree of learner control and perceptions of the instructor's role (Miller and Miller, 1999).

Therefore, communication in web-based instruction involves more than just interactions between the instructor and learners via communication methods such as e-mail and conferencing. Furthermore, Miller and Miller (1999) believe that communication occurs through instructional design features that shape the learner's interaction with content. This definition of web-based communication (learner-content interaction) highlights the connection between pedagogy and communication.

Web-based instruction provides two categories of interactivity: instructional/content interactivity and social interactivity (Liaw and Huang, 2000). These categories are elaborated upon in Table 2.5, and discussed in more detail in Sections 2.2.3.1 and 2.2.3.2.

Table 2.5 Content and social interactivity

Type of interactivity	Description
Instructional/ content interactivity	▪ Content interactivity may be stimulated through immediate feedback, questioning, control of pacing, sequencing, and other interactive controls. ▪ Allows individuals to explore abundant and diverse bits of information in their own ways. ▪ Non-linear content interaction leads learners to reflect more on their own knowledge construction. In this way, content interactivity approaches the constructivist epistemology.
Social interactivity	▪ Social interactivity can be provided by e-mail, voice mail discussion lists, newsgroups, chat rooms, bulletin boards, online conferences, or any other two-way communication media that are integrated into web-based instruction. ▪ Provides enormous potential for social and interpersonal interaction. ▪ Learners and instructors or learners and learners can engage in side-by-side and online questioning, answering, discussion, debate, or negotiation without face-to-face communication. ▪ Tends to have elements of mutuality, flexibility, and bi-directionality that are not as frequently found in purely instructional interaction. ▪ Social and interpersonal interaction are able to directly foster content and instructional interaction.

(summarised from Liaw and Huang, 2000)

From the above it is evident that interactivity in instruction takes on a complex meaning. To sum up, good instruction refers to thoughtful interface design and sufficient feedback, as well as active learning, in which the learner acts on the information to transform it into new, personal meaning. In a constructivist sense, the learner co-constructs meaning by exploring an environment, solving a problem, or applying information to a new situation that he/she helps to define (Campbell, 1999).

2.2.3.1 Instructional/content interactivity

Based on the literature, this section gives instructional design principles for web-learning. Liaw and Huang (2000) define instructional design as the systematic design of teaching and learning environments. Hannafin and Peck (1988) emphasise instructional design principles based on cognitive learning theory: instructional media should support orientation and recall of prior knowledge; and both intellectual skills and learning strategies should be fostered. Cognitive science relates to the reasoning and thinking processes used by learners as they acquire knowledge and skills. Perception and learning are viewed as reorganisation of the brain's knowledge structures, as learners construct meaning by integrating new with existing knowledge, using mental schemata to facilitate comprehension and to aid recall (Inhelder and Piaget, 1958). It is important to include instructional and cognitive features in learning materials, over and above the actual subject matter, to help learners actively plan their study experience.

It is thus imperative that sound principles of instructional design be applied when developing web-based technologies, and that certain guidelines be adhered to. Course material should be designed on the Web in such a way that it adheres to the principles of instructional design as synthesised by Cronjé (1997), but with contributions from other authors:

- Learners **construct** knowledge based on their experience/s, which they then convert into knowledge and skills (Campbell, 1999). Learning is thus an **active process**.
- Interpretation is **personal**, i.e. learners interpret the same material differently, based on their personal knowledge and experiences (Liaw and Huang, 2000:43).
- Learning is **collaborative**, i.e. it is enhanced by **multiple perspectives**.
- Knowledge is based on **real life** experiences, thus learning should be situated in real life (Myers, 1999:51).
- **Integrated testing** and **continuous assessment** are preferable to formal criterion-based testing.

The type of task, the goal of the instruction, and the characteristics/needs of learners also need to be considered (Myers, 1999). Gagne (1965 in: Anand, 1998) sees learning as a form of information processing that is progressive or sequential and builds upon previous knowledge. His research deals with the foundations of effective instruction and has greatly contributed to the field of instructional technology, especially regarding the design of

instruction. According to Gagne the following steps should be considered when designing instruction:

1. Gaining and maintaining attention of learners.
2. Informing learner of objectives.
3. Reminding learners of prior knowledge.
4. Presenting new material clearly and distinctively.
5. Providing guidance for learning.
6. Eliciting performance.
7. Providing feedback on performance.
8. Assessing performance.
9. Enhancing retention and transfer.

Instructional designers should strive to implement web-based instruction with a high quality of interactivity (Liaw and Huang, 2000). However, in literature there is no single accepted definition of interactivity. Each author describes it in his or her own way. According to Campbell (1999), an interactive program provides varying levels of interactivity, ranging from simple point-and-click interaction through to sophisticated search techniques and the analysis, manipulation and application of information in new and authentic contexts. Gilbert and Moore (1998) define interactivity as two-way communication among two or more people within a learning context, for the purpose of either task/instructional competition or social relationship building.

In this regard, the notions of individualised, adaptive and remedial communication are also implied. These characteristics can all be applied in educational programs/web sites. With regard to web sites, forms/Common Gateway Interface (CGI), Java, Javascript, quicktime virtual reality and Shockwave all provide opportunities for flexible design of educational systems.

Borsook and Higginbotham-Wheat (1991) and Cronjé (1996) identify a series of interactivity components which make computer technology interactive, and benefit the learner. These components include:

- Immediacy of response;
- non-sequential access of information;
- adaptability;
- feedback;
- options (that the receiver of instruction is able to select);
- bi-directional communication; and
- grain-size (this refers to the length of a presentation sequence before input is required - the larger the grain size, the lower the interactivity).

However, there are further elements relevant to the success of interactivity, namely:

- The extent to which design has been applied to the application;
- the embodiment of instructional features that promote active learning; and
- engagement and control.

These three elements are discussed in turn.

(a) The extent to which design has been applied to the application

Jonassen (1985:7) believes that only through rigorous instructional design will interactions be effective. He emphasises that "interactivity enables learners to adjust the instruction to conform to their needs and capabilities ... the learner becomes an active participant, rather than passive observer, making significant decisions and encountering their consequences".

(b) Embodiment of instructional features that promote active learning

According to Fenrich (1997 in: Sims, 1998) interaction implies active learner participation in the learning process, and failure to build interactivity into programs reduces learning and retention. Examples of conditions that highlight the nature of interacting with technology are: questions that require thinking, active participation in a simulation or an educational game, providing feedback, building on current knowledge and experience, learner control of pace and sequence, learners' comments and annotations, and learner modifications to the computer program.

This approach is further extended by the possibility for interactive applications to include a risk factor: "can the user lose something or have something unpleasant happen to them? When there is no risk of consequences for the learner ... the mind runs idle" (Allen in: Sims, 1998).

(c) Engagement and control

Engagement refers to the extent to which the learner works with the content, while control involves determining the options available for accessing and navigating through the content structure (Sims, 1998). Csikszentmihalyi's (1990) Flow Theory of Optimal Experience is based on learners becoming very engaged and absorbed by certain activities, and is defined as:

> *…. the state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will do it even at great cost, for the sheer sake of doing it* (Csikszentmihalyi, 1990).

This motivating "flow" can be achieved if web-based technologies are designed in such a way that they are goal-oriented, grab the attention of learners, offer challenges and hand control over to learners (Clarke, 1998).

2.2.3.2 Social interactivity

Communicative interaction between individuals lies at the heart of most approaches to teaching in educational settings (Hewson and Hughes, 1998). It has been discovered that both the "constructivist approach to the design of learning and research on learners approaches to learning, emphasise that active engagement with content and opportunities to interact with teachers and peers are essential elements for deep learning" (Hewson and Hughes, 1998:329).

One way to foster collaborative learning is to use Computer-Mediated Communication (CMC). This section defines CMC, and gives its benefits and limitations for learning.

(a) What CMC is

Wolz (1997 in: Edwards and Clear, 2001) defines CMC as "any form of interpersonal communication that uses some form of computer technology to transmit, store, annotate, or present information created by one or more participants". He states that CMC can help to achieve fundamental educational objectives such as:

- Focus on active learning;
- place the responsibility for learning with learners; and
- encourage peer review and teamwork.

(b) Benefits of CMC for learning

When learners have opportunities to interact with other learners and instructors, this facilitates knowledge building and promotes knowledge sharing (Liaw and Huang, 2000). Much of learning inevitably takes place within a social context, and the process includes the mutual construction of understanding (Bruner, 1971). Group communication offers the opportunity for learners to:

- Gain the motivational support of fellow learners and instructors;
- develop critical judgement, and participate in problem-solving; and
- often has the potential for other incidental learning.

CMC holds considerable benefits for adult learners . Further benefits are shown in Table 2.6, according to Lewis *et al* (1995); Hiltz and Wellman (1997); Chism (1998); and Karayan and Crowe (1997).

Table 2.6 Benefits of CMC for learning

Category	Benefit
Communication	▪ Learners are given the opportunity to refine their communication skills, and think critically and creatively. ▪ CMC enhances the exchange of academic discourse and is a good sounding board for ideas and excellent for networking purposes.
Sense of anonymity	▪ Learners share larger quantities of information than in a traditional classroom, due to the sense of anonymity that prevails.
Greater flexibility	▪ Independent of time ▪ Learners' disabilities, such as an inability to hear, see or move – need not be a limitation in electronic communication.

Access	▪ Learners from impoverished backgrounds can be given access to rich learning environments and form part of stimulating communities of learners via low-cost Internet and web tools.

Owing to the success of discussion lists, real time chat and bulletin boards, it is evident that users feel a need to interact and share thoughts (Dieberger and Hook, 1999). Dieberger and Hook (1999) believe that learners enjoy social interaction on the Web and therefore in the near future it is likely that many more socially enabled systems will appear on the Web.

(c) Limitations of CMC for learning

However, despite the efficiency of Internet resources such as discussion lists, real time chat and bulletin boards to deliver messages, the delivery of messages, in itself, is not sufficient to ensure learning (Hewson and Hughes, 1998). Hiltz and Wellman (1997) report certain limitations of CMC with regard to web-based classrooms. These limitations are given in Table 2.7.

Table 2.7 Limitations of CMC for learning

Category	Limitation
Social-emotional	▪ Limited by lack of visual and social cues and presence. ▪ Good for communicating information, opinion and suggestions, but less suited to communicating agreement or disagreement. ▪ Normless behaviour can result unless there is a clear identification and monitoring of acceptable rules and conventions.
Procrastination	The flexibility of asynchronity may result in procrastination when learners are too busy to log on regularly, which can result in falling behind with regard to deadlines.
Non-participation	Some learners may take on the role of a "lurker", simply observing, learning from the others, but not giving their own input.
Management	Large groups with high levels of interactivity can trigger information overload unless communication tools provide adequate management of information.
Access	It may be argued that CMC in the 21ST century will benefit mainly the technological "haves" rather than the "have-nots". That is, opportunities for the world's population are, and are likely to remain severely limited for some time (Lewis *et al*, 1995).

(summarised from Hiltz and Wellman, 1997)

Due to CMC being limited by a lack of visual and social cues and presence, many of the linguistic and extra-linguistic features of face-to-face communication are removed (Hewson and Hughes, 1998). For this reason, it is the researcher's opinion that, in general, web-based classrooms should not replace face-to-face communication but function as a "web support", so that the end result is indeed a flexible learning system. However, where geographical

barriers cannot be overcome, or where it is an instructor's specific objective that a course runs in this way, exceptions should be made.

2.2.4 Technological aspects

In this section technological aspects relating to the following are discussed:

- Benefits and limitations of web-based material;
- types of CMC; and
- technological benefits and limitations of CMC.

2.2.4.1 Benefits and limitations of web-based material

Table 2.8 presents the technological benefits and limitations associated with web-based material.

Table 2.8 Benefits and limitations of web-based material

Benefits	Limitations
▪ The *cross-platform distribution* of the Web means that a single set of tools can be used to create and access web materials for Windows, Macintosh, Unix and OS/2 computer users (Bacon, 1997; Starr, 1997).	▪ Every web browser *interprets HTML tags a little differently*. Developers should test the implementation of these features in different web browsers (Lynch and Horton, 1997).
▪ *Hypertext* on the Web facilitates the linking of information within documents. Links to information external to the document can also be incorporated, to extend the depth and breadth of information.	▪ Searching and browsing through hypertext is often *overwhelming* (Cronjé, 1997).
▪ Graphical browsers render possible the *delivery of multimedia* on the Web. Audio, video, and animation can be delivered to many users with a once off cost and no decline in quality with repeated use (Starr, 1997).	▪ *Limited bandwidth* slows the access time of multimedia products (Wulf, 1996).
▪ The Web provides easy access and fast, convenient delivery of material across distances. ▪ *True interactivity* goes beyond static web pages and page linking, and creates interactive pages with information exchange between the user and the server (Starr, 1997).	▪ Web servers may not be robust enough to handle heavy traffic. ▪ Not everyone has *access to the Web* (Cronjé, 1997). Dellit (in Bundy, 2000) holds the viewpoint that "the dominant paradigm of the Web is the marketplace and … capitalism thrives on inequality". The Web is therefore by definition a vehicle of inequality. ▪ Access problems can occur due to unstable technology. For example, networks can be unstable.

The infrastructure of an organisation must be considered when making a decision to use web-based instruction (WBI). WBI may not be a viable option in the case of limited

bandwidth, access problems, web servers that are not robust enough to handle heavy traffic, or if problems cannot be resolved quickly.

Before implementing WBI, it is essential that the following should be in place:

- A support infrastructure to help instructors get their material online;
- appropriate technical support to ensure that technology failures do not impact adversely on the success of the class; and
- appropriate hardware and software support for instructors to work with the online environment.

2.2.4.2 Types of CMC

CMC technology allows numerous learners to communicate at a distance, and can be used either synchronously or asynchronously. The former facilitates real-time communication, while the latter relates to the transmission and receiving of messages at different times, i.e. a time gap exists between messages sent and responses received. Asynchronous communication is normally text-based and includes e-mail, discussion lists, and bulletin boards. Synchronous technology includes text-based real-time chat, and audio and video conferencing. Learners can communicate simultaneously using these technologies, but only a small number can effectively converse at one time. Otherwise discussions become confusing and fragmented (Edwards and Clear, 2001).

However, this study focuses on asynchronous web-based technologies. Table 2.9 gives the main technologies incorporated in asynchronous communication with their descriptions, as given by Clarke (1998).

Table 2.9 Technologies incorporated in asynchronous communication (adapted from Clarke, 1998)

CMC Technology	Description
E-mail	For one-to-one text message communication and attaching files for use in other application software.
Discussion list	Uses list-processing software and distributes e-mail to all subscribed users on a list. A moderator is optional. Useful for one-to-many communication.
Bulletin board	For posting comments and accessing information and databases.
Newsgroups	Topic based and similar to bulletin boards, requiring a newsgroup server to temporarily store information that can be accessed by users.
WWW broadcast	Content delivery servers broadcast/"push" information over channels on the Internet. Accessed via special server software, e.g. Pointcast.

Chism (1998) and Cronjé (1997) recommend linking CMC to events that occur in a web-based classroom. Of the various CMC technologies, discussion lists and bulletin boards have been the most widely used in tertiary education (Holden and Wellman, 1993). The purpose of a discussion list/bulletin board is to establish online communities that have common goals and interests, and also to serve as a forum where learners can offer each other support, encouragement, feedback and new ideas.

Nagel (1994) has discovered that every discussion list/bulletin board goes through the same cycle, beginning with a few initial postings, going on to achieve major growth, and ending in stagnation. Learners who subscribe to a discussion list receive all messages in the order they are posted, and electronic conversation therefore tends to be random and disjointed. A bulletin board, in contrast, allows for a more orderly kind of electronic conversation because learners can choose what topics to read and respond to (Wulf, 1996). Table 2.10 depicts the differences between a discussion list and a bulletin board, both providing useful applications for learning.

Table 2.10 Differences between a discussion list and bulletin board

Discussion list	Bulletin board
Learners typically communicate by sending and receiving e-mail through a traditional e-mail program, e.g. Outlook Express.	Learners communicate by posting comments and questions directly to a server, from where the bulletin board is run.
E-mail comes directly to learners, arriving in their "inbox", i.e. "push" mail.	Learners must go to the host server to read the postings/fetch their messages, i.e. "pull" mail.
Messages are random and disjointed.	Messages are structured in order and can be viewed chronologically or by thread.
Dynamic, in that learners can structure and manage their e-mail program in the way they choose. Unnecessary messages can be deleted.	Static, in that messages remain intact and cannot be deleted.

2.2.4.3 Technological benefits and limitations of CMC

A summary of the technological benefits and limitations of CMC is given in Table 2.11 (Cronjé, 1997; McMahon, 1997; Winiecki, 1999), with guidelines for design. The table refers specifically to three categories, namely: CMC in general, discussion lists/bulletin boards and real time chat.

Table 2.11 Technological benefits and limitations of CMC, and its design implications

Type	Benefits of CMC	Limitations of CMC	Design implications
General	Quick delivery	Possible misinterpretation	Use emoticons
	▪ Reliable delivery ▪ Accurate (digital) transfer	▪ Unstable technology, i.e. - networks can be unstable; and - possible time delays ▪ Lack of non-verbal cues	The remote network and host network must be stable before the course begins.
	Inexpensive	▪ High initial cost ▪ Maintenance, upgrade and training costs	Problems likely to decrease in future as bandwidth and connectivity improve and costs come down.
	Availability	Limited accessibility	Develop information kiosks
	Disputes broaden learners' horizons and develop character and interpersonal skills.	Disputes and disruptions may result in hurt individuals.	▪ Foster an open and interdependent exchange (Winiecki, 1999). ▪ Use "netiquette" guidelines to guide behaviour. ▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
	Competent individuals feel comfortable with the technology	Individuals with inadequate skills battle to use the tools to facilitate learning	Teach technology skills where necessary.
Discussion list/bulletin board	▪ Easy to store, forward, save and sort, in the case of discussion lists ▪ Permanently available in the case of bulletin boards	Can generate co-ordination problems, e.g. information overload. Learners may feel overwhelmed by the quantity of information.	Maintain strict discipline in terms of subject headings and message threading.
Real time chat	Fun way of communicating	Emotionally frustrating for learners who cannot access the chat room or who cannot type quickly.	Plan practice sessions
	Almost immediate	Message overlap	▪ Let learners take turns to communicate. ▪ Plan practice sessions.
	Learners free to be themselves, due to the informal nature of the medium	"Chats" are not necessarily saved permanently.	Summary of chat can be sent on the discussion list/bulletin board, to confirm discussion.

2.3 Distinguishing characteristics of learners of different age groups, and the differences and similarities between these age groups in the context of web-based technologies

In line with Outcomes-Based Education (OBE) – a learner-centred approach – the following should be considered in the development and implementation of web-based technologies:

- Different learning styles and rates of learning (Virtual Campus, 1998a); and
- the importance of the existing knowledge of learners.

Hannafin and Peck (1988:48) assert that "learning may be more efficient when the instruction is adapted to the needs and profiles of individual learners". The characteristics of each group of learners under investigation in this study will now be discussed, examining what the literature suggests regarding each group, i.e. children, undergraduates and postgraduates/adult learners. In Chapter 6, the researcher will assess each group's experience of the web-based technology they used, and how it matched/did not match their characteristics.

The various age groups have been classified into distinct categories, namely: the Millennial Generation, Generation X (Xers), and Baby Boomers, for children, undergraduates and postgraduate learners respectively. Table 2.12 lists the different groups along with their generations.

Table 2.12 Groups of learners and their generations

Group of learners	Generation	Period of birth
Postgraduates	Baby Boomers	Between 1941 and 1960 (Laidlaw, 1998)
Undergraduates	Generation X (Xers)	Between 1961 and 1981 (Lankard, 1995)
Children	Millennial Generation	Since the early 1980s (Zoba, 1997)
Children	Net Generation	Between 1977 and 1997. The Net Generation primarily includes the Millennial Generation, and some of the Xers (those born after 1975) (Miller, 2001).

Xers are the children of the so-called "Baby Boomers". This name was given due to the fact that more babies were born during the years 1941 to 1960 (directly after World War II) than during any previous generation (Laidlaw, 1998). They are the single largest demographic group (Judd, 2000). The sheer size of this group led to increased competition for jobs and made upward mobility difficult. Baby Boomers generally believe that hard work and long

service will yield rewards (Judd, 2000). Xers were the latch-key children in an increasingly dangerous world, during a time when society was becoming more and more atomised (Abood, 1997). Literature states that many of the parents of Xers (the Baby Boomers) are now divorced, both go to work, and were more permissive than parents of previous generations. Consequently, the Baby Boomers developed their attitudes, values, and characteristics as a direct result of having to cope with the world they were living in (Laidlaw, 1998).

Society has attached a negative connotation to Generation X. In the early 1990s, Generation X achieved notoriety as a media label designed to pigeon-hole American youth into the stereotypical image of the disaffected slacker. They were classified as “baby-busters”, “slackers”, “twenty-something”, the “generation without a conscience”, the “lost generation”, the “13th generation”, the “me generation”, but most commonly and most enigmatically as “Generation X” (Slattery, 1996).

On the positive side, they are independent thinkers who make their own decisions - using their own values, norms and standards, instead of conforming to convention. Xers are able to face problems on their own and have confidence in their ability to fend for themselves. They grew up with computers and tend to be highly techno-savvy and entrepreneurial. Xers watched as the Boomers were downsized and overtaken by technology trends and believe that the “corporation as parent” is history (Judd, 2000). They tend to be loyal to the project they are attached to, and are concerned about building their individual skills (Judd, 2000).

The Millennial Generation, like the Xers, are used to facing problems on the own, since both parents work outside the home. The latter has made them dependent on their peers. They reach out to people and have a strong desire to be connected and to collaborate with others (Miller, 2001). The Net Generation have been influenced by intensive Internet usage. They are active and participate, in that they inquire, discuss, argue, play, shop, critique, investigate, ridicule, fantasise, seek and inform (Tapscott, 1999). The Millennial Generation encompasses most of the Net Generation, and hence will be discussed under the Millennial Generation.

2.3.1 Characteristics of children as learners

According to du Plooy (*et al*, 1982) each child needs security and safety. The child looks to the future with expectation and from the beginning tries to discern and capture meaning in the world. A fundamental characteristic of children is also the **need to communicate**, and to step out of themselves to **explore and discover** and to become the somebody they want to be. In this respect the teacher needs to provide every child with a fair chance to explore authentically by bringing the world into the four walls of the classroom (du Plooy *et al*, 1982). The Web has the advantage of doing just this, in that it opens up the world to the child, provides a base from which the child can explore, and also exposes a child to the real world and to virtual learning.

Piaget concluded that intellectual development is the result of the interaction of hereditary and environmental factors (Ginn, 1995). As children develop and interact with the world around them, knowledge is invented and reinvented. Piaget believed that a child's thinking and learning involve the active participation of the learner. He asserted that for a child to know and construct knowledge of the world, the child must act on objects and it is action which provides knowledge of those objects, i.e. the mind organises reality and acts upon it. His approach to learning is a readiness approach, which emphasises that children cannot learn something until maturation gives them certain prerequisites. He espoused active discovery-learning environments in schools, believing that children need to explore, to manipulate, to experiment, to question and to seek answers for themselves. Activity is thus essential for children (Ginn, 1995). Piaget's theory of intellectual development is in line with current thinking and Outcomes-Based Education - a method of teaching where the learner is the most important consideration and learning happens through activities (Pretorius, 2000).

According to Miller (2001), as a result of a society that is constantly undergoing change, young people in the Millennial Generation have taken on the following characteristics:

- Prefer to work with their *peers* or groups than with adults;
- need to *reach* people of their own age;
- need *quick responses* to activities;
- are creative thinkers able to *customise* things to their needs;
- need to *explore and do* things; and
- are *achievement-oriented*.

Judd (2000) describes the Millenial Generation as energetic - needing continual stimulation and challenge. They are comfortable juggling many things at once and will move on quickly if they get bored or dissatisfied (Judd, 2000). Tapscott (1999) comments that these children argue and debate, and are easily vocal on any information they encounter with a click of a mouse. They rely on their own point of view, test it, and alter it if appropriate (Tapscott, 1999). They are the first generation to grow up surrounded by digital media.

2.3.2 Characteristics of undergraduate learners

An undergraduate is usually a post-school youth, late adolescent or early adult who has left the pedagogic didactic environment of his family home and school, to continue his/her studies as a learner in the company of other adults to receive training for a career.

Laidlaw (1998) has compiled a profile of a typical Generation X learner, having four main characteristics, namely: independent and self-reliant, technoliterate, expectation of instant gratification and self-building. A description of these characteristics is given in Table 2.13.

Table 2.13 Characteristics of Generation X

Characteristics	Description
Independent and self-reliant	▪ I like to do things my way, build my own meaning. ▪ Give me the information, skills and tools, and let me get on with it. ▪ Tell my why I need to learn something and what I will get out of it. ▪ I need to know how I am doing.
Technoliterate	▪ I am not afraid of technology. ▪ I can cope with multiple sources of information at once. ▪ Visuals appeal to me more than text. ▪ I have five senses, and like to use them all.
Expectation of instant gratification	▪ I need to be involved, to do it myself. ▪ Give it to me straight and to the point. ▪ If something does not interest me I will move on. ▪ I am used to being entertained.
Self-building	▪ I know I need to build my own security by constantly learning new skills. ▪ Things are constantly changing so I need to keep abreast. ▪ I can take responsibility for my own learning process. ▪ I believe breadth of experience is just as important as depth.

(summarised from Laidlaw, 1998)

A further characteristic of Generation X is that they are able to work co-operatively with other young people (Brown, 1997). They are therefore more comfortable with the "collaborative approach" (Haskell, 1996). Problem-solving is a social activity and consequently this form of learning is social activity (Miller, 2001).

Miller (2001) characterises Generation X as independent problem-solvers, self-starters, responsive, focused, ambitious, fearless and technologically literate.

2.3.3 Characteristics of postgraduate learners

Cronjé (*et al*, 2000a) analysed Ference and Vockell's (1994:25) list of adult learning needs and set them out in table format, provided as Table 2.14.

Table 2.14 Characteristics of adult learners (Cronjé, 2000a)

Characteristics	Description
Active learner	Willing to participate in the learning process. Given the opportunity and the proper incentives, they often prefer to be active rather than passive learners.
Experience based	Bring a wide variety of prior educational and life experiences to a new learning situation.
Expert	More self-reliant. Adult learners operating as independent individuals tend to want to accomplish things for themselves. Inclined to draw and rely on their own personal experience and knowledge to seek answers to questions and to solve problems.
Hands-on	Faced with important matters in everyday life. As a result, the adult learner tends to focus attention on real-world situations.
Task-centred	More active in performing tasks directed toward reaching a goal or solving a problem.
Problem-Centred	Focus on dealing with problems they encounter in their particular life situation.
Solution-driven	Operate in the real world, focus on real-life problems and often actively seek out solutions to their problems.
Value-driven	*Need to know* why they should learn something before undertaking to learn it. Given the rationale for learning something, they will often invest considerable energy in investigating the increased benefits gained from the learning experience and the consequences of not learning it.
Skill-seeking	Actively seek out the attainment of new and improved skills in order to better meet and solve real-life problems.
Self-directing	Perceive themselves to be independent and responsible for their own actions and have a need to be directly involved in planning and directing their learning activities.
Motivation (External)	Often externally motivated by such factors as better jobs, increased promotional opportunities and higher salaries.
Motivation (Internal)	Often internally motivated by such factors as self-esteem, recognition, confidence, career satisfaction and the overall quality of life.

(a) Similarities between the groups

From examining the characteristics of each group of learners, it appears that children and undergraduates also take on some of the typical characteristics of adult learners.
These three groups of learners hold certain common characteristics. They are:

- Active learners;
- self-directed;
- skill-seeking;
- need guidance; and
- internally or externally motivated.

Taking the characteristics of Generation X as described by Laidlaw (1998), it would seem that Generation X (undergraduate learners), and Baby Boomers (postgraduate learners) also share some characteristics, namely, they are:

- Hands-on;
- task-centred;
- value-driven;
- skill-seeking; and
- internally or externally motivated.

(b) Differences between the groups

The term "andragogy" is used to distinguish the teaching and learning of adults (including undergraduates) from "pedagogy", the teaching and learning of children (Noren, 1997). Hence, in literature the descriptor "andragogic" is used to refer to adults, and "pedagogic" to refer to children.

Andragogy became an integral part of the language of adult education through the efforts of Malcolm Knowles. Knowles felt that the learning of adults is so different to the learning of children that it required its own descriptor (Noren, 1997). Andragogy embraces a number of concepts, including several mentioned in Table 2.14:

- Adults want to know why they need to learn something before they begin learning it.
- Adults see themselves as self-sufficient and responsible for their own learning.
- Adults have a wealth of experiences which they bring to the learning environment.
- Adults are ready to learn when they have a need to learn.

- Adults are problem-centred in their learning.
- Adults' motivation for learning comes from more internal than external factors (Knowles, 1989).

Andragogy provides designers and lecturers/teachers with a framework from which to approach their work. The differences between the three groups of learners, taking into account the concepts embracing andragogy, are given in Table 2.15.

Table 2.15 Differences between the different groups of learners

Category	Children	Undergraduates	Postgraduates
Background	▪ Come to school with limited experience. ▪ Get taught basic learning content (Fraser *et al*, 1993). ▪ Eager to learn ▪ Eager for the experience of new things and large dimensions (Hajre-Chapman, 2001)	▪ Build further experience from past learning. ▪ Get taught specialised learning content (Fraser *et al*, 1993).	▪ Get taught specialised learning content. ▪ Have a wealth of experiences which they bring to the learning environment. ▪ Concerned with integrating new knowledge and skills into previously acquired knowledge and skills (Noren, 1997).
View on learning	▪ Perspective on learning is long term, i.e. what they are learning now may not be used for a long time (Noren, 1997).	▪ Training for a career ▪ Task-centred, i.e. want to know the task/project they must do and when it must be completed by.	▪ Expect to put what they are learning into practice soon if not immediately, i.e. they are goal-oriented (Noren, 1997).
Motivation	▪ Motivation for learning is external. They go to school because they have to (Noren, 1997).	▪ Motivation for learning can be both internal and external.	▪ Motivation for learning is usually internal, but can also be external. ▪ Participate in educational programs because they want to (Noren, 1997).
Technology	▪ Well accustomed to technology	▪ Well accustomed to technology	▪ Often not well accustomed to technology

Of particular interest in Table 2.15 is learners' view on learning. While children are eager to learn new things, undergraduates and postgraduates seem to be more concerned about the value particular tasks hold, and postgraduates are especially concerned about applying what they have learnt to their life situation.

2.4 Learning possibilities for children, undergraduates and postgraduates in the context of web-based technologies

The Web provides a process that facilitates learning and a metaphor that might help to re-think learning as a more active and engaging process. The engagement of learners in learning and the consequent development of learning as a life-long commitment must be a key objective for the future (Kennedy, 1999).

The Web holds the following advantages as given by Kennedy (1999):

- It is open, accessible and full of potential.
- It facilitates access to information retrieval but leaves individuals free to decide what is important.
- It facilitates communication across national and cultural barriers.
- It provides the conditions under which learning can take place, but does not construct learning in any particular way.

Kennedy (1999) asserts that these advantages need to be the characteristics of pedagogy/andragogy in the new century if learners are to be engaged in learning, and if they are to become committed to lifelong learning.

2.4.1 Children

Kennedy (1999) believes that the Web can and will play a central role as a learning tool in the future, as young people adapt to it easily and schools may be the only social sites where equal access can be guaranteed. Possibilities of web-learning for children include the following:

- Children can search for information, rather than simply look at it. This forces them to develop **thinking and investigative skills**, as they have to become the critics and judge whether resources on the Web are of good quality or not (Tapscott, 1999).
- Interactions can be facilitated by using small discussion groups. Classes could go offline for brief discussions of particular issues and then go online to discuss their findings with a larger group (Flottemesch, 2000).
- Children can communicate with one another and argue and debate issues (Ginn, 1995). This forces them to exercise not only their **critical thinking**, but also their **judgement**. In this regard, they are likely to become a generation of critical thinkers, because they have the tools to question, challenge and disagree at their disposal. According to Tapscott (1999), this results in Millennial Generation children questioning the implicit value contained in information.
- Children can use the Web not only to learn, but to **learn practical skills**, by constructing learning products with an HTML editor, and to engage in peer teaching as they construct their projects with other children. In this way children communicate their understanding of the subject to those around them. They also become **active participants** instead of passive "sponges", and the teacher takes on the role of facilitator as he/she guides them in their creations (Ginn, 1995).
- Children can learn the **social skills** required for effective interaction in the knowledge-based society, as they experience electronic peer relationships, teamwork, criticism, fun online, friendships across geographical boundaries and communicate their ideas (Tapscott, 1999).

Web-based technologies correspond well to Piagetian thought (see section 2.3.1), which postulates that a child's thinking and learning involve the active participation of the learner. It is the teacher's role to assess the child's current cognitive levels, and his/her strengths and weaknesses. Piaget saw teachers as facilitators of knowledge – whose role was to guide and stimulate the children. Teachers can do the latter by presenting children with web-based

technologies that are appropriate for various situations and occasions in which they can discover new learning (Ginn, 1995).

2.4.2 Undergraduates and postgraduates

A wide range of technological options are currently available for undergraduate and postgraduate learners (Huang, 2000). The possibilities of web-based technologies are similar for both groups, hence their joint discussion. Table 2.16 presents commonly used technologies that both can use in web-based instruction. The term “learner” is used in this section to refer to undergraduate and postgraduate learners.

Table 2.16 Web-based technologies and their application for undergraduates and postgraduates

Web-based technologies	Application
E-mail	▪ E-mail can be used for learners and instructors to work one-on-one. ▪ It can facilitate learning activities by gaining feedback from the instructor or other learners. ▪ Learners can also communicate via voice, rather than the text form of e-mail.
Online discussion groups: ▪ Discussion lists ▪ Newsgroups ▪ Bulletin board ▪ Real time chat	▪ Learners can interact widely with other members of a learning community about topics that interest them and can simultaneously be in control of their own learning. ▪ Online discussion groups incorporate discussion lists, newsgroups and bulletin boards.
	▪ Instructors can use a **discussion list** to establish an online community that has common goals and interests, and serve as a means where learners can offer each other support, encouragement, feedback and new ideas. ▪ The learner can construct personal meaning by engaging in dialogue and reflection.
	▪ **Newsgroups** can be used when active participation of learners is required. ▪ Newsgroups are similar to discussion lists, but are kept in the conference, and not sent to individual user addresses.
	▪ Learners and instructors can use **bulletin boards** for posting comments and accessing information and databases.
	▪ **Real time chat** can be used when learners and instructors wish to discuss something, or make a joint decision. ▪ It can be used to establish a sense of immediacy.
Online resources	▪ Learners can use an online search to conduct research or collect relevant information to assist their learning.
CD-ROM	▪ Instructors can place Web-based material on a CD-ROM and distribute it to learners. ▪ Learners do not have to dial-up to a service provider.
Web-based CMSs	▪ Web-based CMSs can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners.
Asynchronous communication	▪ Learners can access the discussion at different times from each other via discussion lists, bulletin boards, or newsgroups. ▪ Learners have more time to reflect on their own ideas and can think critically, seeing that they control the pacing of instruction. ▪ Learners have the opportunity to refine their communication skills, including "process" skills such as communication, critical thinking and creative thinking.
Synchronous communication	▪ Learners can interact with each other at the same time, without having to be in the same place. ▪ Synchronous communication plays the role of a thinking device for the collaborative construction of knowledge and enhances learners' higher-order thinking skills and creative abilities.
World Wide Web (Web)	▪ Learners can use the Web to decide on their own route of inquiry, and work at their own pace. ▪ Learners can search actively and freely to solve problems or to construct their own knowledge.
Web sites	▪ Lecturers can use web sites to display course material. ▪ Learners can present data and findings on their own web page.

(summarised from Huang, 2000)

2.4.3 Learner characteristics and design implications

Table 2.17 summarises the most prevalent characteristics of each group of learners, with design implications based on their characteristics. The table is categorised according to the various aspects considered in this study.

Table 2.17 Characteristics of children, undergraduates and postgraduates and design implications

Aspect	Group of learners	Characteristics/needs	Design implication based on learners' characteristics
Pedagogical	Children	▪ Able to customise things to their needs. ▪ Need physical activity during the learning process.	Must do things, that is, be actively involved in the learning process.
	Undergraduates	Like to do things their own way, and build their own meaning	Need to find/create their own learning content.
	Postgraduates	Independent	Need to find/create their own learning content, surrounding a particular life situation they encounter.
Affective/ emotional	Children	Motivated when using technology	Need material in visual format, with a high level of interactivity.
	Undergraduates	Need content matter which has relevance for a career.	Learning material must hold long-term career value.
	Postgraduates	Work under pressure; have no time to waste.	Need rapid access to learning material, resources and utilities.
Communicative	Children	Peers interact, communicate and support one another.	Divide learners in groups from where they can interact, communicate and support one another.
	Undergraduates		
	Postgraduates	Active learners, problem-centred and solution-driven	
Technological	Children	Need *quick responses* to activities.	Build high level of interactivity.
	Undergraduates	Not afraid of technology, and can cope with multiple sources of information at once.	Allow learners to share their experiences of technology.
	Postgraduates	Technophobia prevalent	Provide support for learners, should any technological difficulties arise.

2.5 Web-learning possibilities for contact teaching and distance learning

In this section the web-learning possibilities for both contact teaching and distance learning are discussed.

Traditional contact teaching can benefit from levels one, two, and three of Harmon and Jones's levels of web use, while distance learning requires the interactivity found in levels four and five (Harmon and Jones, 1999) - see Table 2.1.

2.5.1 Contact teaching

Children and learners need a variety of instructional methods in order to learn. Web-based technologies are one such method that can be used as an extension for learning. Marsh (2000a) suggests assigning part of the instruction to the Web and computer-based lessons, thus enabling learners to engage in more interactive instruction. Ginn (1995) suggests that web sites for real learning, not just drill and recitation be developed, so that learners are able to move back and forth between programs, the Internet and more traditional learning resources. Such work can be done independently, creatively and at the learners' own pace (Kennedy, 1999).

It is Nilakanta's (2001) view that one can no longer only teach the "traditional" way – the advent of technology in schools has brought this into sharper focus. The learner is no longer dependent solely on the teacher for information since he/she can get it with the help of technology. Learners therefore require guidance to develop the skills (cognitive and metacognitive) that will help them gather, analyse, synthesize and share knowledge.

Caudron (1997:22) suggests that learning experiences should be "meaningful, memorable, and fun", especially for the Millenial Generation, who are energetic, and need continual stimulation and challenge (Judd, 2000), and for Generation X who are used to being entertained, and who want to know why they must learn something before taking the time to learn it (Caudron, 1997). Caudron (1997) urges educators to "as much as possible use all the senses, role play, and simulation learning … don't expect Xers to perform without practice". He also recommends capturing learners' attention by focusing on the outcomes more than the

techniques, on what they are going to be able to do, not what they need to know. Abood (1997) agrees with the latter, stating the need to focus on tangible end-results, not processes.

2.5.2 Distance learning

The purpose of distance learning is to serve learners who are not likely to attend traditional classroom instruction because they are either time-bound due to work or travel schedules, or location-bound due to geographic or family responsibilities (Galusha, 1997; Edwards and Clear, 2001). They therefore enrol in distance learning courses for their convenience.

Porter and Lane (2000) define distance learning as a process that connects learners with remote resources. It provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current learners. It offers unique learning benefits to learners not otherwise served. The implementation of distance learning is a process that uses available resources and will evolve to incorporate emerging technologies (Porter and Lane, 2000), such as various discussion software. These tools are being used to enhance communication and overcome the isolation of distance (Flottemesch, 2000). According to Flottemesch (2000), simply having the ability to access information is inadequate: "information must be shared, critically analysed, and applied in order to become knowledge" (Garrison, 1990). According to Kruh and Murphy (1990, in: Flottemesch, 2000):

> *Quality distance education is dependent upon the interaction and participation of the learner, similarly as in traditional face-to-face instruction. It is essential that the distance educator purposefully designs this ingredient into the instructional program.*

Flottemesch (2000) gives general strategies which can be implemented at the beginning, during and at the end of the distance learning course, to improve interactivity between learners.

Beginning of the course: Initially, interaction can be fostered by having learners introduce themselves to other class members at other sites, and learn their names and their particular interests in the course. The instructor could encourage learners to use the discussion software available, and set times when they will reply to learners' correspondence.

During the course: In order for learners to feel an integral part of the classroom, techniques for improving learner-learner interaction should be in place. These techniques could include:

- Instructing learners to provide information across distances in relatively short exchanges. This can add greater attention to what is being communicated.
- Incorporating group presentations into course assignments and/or projects. Group projects require learners to interact with their peers/group members. This reduces the social isolation associated with the use of technology.
- Asking learners questions to promote interaction. Questions should be open-ended, challenging and interpretational in order to maximise learner interaction.
- Facilitating interactions with CMC.

After the course: Learners could assess how they have worked with others.

In a discussion on Adult Education on ITFORUM (a discussion list for Instructional Technologists), Marsh (2000a) comments that he had more communication/contact with his learners than he would have in traditional instruction. Clarke (1999) makes the same claim, stating that "web-based, computer-mediated communication methodology has value as a distance learning tool because it CAN facilitate more person to person interaction and collaboration than correspondence courses and more than in some face-to-face courses". She also asserts that in her experience, a fully online course provided the opportunity for regular and supportive, collaborative interaction with peers and the instructor.

A challenge for those designing web-based instruction or using it, is to consider seriously which presentation method will best enhance the information and work to facilitate interactivity among learners and academic staff (Liaw and Huang, 2000). Misuse of interactivity, synchronity and technology can lead to loss of the learner's attention, boredom, information overload and frustration (Berge, 1999).

2.6 Summary

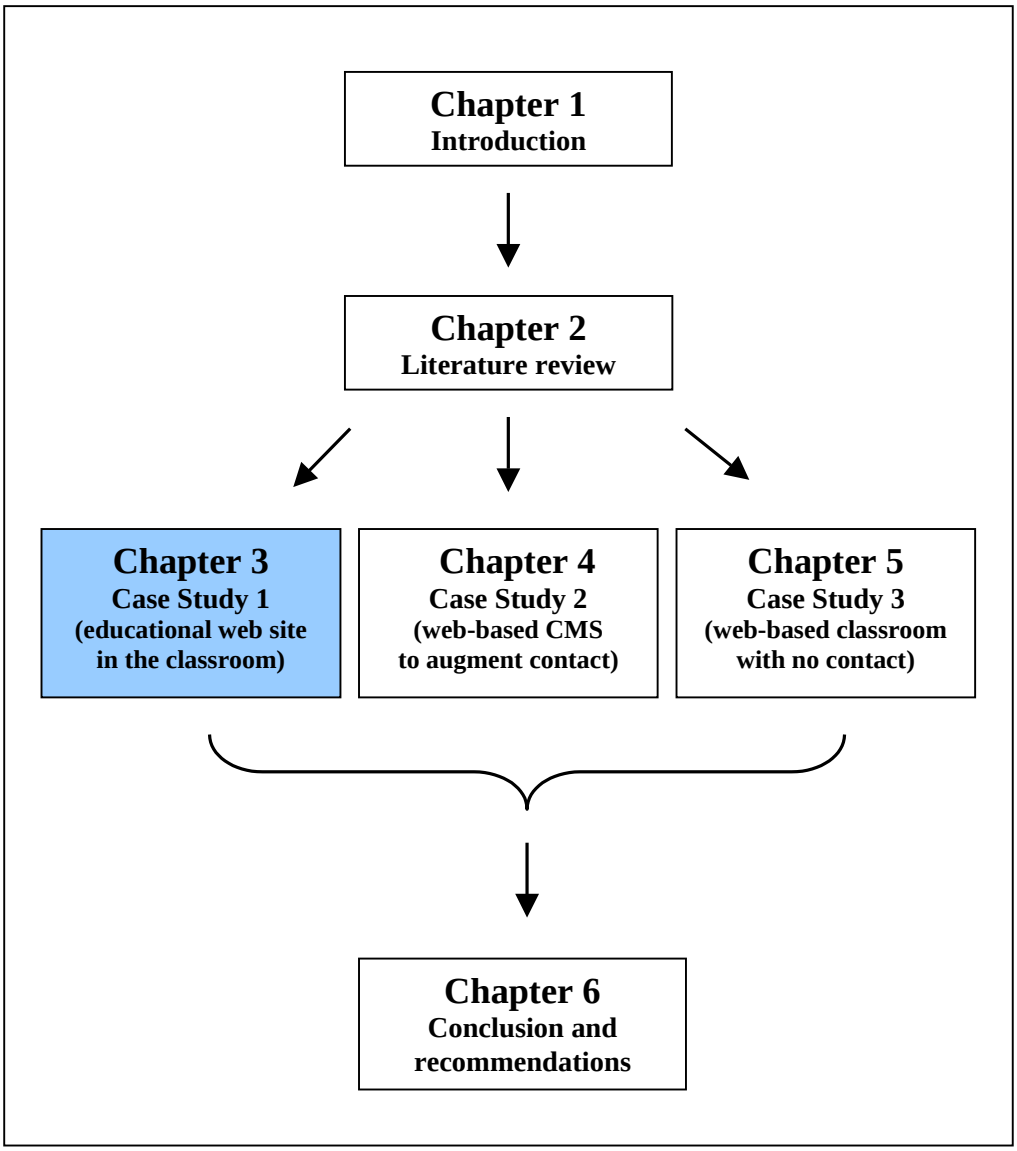
The review of current literature in this chapter indicated the roles different aspects play in web-based technologies. The character traits of each age group were discussed, and their differences and similarities given. An application of where web-learning can be used for each age group was given, as well as the possibilities for web-based learning in contact teaching and distance learning.

Teachers can use web sites as a supplement to traditional contact teaching, in addition to certain communication tools, e.g. e-mail, bulletin boards, etc. CMC can play a major role in meeting the needs of undergraduates and postgraduates (adult learners), as it can facilitate a high level of collaboration and interactivity between learners, as well as between learners and their instructor/teacher.

This chapter has given a review of literature relevant to the research questions and has served the purpose of contextualising the research. In the following three chapters the case studies are discussed, the first being the evaluation of an educational mathematics web site, followed by an investigation of a web-based CMS, and finally, a report on a web-based classroom.

Chapter 3

Case Study 1 – Investigation of an educational web site



3.1 Introduction

This chapter reports on the first case study, namely, the investigation of an educational web site, *Plane Math* (a web-based tutorial and practice environment - http://www.planemath.com), and its usefulness in a Grade 5 classroom. The investigation took place in 1999. The goal of the chapter is to investigate the effectiveness of *Plane Math* and to compare the responses of children in an urban school and children in a rural school.

The case study is a response to the urgent need to conduct research on children's response to educational web sites. The domain of educational web sites is a rapidly growing and dynamic field that is making significant demands on evaluators to keep pace. Due to their currency, few have been evaluated thus far.

To determine the instructional and motivational effectiveness of educational web sites, the following aspects are investigated: pedagogical, affective/emotional, communicative and technological aspects. These aspects incorporate sub-aspects, including: children's response to educational web sites and their motivational effectiveness, and their instructional, curriculum and cosmetic adequacy (Hannafin and Peck, 1988:303-321).

If the feedback generated by such an evaluation is positive, it would be worthwhile to introduce the relevant web site as a supportive tool in the appropriate educational curricula.

The study commences by listing the relevant research questions, followed by a literature review and an outline of the context (international, national and institutional) of the study, with reference to two schools in the New South Africa seeking ways to cope with change and development. This is followed by the research methods used to conduct the research, the specifics of *Plane Math* and the results. Finally, a summary is given, and conclusions and recommendations are proposed.

3.2 Research questions

The researcher set out to answer the research questions indicated in Table 3.1, and assess whether there was a difference between the responses of children from an urban school and those in a rural school. These questions are asked and responses measured under the four main aspects covered in this dissertation, namely: andragogical, affective/emotional, communicative and technological. Some of these, in turn, have sub-aspects, which are shown in Table 3.1 in their respective categories.

Table 3.1 Research questions and their respective categories

	Aspects	Sub-aspect	Research subquestions
Case Study 1	Pedagogical	Children's response	▪ What was the response of the children with regard to their own learning?
		Curriculum adequacy	▪ How relevant is *Plane Math* to the school curriculum?
	Affective/emotional	Motivational effectiveness	▪ Did the children enjoy their learning experience?
	Communicative	Instructional adequacy	▪ To what extent does the site employ adequate Instructional Design (ID) principles?
		Cosmetic adequacy	▪ To what extent does the Human-Computer Interaction (HCI) promote learning or hinder it?
	Technological		▪ To what extent does the technology support effective use?

The researcher will not be measuring learning gain through pre-tests and post tests alike, because she accepts Clark's contention that media do not influence learning (Clark, 1994), and Russel's conclusion that there are no significant differences in performance between individual delivery media (Russell, 1999).

3.3 Literature review

In this section the motivational aspects of children's web sites are discussed, as well as the evaluation of such sites.

3.3.1 Motivational aspects of children's web sites

Although educational web sites may be sound in many respects, success can only be demonstrated once the material has been evaluated. However, Bantjes and Cronjé (2000) mention that most evaluators of web-based material rely on subjective values of style and "coolness", instead of focusing on information content, currency, compatibility, authority, easy of use, connectivity, etc.

Besides those who evaluate educational web sites on subjective values instead of relying on the criteria as mentioned above, to date, few researchers have developed questionnaires to conduct learner-evaluations of educational web sites (Arnone and Small, 1999). For this reason, Arnone and Small (1999) have developed an instrument to address the effectiveness of children's web sites with a specific focus on motivational elements. They state that a child will be motivated to remain at a web site if two essential motivational elements are present, that is:

- The web site has value to him/her; and
- the child has the expectation that he/she can be successful within the web site environment.

Their motivational elements are based on the expectancy-value theory (Vroom, 1964) and Keller ARCS model of motivation (Keller and Kopp, 1987). Expectancy-value theory argues that in order for individuals to devote effort to a task, value and expectancy for success must be present. Keller suggests that strategies designed to increase (A)ttention and (R)elevance contribute to value, while strategies to increase (C)onfidence and (S)atisfaction contribute to one's expectation of success (Arnone and Small, 1999).

Both value and the expectation of success must be present for a child to be positively engaged within a particular web site and in order for him or her to be motivated to return to that same site on another occasion (Arnone and Small, 1999). They state that motivation explains the "why" of behaviour, i.e. why one chooses to expend effort on certain tasks or activities as opposed to others. Malone's (1981) intrinsic motivators, such as: challenge, control, curiousity for learning and fantasy, also play a crucial role.

Arnone and Small (1999) list the motivational attributes that should be present in web sites designed for children. They should be:

- Engaging and stimulating;
- useful and credible;
- organised and easy-to-use; and
- satisfying and effective.

These attributes influence the child's tendency to revisit the web site and to motivate others to visit the site. The motivational elements, the attributes as specified above and a description of each of these attributes are given in Table 3.2.

Table 3.2 Motivational elements within web sites for children

Motivational elements	Attributes	Description
Value	Engaging and stimulating	Includes features that both capture and maintain interest and curiosity.
	Useful and credible	Includes elements that add value and promote relevance, e.g. the appropriateness of the site for the target population, as well as quick and easy links to other relevant web sites.
Expectation for success	Organised and easy-to-use	Features such as ease of navigation, user control, and help mechanisms translate to an organised and easy-to-use web site. This helps to build confidence in a child's abilities, so that they have a successful experience with the web site.
	Satisfying and effective	Opportunities for interaction, exploration, having fun and feeling competent translate to a satisfying experience and an effective web site.

(summarised from Arnone and Small, 1999)

Arnone and Small (1999) emphasise that motivational effectiveness enhances the learning process and is especially critical if a child chooses to visit a particular web site as opposed to having it assigned by a teacher.

3.3.2 Evaluation of educational web sites

Trochim (1999) describes evaluation as the systematic acquisition and assessment of information to provide useful feedback about some object. For the purposes of this research, a summative evaluation was conducted. A summative evaluation examines the effects or outcomes of programs, determining the overall impact (Trochim, 1999). Most often, feedback is perceived as "useful" if it aids in decision-making. Thus, the major goal of evaluation should be to influence decision-making or policy formulation through the provision of empirically-driven feedback (Trochim, 1999).

When evaluating educational programs and web sites, it is important also to look at the underlying learning theory, as this can have a significant influence on learning. Reeves (in: de Lisle, 1997) describes the objectivist basis of much educational software. Grounded in Behavioural Psychology, this kind of software has a limited ability to develop higher-order skills and ignores and/or represses human potential, as is evident in Chapter 2, Table 2.3.

An alternative model is based on cognitive science, commonly known as constructivism. Constructivism is an implementation of cognitive learning theory, just as mastery learning is related to objectivism. It is based upon the tenets of children constructing their own knowledge, i.e. the learner co-constructs meaning by exploring an environment, solving a problem, or applying information to a new situation that he/she helps to define (Campbell, 1999). The NCTM (National Council of Teachers of Mathematics) of the USA expresses a constructivist stance:

> *Learning mathematics is enhanced when content is placed in context and is connected to other subject areas and when students are given multiple opportunities to apply mathematics in meaningful ways as part of the learning process* (NCTM, in: Marsh, 2000b).

3.4 Context and research design

In this section the international and national context of the research will be discussed, as well as the institutional context and research design.

3.4.1 International and national context

Internationally much has been made of the special role of mathematics and science education in promoting a skilled and technically sophisticated work force. Mathematics provides many of the fundamental thinking skills which underpin scientific/technical thought. Children also need to be prepared for the technological challenges of the future, and to have well-developed critical thinking and problem-solving skills. This is slowly, but surely taking place, as is evident in South Africa's improved position on the world competitiveness scale, where its position has climbed six ranks, from being placed 44th in 1996 to 38th in 2000 out of 47 countries (IMD International, 1999).

Although South Africa's position on the world scale has improved, there remains an urgent need for a skilled and technically sophisticated work force to be developed in South Africa in order to continue to improve its position. There is hope, however, in *Curriculum 21* (a new revised and streamlined curriculum), which is to replace *Curriculum 2005* (Pretorius, 2000). *Curriculum 2005* is a curriculum based on the ideal of lifelong learning for all South Africans. It is aimed at equipping learners with the knowledge, competencies and orientations needed for success after they leave school or complete their training. Its guiding vision is to produce future citizens who are competent and think critically (South Africa, 1997a).

However, according to Chisholm (2000), although *Curriculum 2005* inaugurated a new dispensation in education in South Arica, its implementation occurred in conditions that did not enable it to meet either social or personal educational goals. The curriculum was said to be complex, insufficiently balanced and stymied by a lack of resources and capacity to implement them. In June 2000, a decision was made that *Curriculum 2005* could not continue in its present form, and an improved curriculum was envisaged - *Curriculum 21* (Pretorius, 2000). However, the key elements of *Curriculum 2005* will remain (Pretorius, 2000). This embraces the principle of Outcomes-Based Education (OBE) – an approach to

teaching where the learner is the most important consideration and learning happens through activities.

According to Chisholm (2000), the development of creative, critical and problem-solving individuals lies at the heart of *Curriculum 21*, in order to achieve the values of a society striving towards social justice, equity and development. The curriculum places a strong focus on the teaching of mathematics and science, with 50% of classroom time to be spent on mathematics and language teaching in Grade 4 and onwards (Pretorius, 2000). The curriculum consists of six learning areas for Grades 4 to 9, namely: language, mathematics, natural sciences, social sciences, arts and culture, and life orientation. In each of these areas, children should be afforded opportunities to apply what is learnt to "authentic" problem situations and so make their learning relevant and applicable to their lives (Chisholm, 2000).

If implemented successfully, this program has the potential to bring about major changes in the way education is delivered in South Africa. A serious problem, however, is a lack of skills and training resources. There is therefore an extensive area where the Web could make a contribution, both in terms of teacher training and in the realms of using existing and developing new software in the classroom. If the latter is taken seriously, South Africa has the potential to compete in the international market and to improve its position on the world scale.

3.4.2 Institutional context and research design

Educational programs and web sites are used by people with unique needs in a real world. For this reason, two groups were chosen to participate in the investigation, one school in an urban city context (referred to as urban school), the other in a rural town context (referred to as rural school). The urban school, Lynnwood Ridge Primary School, is situated in an upper middle class suburb in the industrial province of Gauteng, while the rural school, Duiwelskloof Primary School, is in a small rural town in a mountainous area, in the remote Northern Province. The latter school is 25km from Tzaneen and 100km from Pietersburg. Figure 3.1 is a map of South Africa, showing the location of the two schools in their respective provinces.

Figure 3.1 Location of the two schools within South Africa

The medium of instruction at Lynnwood Ridge Primary School is English. The children come from various population groups, with English, Afrikaans, Northern Sotho and Tswana as mother tongues. Most of the children come from the affluent surrounding suburbs.

Duiwelskloof Primary School is parallel medium (English and Afrikaans) and has been racially integrated since 1995. The children come from various population groups. Afrikaans and Sotho first-language speakers make up the largest numbers, but English and Shangaan speakers are also well represented. In addition there are a number of black French-speaking children from Zaire, whose parents work at the Ga-Kgapane hospital. Most of the children come from rural areas and from farms. A more detailed description of the children who participated in the actual survey is given in Table 3.3.

The purpose of taking a group from each of the two schools in their different contexts is to see whether children's response to *Plane Math* varied, and to evaluate whether or not educational equality among diverse populations of children was achieved.

A significant problem faced by schools is that Mathematics is a compulsory subject, feared by many children. The basic elements of fun, discovery and self-motivated mastery are absent for the majority of children. To address this problem, both schools have embarked on

major computerisation projects, each now having at least one computer laboratory. The objectives of the computer technology curriculum are similar for both schools, based on the primary schools' syllabi for Computer Skills (Frielick, 1999:4):

- To enable children to feel the empowerment that is brought about by competence in computer technology.
- To prepare children for the technological challenges for the future, challenges which incorporate marketable skills, economic empowerment and critical thought processes.
- To produce school-leavers who are critical thinkers, problem solvers and information seekers.
- To make computer lessons fun, interesting and worthwhile for the children to maintain an interest, and engender an enthusiasm for working with computers.
- To integrate essential learning and thinking skills alongside teaching basic computer skills, meaning that lessons are task-based activities.

3.5 Method

This research falls under a non-experimental survey design. The research is primarily a quantitative study, but qualitative measures were used to record the results of surveying/observing the learners. Quantitative measures were taken in both the questionnaire (where Likert scaling was used), and the expert review checklist. The questionnaire appears as Appendix A and the expert review checklist as Appendix B.

Multiple methods were used to validate the results generated from the questionnaire, i.e. to apply triangulation. The questionnaire was based on a variety of checklists available in literature. It was administered to two groups - ten Grade 5 children from Lynnwood Ridge Primary School (an urban school) and ten Grade 5 children from Duiwelskloof Primary School (a rural school). The children from Lynnwood Ridge Primary School were a sample of volunteers, while the children from Duiwelskloof Primary School comprised an entire class. The children completed the questionnaire after spending time using *Plane Math*. *Plane Math* offers nine lessons from which learners can choose which lesson/s to complete. Each lesson has its own NCTM standards, outcomes, list of supplementary material and activities. The *Plane Math* web site was chosen above two other alternatives because it was visually attractive and appealing for a young target audience.

An expert review checklist was drawn up in collaboration with the teachers from both schools, after they had spent time working on the web site. Observation entailed a researcher and a facilitator being present with the children while they used the web site, to record noteworthy incidents. The presence of two supervisors promoted validity. Informal discussions with the children were also held before and after using *Plane Math* to examine their response to the site.

3.6 Specifics of *Plane Math*

Plane Math was generated as part of *InfoUse's* project entitled "An Internet-Based Curriculum on Math and Aeronautics for Children with Physical Disabilities" which was funded through a cooperative agreement with *NASA*.

The genesis of this project is based around two issues (*InfoUse*, 1996):

1. The awareness that, around the 4th Grade, current mathematics curricula require skilled manipulation of pen and pencil, calculators, or three-dimensional geometric models, placing children with some/certain disabilities at a severe academic disadvantage.
2. The realisation that physically disabled children may not consider, or be prepared for career possibilities in aeronautics, and may not realise the personal relevance of mathematics in pursuing these careers. The Internet, with its multimedia and communication capabilities, holds great potential for allowing these issues to be addressed.

The program has the goal of portraying children and adults as bright, enthusiastic and able to both assist and work with others, regardless of ethnicity, background, disability, or gender (*InfoUse*, 1996). As such, it may be regarded as a radical humanist web site, since it views the individual and his/her well-being and development as the main point of departure (Roode, 1999:5). This approach moves the focus from technology to aspects such as the individual and their productivity. The primary research questions the radical humanist sets out to answer are "how does?" and "what is?". Such questions help to focus the evaluation on the individual and the overthrow of existing social structures (Roode, 1999:5-6).

According to *InfoUse* (1996), the stated mission of the project is:

> *To stimulate and motivate students with physical disabilities in Grades 4-7 to pursue aeronautics-related careers via the development and delivery of accessible math education materials on the Internet.*

Based on this mission statement, the developers pursued four goals, these being to:

1. Improve access to mathematics and aeronautics curricula materials for 4^{th} – 7^{th} Graders with physical disabilities.
2. Improve mathematics proficiency outcomes among 4^{th} - 7^{th} Grade students with physical disabilities.
3. Inspire and motivate children with physical disabilities to pursue aeronautics-related careers.
4. Increase access to, and use of, digital communication and multimedia technology among children with physical disabilities.

The second and fourth goals above appear to correspond well to the objectives of the two schools computer technology curriculum listed in Section 3.4.2. The researcher would have liked to evaluate this web site in terms of a group of physically disabled children, but this was not possible. The site is, however, relevant to the broader range of children, and in this study was evaluated in terms of children from various population groups, some of whom work through the medium of their second language, and others who had specific problems in mathematics, although they were not physically disabled.

3.6.1 Nature of tutorial

Plane Math consists primarily of lessons/instructional units of a tutorial nature. Within the tutorial, teaching segments alternate with question segments. It supports a behaviourist paradigm, and expects children to master a concept before a new one is introduced. The web site also partially supports a constructivist paradigm in that it encourages collaborative learning. This takes the form of group activities, a chat room (not yet functional at the time of writing), links to sites with related topics, an e-mail facility to the authors of the site and contact with live subject matter experts.

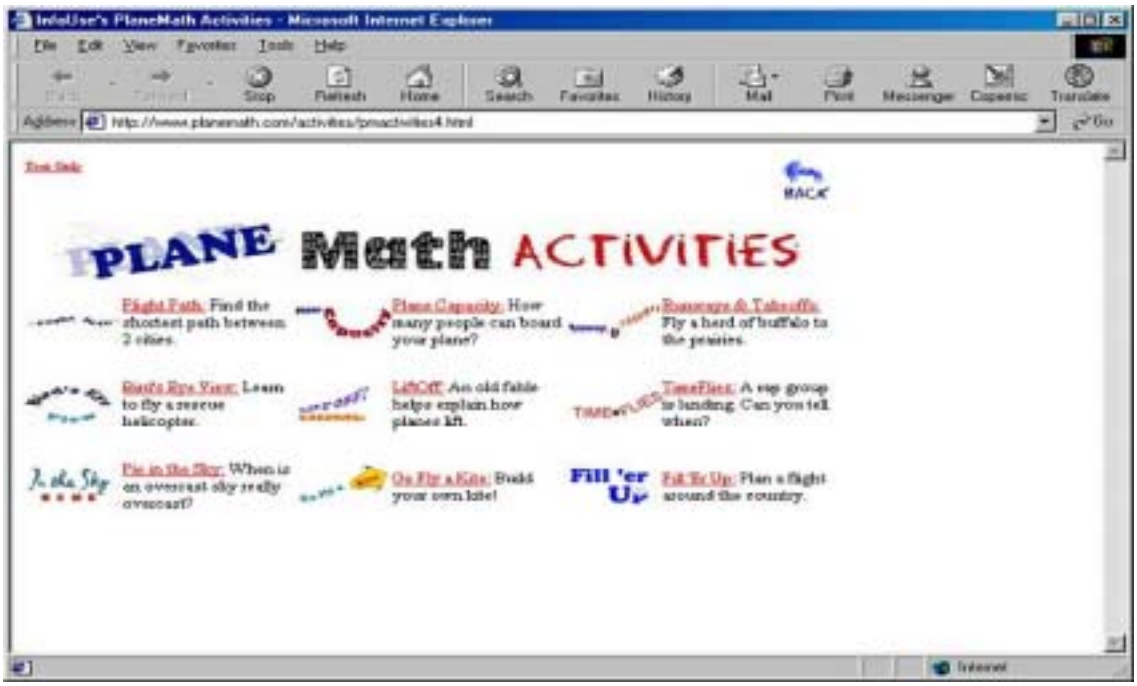
The web site promotes discovery learning in that it has links to other organisations' web sites. Links are divided into three categories, namely: technology and disability, aeronautics, and mathematics.

The web site operates effectively without the presence of a teacher or facilitator, and was demonstrated to be an effective source of remediation and extension. It is simple to move between levels, thus making it possible for weak children to drop a level or go back to previous, unmastered skills. It also facilitates the progress of children who are coping well, and decide to advance to more challenging interactive lessons (if they have the necessary technology).

The Human-Computer Interaction (HCI) is commendable in its use of sound principles of screen design - colour was used appropriately (however, could have been used a bit more extravagantly to make the web site more exciting) and the screen displays were easy to understand. In the expert review checklist, all four teachers who served as respondents gave a rating of 1 ("strongly agree") for the statement that "the screen design of this web site follows sound HCI principles".

The introductory menus stimulate interest, because the headings are semantically clear. Figure 3.2 sets out their real-world purpose.

Figure 3.2 Screen capture from *Plane Math*



Plane Math does not indicate clearly which lessons are appropriate for whom, and what the objective of each lesson is, unless one views this information from the "teacher/parent information" within the site. Consequently, children can get lost, unless given clear guidance from a mathematics teacher as to how best to navigate the site. In general, however, all four teachers agreed that the instructional design of the web site was based on sound learning theories and principles.

Feedback does not spell out the answers. This is in keeping with the goal of portraying children and adults as bright and enthusiastic. If a child answers a question incorrectly, they are assisted by feedback which shows/tells them the result of their action, and encourages them to try again. They are returned to the original screen that presents the problem.

3.7 Results

The results are grouped according to the six research subquestions, using all three methodologies, namely questionnaire, expert review checklist and observation. Percentages were computed for 22 questions on a four point Likert scale which ranged from (1) strongly agree, (2) agree, (3) disagree, to (4) strongly disagree. For the purposes of analysis, however, categories one and two are combined under the label "agree", as are categories three and four under the label "disagree". Results of the subquestions are given, grouped according to their aspects with their respective sub-aspects. There are twenty-two subquestions, with percentages for the two groups, namely the urban and rural school respectively. The final column (Δ) in these tables represents the difference between the two groups, that is:

Δ = urban school value – rural school value.

The difference between the responses of the two groups is also depicted in corresponding figures below each table.

The questionnaire was completed by ten children from the urban school and ten children from the rural school. Seeing that a small sample size was used, these results are tentative.

Table 3.3 gives a description of the two groups of children under investigation.

Table 3.3 Description of the target population

Characteristics		Urban school	Rural school
Gender	Boys	8	8
	Girls	2	2
Home language	English	70%	30%
	Afrikaans	20%	0%
	Black language	0%	60%
	Other	10%	10%
Computer use	Home and at school	70%	20%
	At school only	30%	80%
Use to which computer is put.	Exploring and searching; and playing games	50%	50%
	School projects	40%	30%
	Exploring and searching	0%	20%
	Programming	10%	0%
Internet use	Frequently use it	30%	0%
	Occasionally use it	30%	20%
	Hardly use it	30%	50%
	Never use it	10%	30%
Age range		10-12 years old	11-12 years old
Location of learners		Traditional contact teaching	

When viewing the results it should be remembered that the urban school children were volunteers who were distinction candidates in mathematics, working mainly in their first language, while in the rural school, 70% of the children worked through the medium of their second language and some had specific problems in mathematics. Certain children from the rural school also come from a historically disadvantaged background.

In addition, only 20% of the rural school children used computers at home, in contrast to 70% of the urban school children who used computers both at home and at school. The urban school children also used the Internet on a more frequent basis than did the rural school children. It was interesting to see that both groups of children used computers for a combination of school work and playing games, and not one in isolation.

3.7.1 Pedagogical aspects

In this section children's response to their own learning is discussed, as well as the relevance of the web site to their school curriculum.

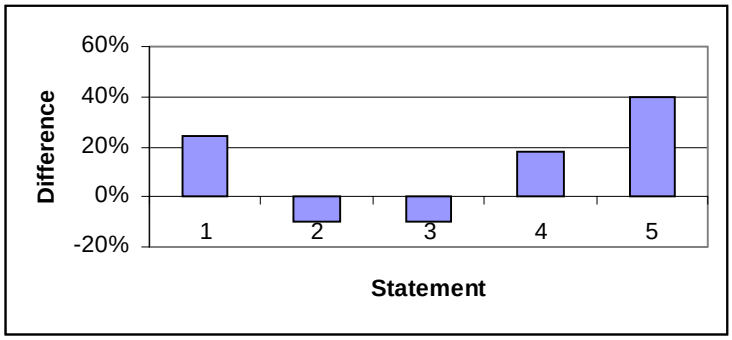
3.7.1.1 What was the response of the children with regard to their own learning?

Table 3.4 and Figure 3.3 depict the differences and similarities in children's response to various statements regarding their own learning. Figure 3.3 indicates that the most notable difference was the difference in the response of children to the site using things they already knew. Otherwise, the responses of the two schools were quite similar.

Table 3.4 Children's response to their own learning

Statement		Group	Agree	Disagree	Δ
1.	I learnt a lot about mathematics.	Urban school	80%	20%	20%
		Rural school	60%	40%	
2.	I am more confident in mathematics now.	Urban school	70%	30%	-10%
		Rural school	80%	20%	
3.	The site made me do a lot of thinking.	Urban school	70%	30%	-10%
		Rural school	80%	20%	
4.	I could use my own ideas.	Urban school	78%	22%	18%
		Rural school	60%	40%	
5.	The site uses things I already know.	Urban school	70%	30%	40%
		Rural school	30%	70%	

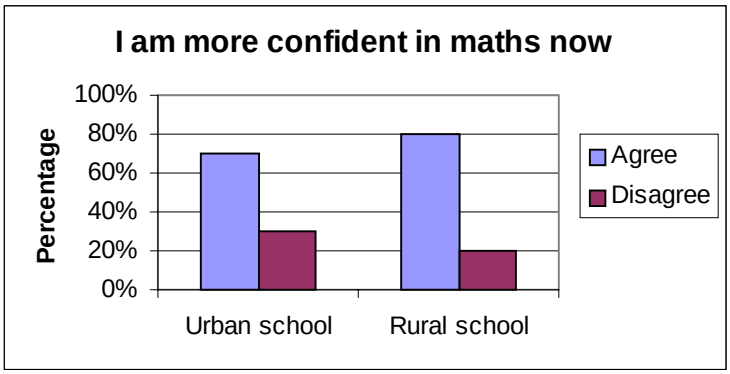
Figure 3.3 Areas of difference between the two groups, with regard to pedagogical aspects



In both groups (urban school: 80%; rural school: 60%) children responded that they learnt a lot about mathematics, especially the children in the urban school.

Figure 3.4 shows the positive effect the web site had on both groups of children (urban school: 70%; rural school: 80%) in terms of their confidence levels in that section of mathematics.

Figure 3.4 Children's confidence levels

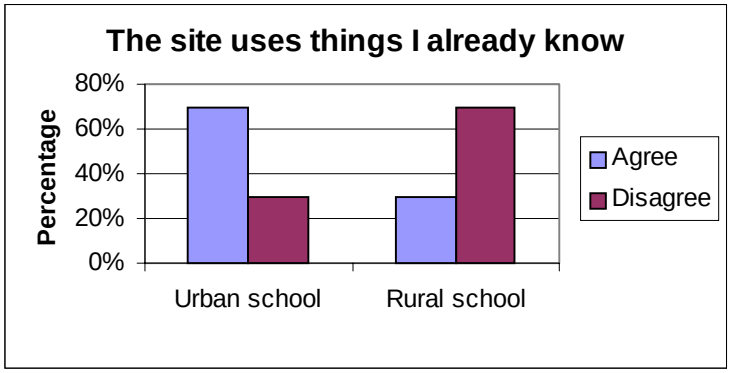


Children responded very similarly to the statement "The site made me do a lot of thinking", in that both groups agreed to this statement (urban school: 70%; rural school: 80%). This was confirmed by the observation in which there were periods of silence while they worked through a particular problem. It was also rewarding to see them working together and pointing to certain objects on the screen to highlight what appealed to them.

In the urban school, 78% of the children responded that they could use their own ideas, in contrast to only 60% of the children in the rural school. This could indicate that the latter group explored the system to a lesser degree than the urban school.

Figure 3.5 indicates that *Plane Math* did not use objects familiar to the children in the rural school, as 70% of these children disagreed with the statement "The site uses things I already know". This demonstrates that the web site is predisposed towards the more advantaged children.

Figure 3.5 How *Plane Math* uses prior learning



3.7.1.2 How relevant is *Plane Math* to the school curriculum?

Table 3.5 indicates that children responded favourably to the statement that the lessons could help them with their school work (urban school: 80%; rural school: 100%).

Table 3.5 Curriculum adequacy

Statement	Group	Agree	Disagree	Δ
The lessons can help me with my school work.	Urban school	80%	20%	-20%
	Rural school	100%	0%	

In the expert review checklist, the teachers agreed that the web site relates to the Grade 5 school curriculum, and plan to use it as a supportive tool in their curriculum in future years. Generally, teachers found *Plane Math* to be a valuable learning tool, as indicated by the following quote:

> *Thanks very much for showing us this very useful site, the children enjoyed it and we the teachers learnt something.*

3.7.2 Affective/emotional aspects

This section examines the motivational effectiveness of *Plane Math*.

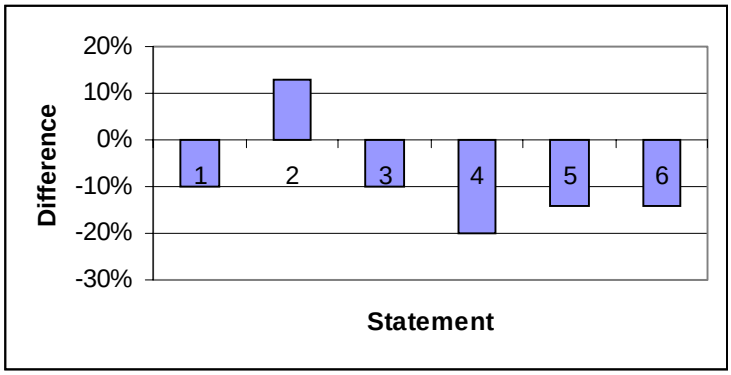
3.7.2.1 Did the children enjoy their learning experience?

Table 3.6 and Figure 3.6 depict the differences and similarities in children's response to various statements surrounding their experience of *Plane Math*. Their responses to the various statements were similar in nature. The most significant difference in this section was their response to using *Plane Math's* web site after the class was over.

Table 3.6 Motivational effectiveness

	Statement	Group	Agree	Disagree	Δ
1.	*Plane Math* was fun and exciting!	Urban school	80%	20%	-10%
		Rural school	90%	10%	
2.	I enjoyed spending time in this web site.	Urban school	80%	20%	13%
		Rural school	67%	33%	
3.	This was a nice way to learn.	Urban school	90%	10%	-10%
		Rural school	100%	0%	
4.	I plan to use *Plane Math's* web site after the class is over.	Urban school	70%	30%	-20%
		Rural school	90%	10%	
5.	Using the *Plane Math* site helped me get better in using computers.	Urban school	56%	44%	-14%
		Rural school	70%	30%	
6.	I don't know the American words (e.g. math and gas).	Urban school	30%	70%	-14%
		Rural school	44%	56%	

Figure 3.6 Areas of difference between the two groups, with regard to affective/emotional aspects



The attitudes of the children to the statement "*Plane Math* was fun and exciting!", were very positive. They responded as follows to open-ended questions:

- *I think this site is excellent.*
- *I enjoyed myself.*
- *I can only say this was very exciting.*
- *It was fun and I learnt a lot.*
- *It's great.*

Observation validates these results, as the children in both groups looked relaxed and discussed the problems amongst themselves. The day after the evaluation, the mathematics teacher from the urban school asked the children who took part in the evaluation if they enjoyed the learning experience. In verbal response, 25% said that it was too easy, while the remaining 75% commented that "it was fun". The teacher felt that these responses depended on the level of maturity of the child.

The children generally agreed that they enjoyed spending time in the web site (urban school: 80%; rural school: 67%). They were asked in the open-ended questions what they liked about the web site. Their responses were very positive, as indicated below:

- *It helps you in mathematics.*
- *It is interesting and I learnt more about mathematics and flying.*
- *The way it gave us information we really wanted to use.*
- *The questions they asked us.*
- *Learning about topics that interest me, using the Internet.*
- *It gives a lot of information and it makes learning easier.*

Both groups of children (urban school: 90% ; rural school: 100%) agreed with the statement that "this was a nice way to learn". However, there were certain aspects that the children disliked about the site, evidenced by the following responses:

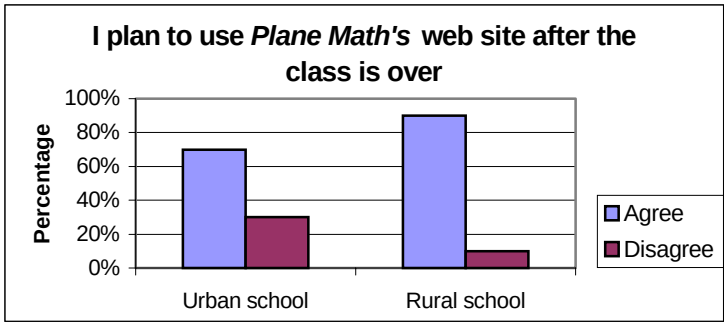
- *Some lessons are boring* (urban school).
- *The fact that it is a bit young* (urban school).
- *Too much white* (urban school).
- *Sometimes I did not understand what was on the screen* (rural school).

- *Took too long for pages to load* (urban school and rural school).
- *I liked everything* (urban school and rural school).

It was interesting to note that a learner from the rural school battled to understand what was portrayed on the screen. This is a learner who works through the medium of English as a second language.

Figure 3.7 depicts the children's response to the statement "I plan to use *Plane Math's* web site after the class is over".

Figure 3.7 Children's attitude to using *Plane Math*



Children from the rural school (90%) were keener to refer the web site to their friends than those from the urban school (70%). These results validate their responses in the open-ended questionnaire, where some of the reasons children from the rural school gave for referring this site to their friends were:

- *Because it is a better way to learn mathematics*
- *It will improve their mathematics.*
- *Exploring the web site really helps you learn more about mathematics and flying.*

Children from the urban school were at a greater advantage, since 70% of them had access to a computer both at school and at home, in contrast to the rural school, where only 20% had access to a computer at home (see Table 3.3). As a result, 70% of the children in the rural school agreed with the statement that "using the *Plane Math* site helped me get better in using computers". It was also interesting to note that children who specified that they use the Internet "not a lot" (urban school: 30%; rural school: 50%), found the exercise far more

enriching and valuable than children who already use the Internet on a frequent basis. Children familiar with the Internet (urban school: 60%) expected far more from the site (e.g. increased interactivity), than those who were less familiar with the Internet (rural school: 80%). Hence there is an urgent need for children who are less advantaged to be exposed to such web sites, so that they too can become critical thinkers and problem solvers. This would help in achieving educational equality.

A further notable point was that the majority of children (urban school: 70%; rural school: 56%) stated that they did not mind the American terminology, thus indicating their familiarity with American vocabulary, possibly due to movies and TV. Although the children did not object, educational web sites that are specifically contextualised to the South African context would provide them with a more appropriate point of contact.

3.7.3 Communicative aspects

In this section the extent to which *Plane Math* employed adequate ID principles is discussed, as well as the extent to which the Human-Computer Interaction (HCI) promoted learning or hindered it.

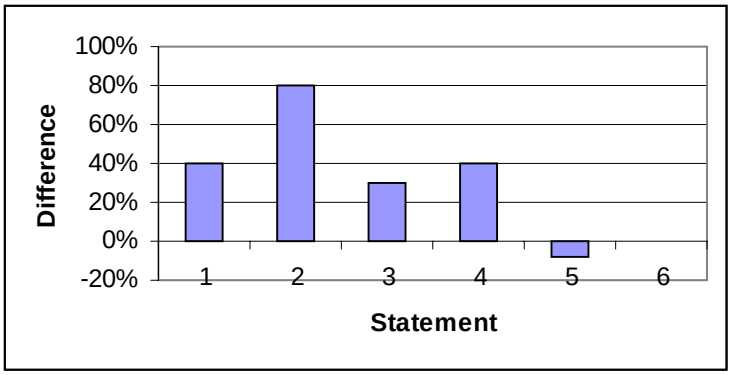
3.7.3.1 To what extent does the site employ adequate Instructional Design (ID) principles?

Table 3.7 and Figure 3.8 depict the differences and similarities in children's response to the instructional value of *Plane Math*. Notable differences in the response of the two groups are depicted in Figure 3.8, the most notable being whether or not they could decide for themselves what to do.

Table 3.7 Instructional adequacy

Statement		Group	Agree	Disagree	Δ
1.	This web site clearly explains what I must do.	Urban school	90%	10%	40%
		Rural school	50%	50%	
2.	I can decide what to do.	Urban school	100%	0%	80%
		Rural school	20%	80%	
3.	It tells me what I do right or wrong.	Urban school	100%	0%	30%
		Rural school	70%	30%	
4.	I could find the information on the screen quickly and easily.	Urban school	100%	0%	40%
		Rural school	60%	40%	
5.	The web site kept my attention from beginning to end.	Urban school	70%	30%	-8%
		Rural school	78%	22%	
6.	It helped that all the pages looked alike.	Urban school	40%	60%	0%
		Rural school	40%	60%	

Figure 3.8 Areas of difference between the two groups, with regard to instructional adequacy



In the urban school, 90% of the children responded that the web site gave them clear instructions on what to do. However, in the rural school, 50% of the children struggled to understand how to operate the system. In addition, 80% of the children from the rural school did not realise that they could decide for themselves what to do. This was in direct contrast to the children from the urban school, where all the children (100%) agreed that they could decide for themselves. The high percentage among the learners in the rural school (80%) could indicate the influence of teaching methods based on passive rote learning, where the learner is told by the teacher what to do, or else it could result from a low rate of exposure to computers (the majority of these children only had access to computers at school). In order to accommodate children from diverse populations and who work through the medium of

their second language, instructions on the available options should be made more explicit. This would optimise learner control.

Both groups of children agreed that they knew from the exercises what they were doing right or wrong (urban school: 100%; rural school: 70%). It is interesting that the percentage in the urban school is 30% higher than that of the rural school. Children in the rural school were also less confident in locating information on the screen quickly and easily, as only 60% of them agreed that they could, in contrast to 100% of the children in the urban school. This could be due to the material not being in their first language, resulting in difficulty in understanding it.

Children found the web site engaging, indicated by the fact that both groups of children responded that the web site kept their attention from beginning to end (urban school: 70%; rural school: 78%).

In both groups, 60% of the children felt that it did not help that all the pages looked alike. This could indicate that children would prefer exciting material, that is, web sites should motivate them and provide them with challenge, curiosity, control and fantasy (Malone, 1981). This would gain their attention and provide a high level of satisfaction (Keller and Kopp, 1987).

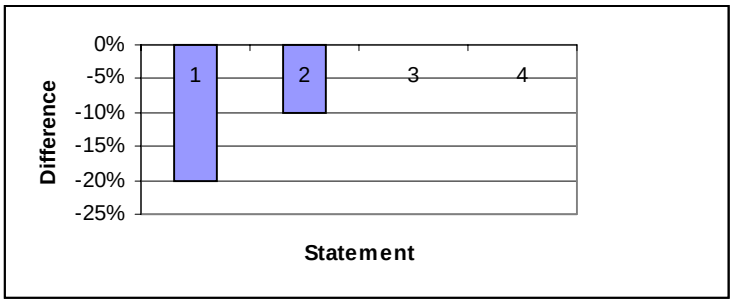
3.7.3.2 To what extent does the Human-Computer Interaction (HCI) promote learning or hinder it?

Table 3.8 and Figure 3.9 depict similarities in children's rating of the cosmetic adequacy of *Plane Math*. Their responses to the various statements were very similar, with no notable differences.

Table 3.8 Cosmetic adequacy

Statement		Group	Agree	Disagree	Δ
1.	I want to explore all there is to see.	Urban school	70%	30%	-20%
		Rural school	90%	10%	
2.	The pictures helped me understand the lesson.	Urban school	80%	20%	-10%
		Rural school	90%	10%	
3.	The screens contained just the right amount of information.	Urban school	80%	20%	0%
		Rural school	80%	20%	
4.	It is easier to read from a computer screen than from a book.	Urban school	78%	22%	0%
		Rural school	78%	22%	

Figure 3.9 Areas of difference between the two groups, with regard to cosmetic adequacy



Children responded positively to each one of the subquestions regarding cosmetic adequacy, especially the children in the rural school, as evidenced in Table 3.8. Children from both groups (urban school: 70%; rural school: 90%) were generally keen to explore all there was to see. The pictures also helped children from both groups understand the lesson (urban school: 80%; rural school: 90%). It was interesting to see that the pictures played a major role with the children in the rural school, helping them comprehend the lesson. Eighty per cent of the children in both groups stated that the screens contained just the right amount of information, indicating that they did not experience sensory overload.

Suprisingly, children in both groups (78%) reacted positively to the statement "it is easier to read from a computer screen than from a book". If this is true in the general target population, then educational web sites and programs have a very valuable potential role in improving and enhancing perceptions of learning.

3.7.4 Technological aspects

In this section the extent to which the technology supports effective use is discussed.

3.7.4.1 To what extent does the technology support effective use?

The children found screen transitions slow and, to a certain extent, this temporarily distracted their attention from the site. This, however, was due to the limited bandwidth available in South Africa, and should the same study be replicated in another environment (e.g. the United States or Australia), the problem might not be experienced.

3.8 Summary

In general, the children from the two groups responded similarly to the web site. Both groups expressed positive responses to the site and its value in their mathematical learning. The results clearly indicate that the basic elements of fun, discovery and self-motivated mastery were present in the web site, and that value and the expectation of success, as suggested by Arnone and Small (1999) were present. However, there were certain differences between the two groups, of which the most important are given in Table 3.9.

Table 3.9 Most important differences betweent the two groups of children

Groups	Differences
Urban school	▪ Responded more positively to the statements on instructional adequacy, due to their familiarity and confidence with computers. This resulted in their using the site as the designers had intended. ▪ Were slightly more critical than the children from the rural school, due to their wider exposure to computer interfaces and learning resources in general.
Rural school	▪ Did not know that they could decide for themselves what to do. ▪ The site did not use objects familiar to them.

3.9 Recommendations

This investigation has demonstrated that the overall effect/outcome of the evaluation was positive. Based on the children's and teachers' feedback, a decision could be made to implement educational web sites as a supportive tool in the appropriate educational curricula. Furthermore, the researcher recommends that the site be used in a South African context, but that many of the lessons should be enriched by having children adapt their responses to South African conditions. The researcher also makes certain recommendations concerning improvements to the site itself, suggestions that may well be useful to people wishing to develop similar sites. The recommendations are divided into the aspects investigated in the study.

Pedagogical aspects

- The web site should provide children with a clear knowledge of who the various lessons are for and should provide clear aims and objectives.
- The same concept should be applied to applications other than those in the aeronautical industry. Also, the curriculum should be made broader, and not just in mathematics.
- Instruction should be adaptable to accommodate different cultural groups, i.e. different examples should be provided which are culturally appropriate for the varied groups of learners.

Affective/emotional aspects

- The site could be enriched in line with current web developments.
- It should be made more interactive and exciting on the Grades 4 and 5 levels, for example, allowing children to control the plane.

Communicative aspects

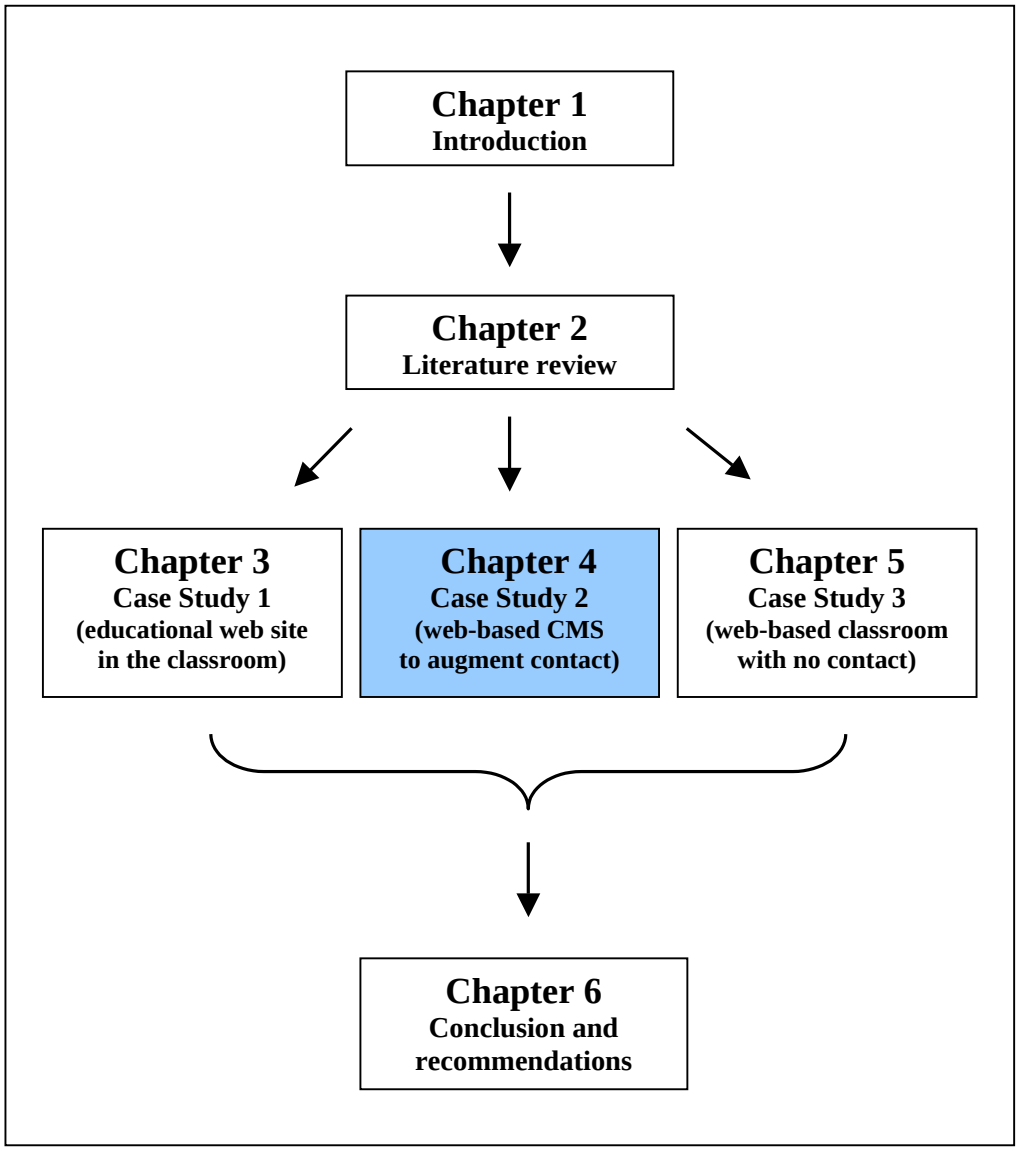
- More hyperlinks and facts should be given.
- Learners should be exposed to computers from early grades; this applies particularly to children in rural schools.
- Children should be given clearer instructions regarding the options offered by the system.

Technological aspects

- Reducing the size of graphics could increase transition speed between screens.
- Bandwidth needs to be improved. This situation will improve, however, as South Africa's bandwidth capacity is increased.

Chapter 4

Case Study 2: Investigation of a web-based CMS delivered by *WebCT*



4.1 Introduction

This chapter reports on the second case study, namely, a web-based course management system (hereafter referred to as web-based CMS) called *WebCT*, for undergraduate and postgraduate learners alike. A web-based CMS refers to tools that support the design, delivery, and management of online courses (Firdyiwek, 1999). Besides *WebCT*, other Internet course management tools include Blackboard, LearningSpace, TopClass, Web course in a Box, and First Class (Huang, 2000). *As it is the web-based CMS that is under investigation in this study, the focus will not be on the course per se.*

WebCT was designed with a view to supporting enriched interactive educational communication on the Web, and to offer enhanced support to instructors and learners as they use the Internet as a medium for learning. It is a developing product and, as a result, has had three updates since it was first used by the University of Pretoria in 1999.

This study investigates the first version of *WebCT*, namely *WebCT* version 1.3, which was implemented in 1999. The University of Pretoria is currently working on the expanded and enhanced version 3.1. The true test of a tool like *WebCT*, apart from its contribution to learning outcomes, is the satisfaction learners gain from using it, and the development of skill and method that it supports. Training programs are often assessed using Kirkpatrick's Four Levels of Evaluation, the four levels being: reactions, learning, transfer and results (Winfrey, 1999). According to this model, evaluation should always begin with level one, and then, as time and budget allow, should move sequentially through levels two, three and four (Winfrey, 1999). This research is grounded in Kirkpatrick's first level of evaluation, namely reactions, which attempts to evaluate the level of satisfaction learners gain from using it.

The research also seeks to investigate the response of two types of learners, namely undergraduate Multimedia learners and postgraduate Engineering learners, i.e. from the "soft" and "hard" sciences respectively.

The case study commences by listing the relevant research questions, followed by a literature review, and an outline of the learning context (international, national and institutional). This is followed by the research methods used to conduct the research, the results and, finally, a summary and recommendations. Instead of the chapter ending with the usual

recommendation section as given in Chapters 3 and 5, the recommendation section is followed by a discussion of the new and enhanced features of *WebCT* version 3.1.

Although a few aspects covered in this chapter are specific to *WebCT* version 3.1, most of the results should apply to web-based CMSs in general.

4.2 Research questions

Table 4.1 shows the subquestions relating to the various aspects under investigation in this case study. The researcher set out to answer these questions, and assess whether there was a difference in the responses of undergraduate and postgraduate learners to *WebCT*. These questions are asked and responses measured in respect of the four main aspects, namely: andragogical, affective/emotional, communicative and technological.

Table 4.1 Subquestions relating to aspects under investigation in Case Study 2

	Aspects	Research subquestions
Case Study 2	Andragogical	▪ To what extent is *WebCT* an aid/obstacle to learners' learning? ▪ Were learners satisfied with the nature of the feedback they received from their instructors via *WebCT*? ▪ To what extent can collaborative learning be stimulated effectively on *WebCT*, using the bulletin board feature?
	Affective/emotional	▪ What are learners' first impressions of *WebCT*? ▪ What emotions, likes and dislikes do learners experience when using *WebCT*?
	Communicative	▪ To what extent is *WebCT* user-friendly? ▪ To what extent is *WebCT* an effective means of delivery? ▪ What method of communication (face-to face/virtual) do learners prefer? ▪ To what extent do learners value a bulletin board?
	Technological	▪ What technological problems did learners/instructors encounter when using *WebCT*?

4.3 Literature review

Communicative interaction between individuals lies at the heart of most approaches to teaching in educational settings (Hewson and Hughes, 1998). It is Hewson and Hughes's (1998:329) opinion that the "constructivist approach to the design of learning and research on learners' approaches to learning, emphasise that active engagement with content and opportunities to interact with teachers and peers are essential elements for deep learning". It is apparent, however, that despite the efficiency of Internet resources such as e-mail, Hypertext Mark-up Language (HTML), File Transfer Protocol (FTP), chat rooms and bulletin boards to deliver messages, the delivery of messages, in itself, is not sufficient to ensure learning (Hewson and Hughes, 1998). Therefore, the challenge when designing flexible programs is to establish sophisticated and effective communication modes and to support a basic set of familiar techniques. In this section two types of interactivity are discussed, namely instructional/content interactivity and social interactivity.

4.3.1 Instructional/content interactivity

Classroom designs employ a range of features to support outcomes, namely: presentations, questioning, brainstorms, discussions, quizzes, debates, project work and so forth. The program *WebCT* supports such a range of features, all in one package. These features are implemented in such a way as to enhance known psychological processes that enhance learning, for example, discussions are conducted to facilitate participation and the free exchange of opinions (Hewson and Hughes, 1998:331).

Classroom designs should be as interactive as possible. They should have a high level of usability and not frustrate learners. Shneiderman (2000) gives two guidelines for user interface design. Instructional designers should strive to:

- Make design cognitively comprehensible, i.e. be consistent, predictable and make user control possible; and
- be affectively acceptable, i.e. promote mastery and satisfaction, and give users a sense of responsibility.

Interactive web environments should be designed according to general web principles, as given by Lynch and Horton (1997) in Table 4.2.

Table 4.2 General web principles

Design principle	Design Implication
Navigation	Provide a rich set of graphic navigation, and interactive links within web pages, to draw learners' attention to content.
Provide the reader with a context.	Provide the reader with a context, so they can see their place within an organisation of information.
Give users direct access.	Strive to provide learners with the information they want in the fewest possible steps and in the shortest time.
Bandwidth and interaction	Avoid features that will keep the learner waiting.
Simplicity and consistency	Use metaphors that are simple, familiar, and logical to the audience.
Design stability	Keep interactive features of the web site working reliably.
Feedback and dialogue	▪ Offer constant visual and functional confirmation of the user's whereabouts and options. ▪ Respond to learners' inquiries and comments. ▪ Make direct links available to instructors.
Design for the disabled	Build in "alternate" messages ("ALT" tags in HTML) so that learners without graphics capabilities can still understand the function of graphics on pages.
Use button bars.	Allow learners to navigate through the information in a site in the intended sequence, by building in button bars such as "Next Page" and "Previous Page".

(summarised from Lynch and Horton, 1997)

4.3.2 Social interactivity

Email, news groups and bulletin boards are known as the standard Internet communication tools available to support asynchronous communicative interaction. These communication tools are flexible, efficient, widely accessible (using standard desktop computers and phone lines) and are capable of supporting enhanced interactivity. They have improved communication drastically in comparison to traditional distance education. The rapid deployment of the Internet also means that these tools can support educational programs on a global scale, a possibility only dreamed of a decade ago. In response to these possibilities for enrichment, teachers and instructors worldwide have worked to harness this potential for educational purposes. The designers of *WebCT* have also worked to harness this potential, including in their package e-mail, a bulletin board, a whiteboard and chat rooms.

However, despite the relative enthusiasm of standard Internet tools - the richness of communicative interactivity is actually very poor when compared to that of the average physical classroom (Hiltz and Wellman, 1997). The restriction to text, while bringing some advantages, removes from the communication many of the linguistic and extra-linguistic features of face-to-face communication. Simply stated, there is no intonation, no body

language, no facial expressions, no accent, no speech rhythm and no proxemics. It is Hewson and Hughes's (1998:331) opinion that attempts at incorporating some of these features, in the form of "emoticons", for example, :-) :-(, are usually inadequate and clumsy, although the attempt itself speaks of the common view that the medium is slightly impoverished. In fact, none of the immediacy and subtlety upon which most established classroom conventions are built can be approached by this medium (Hewson and Hughes, 1998). See Chapter 2, Section 2.2.3.2(c) for further limitations of CMC.

4.4 Context

In this section the international, national and institutional context will be discussed, and a description of the target population will be given.

4.4.1 International

A paradigm shift is currently taking place, moving from an industrial-based society to a knowledge-based society (Marchionini, 1999; Trilling and Hood, 1999). The shift to a knowledge-based society has had a major impact on tertiary education worldwide, specifically as regards the shift from traditional learning towards open learning. The aim of open learning is to provide unhindered access to learning resources so that technologically supported freedom of information may be turned into freedom of education for individuals pursuing their own learning needs, that is, a flexible learning system catering for diverse learning situations (Virtual Campus, 1998b). The use of the Internet and World Wide Web in open learning has increased greatly in the past few years, as vehicles have proliferated to deliver course materials and to create active and collaborative learning experiences. There is a need to investigate such courses to determine whether their benefits and limitations are what the literature claims them to be.

4.4.2 National context

The South African National Qualifications Framework supports the rationale for restructuring South African education through the South African Qualifications Authority (SAQA). The objectives of this framework are to facilitate access to, and mobility and progression within, education, training and career paths (Fregona *et al*, 1999). SAQA recognises that open learning lends itself to Outcomes-Based Education (OBE) in both style and philosophy (Fregona *et al*, 1999). OBE is an approach that requires learners and lecturers to focus their attention on the desired end results of learning, and the teaching and learning processes that will guide the learners to these end results (Geyser, 1999). The focus is less on the teacher as instructor, and more on the *teacher as facilitator,* with the emphasis on *active learner-involvement*, and the learner as the *creator*/*producer of knowledge*. This supports the notion of open learning, which suggests a learner-centred philosophy.

According to Gultig (1997), the main principles underlying OBE are:

- Lifelong learning;
- flexible education and training structures;
- the integration and transfer of learning; and
- the need to teach towards critical, cross-field and specific outcomes.

Critical, cross-field outcomes would promote the development of basic skills such as communication, critical thinking, problem-solving, and team working skills, necessary for functioning in a changing, modern society, while specific outcomes are context-specific and describe the competence learners should demonstrate in particular areas of learning at certain levels (Virtual Campus, 1998a).

4.4.3 Institutional context and target population

A flexible learning system encompasses a range of distance and face-to-face delivery mechanisms and support systems, using appropriate, cost-effective combinations of technologies. At the University of Pretoria, a great deal of attention has turned towards the vision of a Virtual Campus. The Virtual Campus of the University of Pretoria is an electronic extension of current contact teaching facilities, products and services. It provides an Internet-based platform that enables residential and remote learners and staff to access an

integrated educational environment from anywhere in the world (Virtual Campus, 1998b). The aim of the Virtual Campus is to improve the quality of educational processes and products, and to extend existing administration and teaching/learning functions through the application of various technologies. It expands the market of the University of Pretoria by allowing access to remote learners worldwide. Through the Virtual Campus, the university hopes to transform gradually so as to offer increased flexibility to their clients. The idea is to offer fewer contact sessions – mainly for examination, practical work and problem solving - complemented by Internet-based teaching and learning environments (Virtual Campus, 1998b).

The Virtual Campus uses *WebCT* to bring part of this vision to fulfilment. *WebCT* is being used by instructors and learners from a wide range of disciplines at the University of Pretoria. Two of the disciplines in which *WebCT* has been implemented are the Information Science Department in the then "Faculty of Arts", as well as the Department of Engineering and Technological Management in the then "Faculty of Engineering" (the Information Science Department and Faculty of Engineering have subsequently been integrated into the new "Faculty of the Built Environment").

The researcher chose to examine one course in each of these departments to see whether learners' response to *WebCT* differed between two different age groups, i.e., undergraduates and postgraduates, from the "soft" sciences and the "hard" sciences respectively. This provides a more varied perspective on the learners' perceptions of *WebCT*, since to date no such course had been evaluated. A further reason is that any indication of potential problems that could arise in the development and implementation of web-based CMSs would be valuable in maximising the benefits of such a process and counteracting its limitations.

The two courses will now be discussed in more detail.

4.4.3.1 Systems Development course

In 1999, the Information Science Department had eleven courses on *WebCT*, the majority of which were still in their development phase. A course on Systems Development was selected for investigation, since it was the only course in which *WebCT* was used properly in the Information Science Department, although not optimally, as evidenced in the findings. The class was also a good target because the learners were in their second year of studying BA Multimedia and therefore had advanced Internet knowledge, experience and expertise. It was also easy to evaluate this group, because the resources were at the researcher's disposal, due to her studies being based in the department.

The intended outcomes of the Systems Development course are to equip learners with the following skills:

- Knowledge about: database construction, project planning, project management, user needs analysis, system specifications, introduction to interface development, and HCI;
- The ability to plan and manage a multimedia project;
- The ability to design a database;
- Capacity to understand the factors involved with the design of user interfaces;
- Capacity to understand designing from a human user perspective; and
- The ability to apply the theory of HCI to practical user interfaces.

4.4.3.2 Maintenance Management course

The Department of Engineering and Technology Management had four masters-level courses on *WebCT* in 1999. These were also in their development phase. A course on Maintenance Management was selected for investigation, in which *WebCT* was used as a support, in addition to two weeks contact teaching a year.

The desired outcome of the Maintenance Management course is for learners to obtain an introductory knowledge of maintenance management, with an emphasis on the necessary tools to manage the maintenance function within the enterprise.

In this course learners learn how to:

- Specify a maintenance objective;
- formulate a maintenance strategy; and
- structure a maintenance organisation so as to achieve its own objectives.

4.5 Method

This research falls under both a non-experimental survey design, as well as a qualitative ethnographic design. The research is primarily a qualitative study, but quantitative measures were taken to triangulate the data. A questionnaire was completed by the learners (shown in Appendix C). Qualitative measures were used in the questionnaire (where open-ended questions were used), and for interviews with the instructors of both groups of learners. Quantitative measures were taken in the questionnaire sent to learners after completing the course (where Likert scaling was used), as well as in an analysis of the Multimedia learners' communication (i.e. the messages they posted to the bulletin board). Multiple methodologies were used to validate the results generated from the questionnaire, i.e. triangulation was applied.

Data was collected by means of a questionnaire distributed to the entire population of Multimedia learners after they completed the course. Twenty-four questionnaires were given out, and twenty were returned. In the case of the Engineering learners, a random sample of six learners was drawn, and they completed the questionnaire by means of a structured telephonic interview. In addition to the questionnaire, both course instructors were interviewed to obtain their insights and in-depth understanding of their use of *WebCT*, in their respective departments. An analysis of the messages Multimedia learners posted to the bulletin board was undertaken to examine whether or not the bulletin board supported collaborative learning, and what undergraduates used it for. The communication of the Engineering learners was not available to the researcher, and hence was not analysed.

4.6 Specifics of *WebCT*

WebCT is a tool that supports the design, delivery and management of sophisticated web-based learning environments (Firdyiwek, 1999). It supports course designers or instructors in creating sophisticated web-based learning environments, including the instructor's administration, course design, learner evaluation and so forth.

WebCT is the world's leading provider of integrated e-learning systems (Baird, 2001). Over the last three years it has become widely deployed at tertiary education institutions worldwide. According to Baird (2001), over 148 000 faculty members at 1 578 colleges and universities are using *WebCT's* products and services to transform the educational experience for more than 5.9 million learners. It has been made the university standard in many institutions, including the University of Pretoria.

In 1999, features of *WebCT* included: a bulletin board, private e-mail, chat room, course content, online study guides, access to grades, online quizzes, a calendar, a tracking and student administration tool and a student presentations tool (*WebCT* Faculty Lounge, 2000; Virtual Campus, 1998b). *WebCT* offers these various facilities to encourage learners to take ownership of their learning and to support collaborative learning - a constructivist paradigm as discussed in Chapter 2, Section 2.2.1.2.

This case study reports on an investigation conducted in June 1999, and as such all data and screen captures pertain to that year. Figures 4.1, 4.2, and 4.3 give an indication of what the web-based CMS looked like, giving screen captures of the static section, namely the introductory screen (see Figure 4.1) and the course content (see Figure 4.2); and one of the dynamic section, namely the bulletin board (see Figure 4.3).

Figure 4.1 Opening screen of *WebCT*

Figure 4.2 Screen capture of course content

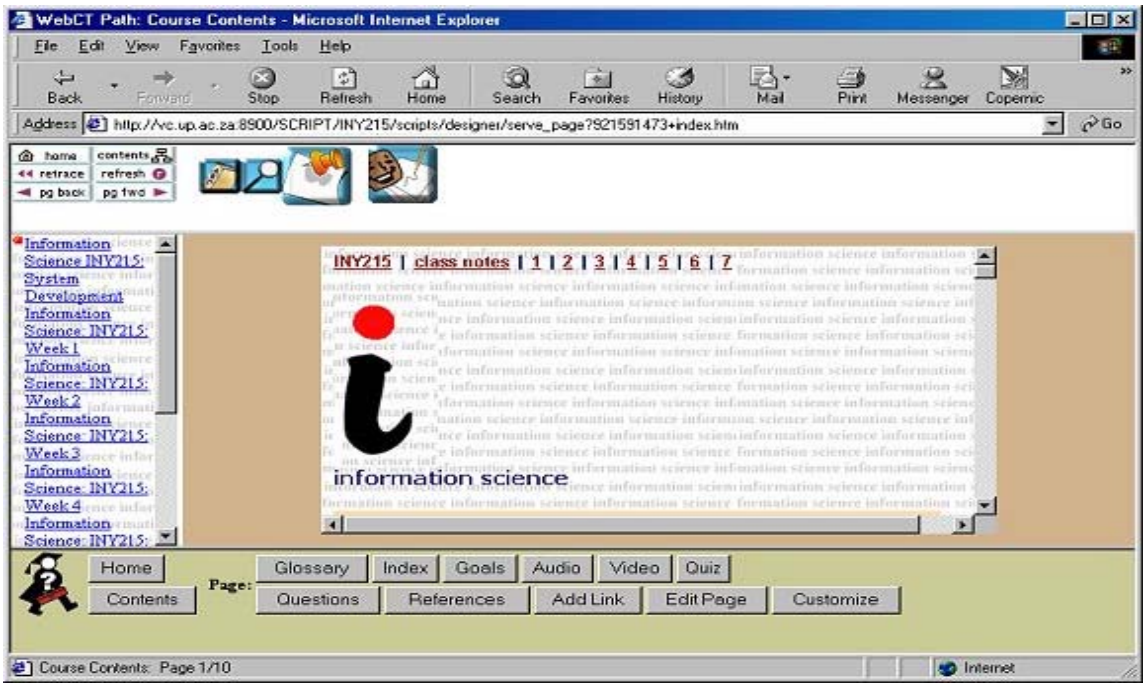
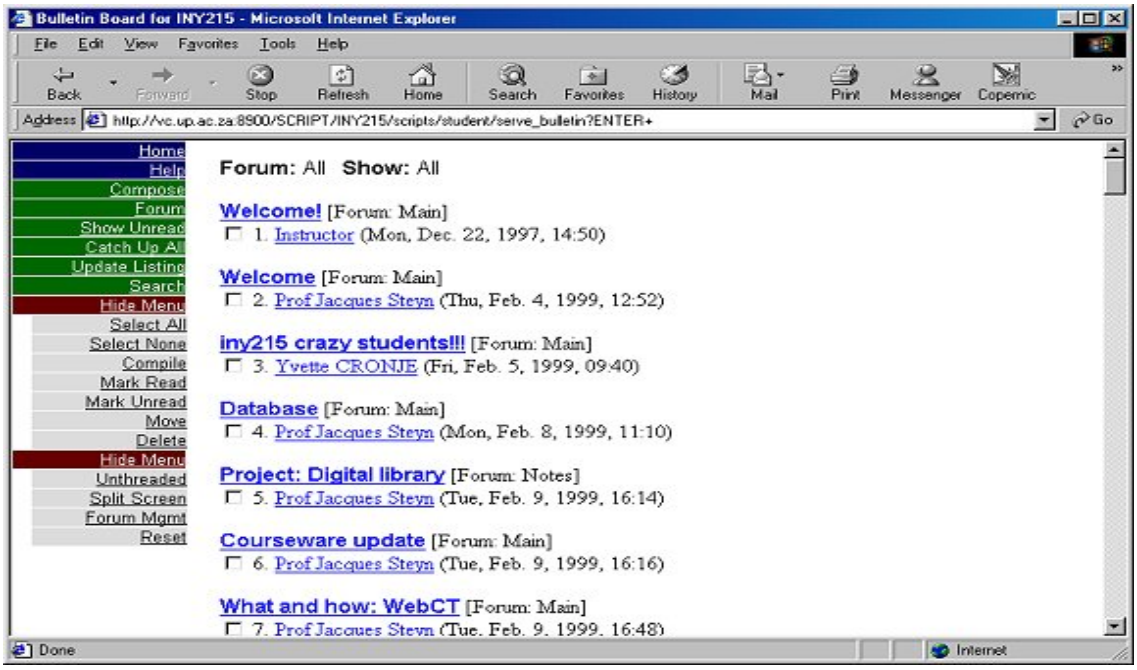


Figure 4.3 Screen capture of bulletin board



The purpose behind using a **bulletin board** in both courses was to facilitate debate, collaboration and dialogue among learners and their instructor for the duration of the course. The **mail tool,** similar to e-mail, was used for private communication within the courses. The learners doing the Systems Development course made use of the **presentation tool** in *WebCT,* in which learners are able to present their findings, by uploading their projects into the *WebCT* course. Each learner can access any of the presentation topics/projects that other learners/groups of learners have uploaded, and can then share the information (Eiffel-Corp, 2000).

4.7 Results

Twenty of the twenty-four Multimedia learners taking the Systems Development course (almost the complete population) participated in the investigation of *WebCT* by means of a questionnaire survey, forming the primary respondents. A sample of six of the forty learners taking the Maintenance Management course took part in a telephonic structured interview, forming the secondary respondents. In short, the primary respondents were the undergraduate Multimedia learners and the secondary respondents were the postgraduate Engineering learners. The difference in sample size is not important, since it is *WebCT* that is under investigation, rather than the learners. However, any results that may be derived from this study are tentative.

The characteristics of the learners who participated in the survey are given in Table 4.3.

Table 4.3 Description of learners using the web-based CMS

Characteristics		**Undergraduate Multimedia learners**	**Postgraduate Engineering learners**
Gender	Male	10	5
	Female	10	1
Employment status		Full-time learners	Full-time employed; part-time learners
Age range		From eighteen to mid-twenty	Three in their mid-twenties Three between thirty and thirty-nine
Internet use	Daily basis	19	4
	Weekly basis	1	2
Location of learners		In close proximity Have traditional face-to-face instruction, four times a week.	Highly dispersed Have two weeks contact-teaching a year.

From Table 4.3, it can be seen that both groups of learners use the Internet on a frequent basis. The main differences between the two groups is their employment status, age, as well as the distance between learners.

4.7.1 Andragogical aspects

This section discusses whether or not *WebCT* was an aid or obstacle to the learning of undergraduates and postgraduates, whether or not learners were satisfied with the nature of feedback they received from their instructor via *WebCT*, and the extent to which collaborative learning is effectively stimulated on *WebCT*, using the bulletin board feature.

The term "andragogy" is used to distinguish the teaching and learning of adults from "pedagogy", the teaching and learning of children, as discussed in Chapter 2, Section 2.3.3(b). Hence the descriptor "andragogical" is used, and not "pedagogical". "Andragogical" in this context includes both undergraduate and postgraduate learners.

4.7.1.1 To what extent is *WebCT* an aid/obstacle to learners' learning?

Figure 4.4 depicts learners' views on whether *WebCT* was an aid or obstacle to their learning.

Figure 4.4 *WebCT* - aid or obstacle?

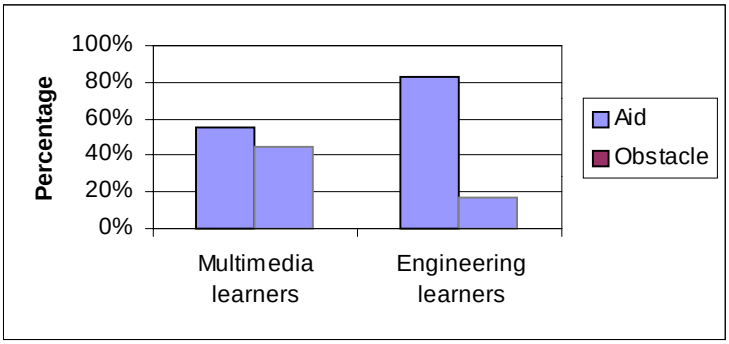


Figure 4.4 indicates that among the undergraduate Multimedia learners, there was no real clarity as to whether *WebCT* was an aid or obstacle to their learning. Fifty-five per cent of the undergraduate Multimedia learners felt that it aided learning, while 45% experienced it as a obstacle. The majority of the postgraduate Engineering learners, in contrast, experienced *WebCT* as an aid to their learning (five of six - 83%), the sixth one feeling frustrated by it at times. These results indicate that web-based CMSs are potentially more valuable for postgraduates who study by means of distance learning, than for undergraduates who study by means of contact teaching. Table 4.4 shows possible factors accounting for the difference in learners' response.

Table 4.4 Possible factors accounting for the difference in learners' response

Factor	Reason	Design implication
Age, maturity and work experience	The groups differed in terms of their age difference, maturity and work experience.	Match learners' tasks with their age, maturity and work experience.
Prior knowledge	The Multimedia learners, at the time of the investigation, were second-level learners, with a traditional school background, used to contact teaching, and were now suddenly exposed to learning virtually, a concept which could have been foreign to their mindsets and contrary to their educational expectations.	Give learners adequate training on *WebCT* and the type of development it supports.
Motivation	The material incorporated no metaphor that drew on their existing skill and knowledge, and was not visually sufficiently stimulating or captivating. Bear in mind that these are Generation X learners - used to being entertained, and if material does not interest them, they move on (see Chapter 2, Table 2.13 for the characteristics of Xers).	Use a metaphor with which learners are familiar.

4.7.1.2 Were learners satisfied with the nature of the feedback they received from their instructors via *WebCT*?

Learners were generally satisfied with the nature and quantity of the feedback they received from their instructors (undergraduate Multimedia learners: 63%; postgraduate Engineering learners: five of the six - 83%). Nevertheless, some of the undergraduate Multimedia learners did not like the fact that certain instructions were only given on *WebCT* and that messages from their instructor were brief. This indicates, however, that the instructor took on a constructivist stance, in that he considered the character traits of this group of learners to be independence and self-reliance, and therefore did not give the answers away, but rather encouraged them to think for themselves.

Table 4.5 gives comments from the undergraduate Multimedia learners regarding the feedback they received via *WebCT*. Their comments relate to both the instructor's method and to *WebCT's* performance.

Table 4.5 Undergraduates' comments regarding feedback

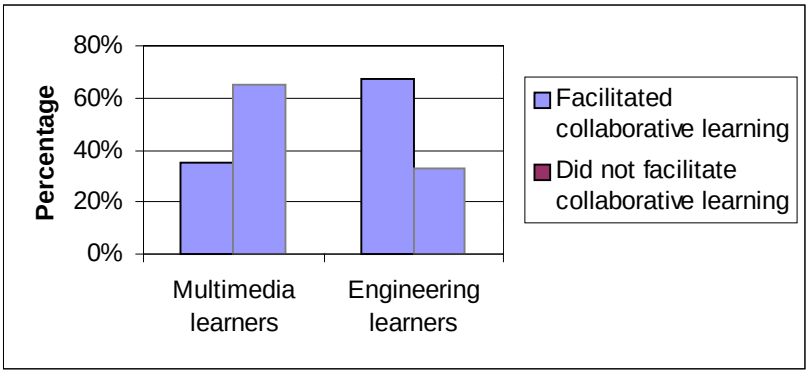
Positive comments	Negative comments	
▪ *Feedback was always in a positive light and of good quality.* ▪ *We were always told what to do.* ▪ *It was exact.*	Feedback on instructor's method	▪ *He kept stereotyped. I had to get my answer out of what he sent.* ▪ *He had the right idea, but the wrong methods.* ▪ *Instructions were given at "bad" times, and important information given only on WebCT.* ▪ *Face-to-face feedback is better - you can express yourself better than on e-mail. His messages were short and not in detail.*
	Feedback on *WebCT*	▪ *Very often valuable comments were missed because one doesn't always have the time to look at WebCT every day.* ▪ *There is always a timespan before messages could be retrieved.*

The Engineering learners were disappointed with two of their instructors who did not use the bulletin board at all. Two Engineering learners felt that the success of a bulletin board depends on the enthusiasm of the instructors and their interaction on the bulletin board. Nevertheless, all the learners experienced it as a valuable means of communication.

4.7.1.3 To what extent can collaborative learning be stimulated effectively on *WebCT*, using the bulletin board feature?

Constructivism emphasizes the importance of collaborative learning. Figure 4.5 depicts learners' view on whether the online discussion facilitated collaborative learning.

Figure 4.5 Learners' view on whether the online discussion facilitated collaborative learning



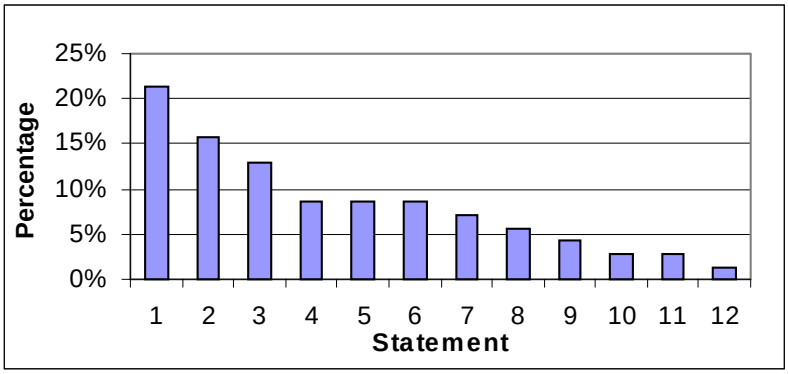
Two thirds (65%) of the undergraduate Multimedia learners were unconvinced about *WebCT's* ability to facilitate collaborative learning, while two-thirds (67%) of the postgraduate Engineering learners felt it did. Considering these results, it does not appear that collaborative learning was supported among the Multimedia learners. However, one must remember that these learners were in close proximity, having traditional face-to-face instruction four times a week.

These results could indicate the following:

- Collaborative learning can be effectively stimulated when learners study by means of distance learning and have a need to communicate. The Multimedia learners had less of a need to communicate because they had traditional face-to-face contact.
- The Engineering learners could choose voluntarily whether or not to participate in the bulletin board. The Multimedia learners, by contrast, were told that their interaction on the bulletin board contributed towards semester marks, which meant that if they wanted good marks, they had to participate regardless of whether they had useful information to communicate.

The messages Multimedia learners posted to the bulletin board were classified into certain categories to determine whether or not these messages supported collaborative learning and for what purposes undergraduates used this feature. The classification was based on the identified areas of similarity. A classification of their communication is given in Figure 4.6.

Figure 4.6 Classification of learners' communication on the bulletin board



Key:

1. Express own view.
2. Provide information.
3. Ask a question.
4. Comment on each others' group work.
5. Technology problems
6. Trivia
7. Course administration
8. Complain
9. Encouragement
10. Thank/express appreciation.
11. Initiate a discussion.
12. Answer a question.

A hundred and thirteen messages were sent to the bulletin board, of which 62% were sent by learners, and 38% by the instructor. Although the largest number of postings were learners expressing their own view, this only occurred after the instructor had expressed his concern that only eight learners had used the bulletin board up to that date. He then told learners to debate whether "Project Management is a waste of time". The percentage given in Figure 4.6 is misleading, as only fifteen out of a total of 24 learners expressed their own view, and their views were generally only a paragraph each. Thus the instructor was correct in saying, "no serious theoretical issues were discussed". However, it must also be realised that these learners did not have the necessary prior knowledge in place to make a worthwhile contribution. The instructor should have taught the learners this knowledge immediately, instead of assuming that they themselves would attempt to seek it. In this way, the Multimedia learners would have something to communicate, and would have received the necessary guidance from their instructor.

In this specific study, considering that only 35% commented that the discussions facilitated collaborative learning, and the small number of learners who expressed their view, it can be said that the discussions did not really facilitate participation and the free exchange of opinions, as suggested by Hewson and Hughes (1998:331).

Multimedia learners used the bulletin board predominantly for providing information, asking questions, commenting on each others' group work, mentioning problems with technology and plain trivia (meaningless comments) (see Figure 4.6). It is interesting to note that one specific learner provided most information and that learners, in general, did not answer each others' questions, except once. The instructor thus intervened and answered the questions. When two learners initiated a dialogue, no others contributed.

The results indicate that although the onus is on learners to take control of their learning environment and available resources, the undergraduate Multimedia learners were not necessarily accustomed to becoming the owners of their own learning. It seems that sharing control of the classroom learning with learners using discussion software, is an uncomfortable situation for some learners. It appears that this group of learners need to adjust to this style of learning, before they can reap its full benefits. Nevertheless, the experience did have value for some learners, and although it was not a socially fulfilling experience, they received useful knowledge nevertheless. Learners were at least introduced to it, and should harness its potential as they become more familiar with it. The bulletin board was therefore not used to its full functionality, and did not support collaborative learning nor facilitate peer problem-solving as it could have, had it been more effectively utilised by both learners and the instructor.

4.7.2 Affective/emotional aspects

In this section the following is discussed: learners' first impressions of *WebCT* and learners' emotions, likes and dislikes with regard to *WebCT*.

4.7.2.1 What are learners' first impressions of *WebCT*?

Figure 4.7 depicts learners' first impressions of *WebCT*. Figure 4.7 indicates a range of emotions from positive first impressions, to mixed emotions, through to negative impressions.

Figure 4.7 Learners' first impressions of *WebCT*

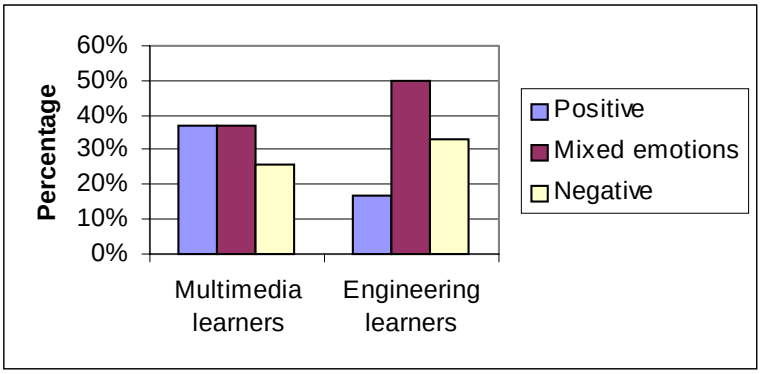


Figure 4.7 gives no clarification as to any predominant impression formed by learners. However, it appears that the undergraduate Multimedia learners had a more positive first impression than that of the postgraduate Engineering learners who predominantly experienced mixed and negative impressions. The Multimedia learners, however, expressed disappointment with *WebCT* as the course progressed, with one learner stating "I liked it, then was desperately disappointed by it".

Table 4.6 gives comments relating to learners' first impressions of *WebCT*, divided into the aspects under investigation in this study. Comments are divided into these aspects for the purpose of clarity.

Table 4.6 Learners' comments regarding their first impressions

Group	Aspect	Positive comments	Mixed emotions	Negative comments
Multimedia learners	Affective/ emotional	▪ *WebCT is a good system and is convenient.* ▪ *The Virtual Campus has done a good job.* ▪ *Good idea, accessible from home as well* ▪ *I was very impressed.* ▪ *Very good supporting learning system*	▪ *O.K, not impressive though* ▪ *Not much of an impression (neither good nor bad)*	▪ *I liked it, then was desperately disappointed by it.*
	Communicative	▪ *Makes interaction between learner and information easier.* ▪ *Smart, very handy, well-structured…. kind of cool* ▪ *Interactive and easy to use. I will definitely recommend it.*	▪ *Looks good, not exciting, but you can easily find needed information.*	▪ *It is hard to get to the relevant information.* ▪ *The information is poorly presented.* ▪ *Terrible user interface*
	Technological		▪ *A help when it worked*	▪ *Somewhat unreliable* ▪ *Slow and unreliable* ▪ *Not good, it did not function correctly or logically.*
Engineering learners	Affective/ emotional	▪ *Quite impressed, could work well.*	▪ *Useful, but takes time to get used to.* ▪ *Nice idea, but doesn't work. Interaction is limited.*	
	Communicative			▪ *Difficult to get into, and not easy to access information.* ▪ *Unwieldy*

Some of the Multimedia learners were quite impressed with *WebCT*, highlighting its convenience - "interactive and easy to use" and found it valuable - "very good supporting learning system", while other learners had mixed emotions to it. Some learners felt negative about *WebCT* and commented that the interface was badly designed, the information was

poorly presented, and that it did not function correctly or logically. In contrast, only two of the Engineering learners found it not user-friendly, commenting that it is "difficult to get into, and not easy to access information" and is "unwieldy".

4.7.2.2 What emotions, likes and dislikes do learners experience when *using WebCT*?

In this section the emotions learners experienced when using *WebCT* are reported, as well as what they liked and disliked about *WebCT*. Table 4.7 depicts their relevant criticisms and comments regarding *WebCT*.

The most common emotion among both groups of learners was frustration, for reasons given in Table 4.7. Seventy per cent of the undergraduate Multimedia learners and 67% of the postgraduate Engineering learners experienced frustration. Emotions experienced to a lesser degree among the undergraduate Multimedia learners were helplessness, alienation, anger and fear. Positive emotions experienced among this group of learners were a sense of achievement, motivation, satisfaction and a feeling of success, once they had mastered *WebCT* as a medium for learning. The two positive emotions experienced by the postgraduate Engineering learners were a sense of achievement and satisfaction.

Table 4.7 Learners' comments regarding their feelings about *WebCT*

Group	Aspect	Likes	Dislikes
Multimedia learners	Affective/ emotional	▪ *If you are behind in your studies you can catch up with WebCT.* ▪ *You can go and get clarity for several times and check dates, etc. One can check it from outside UP.* ▪ *While working at home, it is possible to upload work and then use it again at University.* ▪ *One feels good when you can see your work on the Web.*	▪ *I feel it's an effective idea that isn't being utilised as intensely as it could be.* ▪ *It is slow and totally uncool.* ▪ *I feel negative towards this program, especially seeing that it comprised 90% class time - don't overkill.* ▪ *The product was a bad buy.* ▪ *Boredom*
	Communicative	▪ *Having access to the course material at all times, and therefore not having to make photocopies that are bound to get lost.*	▪ *Having to communicate in a certain way.* ▪ *Not up-to-date* ▪ *Navigation difficult and design unpleasant* ▪ *I guess I have a little cyberphobia left somewhere. The bulletin board boggles me, and no one chats in the chat room anyway.*
	Technological	▪ *It feels good when something (any projects) worked.* ▪ *It is nice that any member of the group has access to the presentations and that others cannot sabotage your work.* ▪ *When it worked, it was a help.*	▪ *It's not reliable! One day it works, the next day it doesn't.* ▪ *At certain times one was not able to log on at all.* ▪ *We were unable to change data quickly and easily.* ▪ *Uploading files is a slow process, since you have to upload one thing at a time.*
Engineering learners	Affective/ emotional	▪ *Good system* ▪ *Happy with service* ▪ *WebCT is good.*	
	Communicative		▪ *Elaborate, superfluous, graphics*
	Technological		▪ *Frustrated with access* ▪ *I did not get very far after using the system for one and a half hours.*

The Multimedia learners found the flexible arrangement of the course content useful and convenient. They liked the fact that it could be accessed at any time, and found it useful for getting clarity, checking dates and for catching up on work if they were behind. One learner also liked having access to the presentations of other groups' work. However, other learners were negative, commenting that it was unreliable, a bad buy, and one learner was bored by it. Another learner commented that the bulletin board "boggles me", indicating that he did not really understand the concept behind a bulletin board.

The undergraduate Multimedia learners gave the following comments about *WebCT*, in the form of suggestions:

- *Could be more user-friendly.*
- *Should be way more interactive.*
- *Good idea, but needs to be more functional.*
- *A great concept, but needs to have all the bugs fixed up.*
- *WebCT needs constant attention and management to work - this stage still has to occur.*

Two postgraduate Engineering learners gave brief, yet positive comments about *WebCT*, stating that they were happy with the service. The results generally indicate that learners are in favour of the open learning approach. They did, however, experience the following frustrations:

- The slow speed between screen transitions. This, however, was due to large graphics, and the limited bandwidth available in South Africa.
- Instructors who did not update the content of their sites when information changed, or left their sites incomplete.
- Two of their instructors did not communicate electronically at all. They found this very frustrating, especially seeing that these were their Information Management and Information Technology instructors.

Two of the Engineering learners preferred using conventional e-mail and found it to support collaborative learning more effectively than a bulletin board. Although the e-mail facility on *WebCT* was well-used, it was considered ineffective by these two learners because it was less responsive than other e-mail packages. These learners found communicating and collaborating with their study group more effective through conventional e-mail, which they

experienced as effective, efficient, flexible and trustworthy. For this specific group of learners, classroom discussions via a discussion list may have been more convenient and beneficial than an online bulletin board. The e-mail facility on *WebCT* was valuable, however, for learners studying on campus, who did not have the Internet at home or access to a sophisticated e-mail program.

The instructors of the two groups of learners also experienced different emotions. The instructor of the Multimedia learners felt disappointed and disillusioned by their use of *WebCT*, in contrast to the instructor of the Engineering learners, who was very positive. The Multimedia instructor felt this way, due to both teaching inadequacies and tremendous problems with technology (discussed further in Section 4.7.4).

Teaching inadequacies

The Multimedia instructor felt that the learners did not use the bulletin board for real problem-solving and to discuss real theoretical issues. It was discovered only much later that learners did not understand certain concepts and did not attempt to get clarification on these concepts, either from their peers face-to-face or on the bulletin board. The instructor should have clarified these concepts with the learners, realising that they did not have the necessary prior knowledge in place.

Technology difficulties

The Multimedia instructor commented that there was also no help facility for course developers, nor a help facility for learners about entering courses on *WebCT*. As a result, he could not help learners with their technology problems, because of being in a different position to them. He solved the problem by creating a phantom learner (i.e. by appearing himself as an additional learner on the course). Despite this problem being solved, it is imperative that support in this regard be improved.

Further frustrations experienced by this instructor were:

- Outsiders were unable to access the course due to the password control; and
- the Virtual Campus could not accommodate the structure required by the Information Science Department and, as a result, the instructor had to fit the course into the "mould" provided.

The instructor of the Engineering learners, in contrast, was very positive about their use of *WebCT*, although they also had their share of technological problems. He found *WebCT* very useful, and a major improvement on the previous running of their Masters course. Communication which in the past had been by conventional mail, was now instant. The instructor also commented that his contact with learners improved significantly, in that he had continuous communication with them. His learners felt more comfortable in saying certain things and were bold in giving their opinions. He also received better feedback from them since using *WebCT*, and found they were more in control of their learning environment than in the past. He also found that *WebCT* saved considerable time in terms of administration.

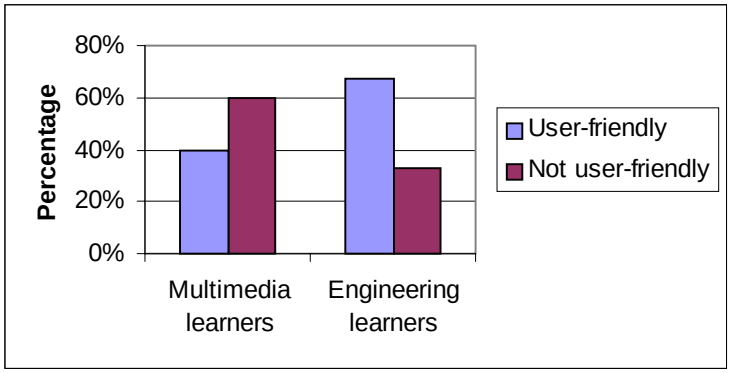
4.7.3 Communicative aspects

In this section the following is discussed: the extent to which *WebCT* is user-friendly and an effective means of delivery, the methods of communication learners prefer and the extent to which learners value bulletin boards.

4.7.3.1 To what extent is *WebCT* user-friendly?

Figure 4.8 depicts the extent to which learners experienced *WebCT* as user-friendly.

Figure 4.8 User-friendliness of *WebCT*



Sixty per cent of the undergraduate Multimedia learners experienced *WebCT* as not user-friendly (see Figure 4.8). On the other hand, four of the six postgraduate Engineering learners (67%) felt that it was user-friendly. Their conflicting responses could be due to the Multimedia learners applying prior knowledge and experience from a previous first-level course including criteria for good web design. The Engineering learners lacked this prior knowledge.

Certain learners in both groups found the design of *WebCT* problematic. This is indicated by learners' comments in Tables 4.6 and 4.7, where they mention things like information being poorly presented, unpleasant design, etc.

The Engineering learners made the following valuable suggestions with regard to the user-friendliness of *WebCT*:

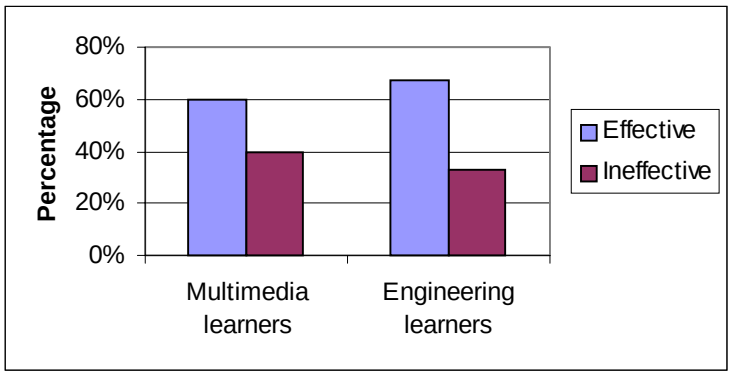
- *A link to your conventional e-mail program would be good. Speed should be improved and it should be made more user-friendly.*
- *Peel off front layers, making it easier to go to straight to where you want to go. All bits and pieces should be on one site.*

The instructor of the Multimedia learners also found the shell approach restrictive, in that it provided a rigid structure.

4.7.3.2 To what extent is *WebCT* an effective means of delivery?

Learners' response to the effectiveness of *WebCT* as a means of delivery were similar, as depicted in Figure 4.9 (undergraduate Multimedia learners: 60%; postgraduate Engineering learners: four of the six - 67%).

Figure 4.9 The effectiveness of *WebCT* as a means of delivery



This indicates the value some learners perceive in web-based CMSs. Two Multimedia learners made the following comments with regard to *WebCT* as a means of delivery.

- *Very good concept, supports learning.*
- *Don't take it away, it saves my life when I need it.*

Some of the Multimedia learners felt, however, that *WebCT* should not be a replacement for lectures, but should merely function as a support for learning. Some of them felt that their instructors placed too much emphasis on *WebCT*, as indicated by the following comments:

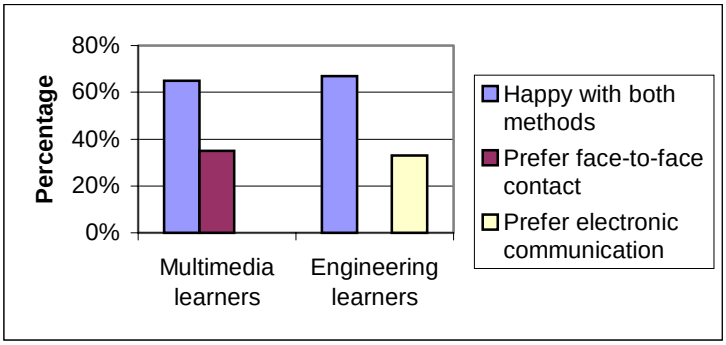
- *WebCT should be a support for the instructor and not a total reference alone.*
- *WebCT is not a replacement for lectures and instructors. We need classes in which our work is explained and discussed, we still need to be fed by a spoon, I guess.*

The latter comment indicates that not all learners have the characteristic of being self-directed, as Laidlaw (1998) suggests (see Chapter 2, Table 2.13). It also appears that for a large number of learners, the basic elements of fun, discovery and self-motivated mastery were absent.

4.7.3.3 What method of communication do learners prefer?

Figure 4.10 portrays the methods of communication preferred by learners.

Figure 4.10 Method of communication learners prefer



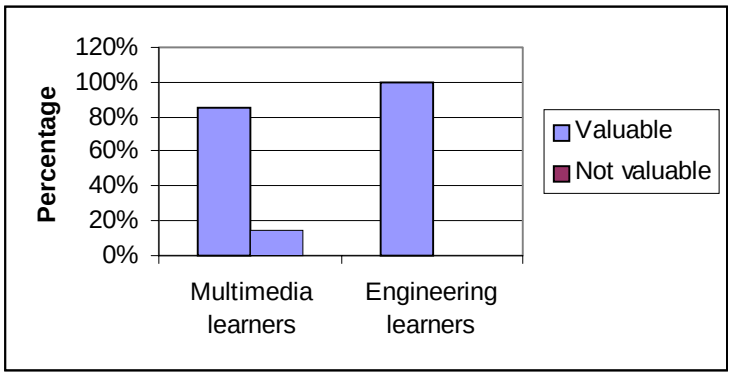
The majority of learners in both groups preferred face-to-face contact as well as virtual communication on a bulletin board. A third of the Multimedia learners, however, preferred only face-to-face contact with fellow learners and instructors. This demonstrates that some learners are still in favour of the traditional approach to learning, where class work is explained and discussed, and that the trend towards virtual learning is a concept foreign to some learners' mindsets and contrary to their educational expectations.

Among the postgraduate Engineering learners, two of the six (33%) preferred electronic communication, while four of the six (67%) were happy with both methods. None of these learners indicated that they preferred face-to-face contact on its own, indicating that lectures alone will not meet the needs of postgraduates. It is nevertheless quite evident that both groups of learners favour the open learning approach and the principles of flexible learning.

4.7.3.4 To what extent do learners value a bulletin board?

Learners were instructed to use the bulletin board feature on *WebCT* to communicate with fellow learners and their instructor, this being their primary method of communication. Figure 4.11 depicts the value learners attach to a bulletin board.

Figure 4.11 Value attached by learners to a bulletin board



Eight-five per cent of the undergraduate Multimedia learners considered it a valuable method of communication, in contrast to all the postgraduate Engineering learners who felt that bulletin boards were valuable. The Multimedia learners who disagreed commented that they preferred gaining knowledge, insight and assistance from their peers face-to-face. Although the Multimedia learners felt that bulletin boards were valuable, they only started using this feature to its full functionality when they heard that their class participation contributed towards semester marks, which meant that if they wanted good marks, they had to participate. This gave some undergraduates a negative perception of *WebCT*, as indicated by the following comment:

> *Hi, look at me! I'm writing, that means I'm participating, that means I get better marks! Now ain't that cool. Please don't just write stuff, it's boring. No use just talking if you have nothing to say (like me now). So don't participate … he he he*

The instructor responded to this learner, stating that, "You'll be amazed to find out that hitting the log does not create marks, only valuable participation does". Instructors and educators can nevertheless learn from an experience like this that as far as possible, discussions should be designed in such a way that they are goal-oriented, grab the attention of learners, offer challenges and hand control over to them (Clarke, 1998).

The characteristics of Xers, such as “used to being entertained”, and “if something does not interest me I move on”, should be taken seriously.

Table 4.8 indicates in more detail how learners felt about the bulletin board and whether or not they found it to be of value.

Table 4.8 Value learners attached to the bulletin board

Group	Positive comments	Negative comments
Multimedia learners	▪ *You can share ideas, offer help, and hear others’ opinions.* ▪ *The interaction with fellow learners was very good.*	▪ *Easier to talk to fellow learners face-to-face.* ▪ *I prefer face-to-face contact.* ▪ *I had no desire to use it.* ▪ *Lots of questions/comments not answered - everyone seems to talk to themselves.* ▪ *Most of the time I am irritated by WebCT, because there are often problems. I don’t spend days in-front of it.*
Engineering learners	▪ *Have a wide range of perspectives, which is mind broadening/useful for sharing ideas and problems.* ▪ *Learning experience was good.* ▪ *Encourage its use. Should be more user-friendly.*	▪ *Frustrated with access* ▪ *Had no need to interact.* ▪ *Minimal ideas. Our study group made use of normal e-mail.*

It is evident from Table 4.8 that once again, face-to-face contact was very important to the Multimedia learners and that they were generally more negative in their responses than the Engineering learners were.

To determine what value learners place on bulletin boards, they were asked whether they would use a bulletin board in similar contexts, having now been exposed to such interaction. Thirteen per cent of the Multimedia learners said “yes”, 40% said “no” and 47% percent gave a qualified “yes”, giving the following conditions for its use:

- *It must be reliable and I don’t want to be forced to use it. It must be so good and interesting that I want to use it.*
- *To pass on general information, not important information.*
- *To use as an extension for learning, not as the only means.*
- *If explained properly and used in conjunction with instructors.*

- *It is good for posting general messages, but face-to-face confrontation is still better.*
- *I prefer classes rather than "virtual" classes.*
- *It should not count for marks.*

Learners who said "no", made the following comments:

- *Because it counts for marks, learners are forced to send something just to get marks, it is a bit irrelevant some times.*
- *It is a bit too slow and plump. Feedback takes longer than just asking a question face-to-face.*
- *It is impersonal.*
- *The process is artificial.*

For both groups of learners, classroom discussions via a discussion list might have been more beneficial than an online bulletin board. For postgraduate learners it would be more convenient, while for undergraduate learners the process might seem more natural.

4.7.4 Technological aspects

In this section the technological problems instructors and learners experienced are discussed.

4.7.4.1 What technological problems did learners/instructors encounter when using *WebCT*?

The numerous technological failures were a significant problem. All learners experienced technological problems of some form or other. A major problem, especially for the postgraduate Engineering learners, was the download time for learners accessing their course from home. This, however, was due to large graphics and the limited bandwidth available in South Africa. Should the same study be replicated in another environment (e.g. United States or Australia), the same problems might not have been experienced.

Table 4.9 shows some of these problems, with learners' comments and implications for design.

Table 4.9 Learners' problems with technology

Problems	Comments	Implications
Access problems	▪ *Access cumbersome* ▪ *My password failed twice in one month and still isn't up and running.*	▪ Provide direct access to course and one page with all the links learners can navigate to (i.e. a site map). ▪ Provide frontline support for both learners and instructors.
Response problems	▪ *Response times were slow – took longer to access the WebCT course from home.*	▪ Increase capacity of server. ▪ Increase bandwidth.
Problems with unreliable servers	▪ *The server had a tendency not to work – usually at crucial times.*	▪ Make sure the host network and remote network are stable.
Problems with uploading	▪ *Uploading is a long and tedious process, since only one file can be downloaded/uploaded at a time.* ▪ *Sometimes newly loaded work does not show until the next day or show at all.* ▪ *Files go missing.* ▪ *Changing information is extremely difficult.*	

The undergraduate Multimedia learners experienced problems with uploading their group tasks on the presentation feature of *WebCT*. Learners had been instructed to post their group tasks to this feature, yet 60% of the Multimedia learners experienced technological problems in the process.

Table 4.10 lists the problems the Multimedia instructor experienced with *WebCT*.

Table 4.10 Instructor's problems with technology

Problems	Comments	Implications
Technology problems	▪ *I experienced network, server and password problems.*	Make sure the host network and remote network are stable.
	▪ *It could not be used offline, making it expensive to use if using outside the university.*	Users would have high telephone expenses on personal accounts.
User problems	▪ *It requires training on the part of instructors, taking them away from their day-to-day work.*	Reduce training to minimum possible, and provide a comprehensive manual.
	▪ *WebCT cannot handle style sheets.*	Design would be labour-intensive.
	▪ *Learners could delete each others files.*	Set rules in place with regard to what learners may or may not do.

The comments received from learners and instructors alike indicate that certain features of *WebCT* version 1.3 were unreliable and unstable.

4.8 Learners' comments matched against their characteristics

This section matches learners' comments with their characteristics as discussed in Chapter 2, Table 2.13 (characteristics of Generation X) and Table 2.14 (characteristics of adult learners). The characteristics of Xers matched against their comments are given in Table 4.11, while the characteristics of adult learners matched against their comments are given in Table 4.12.

Table 4.11 Characteristics of Xers matched against their comments

Characteristics	Comment
Independent and self-reliant	▪ *WebCT is not a replacement for lectures and instructors. We need classes in which our work is explained and discussed, we still need to be fed by a spoon, I guess.* ▪ *Hi, look at me! I'm writing, that means I'm participating, that means I get better marks! Now ain't that cool. Please don't just write stuff, it's boring. No use just talking if you have nothing to say (like me now). So don't participate … he he he.* ▪ *Lots of questions/comments not answered – everyone seems to talk to themselves.*
Technoliterate	▪ *The server had a tendency not to work – usually at crucial times.* ▪ *Face-to-face feedback is better - you can express yourself better than on e-mail. His messages were short and not in detail.* ▪ *Looks good, not exciting, but you can easily find needed information.*
Expectation of instant gratification	▪ *Should be way more interactive.* ▪ *I had no desire to use it.* ▪ *It is slow and totally uncool.* ▪ *WebCT needs constant attention and management to work - this stage still has to occur.* ▪ *Most of the time I am irritated by WebCT, because there are often problems. I don't spend days in front of it.*
Self-building	▪ *You can share ideas, offer help, and hear others' opinions.* ▪ *The interaction with fellow learners was very good.* ▪ *One feels good when you can see your work on the Web.*

The following deductions can be made from Table 4.11:

- Learners' comments indicate that *WebCT* could not support independence and self-reliance on the part of learners.
- Though the Xers were indeed technoliterate, it appears that they also attach value to face-to-face communication and feedback.
- Xers require instant gratification; they are more aggressive – expecting things to happen quickly and immediately. *WebCT* did not meet this expectation.

Table 4.12 Characteristics of adult learners matched against their comments

Characteristics	Description
Task-centred	▪ *Quite impressed, could work well.* ▪ *A link to your conventional e-mail program would be good. Speed should be improved and it should be made more user-friendly.* ▪ *Peel off front layers, making it easier to go to straight to where you want to go. All bits and pieces should be on one site.*
Value-driven	▪ *Instructors should use it more.* ▪ *Learning experience was good.* ▪ *Encourage its use. Must be more user-friendly.*
Problem-centred	▪ *Have a wide range of perspectives, which is mind broadening/useful for sharing ideas and problems.*

The following deductions can be made from Table 4.12:

- Adult learners' comments indicate that they are indeed task-centred and analytical – they concentrate more than the Xers on detailed features of the CMS and their purpose.
- They were less demanding and critical than the Xers, more value-driven and intent on using *WebCT* to solve the problem on hand.

4.9 Summary

Four problem areas were identified, based on the aspects under investigation, these being:

- Teaching inadequacies (andragogical aspect);
- negative attitudes (affective/emotional aspect);
- inadequate design (communicative aspect); and
- technology problems and inadequate support (technological aspect).

Each of these areas influenced the way learners experienced *WebCT*. It would also seem that the perceived usefulness of *WebCT* relates to the way individual learners or instructors experience it, as the responses of learners to the product were diverse, ranging from positive to negative.

Two main findings came out of this study, namely:

- The undergraduate Multimedia learners were typical "techno-savvy kids". They were more aggressive and expected things to happen quickly and immediately.
- The postgraduate Engineering learners were more tolerant and saw the task behind the problem. They were less demanding and critical than the Xers, more value-driven, and intent on using *WebCT* to solve the problem on hand. They were therefore more satisfied with *WebCT* than the undergraduate Multimedia learners were.

It is the researcher's opinion that *WebCT* is more useful for distance learners who have a need for such a product. However, it can also be of great benefit to undergraduates, if it is used as a supplement to traditional class instruction and as a support for learning. Based on the results, it should not be used as the only means of instruction.

If the University of Pretoria is to implement *WebCT* successfully, the deficiencies that have been identified must be addressed. With these problems solved, *WebCT* would have great potential and be able to support complex, linguistically rich and educationally sophisticated interactions.

Future research is needed into learners' response to *WebCT* version 3.1 (the current version of *WebCT*). It would also be interesting to conduct the same study in ten years time, on a group of learners from the Millenial Generation – who are known as critical thinkers (Tapscott, 1999) - to determine how they respond, perceive, and use *WebCT*.

4.10 Recommendations

Recommendations are given for each of the different aspects under investigation in this study.

Andragogical aspects

- Learners must receive regular feedback.
- Learners should report on their progress or attempts/successes/failures on the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners could be experiencing problems, and learners may find that they share the same difficulties.
- Administrative technicalities should be subordinate to the instructional aspects.

Affective/emotional aspects

- Instruction should be designed for relevance and to match learners' interests.
- The interface should be re-designed and made more user-friendly. A metaphor that learners are familiar with should be employed. This metaphor should also draw upon their existing skill and knowledge.
- The basic elements of fun, discovery and self-motivated mastery should be present for learners.
- A questionnaire/s can be sent out to learners at certain times in the course. Instructors could ask learners to report on their progress, perceptions of the course and what they have learnt from the course up to that point. This could help focus the course.

Communicative aspects

- Instructors who have opted to use *WebCT* should not only keep it current, but also use it and build in adequate scaffolding. For example, the instructor should frequently post messages to the bulletin board in the beginning of the course, to familiarise learners with this feature. As the course progresses, the interaction and scaffolding on the part of the instructor should decrease and interaction between learners should increase.
- Instructors should schedule inter-learner debates on controversial, but relevant, topics. Instructors should also interact enthusiastically on the bulletin board.
- The best model is to use a combination of face-to-face contact and electronic communication. Contact sessions should be held to promote a sense of unity and belonging in a group.
- Learners should not be forced to use any of *WebCT's* communication tools, but they should be so visually stimulating and put to such good use, that learners want to use them.

Technological aspects

- The host network and the remote network must be stable.
- Design for stability, by keeping the interactive features of the site working reliably.
- Learners can be given a CD-ROM with additional course material they can use off-line, instead of having to access the Internet and wait for material to load. Course material could include video and sound clips, articles, graphics and so forth.
- Provide support for both instructors and learners.

4.11 New features

Since this study, *WebCT* has been revised and is currently in its third revision. Many of the recommendations made above have, in fact, been implemented.

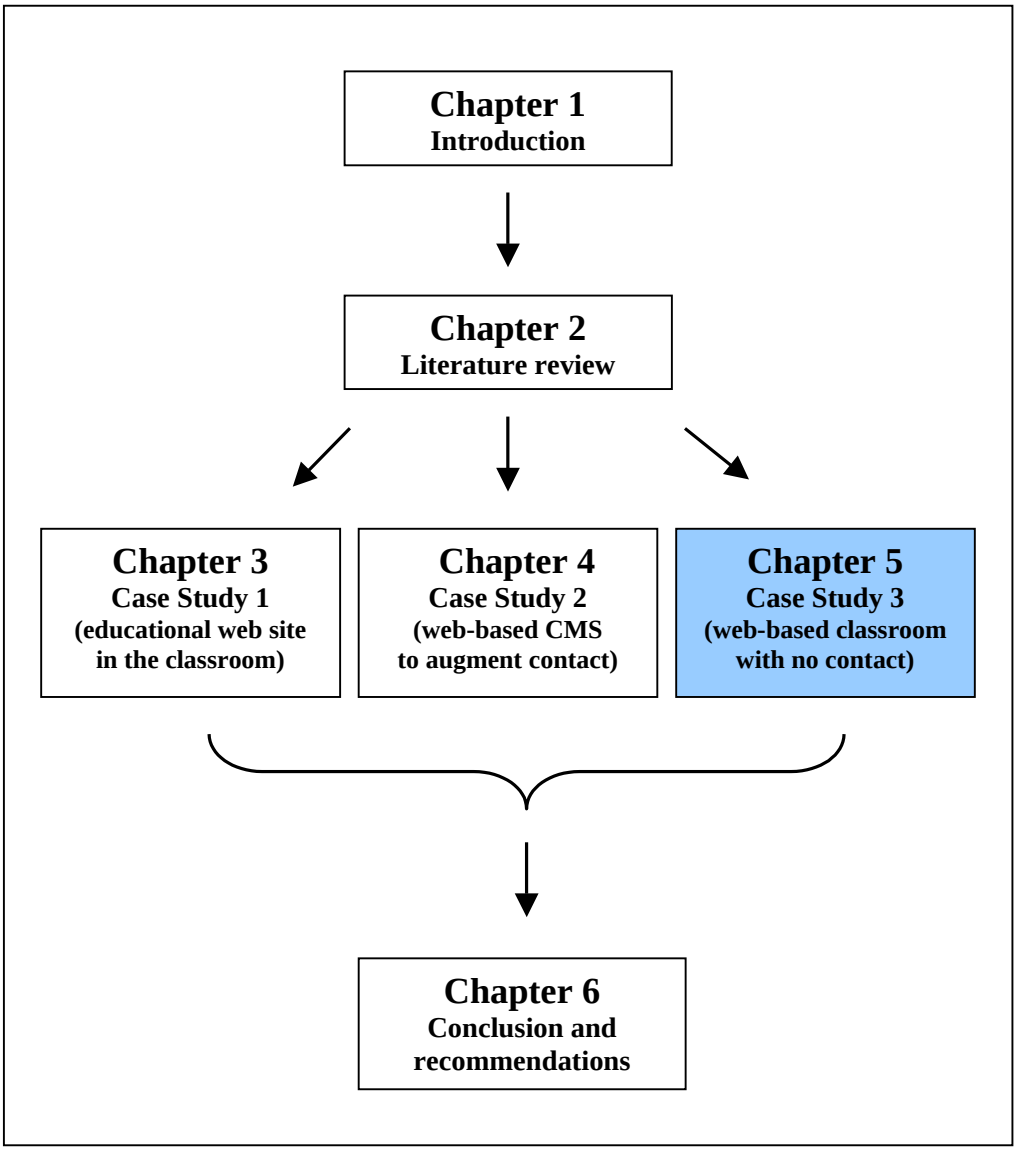
Since the investigation, additional tools and features have been added, of which the following are the main features:

- A completely **different user-interface**.
- Different **administrative** and **designer functions**.
- **My *WebCT***: Each user has an area known as their *my WebCT* area, which is accessed by typing in their Global ID and password. Within their *my WebCT* area, they can access any course listed in this area without having to log in to each course separately. Announcements and resource links are also found in the *my WebCT* area.
- The *WebCT* **Whiteboard** tool: This is a synchronous (real-time) tool. It allows learners within a course to share a common and interactive drawing board. The instructor can draw a diagram in the whiteboard that learners can modify and ask related questions about, all in real-time.
- The **Assignments** tool: This tool contains the descriptions, due dates and mark allocations for assignments that learners need to submit. The learners can submit their assignments by uploading them into the assignments tool in the course.
- The **Image Database Tool**: This database contains a database of images that learners are able to search.
- The **CD-ROM Tool**: This is a facility included in *WebCT* to avoid large multimedia files being downloaded across the Internet. Multimedia files can be cut onto CD and given to the learners, so that while browsing through their courses they can retrieve the multimedia files from a local CD rather than across the Internet.
  (Eiffel-Corp, 2000).

The addition of these tools and features, together with those features already in place, make *WebCT* a useful tool, in which an open and flexible learning environment can be fostered.

Chapter 5

Case Study 3: Investigation of a postgraduate web-based classroom



5.1 Introduction

This chapter reports on the final case study, namely, the investigation of a postgraduate Internet-based course that was run in 1999, taking the form of a "web-based classroom".

The research investigates the Internet-based delivery of a master's level course, on the subject of Internet-based learning. The course had initially required postgraduate/adult learners (henceforth referred to as learners) to travel to the University of Pretoria from their various home regions, spread across South Africa, for face-to-face interaction and contact time. From 1997 onwards, the course was presented solely by means of a "web-based classroom", giving learners the opportunity to enrol for a course that was both computer-delivered and accessible country-wide via Internet and e-mail links.

The goal of this chapter is to investigate the overall usefulness of a course run entirely on the Web, and to investigate the response of two types of adult learners, namely those taking the course as a formal postgraduate course, and those taking it informally in a continuing-education context.

The case study commences by listing the relevant research questions, followed by a literature review and an outline of the learning context (international, national and institutional), within which Internet-based learning is situated in South Africa. This is followed by the research methods used to conduct the research, an outline of the study, the results and, finally, a summary and recommendations.

5.2 Research questions

The researcher set to answer the research questions listed in Table 5.1 and assess whether there was a difference in the responses of formal and informal learners to a course run entirely on the Web. These questions are asked and responses measured under the four main aspects covered in this dissertation, namely: andragogical, affective/emotional, communicative and technological (see Table 5.1).

Table 5.1 Subquestions relating to aspects under investigation in Case Study 3

	Aspects	Research subquestions
Case Study 3	Andragogical	▪ To what extent was the course, with no face-to-face contact, effective in supporting the needs and learning of postgraduate learners? ▪ To what extent can collaborative learning be effectively stimulated on the Internet?
	Affective/emotional	▪ What emotions, likes and dislikes do postgraduates learners experience in a fully online course?
	Communicative	▪ How effective was the design of the web-based material in facilitating learning? ▪ What features characterised the human-human interaction?
	Technological	▪ What technological problems are encountered in a fully online course?

5.3 Literature review

The study explores the usefulness of a web-based classroom for adult learners in a formal postgraduate course, as well as for adults taking the course informally in a continuing-education context. The web-based classroom ran entirely on the Web, placing it at the highest level of Harmon and Jones's (1999) levels of web use, i.e. immersive use of the Web (see Chapter Two, Table 2.1).

A web-based classroom is sometimes known as a "virtual classroom", however the latter term is copyrighted by the New Jersey Institute of Technology (NJIT) (Hiltz and Wellman, 1997). Therefore, for the purposes of this research, the term "web-based classroom" will be used.

Clarke (1998) defines a web-based classroom as a computer-accessible, online learning environment attached to the WWW, which delivers material to adult learners at locations other than the course delivery centre, and which simulates aspects of a physical environment.

According to the NJIT, a virtual classroom is an electronic information exchange system, with specialised software that supports collaborative learning, where members can exchange information, provide and receive support, and develop a sense of belonging (Hiltz and Wellman, 1997).

For the purpose of this dissertation, these definitions are integrated to define a web-based classroom as an online learning environment attached to the Web, which supports collaboration between learners through Computer-Mediated Communication (CMC), within the context of constructivist learning. It delivers material to adult learners at locations other than the course delivery centre and simulates aspects of a physical environment.

Web-based classrooms, supplemented by telecommunications media, are currently being used in tertiary institutions worldwide, offering web-based courses for adult learners who work full-time but seek further education (Gunawardena, 1999; McMahon, 1997; Owston, 1997). Tertiary education faculties, matric teachers and business trainers alike are turning to the World Wide Web as a vehicle for implementing instructional innovations (Khan, 1997; Owstan, 1997; Shaw and Polovina, 1999). Miller and Miller (1999) believe that the avalanche of web-based courses in higher education have been fuelled by the following:

- The widespread availability of, and access to, the Internet;
- a learner population that is increasingly non-traditional; and
- occupational factors that require worker re-education.

Many adult learners attempt to achieve their goal of further education via distance learning options (Chyung, 1999). Although there have been many success stories relating to web-based classrooms, learners and academic staff who operate in this environment may nevertheless encounter barriers to success that do not exist in the traditional face-to-face classroom.

Some of these barriers include characteristics of adult learners themselves, teaching strategies that allow success in other environments but do not translate to success in the online world, and the barriers created by the technology itself and the ways that learners and educators use it (Hillesheim, 1998).

Adult learners are more likely to have insecurities about learning (Knapper, 1988) as a result of financial, family and work-related barriers; lack of experience and training, particularly with reference to technical issues; feelings of alienation and isolation; as well as a lack of support from family and friends, employees, colleagues and teachers (Galusha, 1998). These pressures can result in high drop-out rates. With regard to family and work-related barriers, a professor who enrolled for a web-based course, but who dropped out due to a busy schedule, made the following confession:

> *The things that made me a dropout are the same things that make the Web so compelling. The beauty of "anywhere, anytime, wherever you want," too readily turns into not now, maybe later, and often not at all. Lacking a dynamic instructor, powerful incentives, links to the job and fixed schedules, web learning is at a dramatic disadvantage in capturing and holding attention. In my pyjamas, near computer, phone, refrigerator, cats and pals, it was just too easy to do everything except my Web class* (Rossett, 2000).

Moore and Kearsley (1996) also view retention as a significant challenge associated with distance education. Historically, drop-out rates have ranged from 30 to 50 percent (Hill and Raven, 2000). Chyung (1999) gives three possible reasons why adult learners may drop out, correlating with the four factors in Keller's ARCS model, namely attention, relevance, confidence and satisfaction, and which influence the degree of learners' motivation to learn (Keller and Kopp, 1987). These reasons are given below:

- Learners lose their motivation to learn and quit learning when they do not perceive the instruction as interesting or relevant to their goal;
- they lose motivation when they are not confident of learning processes; and/or
- when they are not satisfied with the instructional processes.

On the other hand, the Internet is claimed to be one of the most powerful tools for providing lecturers and learners with necessary conditions for independent and interactive learning (Le, 1999). It provides a platform for an educational discourse in which learners can interact widely with other members of a learning community and, simultaneously, be in control of their own learning. Their interaction for learning can be immediate, prompt, widely shared and resource-supportive (Owston, 1997), which may not be possible in a traditional mode of teaching, confined by the classroom's physical condition (Le, 1999). Miller and Miller (1999) assert that collaboration occurs when learners:

- Communicate their understanding;
- listen to the views of others;
- explore alternative perspectives;
- are challenged in their beliefs; and
- challenge others.

Communication of this nature requires reflection and introspection for learners to make sense of their experiences. Engagement in real-world or authentic tasks provides a context within which learners construct meaning from their experiences. In order to engage learners in meaningful instruction, it is vital that the characteristics of adult learners be considered, as discussed in Chapter Two, section 2.3.3.

In constructivist learning environments, the predominant communication configuration is that of learners-to-learners. The instructor's role in communicating to learners (one-to-one/one-to-many) is not to dispense knowledge, but to coach or model meaning-making (Jonassen and Reeves, 1996).

Literature suggests that web-based classrooms have the potential to be extremely effective, especially in the way they can be used to support collaboration. It is, however, necessary to test whether the benefits are indeed what literature claim them to be. Hence the need to conduct evaluations on different groups of learners, formal and informal alike, making use of this powerful new medium (Reeves, 2000).

5.4 Context

In this section the international, national and institutional context of web-based adult learning will be discussed, and a description of the target population will be given.

5.4.1 International context

A paradigm shift is currently taking place, from an industrial-based society to a knowledge-based society (Marchionini, 1999). This shift tilts the balance of what is valued in current work and society. Consequently, this changes what is needed to prepare for life and work in society (Trilling and Hood, 1999). Trilling and Hood (1999) believe that the purpose of education - cultivating knowledge and skills - becomes the centerpiece of the age. Recent years have seen tremendous growth in the number of web-based courses globally, of which a significant proportion is provided, not by traditional academic institutions, but by online profit-making organisations (Shaw and Polovina, 1999). As a result, universities can no longer rely solely on their earlier advantage of exclusive access to the resources for assisting learners to gain a higher education qualification (Shaw and Polovina, 1999). While the threat is not immediate, early action to seek a competitive stance in the market is imperative. There is thus an urgent need to evaluate the usefulness of existing web-based courses to examine how and where the Web can be put to the best use in differing situations in adult education.

5.4.2 National context

South African universities have been called upon to make significant changes to their curricula and teaching methods. The Department of Higher Education has adopted an Outcomes-Based approach to education, the quality of which is assured by SAQA (South Africa, 1997b). OBE focuses on learner-centred education, aligned with the constructivist principle that the learner must construct meaning (Virtual Campus, 1998b).

5.4.3 Institutional context and target population

The target population of this study consists of adult learners taking the course on both a formal and informal basis. In 1999, only a small number of MEd learners registered for the course. Such a small number of learners would mean very little interaction on a mailing list – making it difficult to create a feeling of community. To increase the numbers, the instructor admitted learners who were not formally registered for the MEd degree. Table 5.2 presents an overview of the characteristics of both these groups of learners.

Table 5.2 Description of the learners participating in the web-based classroom

Characteristic		Formal learners	Informal learners
Number of learners registered for the *RBO* course.		7	15
Gender	Male	3	6
	Female	4	9
Employment status	Full-time employment	6	15
	Part-time employment	1	
Learner status		6 registered MEd learners 1 registered for MA (Information Science).	15 enrolled for non-degree purposes.
Age range		From early twenties to mid-fifties	From mid-thirties to mid-fifties
Previous contact		All, except one, had worked together on projects the previous year.	Most had not met face-to-face.
Intellectual/academic ability of the registered *RBO* learners in terms of how homogenous or mixed they were.		Reasonably homogenous	Very diverse
Levels of: ▪ Computer literacy/experience		Reasonably homogenous	Very diverse
▪ Internet, web literacy/experience		Extensive background to a basic background.	Extensive background to no background.
▪ Motivational levels		Poorly to moderately motivated learners	Moderately to highly motivated learners
Location of learners		Highly dispersed	Highly dispersed

When investigating the current performance of learners, it was found that their prior knowledge of the Internet was either extensive, basic or non-existent. Internet skills of the informal learners ranged from inadequate to a high level of experience or skills, able to move at a rapid pace. The formal learners were generally at a similar level of expertise.

Table 5.2 indicates that a large number of learners on the course (i.e. 15 of the 23) were not following the formal masters course. These learners are referred to as "informal learners". They were not the instructor's typical learners but were admitted to the course since there were only a few official enrolments. Seven of these learners were studying in a continuing-education context. Three had taken the course in the past and two were guest-students, having been invited to the course by the instructor. A further three were from Rhodes University, intending to do a University of Pretoria course as a credit towards their Rhodes University degrees. The different groups admitted to the course are discussed below.

Observers

The learners who had previously taken the course had provided the instructor with such useful hints for future improvements that he asked them to continue with the course in 1999 as observers, to see if it had improved/deteriorated. The instructor selected them more for the value they could add to the course than for the value they could derive from it. The choice was theirs whether or not to participate in the discussion.

Guests

The two guests were the Webmaster of the University of Pretoria and a friend of one of observers. The Webmaster was invited to take the course to see the joys and frustrations experienced by instructors and learners on the Web. In addition, she wanted to find out for herself the requirements of learners and staff for web-based courses and she remained in the background to correct any problems that might arise during the course.

The other guest was an expert in the field of Multimedia Interactive Computer-Assisted Education, and the instructor invited her so that she could experience participation in an online course at first hand.

Learners from Rhodes University

Taking the course was a group of learners from Rhodes University. Their instructor was investigating to what extent universities could collaborate by presenting joint courses. In fact the collaboration turned out to be unsuccessful, possibly owing to different standards of expertise at the entry level.

Motivation

Seeing that this study investigates affective/emotional aspects, it seems fitting to examine what motivated learners to take the course.

At the outset of the course, learners were asked to explain their reasons for taking the course. These were examined and it was found that initially, the informal learners seemed to have a higher interest level in the course and were more motivated than the formal learners. The informal learners were interested in doing the course to learn more about teaching, learning and communicating on the Web and the Internet, so that they, themselves, would be able to use it for educational purposes, or to enhance their existing usage. This is evident in the following quotes extracted:

> *I hope to fill in enormous gaps in my knowledge of educational theory and practise and have it on good advice that this is the course to do! I also think it is important to have experienced an online learning environment before one can adequately address some of the problems that students may face. So I hope to put myself through an already tested "ring of fire" before subjecting anyone else to it.*

> *I would like to learn about distance teaching on the Internet and how the Internet will influence "the classroom without walls".*

> *I would like to know how the experience I have gained over many years as an adult educator translates into Internet-based education, and I think an excellent way to learn that is to experience an online course myself. I am excited about the possibility of creating innovative learning experiences on the Internet.*

The formal learners, on the other hand, were doing it because of career opportunities, or as one of their nine modules. This is evident in the following quotes extracted:

> *Between two evils I always pick the one I've never tried before. They say the medium is largely race-neutral, location-neutral, status-neutral, age-neutral, personal, friendly and inclusive.*

> *I'm doing this course because I don't want to be a teacher for the rest of my life.*

I have a school to drag into the 21ST century.

Curiosity about the hidden (for me) inside story of Telematic Education and as the sixth of nine modules for the MEd (IT).

5.5 Method

This research has both a non-experimental survey design, as well as a qualitative ethnographic design (McMillan and Schumacher, 1993). The research is primarily a qualitative study, but quantitative measures were taken to triangulate the data. A questionnaire, which is shown in Appendix D, was completed by the learners. Qualitative measures were used in the questionnaire (where open-ended questions were used), participant observation and the interview with the instructor. Quantitative measures were taken in the questionnaire sent to all the learners after completing the course (where Likert scaling was used), as well as an analysis of messages sent to the discussion list and bulletin board. Multiple research methods were used to validate the results generated from the questionnnaire, i.e. triangulation was applied.

In total, three questionnaires were sent to learners taking the course. Two were sent by the instructor himself during the duration of the course, and the third was sent by the researcher, after learners completed the course. The end-of-course questionnaire was completed by seven formal learners and six informal learners, for the purpose of learner- evaluation, so as to gain information on its overall usefulness.

The researcher interviewed the instructor to obtain his insights and in-depth understanding of the course. The final method was participant observation, in which the researcher was an actual participant in the web-based classroom and was therefore in an ideal position to observe the events that took place within the classroom, and able to gain essential information on the dynamics between the two groups of learners within the class.

5.6 Course outline

In this section the background, objectives, components and the instructional strategy of the course are described and discussed.

5.6.1 Background

*RBO*880 (hereafter referred to as *RBO*) is the computer code for the course Internet-based learning. The course is studied in the second year of the part-time two-year Master of Education (MEd.) degree programme in Computer-Integrated Education (CIE) at the University of Pretoria, South Africa. The degree programme consists of five compulsory modules and a selection of four electives from a possible eight, followed by a dissertation. The *RBO* course is one such elective. In 1999 the course was presented in the first semester, from the beginning of February to the end of April, and this particular presentation is the one evaluated in this case study.

RBO was initially offered in 1993 as a self-study literature module with no Internet connectivity. Subsequently, it incorporated increasing use of e-mail and Web access with each succeeding year, plus some face-to-face contact time. In 1997 the course changed to an Internet-based presentation, for the following reasons:

- It facilitated delivery of material across a distance, including graphics and tables;
- it accommodated distance learners by obviating the need for trips to Pretoria;
- it provided opportunities to participate in long-term projects, unconstrained by limited contact time, as had occurred in earlier courses; and
- it provided a platform to display learners' projects, as well as course material.

The fundamental goal of *RBO* is to contribute towards achieving the goals of the MEd (CIE). One of the goals of the MEd is to produce consultants in the field of Computer-Integrated Education (CIE). Within this context the specific goal of *RBO* **is to provide consultants in the CIE field, with the necessary skills to consult in Internet-based learning**.

5.6.2 Outcomes of the course

Learners were required to achieve the following outcomes:

- Competently use various Internet tools and have a sharpened Internet literacy.
- Learn about usage of the Internet and the Web in education, whilst actually using the Internet and the Web.
- Develop the ability to work collaboratively with other learners, at a distance.
- Be able to build their own constructivist learning environment using the Internet and the Web.
- Possess the theoretical and practical know-how to use CMC for managing and facilitating technology-based learning.
- Realise the complexity of the Internet and the Web, and the associated difficulties with them.

Achieving these outcomes would give learners a unique meta-learning experience, that is, teaching "teaching on the Internet" on the Internet (Cronjé and Clark, 1999). The course content was divided into two aspects – educational aspects and physical aspects. Educational aspects covered such themes as:

- Network-based learning;
- aspects of distance learning and the Internet; and
- management of network-based learning.

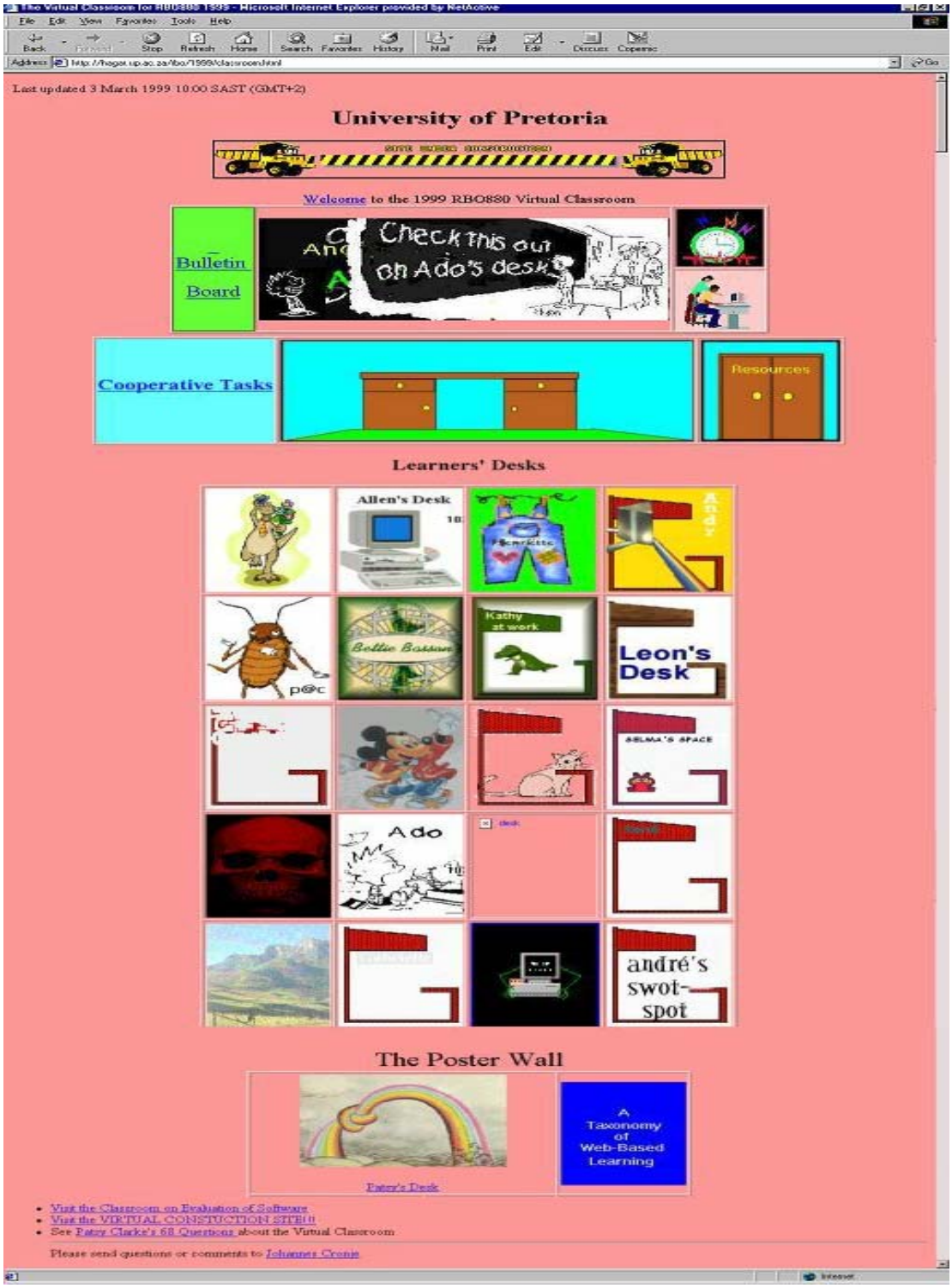
Physical aspects were concerned with the practical competencies learners should display with the following technologies: e-mail, discussion lists, chat groups, FTP, zipping and news groups. Learners also had to find their own free web space and write elementary Hypertext Markup Language (HTML).

5.6.3 Components of the web-based classroom

The web-based classroom had two components: the web site and the discussion list. The web site used the metaphor of a real physical classroom to motivate learners and place them within a familiar environment, while the discussion list was set up to facilitate interaction and communication among the learners in the course.

The web-based classroom can be viewed at: http://hagar.up.ac.za/RBO/1999/classroom.html. The classroom was divided into four sections, namely the blackboard and notice board, instructor's desk and resource cupboard, poster wall and the space for learners' desks (Cronjé, 1999). Figure 5.2 presents a printout of the opening screen, where the different sections can be seen. The discussion that follows indicates how the instructor used each section.

Figure 5.1 Opening screen of the web-based classroom



1. *Blackboard, notice board and bulletin board*

   The blackboard was a graphic file which learners could access and edit, making it the equivalent of graffiti one would find in a physical classroom. Clicking on the blackboard gave comprehensive online study guides. Clicking on the notice board revealed the timetable and tasks, similar to the situation that would be found in a physical classroom. Clicking on the bulletin board took learners to an additional communications tool the instructor added to the course. Figure 5.2 gives an extract of this tool. Used in the way that the instructor used it, this tool proved remarkably effective, namely:

   - For posting learning tasks, and then referring learners to it;
   - for posting follow-ups on different topics/assignments and for threaded discussions; and
   - as a backup for static information.

2. *Instructor's desk and resource cupboard*

   The instructor's desk was linked to his home page, with his curriculum vitae and links of general interest. To the left of his desk was a link to the collaborative tasks and to the right, the resource cupboard, which offered links to subject matter and web site construction programs, such as graphic tools and HTML editors.

3. *Poster wall*

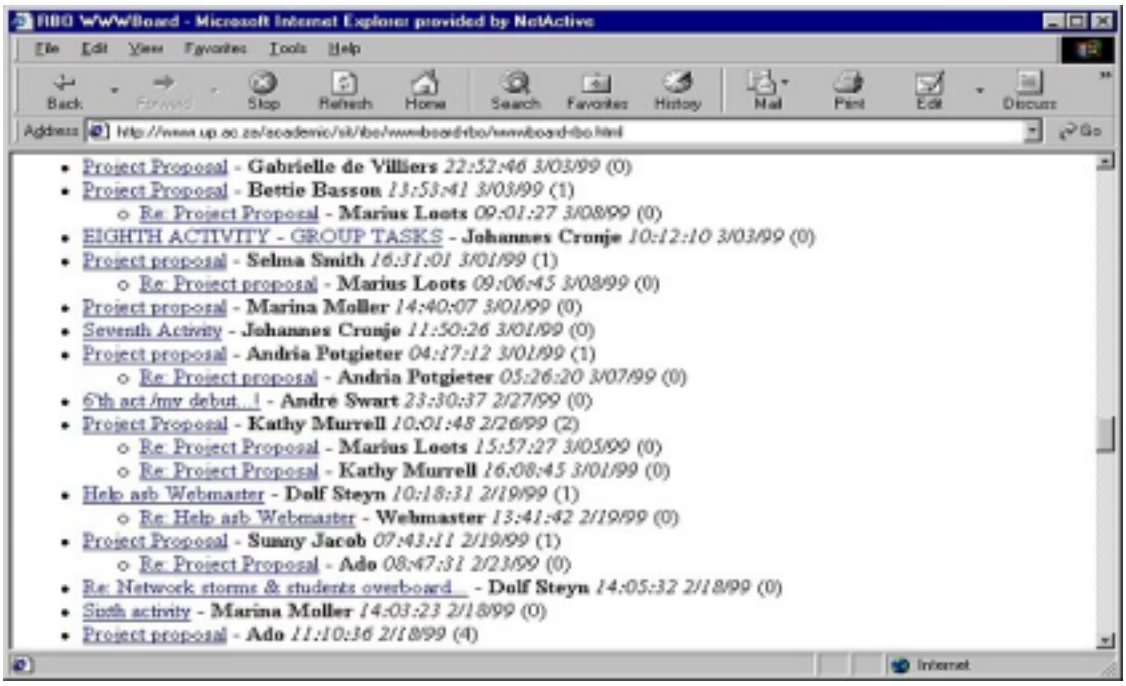
   The poster wall had links to projects by learners from previous years, as well as to the collaborative "posters" created by the learners as the course progressed.

4. *Space for the learners desks*

   Each learner was assigned a directory that was linked to a desk graphic. The learner had to replace this graphic with a personalised one and manipulate it in any way they like. They then had to "fill the desk" with things typically found in a school desk:

   > Your ears (Mailto: ...)
   > Your utility bag (Links to handy stuff such as HTML editors, Search Engines, Clipart libraries, etc.)
   > Your textbooks (Links to useful sites)
   > Your work (Interesting stuff you have done in other MEd modules)
   > Your hobbies (Personal info and/or links to sites of special interest to you)
   > Your class work (Your answers to all the objectives of the course)
   > Your portfolio (A link to the portfolio of your examination project)(*RBO*880 Curriculum, 1999).

Figure 5.2 Extract from the bulletin board



5.6.4 Instructional strategy

The learning theory on which *RBO* is founded is constructivist, constructionist (Papert, 1993) and collaborative. Constructivism is based on learners actively constructing their own knowledge (Tam, 2000). Collaborative learning emphasises group or co-operative efforts among academic staff and learners, and stresses active participation and interaction on the part of both learners and instructors. Knowledge is viewed as a social construct and therefore the educational process is facilitated by social interaction in an environment that facilitates peer interaction, evaluation and collaboration (Hiltz, 1995).

In the *RBO* course, learners are required not only to construct their own meaning but also to construct individual and collaborative web pages around certain real-world situations and problems. In constructing their own web pages, in the form of a hypertext knowledge base, learners are required to use higher order thinking skills (HOTS). In this way, the web site is used as a **construction or dumping site**, which according to Khalili and Peté (1999) is the most advanced use of the Web for learning, as it facilitates the process of learners actively constructing their own knowledge. Berenfield (1997:4, in: Khalili and Peté, 1999) states that "… virtual publishing can authenticate learning by setting students' scholarship in the real

world." The advantage of such publishing is that learners can benefit from the knowledge of other learners, due to their access to one another's contributions.

The course began with an introductory session on the bulletin board, where learners introduced themselves and gave their motivation for doing the course. Learners then worked on their desks. The collaborative period followed, where learners built "posters", working in groups of three to four on a task. The collaborative tasks met Johnson and Johnson's five prerequisites for effective collaborative learning, namely: positive interdependence, individual accountability, a mutual goal, face-to-face promotive interaction and social skills (Johnson and Johnson, 1999), as discussed in Chapter 2, Section 2.2.1.3.

Finally, learners had to submit proposals for their individual three-month, web-based projects. These had to be discussed on the bulletin board, executed and published in their own desk (see Figure 5.1).

The instructor deliberately avoided supplementing the web-based classroom with face-to-face contact, which would have been at the expense of pure distance learning. Distance learning was an inherent objective of the course – the idea being to study distance education by means of distance education. If the instructor had a face-to-face contact session, he could have got more information across to them in tangible format, that is, if he wanted it to be more behavioural, but it would have lost out on constructivism. The following quote indicates what the instructor set out to achieve.

> *I wanted them to experience what it feels like when they are actually at a distance without contact. In fact, when some things don't work, that's also OK, because then they also learn how NOT to do things* (Cronjé, 2000b).

The *RBO* web-based classroom was therefore the means by which learners would actively learn and collaborate via the Internet and the Web and, in the process, experience the different aspects of Internet-based learning, and its benefits and pitfalls alike.

5.7 Results

This section describes the findings that emerged and attempts to answer the research questions. These questions are divided into four aspects relating to the usefulness of Internet-based learning, namely: andragogical, affective/emotional, communicative and technological aspects, and are discussed in turn in the sections that follow.

Percentages were computed for all these questions on a four point Likert scale which ranged from (1) strongly agree, (2) agree, (3) disagree, to (4) strongly disagree. For the purposes of analysis, however, categories one and two are combined under the label "agree", as are categories three and four, under the label "disagree". A table with subquestions is given for each aspect. These tables give a list of the subquestions, with percentages for the two groups (i.e. the formal learners and the informal learners). The final column (Δ) in these tables represents the difference between the two groups, that is:

Δ = formal learners value – informal learners value.

The difference between the responses of the two groups is also depicted in figures below certain tables. The end-of-course questionnaire was completed by seven learners from the group of formal learners and six learners from the group of informal learners (fifteen questionnaires were sent out to the informal learners and six were returned). The numbers in brackets within the tables, reflect the number of respondents. These results are tentative, seeing that a small sample size was used.

5.7.1 Andragogical aspects

In this section, the extent to which the course was effective in supporting the needs and learning of learners is discussed, as well as the extent to which collaborative learning can be effectively stimulated on the Internet.

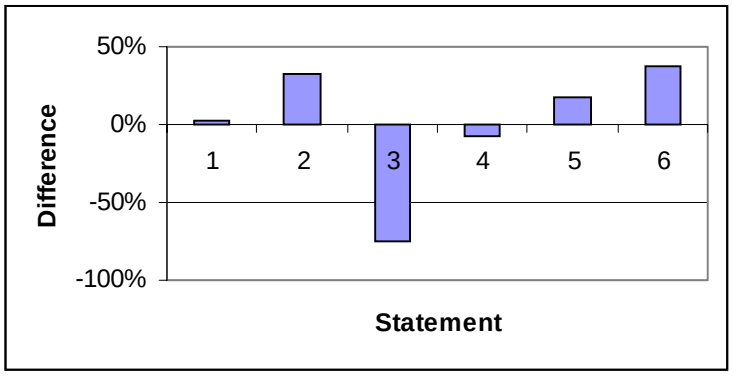
5.7.1.1 To what extent was the course, with no face-to-face contact, effective in supporting the needs and learning of postgraduate learners?

Table 5.3 and Figure 5.3 depict the differences and similarities in learners' response to various statements regarding the extent to which the course was effective in supporting the needs and learning of adult learners. Notable differences in the response of the two groups are depicted in Figure 5.3, the most notable being the negative response of the formal learners with regard to the feedback and assessment they received from the instructor.

Table 5.3 Andragogical aspects

Statement		Group	Agree	Disagree	Δ
1.	The course adequately guided, facilitated and enhanced my learning.	Formal learners	86% (6)	14% (1)	3%
		Informal learners	83% (5)	73% (1)	
2.	The course met my needs as an adult learner, i.e. relevant, self-directed, self-paced, flexible, hands-on, etc.	Formal learners	100% (7)	0%	33%
		Informal learners	67% (4)	33% (2)	
3.	The course supplied feedback to and assessment of our various tasks.	Formal learners	0% (0)	100% (4)	-75%
		Informal learners	75% (3)	25% (1)	
4.	The course facilitated collaborative tasks between learners.	Formal learners	57% (4)	43% (3)	-7%
		Informal learners	67% (4)	33% (2)	
5.	The course was a real learning experience.	Formal learners	100% (7)	0%	17%
		Informal learners	83% (5)	17% (1)	
6.	I experienced overload and/or anxiety.	Formal learners	71% (5)	29% (2)	38%
		Informal learners	33% (2)	67% (4)	

Figure 5.3 Areas of difference between the two groups, with regard to andragogical aspects



Nearly all of the learners in both groups agreed that the course adequately guided, facilitated and enhanced their learning (formal learners: six of the seven (86%); informal learners: five of the six - 83%). Ference and Vockell (1994) indicate that one of the needs of adult learners is to be independent and responsible for planning and directing their own learning activities. In this regard, both groups of learners commented that this worked well for them in *RBO* (formal learners: all the learners - 100%; informal learners: four of the six - 67%).

Due to the fact that these adult learners were part-time learners, and independent, five of the seven formal learners (71%) experienced overload and anxiety at some point in the course. This was mainly due to difficulty in complying with the deadlines set by the instructor. As a result, several of them completed the course several months later. It was interesting to note that only two informal learners experienced overload and/or anxiety. One commented that it was difficult to keep up to date, when it was an add-on to a large body of other commitments, while the other was anxious because some learners in the course were not communicating anymore, or were dropping out, and she suspected intimidation might have played a role.

There was a notable difference (75%) in the response of learners to the statement: "The course supplied feedback to and assessment of our various tasks" (see Figure 5.3). In the response to the open-ended questions, three of the seven formal learners responded that they wanted feedback to know if they were on the right track, in contrast to only one of the informal learners, who indicated that he would have liked more feedback. The difference in the response of the two groups could be due to the fact that the formal learners were accustomed to frequent tests and quick turnaround time, within a highly structured conventional learning paradigm. Within this background they all noticed the lack of direct feedback in *RBO*. The informal learners, on the other hand, had lower expectations in terms of assessment and three of the four were satisfied.

Both groups of learners responded that the course facilitated collaborative tasks (formal learners: four of the seven - 57%; informal learners: four of the six - 67%). This aspect is discussed in more detail in section 5.7.1.2. These results indicate that informal learners attach more value to working collaboratively over a distance.

The majority of learners in both groups agreed with the statement that the course was a real learning experience (formal learners: all the learners - 100%; informal learners: five of the six - 83%). Three formal learners commented that one of the most important things they learnt from the course was to find out things for themselves, which indicates appreciation of the constructivist approach to the course. One of the formal learners commented that "the digital classroom created a feeling of cohesiveness - we were in this together and we had to pull through". Learners also found the course useful in their personal and professional lives. Five of the seven formal learners appreciated the

practical skills they gained from the course and commented on the impact it had had on the way they do things at work. For two of the informal learners it highlighted some of the problems of distance learning, with one learner commenting:

> *The opportunity to indulge myself in an online course was invaluable. It has given me a "students" perspective, including the problems associated with technology.*

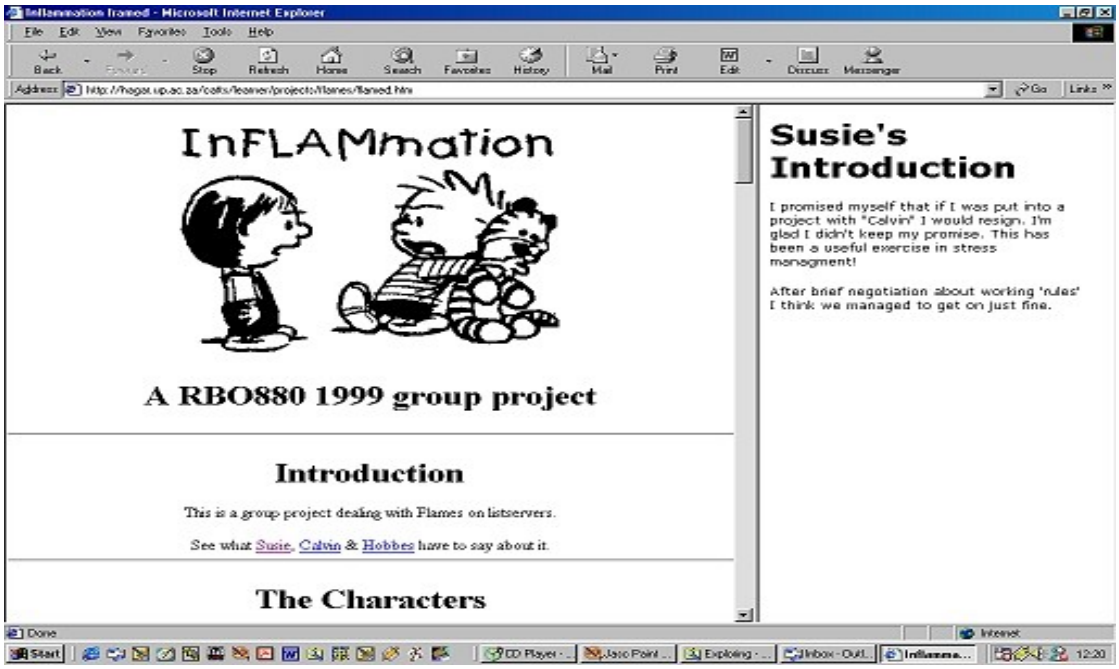
5.7.1.1 To what extent can collaborative learning be effectively stimulated on the Internet?

The Internet as a medium greatly facilitated collaborative tasks, when compared for example, with doing such tasks via conventional mail or telephone. In both groups, learners agreed that the course, without face-to-face interaction and contact time, facilitated collaborative tasks (formal learners: three of the five - 60%; informal learners: four of the six - 67%) - see Table 5.3. The collaborative tasks helped the learners to get to know each other better and reduced the social isolation associated with the use of technology. Nevertheless, two of the formal learners and one of the informal learners, respectively, would have appreciated face-to-face contact, as such contact would have helped them form impressions about the people with whom they were working.

On the whole, the collaborative group projects were effective. One group project was particularly successful in the way in which the instructor handled a difficult situation. Early on in the course a controversy arose between two participants who were both informal learners and therefore did not know each other. This supports King's (1995) statement (see Chapter 2, Section 2.2.2) that flame wars often erupt among strangers (newcomers to Internet discussion groups), and that new members of a particular group are often the source of, or the target of, inflammatory messages. The conflict continued, resulting in different reactions from the rest of the group. Some learners took sides, others remained silent. To resolve the conflict between these two learners, the instructor placed them together in a collaborative learning group. Their task was to "build a website dedicated to conflict and conflict management in virtual learning environments". One of the instructor's graduates, a calm and serene individual, was used as the intermediary to "pour oil on troubled waters". They called their task "inFLAMation" and came up with the very appropriate metaphor of Susie, Calvin and Hobbes.

Figure 5.4 presents the opening screen of their site on conflict in virtual learning environments.

Figure 5.4 Opening screen of "inFLAMation"



One member of the team played the role of Susie, the other that of Calvin, while the peacemaker took the part of Hobbes. The character of Susie is depicted in Figure 5.5, while Figure 5.6 shows Calvin's view of a flame. The perpetrator (taking the role of Calvin) was without a doubt, more blunt and uninhibited than he would have been in face-to-face contact, and very likely took liberties, taking the anonymity of cyberspace as an excuse to be rude, as King (1995) suggests.

Figure 5.5 Character of Susie

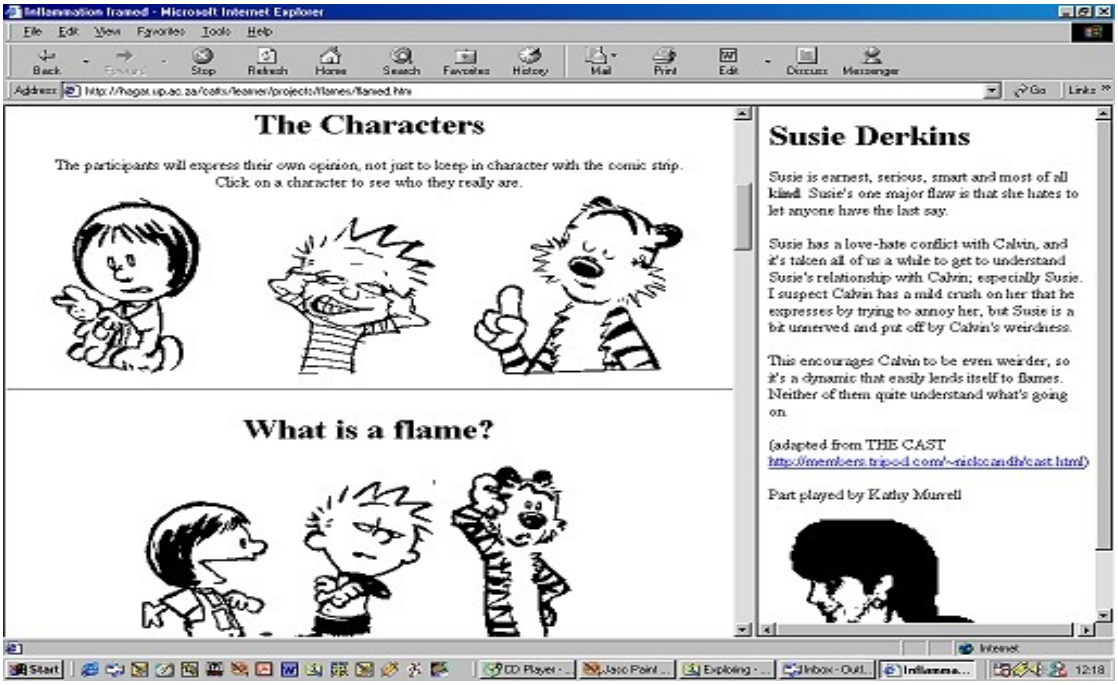
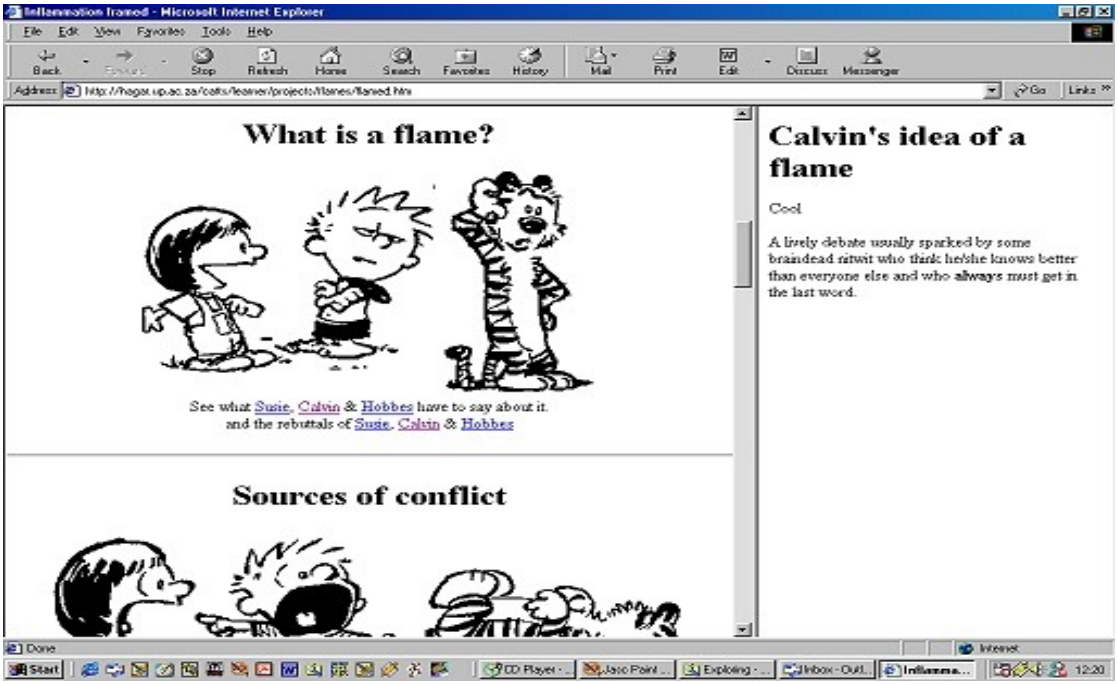


Figure 5.6 Calvin's view of a flame



One of the observers on the course commented:

> *That the facilitator's eventual solution to group the perpetuator of the 'flaming' together with a main target of his 'flames' plus one other (highly) suitable facilitative personality into one group for a project was the most brilliant solution I have observed to date. It resulted in a highly creative and successful project.*

This group project was very effective because it sorted out the conflict between these two learners. The other group tasks ranged from being ineffective to very effective. The positive factors that contributed to group tasks are discussed in Table 5.4, while negative factors that were counterproductive in group tasks are discussed in Table 5.5.

Table 5.4 Positive factors that contributed to collaborative tasks

Factors	Description
Communication	▪ The use of the discussion list, which was used by three groups to conduct their collaborative group task (learners were instructed to build various features). This communication provided the instructor and the other learners with more access and insight into the learning processes learners follow. The other groups conducted their collaborative tasks through private communication.
Participation	▪ Learners generally made suggestions, and then took the initiative, in the way of offering to do an activity, and then following through. Once they had completed this activity, they asked their group members to review it. An important part of support within certain groups, was thanking and expressing appreciation for completed work, especially if it was work done well.
Effective grouping of learners.	▪ The instructor placed all the headmasters together in one group, to build the mother of all resource sites for "The Internet in Schools", and placed the two learners who were in conflict with each other in one group. ▪ The instructor allocated a role to each learner in a group, according to their specific skills. Three primary roles allocated to learners were the architecture of the site, look and feel, and technological and authoring. This was effective, in that learners could collaboratively construct a part of the product that matched their level of skill, and at the same time, learn from each others' respective roles. This saved time and made for effective group work.
Motivation	▪ The instructor initiated a conversation on the design of one of the collaborative tasks, that is, "inFLAMation". He asked learners to express their own view, about the design of this site. Learners responded with valuable suggestions, which not only resulted in this specific group improving their final product, but also led to learners benefiting from the discussion, and applying some of the suggestions in subsequent tasks. For example, in this specific case, learners learnt how to resize frames, and factors that contribute towards effective web design.

Table 5.5 Factors that were counterproductive in collaborative tasks

Factors	Description
Medium	▪ The electronic disappearance of some learners. These were learners who had hectic schedules in the case of the formal learners, and learners who dropped out of the course in the case of the informal learners. As a result, some learners lost their partners to cyberspace, and one collaborative task in particular was not as effective as it could have been, due to learners dropping out. ▪ Two groups of formal learners met face-to-face at some point in the collaborative task. They probably decided to meet face-to-face because they knew each other, in contrast to the informal learners who did not know one another. The instructor would have preferred it if learners had kept to the objective of the course, which was that they work entirely on the Web.
Time constraints	▪ The collaborative tasks did not fit into some learners' time schedules. The idea was to allocate a certain time period to do their bit and then hand it over, but some learners exceeded their time frame. One of the formal learners felt that collaborative tasks do not work, because they all work to tight schedules and cannot wait for each other. ▪ One learner had a baby right in the middle of the course. This drastically reduced the amount of time she could spend on the collaborative group task.
Team membership	▪ Work allocation problems occurred when learners dropped out of the course. ▪ An informal learner felt at lost since she was not an MEd learner, but was in the group which had to build a museum for the MEd. She had to rely on the other learners in the group to guide her and to inform her as to what information to collect. This same learner also felt intimidation by the advanced skills of one of the formal learners in her group.
Technological problems	▪ At times, learners were unable to access the University of Pretoria's server. ▪ Some learners experienced problems with their own servers. ▪ One learner had her computer hit by a lightning conductor.

5.7.2 Affective/emotional aspects

This section examines the emotions learners experienced during the course, and what they liked and disliked about it.

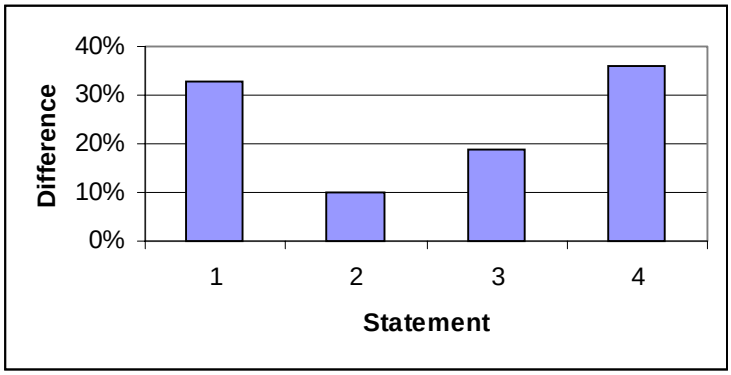
5.7.2.1 What emotions, likes and dislikes do postgraduate learners experience in a fully online course?

Table 5.6 and Figure 5.7 depict the differences and similarities in learners' response to affective/emotional aspects. The most notable difference was the negative response of the informal learners with regard to feeling a sense of community building. Otherwise, their responses to various statements are similar in nature, indicating that learners in both groups experienced similar impressions of the course.

Table 5.6 Affective/emotional aspects

Statement		Group	Agree	Disagree	Δ
1.	I felt a sense of community building.	Formal learners	50% (3)	50% (3)	33%
		Informal learners	17% (1)	83% (5)	
2.	The environment was supportive.	Formal learners	43% (3)	57% (4)	10%
		Informal learners	33% (2)	67% (4)	
3.	I found the course exciting.	Formal learners	86% (6)	14% (1)	19%
		Informal learners	67% (4)	33% (2)	
4.	The course met my expectations.	Formal learners	86% (6)	14% (1)	36%
		Informal learners	50% (3)	50% (3)	

Figure 5.7 Areas of difference between the two groups, with regard to affective/emotional aspects



Five of the six informal learners (83%) did not agree with the statement "I felt a sense of community building". Among the formal learners, only 50% (exactly half) felt this way. The differences in their responses are evident in Figure 5.7. In addition, four of the seven formal learners (57%), and four of the six informal learners (67%), did not experience the environment as supportive.

The reason behind this unusually negative response in the informal group was that early in the course a controversy had arisen between two learners, when one misinterpreted the other's sense of humour. The humour was subtle, but was perceived by the other learner as harsh, biting and humiliating (Cronjé, 2001). The instructor deliberately did not intervene, so as to see what would become of the situation and whether or not other learners would react. One of the formal MEd learners did step in, but failed to resolve the conflict, because he too misinterpreted this learner's sense of humour. The conflict continued for some time and

when the instructor did decide to intervene, he was unable to do so due to network problems (Cronjé, 2001). Eventually, the instructor suspended the course for two weeks in order to:

- Calm the angry learners;
- sort out the technological problems; and
- allow the slower learners to catch up.

The conflict affected the self-esteem of two learners in each group, i.e. the group of formal learners and informal learners. However, in response to an open-ended question, the informal learners indicated that they appreciated the experience and came out stronger as a result. The following quotes depict certain learners' responses to the conflict, with the bracket behind the quote indicating the learner's group.

> *I learnt that group identity is not merely an issue of people seemingly working towards similar goals, and that one person (or a clash of personalities between two people) could sabotage the whole process* (informal learner).

> *I questioned myself in relation to interactions with other people, and realised that I had taken for granted the rapport I have developed with colleagues in a face-to-face environment. This is an important learning curve for online learning so the experience is appreciated* (informal learner).

> *I did not have a nice experience with the group of people* (formal learner).

However, although learners gave negative ratings for community building and a supportive environment, they nevertheless still found the course exciting, especially the formal learners (formal learners: six of the seven - 86%; informal learners: four of the six - 67%).

Attention will now be devoted to what learners liked and disliked about the course.

Learners' likes

Both groups of learners had clear likes, as evidenced by the quotes:

- The innovative and creative tasks:
  I liked the creative tasks, because you can do almost anything with them.
- Exploring other learners' creativity and their advanced technological skills:
  I have liked the amazing, incredible creativity of my fellow students.
- The support learners give each other:
  It is really awesome seeing other learners help each other with their problems so willingly and quickly.
- The uniqueness of the medium:
  I have enjoyed the uniqueness of the medium.
- The discussions:
  I've liked the correspondence, although I was only lurking and *the way in which the medium has allowed personalities to reveal themselves and express emotion, although most of this has been from the ones with very advanced technological skills.*

Learners' dislikes

Learners experienced certain dislikes, which are elaborated on below.

- Five of the seven formal learners experienced difficulty in complying with deadlines. As a result, some learners took lengthy periods to post their work, because for many it was an add-on to a large number of other commitments. Some of these learners completed their tasks months later.
- One of the informal learners found the "slow pace of the course very frustrating", while another learner in the same group found the course "a bit fast for a working person". One of the formal learners and two of the informal learners, commented that they felt the course was rushed, and suggested that the instructor should give learners more time to do the fun tasks.

- In both groups of learners, two learners were radically affected by the conflict that took place on the discussion list. This is evident in the following quote from one of the informal learners.

> *I do think that two of us dominated the course in a way that was not constructive. I would have liked a more supportive environment, which I think was curtailed by "X's" aggressive stance, even after the project on flames. I'm not sure what one can do about this, and it is bound to happen from time to time – so even this was a learning experience for me. I do know that sometimes X's barbs hit home, and it was difficult, even later on, not to rise to the bait (although I am now aware that it was bait). However, if "X" could denigrate my computer knowledge, others who had less skill must have felt totally isolated.*

Two other informal learners also commented that they felt other learners might have experienced isolation or intimidation. This, however, was not the case, as only one of the formal learners on the course felt this way.

- One formal learner, and two informal learners respectively, commented that they did not enjoy or benefit from the discussion list. This is evident in the following quotes:

> *I did not really benefit from the listserv. It seemed to be more of a waste of time than anything. I suppose it would work better with different people conversing. Participants only seemed to respond to things that either got them really angry or if they were interested enough to respond* (formal learner).

> *There was irrelevant bickering and chat on the listserv* (informal learner).

- One learner was frustrated by the high drop-out rate, as evident in the following quote:

> *The pathetic co-students who dropped out like flies. What did they expect – to be spoonfed.*

The overall attrition rate among the informal learners (excluding the observers, guests and learners from Rhodes University) was 75%. The main reasons learners gave for discontinuing the course were busy time schedules, technological problems, inadequate Internet skills and expectations not met. However, some of the learners who dropped out of the course, remained in the background, and "lurked". Further research is necessary regarding the extent to which learners do or do not benefit from lurking.

- Learners would have appreciated more feedback, especially the learners doing the course formally.
- One of the formal learners, and two of the informal learners, would have liked clearer instructions. The instructor, however, deliberately gave tasks that were somewhat vague so that learners could take ownership of their tasks and use their own initiative. Nevertheless, some learners found this disturbing.

Six of the seven learners (86%) in the group of formal learners responded that the course met their expectations. However, three of the six informal learners (50%) found it did not meet their expectations, giving the following reasons:

- Learner 1 was frustrated with the slow pace of the course, due to those who could not keep up with the others. The learner did not enjoy the medium used in the course, as evident in the following quote: "I like low-tech high-person learning experiences".
- Learner 2 already knew everything, having already designed many of his own web sites. As a result he was not motivated, nor challenged by the course.
- Learner 3 would have liked more direct information and experiences on teaching via the Web, rather than the indirect way of just experiencing it. She would also have liked the pre-requisite knowledge and competence for the course to have been more clearly spelled out, as in her experience, the course required more than a reasonable proficiency and passing familiarity with the Web.

Learners' expectations of the course correspond with that of Chyung's (1999) possible reasons why adult learners drop out of a distance learning course. Learners 2 and 3 did in fact drop-out - learner 2 because he did not perceive the instruction as interesting or relevant to his goal, while learner 3 dropped out because she was not confident about the learning processes. While learner 1 completed the course, he was not entirely satisfied with the instructional processes (see Section 5.3).

5.7.3 Communicative aspects

This section examines the effectiveness of the design of the web-based material, the features that characterised the human-human interaction, and the extent to which collaborative learning was effectively stimulated on the Internet.

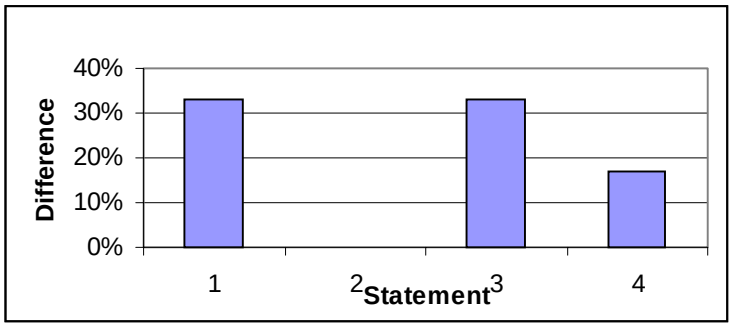
5.7.3.1 How effective was the design of the web-based material in facilitating learning?

Table 5.7 and Figure 5.8 illustrate the differences and similarities in learners' rating of the effectiveness of the design of the web-based classroom.

Table 5.7 Instructional/content interactivity

Statement		Group	Agree	Disagree	Δ
1.	The site layout and page layout was effective.	Formal learners	100% (7)	0% (0)	33%
		Informal learners	67% (4)	33% (2)	
2.	The design of the classroom motivated me to explore the site.	Formal learners	100% (7)	0% (0)	33%
		Informal learners	67% (4)	33% (2)	
3.	I could find my way around the site.	Formal learners	100% (7)	0% (0)	0%
		Informal learners	100% (6)	0% (0)	
4.	The page containing the course's objectives and expected outcomes was helpful.	Formal learners	100% (7)	0% (0)	17%
		Informal learners	83% (5)	17% (1)	

Figure 5.8 Areas of difference between the two groups, with regard to instructional/content interactivity



The informal learners were generally more critical regarding the design of the material than the formal learners, who all gave the highest rating (100%) in each of the statements, as is evident in Table 5.7. This could be a result of their exposure to sites that have been well designed, as well as their high skill level when they entered the course. Among the informal

learners, five of the six (83%) learners who completed the end-of-course questionnaire had already been exposed to the Internet and Web in teaching.

The web-based material was very successful in helping learners navigate around the site, and giving learners sufficient course information, as is evident in statements 3 and 4. In the open-ended questions, three formal learners commented that the web-based classroom was functional, one commented that the idea was good and one learner experienced it as user-friendly.

Among the informal learners, two learners found the design visually stimulating, as evidenced by the following quote:

> *The metaphor is effective. I also quite like the idea of the "unprofessional" design in the sense that graphic artists were not used to develop a slick image. This made it comfortable for learners to experiment.*

However, two learners in this group did not appreciate the design, with one learner commenting "the simulation of an actual classroom, though cute (ugly but nice), is probably not the most effective design". In both groups, learners commented that it took too long to download due to the large animations, as is evident in Figure 5.1.

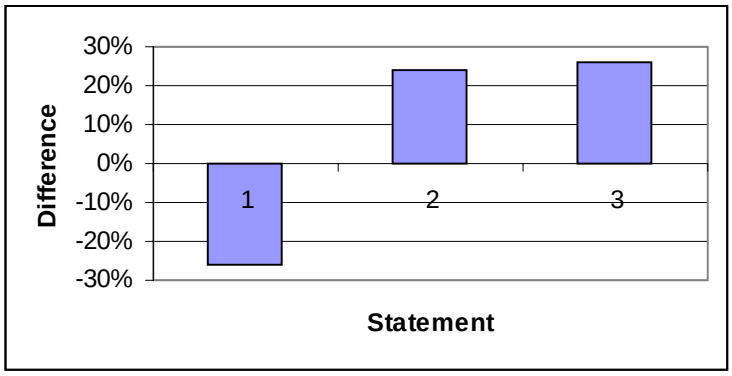
5.7.3.2 What features characterised the human-human interaction?

Table 5.8 and Figure 5.9 depict the differences and similarities in learners' response to four statements surrounding the social interactivity/human-human interaction in the course.

Table 5.8 Social interactivity

Statement		Group	Agree	Disagree	Δ
1.	The course, without face-to-face interaction and contact time, provided adequate and effective communication amongst the learners and our instructor.	Formal learners	57% (4)	43% (3)	-26%
		Informal learners	83% (5)	17% (1)	
2.	I would have preferred some face-to-face interaction, rather than just the discussion list and bulletin board.	Formal learners	57% (4)	43% (3)	24%
		Informal learners	33% (2)	67% (4)	
3.	I benefited from the electronic communication.	Formal learners	86% (6)	14% (1)	26%
		Informal learners	60% (3)	40% (2)	

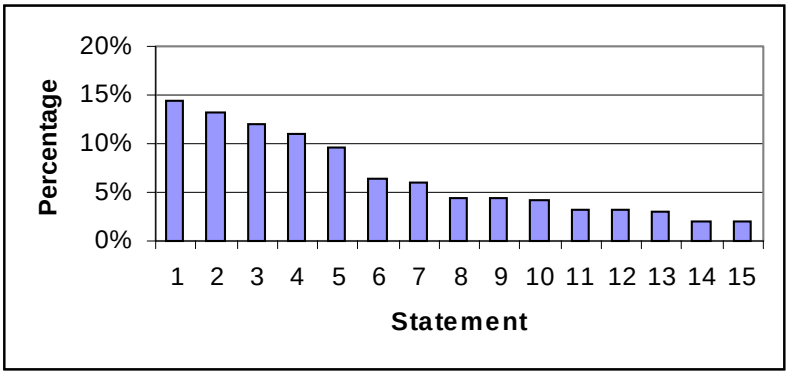
Figure 5.9 Areas of difference between the two groups, with regard to social interactivity



The informal learners were highly positive that the course provided adequate and effective communication amongst themselves and their instructor, in that five of the six learners agreed to this statement (83%). By contrast, only four of the seven formal learners (57%) agreed. This difference in response could be due to the fact that 57% of the formal learners (four of the seven) would have preferred some face-to-face interaction, rather than just the discussion list and bulletin board. The majority of the informal learners, however, were content with just the discussion list (four of the six - 67%).

Both groups of learners agreed with the statement that they benefited from the electronic communication, especially the formal learners (formal learners: six of the seven - 86%; informal learners: three of the five - 60%). This could be due to the valuable input of the informal learners into the discussion – in fact, 56% of all the messages sent to the discussion list and the bulletin board were from these learners (i.e. the guests, observers and outsiders combined). Many of these individuals (some more dominant than others) shared valuable insights and provided relevant information which they thought might be of interest to other learners. Figure 5.10 classifies all the messages sent to the discussion list and bulletin board, giving an indication of the influence had by these informal learners.

Figure 5.10 Classification of learners' communication



Key:

1. Provide information.
2. Express own view/continuing discussion.
3. Collaborative tasks
4. Answer a question/provide explanation.
5. Ask a question/request help.
6. Technology problems
7. Learners' introductions
8. Trivia
9. Thank/encourage.
10. Write own poem.
11. Initiate a discussion.
12. Humorous comment
13. Other
14. Conflict/confrontation
15. Apology

The highest number of messages were from learners' *providing information* they felt was useful, and which they wanted to share with the rest of the group, as well as learners *expressing their own views/continuing a discussion*. These individuals, as well as some of the others on the course, also offered valuable help to those who asked a question/requested help. This confirms King's (1995) third symptom of regression, namely the extraordinary generosity one sees on the Internet (see Chapter 2, Section 2.2.2).

A high percentage of messages were also based on communication relating to the *collaborative tasks*, *answering questions/providing explanation*, *asking questions/requesting help*, and *technology problems*. There were also messages based on conflict/confrontation, which had a drastic effect on some learners' impressions of the course, as has already been outlined in Section 5.7.2. A total of 481 messages were sent: 376 to the discussion list, and 105 posted to the bulletin board.

General impressions of the communication will now be given:

- Overall, learners found the bulletin board effective in the way the instructor used it. The following comment by one of formal learners indicates this:

  The bulletin board provided insight and was useful in the sense that the messages were retained, they could all be seen at once, and it was easy to make comments or follow-up comments.

  However, two of the formal learners did not like the fact that if they did not check it regularly, they would fall behind, which they found demotivating. One of these same learners also found it frustrating having to access it via the classroom, unlike the discussion list, where the message appears on one's screen immediately.

- The discussion list was effective in providing adequate and effective communication among the learners and between learners and the instructor, as the following comments suggest:

  Feeling free to learn from others definitely made me learn more and enjoy the process.

  It was wonderful to acquire new skills with other students. I really appreciated the collaborative aspect.

- There was no inhibition from some learners. One of the formal learners liked the fact that they could speak their minds freely, as the following comment suggests:

> *The most enjoyable was naturally the opinions of the experts who participated freely on the discussion list. Although my participation was minimal, I learnt a great deal, for example, that you can freely put your point of view across, even if others don't agree with you.*

However, this was even to a fault, in that the communication of one particular outsider evidenced an aggressive stance, which negatively affected the self-esteem of some learners.

- By posting their questions on the discussion list, learners observed that others were experiencing the same problems. At times, classmates responded sooner than the instructor – possibly with a better solution, and he therefore had no need to intervene. However, not all learners enjoyed their interaction, or benefited from it, as depicted in Table 5.9, and as the following comments indicate:

> *I feel that the outsiders got more attention and were more opinionated than the serious students. There were certain conversations that were completely out of place in a course like RBO* (formal learner).

> *There was too much unproductive, non-relevant bickering* (informal learner).

Table 5.9 Learners' experience of interaction

Statement	Group	A qualified positive attitude: useful, but at times frustrating	Negative attitude: Frustrating/ irrelevant	Δ
How did you experience interaction with your classmates?	Formal learners	67% (4)	33% (2)	27%
	Informal learners	40% (2)	60% (3)	

Despite the fact some learners perceived communication as frustrating/irrelevant, six of the seven formal learners (86%), and three of the five informal learners (60%) still benefited from the electronic communication, as is evident in Table 5.8.

5.7.4 Technological aspects

In this section the technological aspects that were encountered in the course will be discussed.

5.7.4.1 What technological problems are encountered in a fully online course?

Table 5.10 indicates the problems learners experienced. Some of these problems were minor, while others were major.

Table 5.10 Technological aspects

Statement		Group	Yes	No	Δ
Did you experience problems with the following:					
1.	Computer use	Formal learners	29% (2)	71% (5)	12%
		Informal learners	17% (1)	83% (5)	
2.	Software	Formal learners	29% (2)	71% (5)	12%
		Informal learners	17% (1)	83% (5)	
3.	Internet connection	Formal learners	43% (3)	57% (4)	-7%
		Informal learners	50% (3)	50% (3)	
4.	E-mail communication with the instructor/class members?	Formal learners	14% (1)	86% (6)	-19%
		Informal learners	33% (2)	67% (4)	

Minor problems

The technological problems that were encountered in both groups were very similar. Learners experienced problems with their own computers and hardware/software, as well as e-mail communication problems.

Major problems

Major technological problems were problems surrounding the Internet connection. These occurred when learners accessed the Internet connection of their own server, as well as in accessing the campus's servers, in this case the University of Pretoria server and the Hagar server. These problems were experienced among both groups of learners (formal learners: three of seven - 43%; informal learners: three of six - 50%). On occasion, learners could not access the classroom or the bulletin board, because these servers were down. As a result, some learners experienced problems when trying to FTP their work to the server, to meet the deadline. This problem was heightened when learners, primarily from academic institutions, experienced problems with their own servers as well. The access problems arose because at the time of the 1999 *RBO* course, the UP network was being upgraded, and on other occasions, maintained. A large number of messages on the discussion list also pertained to technological problems (6.5%).

The following quote from the instructor indicates the severity of the problem:

> *When I designed this module I had no idea we would be so seriously handicapped by technology. The network infrastructure has driven me to tears.*

Table 5.10 indicates that there were no stark differences in the technology problems, as experienced by the two groups of learners, and problems related to Internet connection are ones that are typically experienced in Internet-based learning. Nevertheless, to ensure effective use of the Internet, this problem must be overcome.

5.8 Summary

The responses of both groups of learners to the various aspects under investigation in this study, namely: andragogical, affective/emotional, communicative and technological aspects, were generally similar. The formal learners were generally more positive than the informal learners. This could be as a result of the diversity of the backgrounds of the informal learners. These learners did not know each other up-front, and were not familiar with each other's mannerisms. Nevertheless, both groups of learners, formal and informal alike, benefited from the course.

Both groups of learners agreed that the environment was not supportive in the sense that it did not facilitate community building. It was interesting to note that the conflict had a greater emotional effect on the informal learners. However, despite the negative emotions experienced by some learners, the learners who remained in the course learnt a great deal about group processes in the online environment and developed a sophisticated understanding of the interactive potentials, pitfalls and issues faced in online collaboration.

The main differences between the two groups lay in their response to the following:

- The course did not meet the expectations of half of the informal learners.
- The informal learners did not mind the lack of feedback.
- The majority of the informal learners did not experience overload/anxiety (67%), while 71% of the formal learners did experience overload/anxiety.
- Eighty-three per cent of the informal learners did not experience a sense of community building.
- The informal learners were more critical about the design of the web-based classroom.

Certain challenges arise from the study, namely:

- To maintain a sense of group identity throughout the course.
- To manage diversity among different kinds of learners.
- To keep interaction on discussion lists useful, preventing learners from feeling frustrated by the communication on the discussion list.
- To keep discussion lists running, and not dying out after the course is over.

This study has helped to identify some of the similarities and differences between two groups of adult learners, formal and informal alike, specifically looking at their responses, reaction and experience of a web-based classroom. It is hoped that this research will expand instructors' abilities to effectively educate and train via the Internet, so as to attain greater success in future web-based classrooms.

The conclusions and recommendations arising from this study should be applied with caution, seeing that a small sample size was used.

5.9 Recommendations

Recommendations are given for each of the different aspects under investigation in this study.

Andragogical aspects

- Monitor learners carefully, and give feedback regularly.
- Include many subdeadlines and place pressure on learners to abide by them.
- Ask learners to report on their progress or attempts/successes/failures in the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners could be experiencing problems, and learners may find that they share the same difficulties.

Affective/emotional aspects

- Strive to integrate the class at the outset of the course, through brief collaborative tasks. This would help learners get to know each other, and keep them from feeling isolated from the rest of the group.
- Encourage learners to post introductions along with their fears and expectations for the course, at the outset of the course, or, when possible, create a homepage that other learners in the group can visit.

Communicative aspects

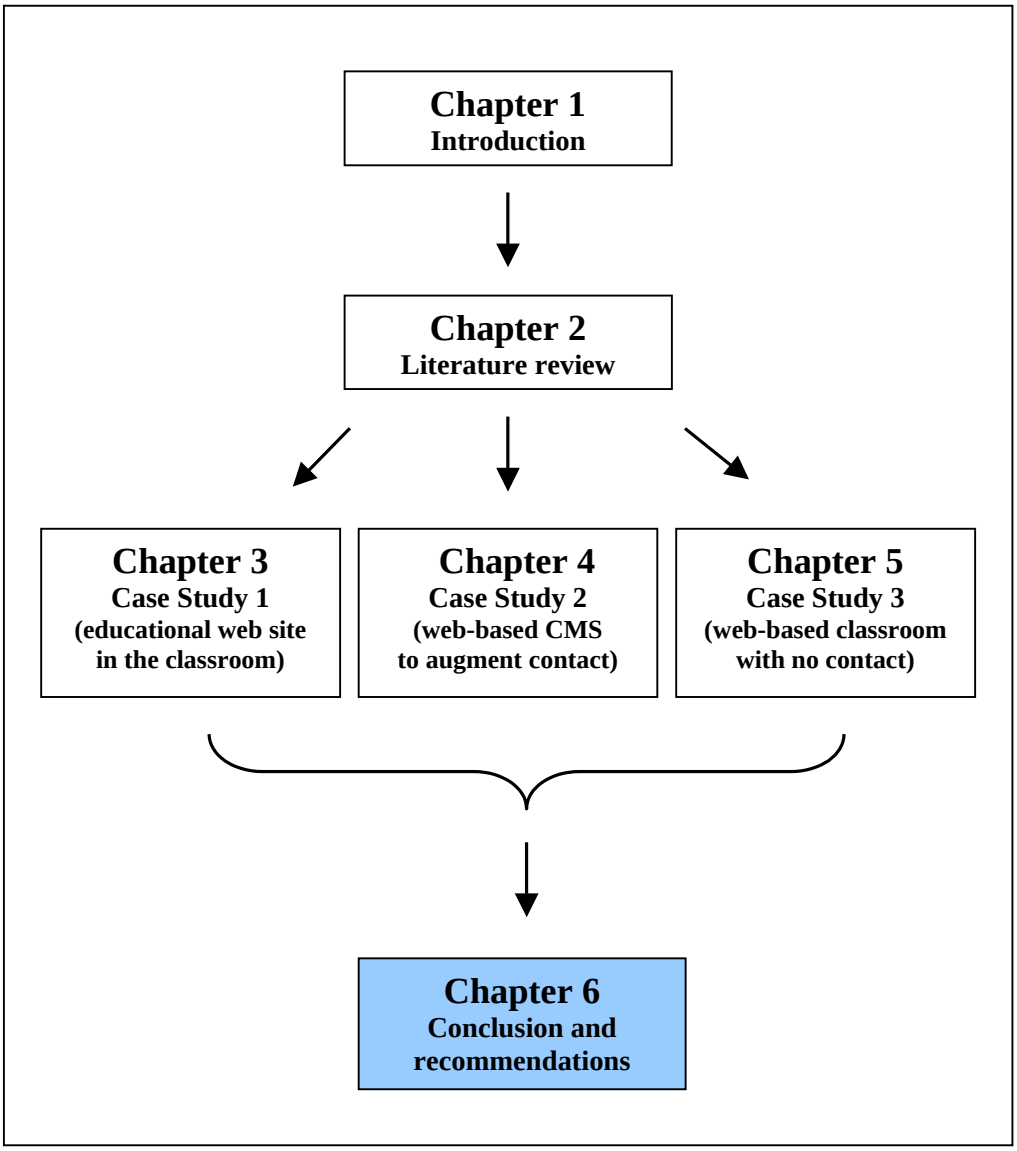
- Design learning material in such a way that it is cognitively comprehensible, that is, consistent and predictable. This would meet the needs and requirements of informal learners.
- Encourage learners to establish and agree to clear norms and guidelines at the outset of the course (Fisher *et al*, 2000) and then abide by these norms and guidelines for the duration of the course.
- Schedule inter-learner debates on controversial, but relevant topics.

Technological aspects

- Make certain that the host network and remote network are stable.

Chapter 6

Conclusions and recommendations



6.1 Introduction

In Chapter 1, Section 1.2, the problem was identified that numerous web-based technologies are currently available, yet there is no systematised structure stating which should be used for whom and how they should be used. This chapter seeks to provide such a structure and to obtain the best possible match between the characteristics of learners, web-based technologies, and teaching methods employed (i.e. contact and distance).

Chapters 3, 4 and 5 answer the subquestions relating to the three case studies. These questions covered aspects regarding the effectiveness of certain pedagogical/andragogical, affective/emotional, communicative and technological aspects. The goal of this chapter is to merge the results into one coherent whole, in an attempt to answer the major research questions (see Chapter 1, Table 1.1), conclude the study and propose recommendations for the way forward.

The chapter commences by answering each research question in turn.

6.2 What role do the aspects under investigation play in web-based technologies?

The researcher set out to answer the major research questions and assess whether or not there was a difference in the response of the different types of learners to the various aspects under investigation, namely:

- Pedagogical/andragogical;
- affective/emotional;
- communicative; and
- technological.

This section presents the findings of the research and is subdivided according to the different aspects of web-based technologies. Table 6.1 presents the target population used in each case study.

Table 6.1 Target population of learners in each case study

Case study	Target population	Generation
Case Study 1	Urban school and rural school	Millenial Generation
Case Study 2	Undergraduate Multimedia learners and postgraduate Engineering learners.	Generation X (undergraduates) and Baby Boomers (postgraduates)
Case Study 3	Formal learners and informal learners	Baby Boomers

Table 6.2 gives the principles derived from the results of the case studies in Chapters 3, 4 and 5. The principles have been placed under the different aspects under investigation in the study. The final column indicates the group of learners amongst whom the principle was found.

Table 6.2 Principles derived from the case studies

Aspect	Principle		Group
Pedagogical/ andragogical	*Children's responses to a site differ slightly, depending on their maturity level, computer and Internet skills, home language and prior knowledge.*		▪ Urban school and rural school
	Postgraduate learners take more responsibility for their learning and are more mature.		▪ Formal learners and informal learners ▪ Engineering learners
	Feedback is important to learners.		▪ All three groups of learners
	Collaborative learning can be effectively stimulated on the Internet, with no face-to-face interaction and contact time.		▪ Engineering learners ▪ Formal learners and informal learners
Affective/ emotional	Motivation	*A creative environment motivates learners.*	▪ Formal learners and informal learners
	Satisfaction	*The ways in which learners react to web-based material depends upon their background and expertise.*	▪ Urban school and rural school ▪ Multimedia learners and Engineering learners
	Frustration	*The more sophisticated and technologically advanced learners are, the more critical they become.*	▪ Urban school and rural school ▪ Multimedia learners and Engineering learners
	Conflict	*Conflict that is well managed can produce beneficial results.*	▪ Formal learners and informal learners
Communicative	Instructional/ content interactivity	*Children experience difficulty grasping all the aspects of a system that is not in their mother tongue.*	▪ Rural school
		"Techno-savvy" individuals expect sophisticated interfaces.	▪ All three groups of learners
	Social interactivity	*Undergraduate learners are reserved when it comes to communicating on a bulletin board.*	▪ Multimedia learners
		WebCT courses and fully online courses can provide the opportunity for regular, collaborative interaction with learners and the instructor.	▪ Formal learners and informal learners ▪ Engineering learners
Technological	*Time should be allocated for learners to master the technology.*		All three groups of learners
	Contingency plans are required by both instructors and learners to cope with technological failure.		All three groups of learners

These principles are elaborated on in turn, under their respective aspects, as indicated in Table 6.2.

6.2.1 Pedagogical/andragogical aspects

Principles surrounding pedagogical/andragogical aspects will now be discussed.

- **Children's responses to a site differ slightly, depending on their maturity level, computer and Internet skills, home language and prior knowledge.**

Both groups responded positively to the site and appreciated its value in their mathematical learning. However, *Plane Math* did not support the orientation and recall of prior knowledge for the rural school children, in that the site did not use objects they were familiar with. They also battled to understand some of the concepts, due to the material not being in their home language.

- **Postgraduate learners take more responsibility for their learning and are more mature.**

Ference and Vockell (1994) indicate that one of the needs of adult learners is to be independent and responsible for planning and directing their own learning activities. In this regard, both the formal and informal learners on the *RBO* course commented that this suited them. The formal learners were more committed to their studies than the informal learners who were doing the course in a continuing-education context. Although the formal learners experienced difficulty in complying with deadlines, they nevertheless persevered with the course and completed it, despite their initially low enthusiasm and their high anxiety levels during the course. The informal learners, on the other hand, withdrew early, or dropped out at a later stage, which is ironic considering their initially high enthusiasm and lack of anxiety.

The Engineering learners also took responsibility for their own learning. The results indicate that the Engineering learners were indeed task-centred and analytical, more value-driven and used *WebCT* to solve problems on hand.

- **Feedback is important to learners.**

With regard to the *WebCT* courses, the Engineering learners were generally satisfied with their feedback. They were, however, disappointed with two of their instructors who did not use the bulletin board at all.

The Multimedia learners were also not entirely satisfied with their feedback. Some of the learners had specific problems with the quality of feedback they received from their instructor, expressing concern that their instructor was over-reliant on technology and that his messages were vague.

Table 6.3 gives the feedback each group received and expected from their respective courses.

Table 6.3 Feedback each group received and expected

Group	Feedback received	Nature of feedback expected
Children	Children received system-generated feedback from the *Plane Math* site, as they progressed through the lessons.	In addition to feedback from the system, children appreciate the physical presence of a teacher.
Undergraduates	The *Multimedia* instructor provided e-mail feedback, which was constructivist in that he encouraged learners to think for themselves.	The undergraduate learners expected in-depth feedback and assessment.
Postgraduates	▪ The formal and informal *RBO* learners received minimal feedback via the discussion list. ▪ The Engineering learners doing the Maintenance Management course were content with the feedback they received via the bulletin board and e-mail.	▪ The formal learners expected regular feedback, as opposed to the informal learners who were content with less feedback. ▪ The novice learners on the *RBO* course expected more guidance and assistance, while those with advanced Internet knowledge took their own initiative, and proceeded with tasks without the guidance of an instructor. ▪ The Engineering learners expected regular feedback and were dissatisfied with some of their other instructors who did not use *WebCT* for its intended purpose.

- **Collaborative learning can be effectively stimulated on the Internet, with no face-to-face interaction and contact time.**

A dominant characteristic of constructivist learning is collaboration among learners. Both the courses run on *WebCT* and the *RBO* course were designed with social negotiation in mind. Collaborative learning was more effective among the postgraduate Engineering learners who were geographically dispersed and who had a greater need to collaborate, than for the undergraduate Multimedia learners who had traditional face-to-face instruction, four times a week. The Multimedia learners were unconvinced about *WebCT's* capacity to facilitate collaborative learning. The researcher believes this was a result of teaching inadequacies on the part of the instructor, who did not use *WebCT* to match learners' characteristics.

Both the formal and informal learners agreed that the *RBO* course, without face-to-face interaction and contact time, facilitated collaborative tasks, especially as compared with doing such tasks via conventional mail or telephone.

Although *Plane Math* (the educational web site) included collaborative group activities, these were not investigated due to time constraints. However, it is very likely that such activities would not only increase learner-learner interaction, but also take advantage of a medium that supports collaborative group work.

6.2.2 Affective/emotional aspects

The main findings are classified into four categories, namely:

- Motivation;
- satisfaction;
- frustration; and
- conflict

Under each category, the principles are elaborated upon on the basis of the results.

6.2.2.1 Motivation

- **A creative environment motivates learners.**

The use of a physical classroom as a metaphor in the *RBO* course, motivated learners effectively. The classroom metaphor also helped the learners to enter into the spirit of a physical classroom, and their personal contributions gave them a sense of ownership. Some learners even felt a sense of cohesiveness, as if they were part of the family. In contrast, *WebCT* did not employ a familiar metaphor.

6.2.2.2 Satisfaction

- **The ways in which learners react to web-based material depends upon their background and expertise.**

Learners were generally satisfied with *Plane Math* and the majority of learners in both groups were engaged by it. The basic elements of fun, discovery and self-motivated mastery were evident in the web site, and that value and the expectation of success, as suggested by Arnone and Small (1999), were present. However, the rural children enjoyed the web site more than the urban school children did, and found it an enjoyable, pleasant and novel way to learn, due to their lower exposure to technology. Both groups of children commented that some pages took too long to load, but otherwise they were satisfied.

The Multimedia learners, competent in the use of various technologies and media, found *WebCT* useful and credible, but not engaging and stimulating. They were neither challenged nor engaged by the learning experience. *WebCT*, therefore, did not match their characteristic of instant gratification. Some learners were satisfied, while others did not benefit or approve of the way the course was run.

On the other hand, the postgraduate Engineering learners who were less immersed in state-of-the-art technology, were more tolerant of *WebCT* than the undergraduate Multimedia learners, and they saw the task behind the problem. They were less demanding and critical than the Xers, more value-driven and intent on using *WebCT* to solve the problem on hand.

6.2.2.3 Frustration

- **The more sophisticated and technologically advanced learners are, the more critical they become.**

The children from the urban school were more critical than the children from the rural school, due to their wider exposure to the Internet, computer interfaces and learning resources in general. For the same reasons, they also expected far more from the site (e.g. increased interactivity) than the rural school children. The urban school learners found some lessons boring, that it was "a bit young", and that there was too much white on the screen.

The undergraduate Multimedia learners were aggressive learners, and expected things to happen quickly and immediately. Hence their considerable frustration with *WebCT*. Their main frustrations were due to teaching inadequacies, inadequate design, and technological problems and inadequate support.

Although the Engineering learners were less sophisticated technology users, they did not like the fact that two of their instructors did not use the bulletin board.

Learners also experienced frustration with technology. Each age group experienced frustration at the speed with which material appeared on their screen. This was more of a problem for the Engineering learners who accessed their *WebCT* course from home and required relevant information quickly. Instead, some learners felt that they wasted their time trying to access the relevant information from *WebCT*. Further problems experienced in *RBO* and the *WebCT* courses, were unstable and/or unreliable links.

6.2.2.4 Conflict

- **Conflict that is well managed can produce beneficial results.**

This was evident in the way the *RBO* instructor handled controversy/conflict that took place on the course discussion list. The instructor resolved/managed the conflict by placing the conflicting learners together in a collaborative learning group. They were instructed to build a web site dedicated to conflict and conflict management - the very topic that had given rise to their dispute. In this website they defined concepts associated with web-flaming and proposed strategies for handling it, addressing the topic by means of an appealing and

humorous metaphor. Due to this occurrence and the subsequent project on conflict, all the class were exposed to valuable issues of online collaboration.

6.2.3 Communicative aspects

In this section principles are given with relation to both instructional/content interactivity and social interactivity.

6.2.3.1 Instructional/content interactivity

- **Children experience difficulty in grasping all the aspects of a system that is not in their mother tongue.**

Although sound principles of ID were applied in *Plane Math*, the rural school children struggled to operate the system, possibly due to the material not being in their mother tongue, leading to difficulty in understanding it. They struggled to locate information on the screen quickly and easily, and to understand the system's feedback. They did not realise that they could decide for themselves what to do, and were unsure of the options.

In contrast, the children from the urban school, the more advantaged, well informed and computer literate group, had no problems in operating the system.

- **"Techno-savvy" individuals expect sophisticated interfaces.**

All in all, the undergraduate Multimedia learners were the most critical regarding the computer interfaces. They were typical "techno-savvy kids", expecting instant gratification due to their sophisticated knowledge of interfaces and principles of good design. To them *WebCT*'s interface was neither intuitive nor appropriate.

The Engineering learners, in contrast, felt that *WebCT* was user-friendly, although a few made negative comments about the design. In general they were less critical about the design of the web-based material than the Multimedia learners. Instead, they were concerned about functionality and doing their tasks successfully.

The *RBO* learners were also more concerned about functionality. Some learners found the design visually stimulating, while two of the informal learners did not appreciate the design.

There were also “techno-savvy” individuals among the children in the urban school. These children were more critical than those in the rural school, and found some lessons boring, that it was "a bit young", and that there was too much white on the screen. This is in line with Tapscott (1999) who believes that Millennial generation children question the implicit value contained in information.

Each group of learners comprised some technologically competent individuals who required sophisticated interfaces. Institutions should strive to match learners’ characteristics and develop sophisticated interfaces that also conform to sound principles of instructional design.

6.2.3.2 Social interactivity

Educational web sites can be enriched by offering social interactivity, especially with guidance from the instructor/teacher acting as a “virtual coach”.

The principles surrounding social interactivity will now be discussed.

- **Undergraduate learners are reserved when it comes to communicating on a bulletin board.**

The literature states that communicative features significantly enhance the exchange of academic discourse, serving as a sounding board for ideas and being useful for networking purposes. This, however, was not the case among the Multimedia learners. Only a third commented that the discussions facilitated collaborative learning, in contrast to the positive response from the Engineering learners, and the formal and informal learners on the *RBO* course.

It was interesting to note that undergraduates felt comfortable about asking certain questions, but not about initiating discussions or answering questions, as indicated in Chapter 4, Figure 4.6. In contrast, the postgraduate learners in the *RBO* course felt comfortable about using the discussion list for their collaborative tasks and to answer each other’s questions.

The findings showed that some learners were uncomfortable with discussion software. It is therefore essential that instructors give learners the necessary guidance and motivation for

successful performance. It must also be borne in mind that success does not necessarily equate to learners being fully engaged in discussion software.

- ***WebCT* courses and fully online course can provide the opportunity for regular, collaborative interaction with learners and the instructor.**

The success of collaborative interaction depends on both the instructor and learners. In the *RBO* course (a fully online course) the instructor set up a discussion list for his learners, but its success depended on the learners themselves, who used it for its intended purpose. That is, learners reflected and learnt from the contributions sent by peers. The informal learners in the *RBO* course were especially active and provided valuable interaction.

In contrast, collaborative interaction was low among the undergraduate Multimedia learners. The researcher believes this was due to both teaching inadequacies and reluctance on the part of the learners. At that stage the learners did not know a great deal about the topic, and secondly, were not comfortable with the new means of communication. The postgraduate Engineering learners, in contrast, had regular collaborative interaction with one another and the instructor, and were more tolerant of the new medium. They saw the task behind the problem and looked beyond the technological hitches.

6.2.4 Technological aspects

Principles surrounding technological aspects will now be discussed.

- **Time should be allocated for learners to master the technology.**

It is critical that time be allocated for learners to master the technology within their courses. This would familiarise learners with the technology and help them become accustomed to it prior to the course. Once learners are comfortable with the medium as such, they should participate confidently.

- **Contingency plans are required by both instructors and learners to cope with technological failure.**

It is crucial that instructors have a contingency plan as a backup in the event of technological failure. In traditional contact teaching, instructors have recourse to face-to-face communication, and learners can be given printouts of study materials. Emergency plans become harder to generate in distance learning environments, because one is unable to resort to direct communication. Instructors could, however, load their courses on two different servers, so if the one is down, the other could be used. They could also have course material placed on a CD-ROM, which learners could use offline, and at their own time and pace.

6.3 What are the distinguishing characteristics of learners of different age groups, and what are the differences and similarities between these age groups in the context of web-based technologies?

Tables 6.4 – 6.6 examine the characteristics of each group of learners against their experience of the web-based technology. This is with the purpose of assessing whether or not the different web-based technologies took into account the characteristics/needs of learners.

6.3.1 Children

Table 6.4 gives children's experience of *Plane Math*, under the different characteristics of Millennial Generation learners.

Table 6.4 The Millennial Generation learners' experience of *Plane Math*

Characteristics	Experience
Work with their *peers* or groups in preference to adults.	Children explored the web site with their peers, in a school context.
Need to *reach* people of their own age.	Children in the rural school were more excited about referring the web site to their friends than children from the urban school, due to the former group's lower exposure to the Internet.
Need *quick responses* to activities.	Children found the transitions between screens slow and to a certain extent this temporarily distracted their attention.
Are creative thinkers able to *customise* things to their needs.	Children could choose which lessons they wanted to work through. The computer customised the lesson based on learners' responses.
Need to *explore and do* things.	They found *Plane Math* fun and exciting, and enjoyed the learning experience. They could also choose which lesson they wanted to do.
Achievement orientated.	Self-motivated to assume learning responsibility. The children engaged in activities they found were meaningful.

Owing to the fact that children in the Millennial Generation have grown up with technology, it is the researcher's opinion that they will adapt to electronic communication more easily than Generation X learners, and certainly more easily than the Baby Boomers. They will also have the advantage of using technologies that have been tried and tested, in contrast to those who were the guinea pigs, that is, the undergraduates and postgraduates. When these learners reach tertiary education, they may accept the absence of face-to-face contact. Future research into this aspect would be interesting, as well as an investigation as to how children experience communication technologies such as bulletin boards and chat rooms, and the extent to which these technologies support their learning.

6.3.2 Undergraduate learners

Table 6.5 gives Multimedia learners' experience of *WebCT*, under the different characteristics of Generation X learners.

Table 6.5 Generation X learners' experience of *WebCT*

Characteristics	Experience
Independent and self-reliant	▪ Not all learners showed the characteristic of independence. Certain learners commented that *WebCT* is not a replacement for lectures and instructors, and required classes in which their work is explained and discussed.
Techno-literate	▪ Learners did not appreciate the over-reliance on technology and objected to the enforced use of certain communication technologies. ▪ They experienced numerous technological problems beyond their control.
Have an expectation of instant gratification.	▪ Learners were situationally self-motivated to assume learning responsibility in areas of their own interests, and not the instructor's. Some learners willingly gave up control and expended less effort in areas that did not interest them. ▪ Learners were not overly stimulated by the material. ▪ They experienced frustration when instructors did not update web sites when information changed, or left their sites incomplete.
Self-building	▪ They asked questions to complete projects.

The Multimedia learners (Xers) came across as self-confident, desiring to be independent and free, and to choose the direction of their own learning. This corresponds to one of their labels as described in literature, namely the "me generation" as Slattery (1996) suggests. However, educators can harness this negative image, by designing ways to harness their characteristics, e.g. engaging them in web-based material that appeals to them.

6.3.3 Postgraduate learners

Using Ference and Vockell's (1994) characteristics of adult learners, Table 6.6 lists adult learners' experience of both *RBO* and Maintenance Management.

Table 6.6 Postgraduate learners' experiences of *RBO* and the Maintenance Management course

Characteristics	Experience
Active learner	▪ In the *RBO* course, certain learners were actively involved in their collaborative tasks, and in the participation on the discussion list. The informal learners were especially active on the discussion list. ▪ Despite the high drop-out rate in the *RBO* course, learners had learned.
Experience-based	Learners conducted their projects and based them on prior experience.
Expert	Learners were experts in their fields, hence they could add value to the discussions that related to their fields.
Hands-on	Adults were like children in that they liked to be practical and do things. In *RBO*, learners were given hands-on tasks to do.
Task-centred and problem-centred	▪ Engineering learners were frustrated by the slow speed of screen transitions. ▪ In the *RBO* course, learners had to find things out for themselves, as they tackled real-life problems in context and presented solutions collaboratively.
Solution-driven	In the *RBO* course, learners took personal ownership of their tasks.
Value-driven	Some of the engineering learners were happy with the *WebCT* service.
Skill-seeking	▪ Postgraduates were seeking skills, in that they actively desired to attain new and improved skills in order to better meet and solve real-life problems. ▪ The formal learners in the *RBO* course were predominantly externally motivated, and were completing the masters degree in CIE for career benefits. The informal learners in contrast were internally motivated, having a high interest level in the course for its intrinsic value and desiring to learn new skills. ▪ Learners in both courses attached value to the communication features. Learning to use these features gave an added real-life skill.
Self-directing	▪ The course worked well for both groups of learners (formal and informal) in terms of being independent and responsible for planning and directing their own learning activities. ▪ The Engineering learners were self-motivated to assume learning responsibility.
Motivation (External)	The formal learners were motivated to do the course due to career opportunities. This contributed to their persistence when tempted to drop out.
Motivation (Internal)	The informal learners were doing the course primarily due to a high interest level. The Engineering learners were frustrated that two of their instructors did not communicate electronically at all.

Andragogy provides designers and instructors/teachers with a framework within which to approach their work. Table 6.7 shows the differences between the three groups of learners, taking into account the concepts embracing andragogy.

Table 6.7 Characteristics of learners of different age groups

Characteristics	Children	Undergraduates	Postgraduates
Active learners	Prefer to be active rather than passive learners.	Prefer to be active rather than passive, if material appeals to them.	Prefer to be active rather than passive learners, if material is relevant to their work situation.
Self-directed	It was easy for the children to take responsibility for their own learning, because *Plane Math* is not dependant on a teachers'/parents' presence.	▪ Were not fully self-directed, and would have liked more assistance. ▪ Focused on work they were doing, and on doing a thorough job.	▪ Both the Engineering learners and formal learners were self-directed, taking responsibility for their own learning, although the latter group did extend the deadlines. ▪ The majority of the informal learners did not take responsibility for their own learning. ▪ Learners in the *RBO* course were focused on dealing with problems they encounter in their particular life situation.
Skill-seeking	Web-based material must be relevant and engage attention (Keller's motivational model applies here).	Web-based material must be real-life oriented, in that they must be able to see its potential use.	Web-based material/course must be practically useful in the work situation.
Need guidance	Responded well to the feedback and branching in *Plane Math.*	Multimedia learners had high expectations in terms of feedback and assessment.	Formal learners had high expectations in terms of feedback and assessment. Informal learners had lower expectations in terms of feedback and assessment.
Internally or externally motivated.	They were internally motivated by *Plane Math's* web site.	Undergraduates' motivation for using *WebCT* was primarily external because they HAD to use *WebCT*, and their participation counted for marks.	High completion rate among the formal learners. Their motivation for learning was primarily external. High drop-out rate among the informal learners, who ironically, were internally motivated to do the course.
Technoliterate	▪ Urban school children were familiar with technology, in contrast to the rural children. ▪ Children are more forgiving when it comes to errors, such as slow download speed.	▪ Undergraduate learners were the least patient. ▪ Early adolescents are aggressive people.	▪ Engineering learners were angry when they were unable to access material – wasting their time. ▪ Engineering learners found *WebCT* too slow; as a result some resorted to e-mailing each other.

Interesting deductions can be made from Table 6.7, namely:

- Across the age groups, learners seek different skills with regard to web-based material, i.e. children want to see relevance, undergraduates want to see its potential use and postgraduates want to see its practical use, as applied to their specific work situation.
- With regard to technology, it was discovered that impatience increases up the age scale from children to postgraduates. In addition, if something does not work out well for them, they will use something which is more convenient to use, e.g. the Engineering learners resorting to conventional mail.
- Extrinsic motivation plays an important role with adults. For example, the formal learners completed the course due to being extrinsically motivated, in contrast to the informal learners who were essentially internally motivated, yet many of whom dropped out of the course.

6.4 What are the learning possibilities for children, undergraduates, and postgraduates in the context of web-based technologies?

Schools and universities need to implement web-based technologies that suit their budget. Complex and expensive Web-based technologies are not required to guarantee learning, as learning can even take place using simple and inexpensive technologies. It is not about the medium/technology that is used, but how one designs for it.

Possibilities and implications for instructional design and the promotion of learning are given for specific web-based technologies from the perspective of the different age groups, i.e. children, undergraduates and postgraduates. These are given in Tables 6.8 to Table 6.17. The web-learning possibilities and implications arise from the case studies, but some are extracted from the literature study. The implications for instructional design and promotion of learning should be useful to developers as they design and develop web-based technologies for future use.

The web-based possibilities and implications are not restricted to the specific age group under which they have been classified, and could well apply to others. The tables only serve as a guideline, based on the literature and the three case studies. Before any web-based technology is developed, it is essential that the target population is investigated to determine their specific characteristics/needs, so as to design relevant material.

Recommendations also depend on the epistemology one is using, i.e. how objectivist or constructivist the web-based technology is intended to be. Where web-learning possibilities are the same for two or more groups, these columns have been merged. This occurs frequently in the possibilities common to both undergraduate and postgraduates learners.

6.4.1 Educational web sites

Educational web sites and programs play a valuable role in improving and enhancing children's perceptions of learning, as indicated by the results of *Plane Math.*
From the positive response of the children from the two schools, it would seem that children easily accept educational web sites. It would therefore seem worthwhile to introduce such web sites/tutorials as a supportive tool in the appropriate educational curricula.

Table 6.8 shows the possibilities of educational web sites for different age groups, while Table 6.9 lists the implications educational web sites hold for instructional design and promotion of learning. Developers should address these as they design web pages for their target audience.

Table 6.8 Web-learning possibilities for educational web sites targeted at different age groups

Children	Undergraduates	Postgraduates
▪ Web sites can provide exploratory and discovery learning, allowing learners to participate in an active process (i.e. having control over its nature and direction), enabling them to develop their own feeling of autonomy and sense of values. ▪ Children, in searching for information, are forced to exercise not only their critical thinking, but also their judgement. ▪ Children can access information they need for class projects by surfing the web.	▪ Developers can incorporate Multimedia to simulate real life, and to provide different stimuli that present the same content. Graphics, text, sound, and video can be used to grasp learners' attention and stimulate them.	▪ Web sites can include multiple levels of materials with choice of links offered, and which learners can peruse in their own time and at their own pace. ▪ Web sites can incorporate problem-solving situations. ▪ Web sites can include "how to" reference guides, booklets and tutorials. ▪ Meaningful relationships can be formulated through the integrated use of sound, video, graphics, animation and text.

Table 6.9 Implications of educational web sites for instructional design and promotion of learning for different age groups

Aspects	Children	Undergraduates	Postgraduates
Pedagogical/ andragogical	▪ Children must participate actively in the learning process. ▪ Web activities should have relevance to real situations and provide integrated experiences. ▪ Clear aims and objectives should be provided, including information as to the target age group of each lesson. ▪ Instructions should be clear and outline the options offered.	▪ Learners should be engaged in problem-solving activities. ▪ Undergraduates should find/create their own learning content that holds potential value.	▪ Learners should be engaged in advanced problem-solving activities. ▪ Postgraduates need to find/create their own learning content, relating to a particular life situation they encounter.
Affective/ emotional	▪ Children need material in visual format, with a high level of interactivity. ▪ Sensitivity to learners' social and cultural background should be exercised. ▪ Motivational elements in web sites must be: engaging and stimulating; useful and credible; organised and easy-to-use; and satisfying and effective, i.e. both value and the expectation of success must occur within an educational web site.	▪ Learning material must hold long-term career value.	▪ Learners need content matter which has relevance for a career/particular life situation. ▪ Learners need fast access to learning material as they have no time to waste.
	▪ Sites should incorporate a high-level of interactivity and be exciting. ▪ Sites could be enriched by keeping abreast of current web developments.		
Communicative	▪ Learners can present what they learn by developing their own web sites. ▪ Divide learners into groups within which they can interact, communicate and support one another. Create an ethos of mutual support and community building.		
	▪ Give learners hypertext, adaptive and multiple access. Avoid step-by-step instruction.		▪ Engage learners in learning real world skills, through solving their own problems.
Technological	▪ Build high level of interactivity.	▪ Allow learners to share their experiences of technology.	
	▪ Provide support for learners in the event of technological difficulties. ▪ Reducing the size of graphics could increase transition speed between screens.		

Harbeck and Sherman (1999) give further instructional design implications for children:

- Children's web sites should be concrete; provide clear, simple navigation; have simple page design; and use large, obvious icons.
- Web sites should be exploratory, include multiple branching options, and provide predictable action.
- Web sites should be progressive and customised, in that design and content are adaptable to the age of the user.
- Web sites should provide active and enjoyable experiences to ensure a positive, affective response.

Children should also be afforded opportunities to apply what is learnt to "authentic" problem situations and so make their learning relevant and applicable to their lives (Chisholm, 2000).

The enthusiasm of the children, as indicated from the observation and questionnaire, indicates that educational web sites hold immense potential for children as a tool to support learning, as a supplement to traditional class time. Educational web sites should, however, be sensitive to learners' social and cultural background, as there was an obvious difference in the response of the rural school children to the use of unfamiliar objects in *Plane Math.*

6.4.2 Web-based CMSs

Many of the possibilities of web-based CMSs are the same for both undergraduate and postgraduate learners. Consequently, these two age groups have been combined, and referred to as tertiary learners. Children are not included in Tables 6.10 - 6.13, since technologies such as web-based CMSs and web-based classrooms are not as appropriate in tertiary environments, where a large number of learners study by means of distance learning. Furthermore, the children's application investigated was a web-based tutorial and practice environment, and not a web-based CMS/web-based classroom. Children also attend traditional classes and therefore do not need these technologies for direct teaching, although they can be used as a support, and to reinforce ideas.

Table 6.10 shows the possibilities of web-based CMSs for different age groups, while Table 6.11 lists the implications web-based CMSs hold for instructional design and the promotion of learning.

Table 6.10 Web-learning possibilities for web-based CMSs targeted at tertiary learners

Tertiary learners
▪ CMS can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners. ▪ CMS can be designed in the way the instructor or organisation chooses, and with the "look and feel" they specify. Instructors can choose a combination of features they would like to use, i.e. online study guide, discussion tools, presentations, quizzes, whiteboard, etc. ▪ Learners can conduct tests using the online quizzes instructors place on *WebCT*, eliminating time spent by instructors in marking written tests.

Table 6.11 Implications of web-based CMSs for instructional design and promotion of learning for tertiary learners

Aspects	Tertiary learners
Andragogical aspects	▪ Learners must receive regular feedback. ▪ Learners should report on their progress or attempts/successes/failures on the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners experience problems, and learners may find that they share the same difficulties. ▪ Make sure that the administrative technicalities are subordinate to the instructional aspects.
Affective/ emotional aspects	▪ Instruction should be designed for relevance and to match learners' interests. ▪ The interface should be re-designed and made more user-friendly. A metaphor that learners are familiar with should be employed. This metaphor should also draw upon their existing skill and knowledge. ▪ The basic elements of fun, discovery and self-motivated mastery should be present for learners. ▪ A questionnaire/s can be sent out to learners at certain times in the course. Instructors could ask learners to report on their progress, perceptions of the course and what they have learnt from the course up to that point. This could help focus the course.
Communicative aspects	▪ Instructors who have opted to use *WebCT,* should not only keep it current, but also use it and build in adequate scaffolding. For example, the instructor should frequently post messages to the bulletin board in the beginning of the course, to familiarise learners with this feature. As the course progresses, the interaction and scaffolding on the part of the instructor should decrease and interaction between learners should increase. ▪ Instructors should schedule inter-learner debates on controversial, but relevant, topics. Instructors should also interact enthusiastically on the bulletin board. ▪ The best model is to use a combination of face-to-face contact and electronic communication. Contact sessions should be held to promote a sense of unity and belonging in a group. ▪ Learners should not be forced to use any of *WebCT's* communication tools, but they should be so visually stimulating and put to such good use, that learners want to use them.
Technological aspects	▪ The host network and the remote network must be stable. ▪ Design for stability, by keeping the interactive features of the site working reliably. ▪ Basic network support should be provided to learners and instructors, and learners should be informed of changes made to systems that affect access, navigation or transfer procedures, e.g. when the classroom server is down.

6.4.3 Web-based classrooms

Various technologies can be incorporated as part of a web-based classroom.

Table 6.12 shows the possibilities of web-based classrooms for tertiary learners, while Table 6.13 lists the implications of web-based classrooms for instructional design and the promotion of learning. Many of the web-learning possibilities for web-based classrooms are the same for both undergraduate and postgraduates learners. Once again, these two age groups are combined, and referred to as tertiary learners. Children are not included in the table, because the investigation of learning by children did not relate to a web-based classroom.

Table 6.12 Web-learning possibilities for web-based classrooms targeted at tertiary learners

Tertiary learners
▪ Instructors can emphasise open-structured tasks that learners can "own" for themselves, and make applicable to their real-life tasks.
▪ Core syllabi and study objectives can be presented on a web site, and regular "classroom" discussions conducted via a discussion list and/or bulletin board.
▪ A free group service can be used to support collaborative learning, e.g. *Yahoo! Groups.*
▪ Learners can build and manage their own constructivist learning environments using the Web, in so doing taking responsibility for their own learning.
▪ Learners can jointly construct collaborative web knowledge sites, and in the process learn practical skills on how to build a site over a distance.

Table 6.13 Implications of web-based classrooms for instructional design and promotion of learning for tertiary learners

Aspects	Tertiary learners
Andragogical	▪ Monitor learners carefully, and give feedback regularly. ▪ Include many sub-deadlines and place pressure on learners to abide by them. ▪ Ask learners to report on their progress or attempts/successes/failures on the tasks given them, on a weekly basis. ▪ Let learners take initiative. ▪ Start the course with basic tasks, such as text and e-mail activities (e.g. virtual debates), to familiarise learners with the medium. ▪ Ask learners to report on their progress or attempts/successes/failures in the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners could be experiencing problems, and learners may find that they share the same difficulties. ▪ Specify clearly the pre-requisite knowledge and competencies for the course, so that prospective learners can then decide whether they have the pre-requisite knowledge for the course, or if not, whether they have the time to acquire this knowledge. ▪ Identify with various problems learners may encounter, especially if the technology is new to them and they are battling to master it.
Affective/ emotional	▪ Encourage learners to post introductions along with their fears and expectations for the course, at the outset of the course, or, when possible, create a homepage that others learners in the group can visit. ▪ Schedule inter-learner debates on controversial, but relevant topics. ▪ Strive to integrate the class at the outset of the course, through brief collaborative tasks. This would help learners get to know each other, and counter feelings of isolation. This applies specifically to distance learners. ▪ Set ground rules and protect the "weak" if confrontation/conflict arises. ▪ Give learners considerable choice and freedom concerning the direction of their tasks, and in how they can be implemented.
Communicative	▪ Base designs on sound principles of instruction design. ▪ Design material to be cognitively comprehensible, that is, consistent and predictable. ▪ Keep the web site dynamic to attract learners' attention. ▪ Establish clear norms and guidelines, at the outset of the course (Fisher, 2000) that learners agree to. These are then adhered to for the duration of the course.
Technological	▪ Ensure that the host and remote network are stable. ▪ Provide basic network support to learners from the university concerned, and inform learners of any changes made to any systems that affect access, navigation or transfer procedures, e.g. when the classroom server is down. ▪ Design web site to load quickly. Large graphics should not be used unnecessarily. ▪ Place sites demanding large bandwidth on CD-ROM's, which learners can use off-line in their own time and leisure. Video clips, material and articles can also be placed on a CD-ROM and used as a supplement to the Web.

6.4.4 Discussion lists/bulletin boards

Table 6.14 sets out the possibilities of discussion lists/bulletin boards for different age groups, while Table 6.15 gives the implications discussion lists/bulletin boards hold for instructional design and the promotion of learning. Where the web-learning possibilities of discussion lists/bulletin boards are the same for two or more groups, these columns have been merged, as evident in the possibilities shared by both undergraduate and postgraduates learners. Consequently these two age groups are combined, and referred to as "tertiary learners".

Discussion lists and bulletin boards are usually included as components in web-based CMSs and web-based classrooms, but for the purpose of in-depth examination, these have been split into two tables.

Table 6.14 Web-learning possibilities for discussion lists/bulletin boards targeted at different age groups

Children	Tertiary learners
▪ CMC allows the use of techniques such as collaborative group work, group discussions and brainstorming. ▪ Children can interact and exchange ideas through computer networks, regardless of whether they are on the same site or at distant sites. ▪ Children can give their own views.	▪ Discussion lists/bulletin boards can be set up to facilitate interaction and communication among the learners in the course, and between learners and their instructor. ▪ Learners can reflect on, discuss, and defend their knowledge/skill. ▪ Instructors can use discussion lists/bulletin boards to engage learners in solving problems. ▪ Learners can moderate discussions themselves, then summarise the results, and make them available to the rest of the class. Learners would experience the role of the lecturer in this way. This would hand control over to learners, and motivate them. ▪ A guest "speaker" who is an expert in the field, can be used to introduce content and answer learners' questions. ▪ The bulletin board can allow for threaded discussions and can be used as a backup for static information. ▪ Learners can use discussion list/bulletin board for collaborative tasks.

Table 6.15 Implications of discussion lists/bulletin boards for instructional design and promotion of learning for tertiary learners

<table>
<tr><th>Children</th><th>Undergraduates</th><th>Postgraduates</th></tr>
<tr><td rowspan="2">▪ Gently prompt and motivate learners to express their own views.
▪ Use as an extension to learning.
▪ Use in conjunction with traditional contact teaching.
▪ Encourage learners to subscribe to discussion groups on topics that interest them or on themes they doing in class.</td><td>▪ Should be used as an extension to learning, and not as only means.
▪ Should be reliable and learners given the choice whether to participate or not.
▪ Use correctly and in conjunction with teachers/instructors.</td><td>▪ Learners can share files for use in other application software, by attaching them to their e-mail message. In this regard, a group of learners can construct a web site without physically seeing each other.</td></tr>
<tr><td colspan="2">▪ Should capture learners' attention so that they want to contribute and intervene in the discussion.
▪ Encourage learners to engage in dialogue with other learners and with the instructor.
▪ Engage learners in experiences that show contradictions to initial understandings and then encourage discussion.
▪ Use "Netiquette" guidelines to guide behaviour.
▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
▪ Discussions should be relevant to learners' careers.
▪ Group learners appropriately in the case of collaborative tasks.</td></tr>
<tr><td colspan="3">▪ Learners learn real world skills in realistic settings.</td></tr>
</table>

A combination of a bulletin board and a discussion list could be used, seeing that general notices can be posted on the former, and classroom discussions held on the latter. Instructors

can inform learners when they have placed new material on the bulletin board, so that learners know when to check it.

6.4.5 E-mail

Table 6.16 outlines the possibilities of e-mail for different age groups, while Table 6.17 gives the implications e-mail holds for instructional design and the promotion of learning.

Table 6.16 Web-learning possibilities for e-mail targeted at different age groups

Children	Undergraduates	Postgraduates
▪ Children can e-mail experts in the field. ▪ Children can use e-mail to communicate their ideas, stand up for what they think, and establish friendships across geographies.	▪ Undergraduate learners can communicate with experts in the field, offering learners the opportunity to become cognitive apprentices and develop their higher-order thinking skills in real world contexts.	▪ Collaborative problem-solving should be undertaken, providing learners with skills, expertise and knowledge. ▪ Adults can apply what they learn soon after learning it.
▪ Learners and instructors can work one-on-one. ▪ E-mail has great potential to shift the focus from instructor-centered teaching practices to a learner-centered environment. ▪ Learners can communicate real-life problems and request help from other learners. ▪ Instructors and/or learners can give feedback to each other, facilitating learning activities.		

Table 6.17 Implications of e-mail for instructional design and promotion of learning for different age groups

<table>
<tr><th>Children</th><th>Undergraduates</th><th>Postgraduates</th></tr>
<tr><td rowspan="2">▪ Present relevant problems, and direct the learners to experts for further information.
▪ Use emoticons, to indicate learners' emotions.</td><td>▪ Identify what attracts and retains the attention of learners.
▪ Evaluate learners' progress by asking them a question/s.</td><td>▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
▪ Encourage learners to discuss real-life problems/opportunities they encounter in the workplace with regard to any aspect of the content they are learning.</td></tr>
<tr><td colspan="2">▪ Give learners frequent feedback.
▪ Encourage learners to share files, by attaching them to their e-mail messages, in the case of collaborative group tasks. In this way, two or more learners can construct a web site without physically seeing each other.</td></tr>
<tr><td colspan="3">▪ Foster an open and interdependent exchange (Winiecki, 1999).
▪ Encourage learners to create different folders for different topics and groups of people.</td></tr>
</table>

Tables 6.8 – 6.17 indicate that the Web serves various functions and offers a wide range of possibilities to teachers/instructors and learners. It provides a unique set of tools, and is a resource-rich technology for use in education. The Web allows learners to participate in an active process of handling and processing information, and constructing their own knowledge.

6.5 What are the web-learning possibilities for contact teaching and distance learning?

The Internet has become indispensable both in contact teaching and distance learning, especially the latter where the Web can connect learners who are geographically dispersed. This was particularly useful in the case of the Engineering learners and the learners who were part of the *RBO* course.

In this section, the web-learning possibilities for both contact teaching and distance learning will be discussed, as determined from this research.

6.5.1 Contact teaching

Traditional contact teaching can benefit from the first three levels of Harmon and Jones' five levels of Web use (see Chapter 2, Table 2.1), which generally include using the Web for:

- Making information available and for general announcements, and to communicate and publicise courses;
- placing course content on the Web; and
- for learners to complete course work and use for general searching.

WebCT and *RBO* went beyond these levels, making communal and immersive use of the Web, respectively.

Further web-learning possibilities for contact teaching are given in Table 6.18, with its implication for instructional design and the promotion of learning.

Table 6.18 Web-learning possibilities for contact teaching and its implication for instructional design and promotion of learning

Possibilities	Implication for instructional design and promotion of learning
▪ Educational web sites (web-based tutorial and practice environments) can be of value to learners and meet learners' expectation of success (Arnone and Small, 1999), if designed according to sound instructional design principles. ▪ Contact teaching can be supplemented by web-based CMSs to facilitate communication between and among learners, and offer enhanced support to teachers and learners through its various features, such as those on *WebCT*. ▪ Learners given a project can assimilate needed information by searching the Internet and other mediums, and then create their own web pages. ▪ The Internet can be used to gain essential skills, such as critical thinking, problem-solving, investigative, evaluative and writing skills. ▪ The Internet can be used for learners to contact professionals in the field. ▪ Learners can participate in forums with other learners, and in chat rooms.	▪ Web-based technologies should be designed in such a way that they are goal-oriented, grab the attention of learners, offer challenges and hand control over to the learner. ▪ As far as possible, instruction should be individualised and learners should have opportunities to communicate with one another, to argue and debate issues (Ginn, 1995). ▪ The basic elements of fun, discovery and self-motivated mastery should be present in the web site. ▪ Teachers should supply learners with the necessary guidance to gain skills that will enable them to gather, analyse, synthesize and share knowledge.

Based on the results, it is the researcher's opinion that web-based technologies should be used as an extension of learning. The use of the Web in schools should not replace school (face-to-face contact), but should be used as a support, and to reinforce ideas. The web should not replace the teacher. It is evident from examining the needs of children, as given in Chapter 2, Section 2.3.1, that children need supervision, support and the assurance that they are cared for.

6.5.2 Distance learning

In this section the principles derived from the case studies concerning the nature of distance learning are discussed.

- **Web-based CMSs and web-based classrooms are more valuable for learners who study from a distance than for learners who have traditional contact classes.**

This was indicated by the positive responses of the postgraduate Engineering learners regarding their experience of *WebCT* as an aid, and to the effect that the online discussion facilitated collaborative learning. The informal learners on the *RBO* course also attached more value to working collaboratively over a distance than did the formal learners who were accustomed to traditional contact teaching.

- **Learners would like a combination of face-to-face contact and electronic communication.**

Some learners felt isolated studying on the Web and would prefer a combination of both face-to-face contact and electronic communication. This was stressed by the undergraduate Multimedia learners time and time again, and by some of the novice learners on the *RBO* course. A combination of both would provide a good model for future courses, and will most likely become a common and widespread medium for continuing professional education.

Web-learning possibilities for distance learning are given in Table 6.19, with their implications for instructional design and the promotion of learning.

Table 6.19 Web-learning possibilities for distance learning and their implication for instructional design and promotion of learning

Possibilities	Implication for instructional design and the promotion of learning
▪ The Internet can be used to gain essential skills, such as critical thinking, problem-solving, investigative, evaluative and writing skills. ▪ Educational web sites are widely accessible. However, learners who do not have access are excluded. ▪ Web-based CMSs can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners. It can be easily managed, but can be very restricted. ▪ Web-based classrooms can consist of two components: the web site and the communication tools. The web site can include an online study guide, as well as learners' individual sites that they have built. The communication tools can be used to facilitate interaction and communication among learners. ▪ CMC can be used to facilitate collaborative learning.	▪ Instructors must keep material current. ▪ Instructors should stimulate discussion. ▪ Instructors need to give web-based CMSs/classrooms constant attention, to enable learners and lecturers to get the most out of it. ▪ Instructors should be enthusiastic about technology, and strive to foster a caring and supportive environment. ▪ Learners should be encouraged, rather than forced, to interact. If the system is reliable and stimulating, they will choose to use it.

It appears that the distinction between contact and distance is fading away, and that contact teaching and distance learning are converging. The communication tools available on the Web hold enormous potential to reduce the social isolation originally equated with distance learning. Increasingly, the Web is being used to support and enhance teaching processes, or in some instances, to present fully online courses catering specifically for distance learners. In the context of contact teaching, while the Web can be used as a source of course delivery (information transfer) and for communication, interaction and collaboration, instructors can use traditional class time to teach real learning content.

6.6 Gaps in this study

The results of this study leave some gaps. The latter relate to the response of the different groups of learners under investigation, and to the effectiveness of collaborative group activities that were not investigated in this dissertation.

6.6.1 Response of different groups

Due to the small sample sizes used in this study, further research is needed to clarify these results. Suggestions for future research include investigating in more detail, the reasons why learners responded the way they did.

Of particular interest is the unusual response of the Multimedia learners, known as the Xers, as to:

- The reason behind their attitude and their directness. Was this due to their instructor, the media used, life in general, or their age?
- Why were Multimedia learners more reserved in communicating on the bulletin board?

Of further interest are the reasons why learners discontinue web-based courses/classrooms. This is of particular interest because of the high drop-out rate among the informal *RBO* learners, who did the course in a continuing-education context.

6.6.2 Collaborative group activities

Suggestions for future research include investigating in depth the effectiveness of collaborative group activities among children. The collaborative activities in *Plane Math* were not investigated in a group of learners in this specific dissertation, and it would have been interesting to see how learners respond to these activities, and whether or not Miller (2001) is correct in saying that “The Millennial Generation reach out to people and have a strong desire to be connected and to collaborate with others”.

6.7 Challenges arising

The following challenges arise from the study and are grouped under the two kinds of teaching, namely contact teaching and distance learning.

6.7.1 Contact teaching

- Web-based material should be designed to adhere to both Malone's intrinsic motivators (Malone, 1981), and Keller ARCS model of Instructional Design (Keller and Kopp, 1987). This is essential considering that learners are becoming increasingly sophisticated and have high expectations of course material.
- Web-based learning environments should meet the characteristics of their specific target population/generation.

6.7.2 Distance learning

- Instructors should explore how one can create a cohesive supportive group of participants who do not communicate face-to-face in the case of web-based classrooms.
- Instructors should strive to take the "distance" out of distance learning, for their learners.

6.7.3 Contact teaching and distance learning

- Instructors should facilitate adequate and effective communication among learners, and between learners and the instructor.
- Instructors should keep interaction on discussion lists/bulletin boards useful, preventing learners from feeling frustrated by it. A further challenge is how to keep discussion lists/bulletin boards running, rather than dying out after the course is over.

6.8 Concluding remarks

This chapter has merged the results into one coherent whole, in an attempt to answer the major research questions and provide a systematic structure of web-learning possibilities for learners of different age groups, and for different types of teaching, namely contact teaching and distance learning. The findings are used to propose appropriate matches between the characteristics of learners, the web-based technologies used and the teaching methods employed (i.e. contact teaching and distance learning). Web-based technologies can, if designed correctly, accommodate individual learning differences and meet the characteristics of the age group they are targeting.

There are many unknowns, as educators/trainers move into this new and exciting territory, that poses stimulating opportunities, but also many challenges, especially the changing roles of both learners and instructors. Learners have to take responsibility for their own learning – through collaborating with others, and constructing and generating their own knowledge, while instructors have to change their role from "sage on stage" to that of being a mentor and guide, and structuring learning opportunities. A high level of interactivity can be fostered through CMC, where instructors and learners engage in dialogue, and learners themselves contribute to the pool of knowledge.

Teachers/instructors no longer have all the answers. The main focus needs to be on the educational aspects addressed in this study, including sound instructional design, taking into account the needs and characteristics of the age group the web-based technology is targeted at.

It is hoped that the possibilities suggested in this study will present designers with a greater understanding of the distinguishing characteristics of learners of different age groups and how their needs can be met using web-based technologies, and thus contribute to the development of instructional web courses that are successful in supporting learning.

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Appendix A *Plane Math* questionnaire

Questionnaire for the investigation of an educational Mathematics web site - http://www.planemath.com

The purpose of this questionnaire is to test the overall effectiveness of *Plane Math* (an educational Web site for learners in grades 4-7) and to determine the degree to which it helped you learn. You will exploring the site for one hour, and will then fill in the questionnaire.

Your answers will really help to add important information to this field. We really appreciate your answers and any other information you might like to give.

Please write your details in on the lines and place a cross ("X") on the option that describes you.

Section A: General information

1. Gender:

Boy		Girl	

2. What would you like to be when you grow up? _____
3. Home language:

English	
Afrikaans	
Sotho	
Other	

3.1. If "other", please specify: _____

4. I use the computer at:

School	
Home	
My friends	
Other	

4.1 If "other" please specify: _____

4.2 I use the computer for: _____

5. I use the Internet:

A lot	
Now and again	
Not a lot	
Never	

Here is the key you will use. This is what the different faces mean:

☺ **I really agree**

😊 **I agree**

😕 **I do not agree**

☹ **I definitely do not agree**

Choose the face that you think matches the sentences below, and draw a cross ("X") in ONE of the four empty boxes provided for each question.

Section B: Pedagogical aspects

	The face I choose is:	☺	😐	😕	☹
Children's response to their own learning					
1.	I learnt a lot about mathematics.				
2.	I am more confident in mathematics now.				
3.	The site made me do a lot of thinking.				
4.	I could use my own ideas.				
5.	The site uses things I already now.				
Curriculum adequacy					
6.	The lessons can help me with my school work.				

Section C: Affective / emotional aspects

	The face I choose is:	☺	😐	😒	☹
Motivational effectiveness					
7.	*Plane Math* was fun and exciting!				
8.	I enjoyed spending time in this web site.				
9.	This was a nice way to learn.				
10.	I plan to use *Plane Math's* web site after the class is over.				
11.	Using the *Plane Math* site helped me get better in using computers.				
12.	I don't know the American words (e.g. math and gas).				

Section D: Communicative aspects

	The face I choose is:	☺	😐	😒	☹
Instructional adequacy					
13.	This web site clearly explains what I must do.				
14.	I can decide what to do, e.g. repeat work or to skip some stages.				
15.	It tells me what I do right or wrong.				
16.	I could find the information on the screen quickly and easily.				
17.	The web site kept my attention from beginning to end.				
18.	It helped that all the pages looked alike.				

	The face I choose is:	☺	😐	😑	☹
Cosmetic adequacy					
19.	I want to explore all there is to see.				
20.	The pictures helped me understand the lesson.				
21.	The screens contained just the right amount of information.				
22.	It is easier to read from a computer screen, than from a book.				

Section E: General

23. What do you know now that you did not know before?

_____

_____

24. What did you like about this web site?

_____

_____

25. What did you not like about this web site?

_____

_____

26. How can it be made better?

_____

27. Would you tell your friends about this site? If so, what would you tell them?

---

28. Would you like to say anything else?

Thank-you for your participation.

Appendix B Expert review checklist for *Plane Math*

Expert Review Checklist

Investigation of *Plane Math* (http://www.planemath.com)

Please circle your rating. "1" represents the highest and most positive impression, while "4" represents the lowest and most negative impression of the scale.

The key you will use is as follows:

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

Instructional Design Review

1. This web site provides learners with a clear knowledge of the program objectives. 1 2 3 4
2. The instructional interactions in this web site are appropriate for the objectives. 1 2 3 4
3. The instructional design of this web site is based on sound learning theory and principles. 1 2 3 4
4. The feedback in this web site is clear. 1 2 3 4
5. The pace is appropriate. 1 2 3 4
6. The difficulty level of this web site is appropriate. 1 2 3 4

Cosmetic Design Review

7. The screen design of this web site follows sound HCI principles. 1 2 3 4
8. Colour is appropriately used in this web site. 1 2 3 4
9. The screen displays are easy to understand. 1 2 3 4

Program Functionality Review

10. The web site operated flawlessly. 1 2 3 4

Curriculum Review

11. This web site relates to the Grade 4 and 5 school curriculum. 1 2 3 4
12. I will use this web site in my curriculum next year. 1 2 3 4

Any further comments you would like to make?

_____

_____

Thank-you for your participation

Appendix C *WebCT* questionnaire

Questionnaire for the investigation of WebCT

The purpose of this questionnaire is to investigate the effectiveness and efficiency of *WebCT* as a medium of learning.

The questionnaire will take approximately 10 minutes to complete. Your answers will be greatly appreciated as well as any additional input you may like to give.

Section A: General information

1. Describe your status as a student.

   (Please mark the appropriate square with an "X")

Undergraduate	
Postgraduate	

Full-time	
Part-time	

2. Age:

17 - 19 yrs	
20 - 29 yrs	
30 - 39 yrs	
40 - 49 yrs	
50 + yrs	

3. Gender:

Male		Female	

4. Present direction of study:

_____

5. General Internet use:

Daily	
Weekly	
Bimonthly	
Monthly	
Seldom	

Section B: Pedagogical aspects

1. Was *WebCT* an aid or hindrance to your learning?

Aid	
Hindrance	

2. Were you satisfied with the nature of feedback you received from your instructors via *WebCT*?

Yes		No	

2.1 Please elaborate:

_____

_____

Section C: Affective / emotional aspects

3. Give your first impression of *WebCT*.

_____

_____

4. In your experience, is *WebCT* user-friendly or user-unfriendly?

User-friendly	
Not user-friendly	

5. Which of the following emotions did you experience in using *WebCT*?
(Place a cross on the ones that apply)

Alienation	
Helplessness	
Anger	
Frustration	
Fear	

Satisfaction	
Achievement	
Feeling of success	
Motivation	
Desire to do more	

5.1 Please elaborate:

_____

_____

6. What joys or satisfaction did you experience with *WebCT*?

_____

_____

7. What frustrations did you experience with *WebCT*?

_____

_____

Section D: Communicative aspects

8. Which *WebCT* facilities did you make use of?

(Place a cross on the ones that apply).

Discussion list	
E-mail	
Chat room	
Whiteboard	
Quiz's	
Presentations	

9. Rate this statement: *WebCT* is an effective method of delivery.

Strongly agree	
Agree	
Disagree	
Strongly disagree	

10. Which do you prefer?

Face-to-face contact with fellow learners and instructors.	
Electronic communication using a bulletin board	
Happy with both methods	

11. Do you feel bulletin boards (on-line discussions) are valuable?

Yes		No	

11.1 If “no” do you prefer gaining knowledge, insight and assistance from your peers face-to-face?

Yes		No	

12. Did you gain knowledge, insight and assistance from the on-line discussion?

Yes		No	

13. Did the online discussion facilitate collaborative learning?

Yes		No	

14. Rate your own interaction with your fellow students and instructor on the bulletin board.

Excellent	
Good	
Fair	
Poor	

14.1 Please elaborate:

_____

_____

15. Will you use the bulletin board in similar contexts, now that you are familiar with its workings? (Please elaborate).

_____

_____

Section E: Technological aspects

16. Did you experience any technology problems?

Yes		No	

16.1 If "yes", what were they:

_____

_____

17. Did you experience any problems or difficulty with presenting your work on *WebCT*?

Yes		No		Not applicable	

17.1 If "yes", what problems did you experience?

_____

_____

Section F: General

18. Final comments on *WebCT*

_____

_____

Thank-you for your participation.

Appendix D *RBO* questionnaire

Questionnaire for the investigation of the RBO course

This questionnaire is to evaluate your perceptions and experiences of the *RBO* course on Internet-based learning/Computer-Assisted Communication and Management.

Section A: General information

1. Name: _____ (optional)
2. Email address: _____
3. Age: (please mark the appropriate square with an "X")

18 - 24	
25 - 29	
30 - 39	
40 - 49	
50 - 59	
Over 60	

4. Gender:

Male		Female	

5. Are you studying full-time or part-time?

Full-time		Part-time	

6. Job title and sector of employment:

_____

7. Before doing the *RBO* course, had you used the Internet and the World Wide Web before in teaching/training?

Yes		No	

7.1 If "Yes", please elaborate.

_____

_____

_____

8. With the *RBO* course behind you, what do you classify yourself as: a newbie or a webbie?

Newbie		Webbie	

9. I did the course as:

A credit for the MEd (CIE)?	
An "extra" module for the MEd (CIE)?	
An outsider – to be exposed to Internet-based learning?	
None of the above?	

Section B: Andragogical aspects

Please mark an "X" in the applicable box.

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	The course adequately guided, facilitated and enhanced my learning.				
2.	The course met my needs as an adult learner, i.e. relevant, self-directed, self-paced, flexible, hands-on, etc.				
3.	The course supplied feedback to and assessment of our various tasks.				
4.	The course was a real learning experience.				
5.	The course met my expectations.				

6. Did you at any time experience overload and/or anxiety?

Yes		No	

6.1 If "Yes", please elaborate.

_____

7. What were the most important things you learned from this course?

_____

Section C: Affective / emotional aspects

Please mark an "X" in the applicable box.

	Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
8.	I felt a sense of community building.				
9.	The environment was supportive.				
10.	I found the course exciting.				

11. Did the course affect your self-esteem and confidence in any way?

Yes		No	

11.1 If "Yes", how?

_____

_____

12. If you were NOT registered for the M. Ed. (CIE) course, i.e. you took *RBO* as a guest, do you think there were any disadvantages you experienced from not having been in a previous study class with other participants. If so, what were they?

_____

_____

13. To what do you attribute your success/failure to perform during the course?

_____

_____

Section D: Communicative aspects

Instructional / content interactivity

Please mark an "X" in the applicable box.

		Strongly Agree	Agree	Disagree	Strongly Disagree
14.	The site layout and page layout was effective.				
15.	The design of the classroom motivated me to explore the site.				
16.	I could find my way around the site.				
17.	The page containing the course's objectives and expected outcomes was helpful.				

18. What do you think of the design of the web-based classroom? Please elaborate.

_____

_____

Table 5.5 Social interactivity

		Strongly Agree	Agree	Disagree	Strongly Disagree
19.	The course provided adequate and effective communication amongst the learners and between learners and the instructor.				
20.	I would have preferred some face-to-face interaction, rather than just the discussion list and bulletin board.				
21.	I benefited from the electronic communication.				
22.	The course facilitated collaborative tasks between learners.				

23. How did you experience interaction with your classmates, e.g. useful/ supportive/complex/frustrating, etc?

_____

_____

24. Were there any issues relating to the discussion list and the chat sessions – other than the technology – that were problematic, e.g. misunderstandings of meanings or intentions?

_____

_____

25. Did you use any other means of communication during the course with the instructor or other learners, e.g. phone, face-to-face, fax, etc.

Yes		No	

25.1 If "Yes", why did you use this alternative method of communication?

_____

_____

Section E: Technological aspects

26. Did you experience any problems with the following during the course?

		Yes	**No**
26.1	Hardware		
26.2	Software		
26.3	Internet connection		
26.4	E-mail communication with the instructor/class members.		

26.5 If "Yes", describe the problem(s) briefly, along with any others not mentioned above.

_____

_____

Section G: General

27. What difficulties/barriers, if any, did you experience in participating in this course, that have not been mentioned in this questionnaire?

_____

_____

28. How did you find the course useful in your personal or professional life?

_____

_____

29. Is there anything else you'd like to say? Feel free!

_____

_____

_____

_____

Thank-you for your participation.