

Using the Internet communication tools to facilitate learning

**A mini-dissertation by
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Dedicated to:
My son, Mbuso and my daughter, Nonkululeko

Acknowledgements

I gratefully dedicate this work:

To my parents

My mother, for her unconditional love and support, and
My dad, for always believing in me.

To my lovely children

My son, Mbuso for his genuine love and for looking after his little sister when I
was not there,
My daughter, Nonkululeko for her understanding and patience through out my
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SUMMARY

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a mini dissertation by

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Didactics

**Degree
(RGO)**

MEd

An increasing number of universities are resorting to the Internet to offer courses on-line. This dissertation describes research which investigated the use of communication tools in a WebCT learning environment. The instrumental case study investigated the level and frequency of use of the web-based communication tools during a full-fledged course delivery at a university that enrolls only full-time students. The unit of analysis was the case and the instruments included group interviews, observation anecdotal notes, communication diaries, focus group and a journal/logbook. A mixed qualitative and quantitative research method was used in this research.

The study evaluated how the interactivity and not how either the lesson or the WebCT function. The conceptual framework focused on interactivity, features of communication tools that promote interactivity, as well as the domains such as cognition, motivation and learner interface as aspects that influence the use of communication tools. Various web-based tools were used by a sample consisting of a selected small group of IT students who participated in the study. Those communication tools were used to facilitate learning in WebCT.

The results showed a total of 145 interactions for the duration of ten sessions. The WebCT communication tools supported either synchronous or asynchronous communication. Communication tools were used to retrieve

information and send text-based messages to lecturers and students. Interaction at different levels was evident between student and student, student and lecturer, lecturer and student, lecturer and lecturer, as well as, student and content. In addition to the WebCT communication tools, students used extra web-based communication tools, to facilitate their learning.

It was concluded that with continuous advances in information and communication technology and with ever increasing student numbers at resident universities, more tertiary institutions should offer on-line courses. More communication tools should be considered on WebCT to facilitate more interactive learning.

OPSOMMING

Die gebruik van Internet kommunikasie hulpmiddels om die leerproses to fasiliteer

Leier

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Departemente

Didaktiek

**Graad
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MEd

Die hoeveelheid universiteite wat internet kursusse aanbied is besig om te groei. Hierdie tesis beskryf navorsing wat die gebruik van kommunikasie hulpmiddels in 'n web gebaseerde omgewing ondersoek. Die instrumentele gevallestudie het die vlak en die gebruiksfrekwensie, van die gebruik van webgebaseerde kommunikasie hulpmiddele ondersoek, in 'n kursus wat aangebied word in 'n universiteit wat slegs voltydse studente inskryf. Die eenheid van analise was die geval en die instrumente het ingesluit: die groep onderhoude, observasie, notas kommunikasie dagboeke, 'n fokus groep en 'n joernaal. 'n Kwalitatiewe navorsingsmetode is vir die studie gebruik.

Die studie het geëvalueer hoe die interaktiwiteit funksioneer en nie hoe die les of WebCT funksioneer nie. Die konseptuele raamwerk fokus op interaktiwiteit, kenmerke van kommunikasie hulpmiddele wat interaktiwiteit bevorder en domeine soos kennis motivering en leerder interfase, as aspekte wat die gebruik van kommunikasie hulpmiddele beïnvloed. Verskeie web-gebaseerde hulpmiddele was deur 'n steekproef wat bestaan het uit 'n geselekteerde aantal IT studente gebruik. Hierdie hulpmiddele was gebruik om die leer in WebCT te bevorder.

Die resultate het gewys dat 'n totaal van 145 interaktiwiteitsfrekwensies die genoteerde aantal interaksies was, wat voorgekom het gedurende die gebruik van WebCT, vir die verloop van tien sessies. Die WebCT kommunikasie hulpmiddele het of sinkroniese of asinkroniese kommunikasie ondersteun. Kommunikasie hulpmiddele is gebruik om informasie te onttrek en om teks gebaseerde boodskappe na studente en lektore te stuur. Interaksie op

verskillende vlakke was duidelik waarneembaar tussen student en student, student en lektor, lektor en student en ook tussen student en die inhoud. Ter byvoeging van die WebCT hulpmiddele, het studente ook ekstra web-gebaseerde kommuniekasie middele gebruik om leer te fasiliteer.

Die gevolgtrekking was dat met volgehoue ontwikkeling in informasie en kommunikasie tegnologie en met 'n toename in studentegetalle in universiteite met voltydse studente, behoort meer tersiere instansies aanlyn kursusse aan te bied. Meer kommunikasie hulpmiddele moet ook oorweeg word om interaktiewe leer te fasiliteer

Key words and phrases

- Interactivity
- Web-based communication tools
- E-mail
- Synchronous and asynchronous communication
- Web-learning environment
- WebCT
- Collaborative learning
- World Wide Web
- Level of interactivity
- Frequency of interactivity
- Bulletin board
- Chat rooms
- Newsgroup
- Mailing list
- Listservs
- Cellphone messaging

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CHAPTER 1: BACKGROUND INFORMATION

1.1 Introduction

Interactivity in learning is “*a necessary and fundamental mechanism for knowledge acquisition and the development of both cognitive and physical skills*” (Barker P, 1994:1).

Interactivity is therefore not simply the ability to speak back to a machine but, as Cronjé (1996) explains; interactivity has to do with simulating the interchange between two people who are communicating meaningfully. Web-based communication may refer to any form of interpersonal communication that uses Internet technologies to transmit, present, explain or store information. This process may be supported by web-based communication tools such as e-mail, bulletin boards, chat rooms, group discussions, conferencing and Internet-based audio applications.

This dissertation describes research that investigates the relationship between the frequency and level of interactivity, features of communication tools that promote interactivity, and conditions that influence the use of communication tools in a web-based learning environment. This chapter presents the problem statement, the objective of research, the aim of the research, the motivation and rationale for the study, the research problem, the research design, the limitations of the study, and the value of the research that is presented. This chapter concludes with a graphic presentation of the content of all the remaining chapters.

1.2 Problem statement

There is evidence that more and more universities are exploring the potential of the Internet as a medium for transmitting and facilitating learning for students. When Cronjé (2000) analyses the use of such tools to facilitate

learning, he describes web-based interactivity as being “at one end of the scale, ad-hoc e-mails between students and lecturers, discussion groups, bulletins and web-sites supporting classroom work. At the other end fully-fledged course delivery, learning guidance and examination through custom delivery software”.

It is not pedagogically sufficient or adequate to limit the online instructional design of interactivity only to utterly basic or even trivial options such as simple menu selection, clickable objects, or linear sequencing. This point of view is supported by Delpoort (2003) when she states that learners associate a varied and challenging learning environment with feedback from the instructor or lecturer and with the lecturer’s encouragement to engage in frequent online interactions with other students through the medium of the e-mail facility and the bulletin board.

Because of the rapid growth and ever-increasing sophistication of information and communication technology (ICT) products, and because of the escalating cost of supporting and maintaining ever-growing numbers of residential students at universities, more and more tertiary institutions are examining the benefits that accrue from offering tuition by means of on-line courses. According to McNeil et. al. (2000), there are certain key indicators of change in tertiary education from conventional models to those associated with the Internet. Among such indicators are the following:

- Students are changing from being passive recipients of information in lecture halls to being active participants in their learning environment.
- The widespread use of Internet communication tools has given a new flexibility and freedom to both teachers and learners with regard to the way in which they organise and pursue their studies, and has created a climate in which learning takes place as and when it is convenient.

- Traditional occurrences and events in face-to-face classrooms are being replaced by new modes of social and instructional interaction and engagement.

Harasim (in Mason & Kaye, (1999) describes on-line and Internet delivery of course material as being either “an adjunct in traditional courses, or mixed with face-to-face teaching, or alternatively course material that is completely delivered on-line”.

Effective interaction in web-based learning will only occur if both learner and facilitator are knowledgeable about, and are committed to, the use of Internet communication tools to facilitate teaching and learning. Tu (2002) supports the assertion by Harasim et al. (above) when he states that a thorough understanding of the strengths and weaknesses of the web-support system used, for example, in the WebCT (Web Course Tool), and of the users themselves (i.e. students, teachers and designers), is a necessary condition for integrating web-based communication technology into virtual classrooms.

1.3 Aim and objective of research

The focus of this case study was to investigate the use of communication tools to facilitate learning in the WebCT (Web Course Tool) learning environment. The researcher explored the patterns and behaviour of a selected group of eight undergraduate (IT) students with regard to frequency and levels of interactivity as they utilised the WebCT learning environment in a context of collaborative and interactive learning. Interactivity may take place between: teachers (lecturers) and learners, learners and learners, learners and content, learners and communities, designers and teachers (lecturers), teachers (lecturers) and designers, and among the learners themselves.

During the course of the study, I gave special attention to the various issues that arise from interactivity and the use of communication tools in the WebCT. I directed my main focus of attention and analysis towards the levels and

frequency of interactivity that became evident in the WebCT learning environment during the course of the research. I was especially interested to separate and describe:

- Features of web-based communication tools that promote interactivity such as:
 - Asynchronous communication
 - Synchronous communication

- Aspects that influence the use of communication tools in web-based learning such as:
 - Cognition
 - Motivation
 - Learner interfaces

WebCT was used as a platform to gather data from applications that generated text-based asynchronous and synchronous group discussions. Eight of the thirteen volunteers who participated in the case study were full-time students from Monash South Africa, a wholly owned subsidiary of

Monash University, an Australian university that offers research, teaching and pioneering graduate programmes. The sample for the case study was composed of eight Information Technology (IT) students, a lecturer who is also a designer, and two other lecturers. Two Information Technology Services (ITS) technicians were also included in the sample. These technicians assisted the process by contributing their technical skills and knowledge during the empirical part of the research.

1.4 Motivation and rationale for the study

1.4.1 Motivation

This case study elaborates on the research undertaken by Delpoort (2003) who indicated a relationship between a varied and challenging learning environment and frequent interaction. A practical problem associated with this research project is the assumption that Monash SA University has liberally provided state-of-the-art communication technology for its students on the campus and that this technology is underutilized because on-campus residential students have the advantage of being able to access the university's resources more frequently and readily than off-campus (non-residential) students.

The selected focus group sample in this case study comprised only thirteen participants (eight of whom were regular students) out of the total student population of one thousand two hundred who were registered at Monash South Africa at the time of the study. The results cannot therefore be generalized to the whole student population, but they may be taken to reflect a tendency and pattern of communication tools usage by typical users. The total sample therefore consisted of eight selected students, two lecturers in Information Technology (IT), an Instructional Designer who was also a lecturer, and the two technicians mentioned above. This study was motivated by the abundance of ICT resources on the Monash SA campus, and a question about whether communication tools were being fully and effectively used to facilitate web-based learning for Monash SA students. The following paragraphs briefly explain the rationale for this study.

1.4.2 Rationale

The study builds on the research done by Delpoort (2003) who indicated a relationship between a varied and challenging learning environment and

frequent interaction. The problem that is investigated in this study is the assumption that while Monash South Africa University makes lavish provision of state of the art communication technology for students on the campus, it is currently being underutilised.

The rationale for this study is based on three features of web-based learning that are logically linked to one another. These factors are:

- Interactivity
- Features of communication tools that promote interactivity in a web-based learning environment
- Aspects that influence the use of communication tools in the web-based learning

These three features of web-based learning are reviewed below in terms of the empirical studies in which they have been researched and the literature in which they have been described. The first that will be described is interactivity.

1.4.2.2 Interactivity

Manhazz (2003) asserts that there are two types of interactivity, namely (a) cognitive or individual interaction (interaction between learner and content), and (b) social or interpersonal interaction between learners themselves or between learners and lecturers. Cronjé (1996) clarifies that when this interactivity is mediated by technology, the level or intensity of the interaction is measured in terms of the interdependence of the participants. A learner can interact at the lowest level of interactivity. When a learner interacts at the lowest level, he or she is not engaged in the thinking processes indicated in the highest tier or level of Bloom's taxonomy (characterised by analysis, synthesis and evaluation and requiring the application of higher order thinking skills), Instead, he or she is engaging in simply reacting to information by clicking buttons, following instructions, and making choices from drop-down menus without any accompanying understanding or comprehension. Tertiary-

level learners who interact with online learning materials in this way are interacting in the most superficial possible way and cannot expect to obtain good results, lasting benefit or satisfaction from their studies.

Bohlin (2004) suggests that motivation can only be reinforced when the mode of instruction offers students personal satisfaction and a sense of incremental achievement. This is supported by the literature that describes the six levels of Bloom's taxonomy of cognitive thinking. LaRose and Whitten (1999), McNabb, (1994), and Sherry (1996) also describe research into levels of interactivity (communication, participation and feedback) between students and among teachers and their students. Woods (2004) suggests that LaRose and Whitten (2000) borrowed from social cognitive theory as a framework to develop a unified construct of interaction and instructional immediacy for Web-based learning material. He further states that they created a model that incorporated both teacher-student immediacy and computer immediacy. Further discussion about interactive learning will be conducted in the literature survey.

This particular case study examined the frequency and level of interactivity when WebCT (Web Course Tools) software was used to facilitate student learning. The study also tried to establish whether learners who interacted frequently by using the communication technology but who only receive information without mentally analyzing, synthesizing and evaluating the content of the information, achieved as much satisfaction as learners who interacted less frequently but who manifested Bloom's higher order thinking skills to analyse content whenever they did so. While various researchers have offered different descriptions of the levels of interactivity, Berlo's (1960) taxonomy of communicative interdependence is the oldest and the most respected theory and will therefore be used in this study.

Vygotsky (1978) explains that learning as a social construct is mediated by language and social discourse. Features of communication tools that promote or allow interactivity are explained briefly below.

1.4.2.3 Features of communication tools that promote interactivity in a web-based learning environment

Features of communication tools refer to those characteristics of the communication technology that promote any kind of interpersonal communication that uses Internet-based technologies to transmit, present, explain and store information. Examples of web-based communication tools are e-mail, bulletin boards, chat rooms, group discussions, conferencing and Internet-based audio applications.

Communication may either be *synchronous* (it takes place *at the same time*) or *asynchronous* (communication is not simultaneous but individuals can retrieve sent messages at their convenience). Individual users may retrieve or send text messages at anytime and from any suitable terminal provided that their computers are connected to the Internet. This is supported by Clarke & Cronjé (1999), De Villiers, (2001), and Alessi & Trollip (2001), who assert that learners who are connected by this kind of Internet-based technology have the facility to the e-mail other learners, their instructors and other groups at any time of the day or night throughout the year.

Delpoort (2003) suggests that interaction is only possible if both learner and facilitator are completely knowledgeable about, and are committed to the use of, the communication tools at their disposal. What follows below is a brief discussion of the factors or aspects that influence the use of communication tools.

1.4.2.4 Factors that influence the use of communication tools in web-based learning

For the purpose of the study, the factors that influence the use of communication tools that I will discuss in this study are: cognitive factors, motivational factors, and learner interface.

- The *cognitive* factors refer to stimulation of cognitive and physical activity during activity. Sims (1994) points out that the way in which the motor, cognitive and collaborative elements of interactivity coalesce with the task being undertaken contribute to the successful engagement of the learner with the activity. Moore (1991) supports this by asserting that the social dimension of interactivity places an emphasis on a collaborative and cooperative learning environment and encourages dialogue.
- The *motivational* factors are determined by, among other things, challenge, curiosity and the relevance of the content. Malone (1981) extrapolates the motivational factors of *curiosity, fantasy, control* and *challenge* from games theory when discussing web-based learning. Keller's (1983) research into motivational design entails instructional strategies that motivate rather than frustrate learners. Keller and Suzuki's (1988) satisfaction model of motivation (ARCS) advocates gaining attention, demonstrating relevance, instilling confidence, and providing satisfaction.
- The *learner interface* gives learners various options that they may use to exercise some degree of control over their virtual environment. Alessi & Trollip (2001) state that, from an operational point of view, the designer and programmer offer learners various options for controlling some aspects of their virtual environment, and that whatever they do *not* offer the learner, is controlled by the program itself and cannot therefore be changed by a learner. It is important for web-based learning to offer learners and optimal selection of options for exercising control over the web-based environment.

While this study acknowledges the fact that there may be many factors that influence the use of web-based communication tools, this research uniquely intends to answer questions listed in the following section.

1.5 Research problem

This case study aimed to investigate the level and frequency of the way in which web-based communication tools were used in fully fledged course delivery, the provision of learning guidance, and in modes of assessment based on WebCT at a university (Monash SA) that enrolls only full-time students.

Three critical research questions were identified to focus the study. The areas of research that were identified for the purposes of this study were: (a) interactivity, (b) the features of web-based communication tools that promote interactivity, collaboration and personal satisfaction, and (c) three specific andragogical factors of web-based communication tools. These three research areas and the questions that arise from them are listed in Table 1.1 below:

Table 1.1 Research areas and questions

Research area	Questions
Interactivity	What was the frequency and level of interactivity in the WebCT learning environment?
Features	What are the features of web-based communication tools that promote interactivity?
Andragogy	How do the factors of cognition, motivation and learner interface influence the interactive use of web-based communication tools?

Table 1.2 below lists the sub-questions that were relating to the aspects under investigation.

Table 1.2 Sub-questions relating to the areas under investigation

Andragogical domains	Research sub-questions
Interactivity	(a) What is the frequency of interactivity in a WebCT learning environment? (b) What is the level of interactivity in a WebCT learning environment?
Features of web-based communication tools	What are the features of communication tools that promote interactivity in web-based learning?
Cognition	<ul style="list-style-type: none"> • To what extent does WebCT help or hinder learners' learning? • How does WebCT adequately facilitate and enhance learning? • How can collaborative learning be effectively stimulated on WebCT by using Internet communication tools?
Motivational	<ul style="list-style-type: none"> • How can a web-delivered course provide students with materials, models and metaphors that elicit sufficient motivation with respect to the following? <ul style="list-style-type: none"> ○ Challenge ○ Curiosity ○ Levels of learner control ○ Fantasy (Malone, 1981) <ul style="list-style-type: none"> ○ Achievement ○ Relevance ○ Confidence ○ Satisfaction (Keller, 1983, cited in Duchastel, 1998)
Learner interface	<ul style="list-style-type: none"> • What design factors best facilitate learning via on-line Web-based material?

1.6 Previous research

The following table situates this research project in the context of research that has already been conducted in South Africa. Table 1.3 shows similar research studies that are relevant to this project in the large body of literature that exists on the topic.

Table 1.3 Related research topics

Researcher	Title of research	Year	Degree
Adendorff, D.E.	Instructional design principles for developing interactive learning programme using Arel: A case study	2000	MEd
Brown, S.	A framework for Internet-supported collaborative learning in South Africa	1998	MTech
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
Delpoort, R.	Computer-mediated communication in an undergraduate mathematics course	2003	MEd (CIE)
De Villiers, G.J.	Asynchronous web-based technologies to support learning	2001	M A in Information Science
De Villiers, M.R.	The dynamics of theory and practice in instructional system design	2002	PhD
Van Ryneveld, L.	An exploration of cost effective solutions for Internet-based interactive learning	2000	MEd
Pete, M.M.	The design and development of a resource-based, open learning system on the World Wide Web	1998	MEd

An examination of Table 1.3 shows that the research conducted by G.J. de Villiers (2001), M.R. de Villiers (2002), Van Ryneveld (2000) and Adendorff (2000) is relevant to this study. What makes this research unique, however, is the fact that it seeks primarily to investigate the use of communication tools in a web-based learning environment *with specific attention to exploring the frequency and level of interactivity in facilitating learning*. The study will examine, discuss and analyse cognitive, motivational, and learner interfaces

as factors that may influence the use of Internet communication tools in collaborative learning.

1.7 Research design and method

This instrumental case study investigated the level and frequency of the use of web-based communication tools in fully fledged course delivery, learning guidance and assessment in a Web Course Tools (WebCT) format at a university that enrolls only full-time students.

It should be noted that the generic terms *student* and *undergraduate* will be used synonymously and interchangeably throughout this study. The unit of analysis was the *case*, and the instruments used by the researcher were group interviews, observation, anecdotal notes, communication diaries, focus groups and journals/logbooks. These were the means that the researcher used to gather data from many different sources during the course of the research.

Monash SA University also offers its students a foundation programme that equips them for enrolment in an undergraduate degree. ADP 1003 and ADP 1008 are recommended basic computer modules offered in each semester prior to a first year IT degree at this university. A sample of eight students was selected from the target population of eighteen IT undergraduate students. These students came from different backgrounds and countries. Three of the students come from Botswana, two students were South African citizens, one student came from Kenya, and two students came from Zimbabwe. All the students in the sample were enrolled full time at the university at the time of the research. In addition, two lecturers, one Course Designer who is also a lecturer, and two Information Technology Service (ITS) technicians took part in the study.

Various factors influence the effectiveness of web-based learning or the degree to which learning is supported on the web. These factors need to be

carefully considered because each of them exerts an important influence on the use of web-based technologies that facilitate learning. For the purpose of this study, sub-questions that relate to the factors that have been identified are tabulated under the heading *Main research questions* below:

1.8 Limitations of this study

There are problems that may affect the results of this case study and so limit its utility. What follows below is a brief discussion of these problems and limitations.

Problems of access can occur because of unstable technology and infrastructure (such as, for example, unstable networks).

The findings of this case study cannot be generalized because the selected focus group was not representative of the whole student population of Monash South Africa University. This research was undertaken with a small but typical group of full-time students at the university.

ADP1003 and ADP1008 are recommended basic computer modules that are offered in each semester prior to a first-year IT degree at Monash SA University. Some students, however, bypass the Academic Development Programme and enrol immediately for undergraduate courses.

1.9 Value of the research

The value of this research is that it should provide additional data that designers and practitioners (lecturers) of online web-based courses will be able to use in the design and implementation of effective online learning. It should contribute to an understanding of the dynamics of learning and instructional theories and should therefore inform practice in the design, development and delivery of instructional systems and learning environments.

The literature in this field generally acknowledges the value of interactivity for on learning and the use of web-based communication tools is usually regarded as a source of support in educational environments that emphasise interactivity and collaboration. Whatever model of web-based support is used, and whatever level of interactivity is present, the literature identifies the benefits of using Internet communication tools that are tabulated in Table 1.4 below.

Table 1.4 shows various benefits of interactivity for learning suggested by some researchers.

Table: 1.4 The benefits of interactivity in web-based learning

Authors	Benefits of interactivity for students
Hara, Bonk & Angeli (1998); McComb (1993); Lee et.al. (1999).	A permanent text record of interactions is maintained and made available to students so that they can refer and keep up to date with information.
Clarke & Cronjé (1999); De Villiers (2001); Alessi & Trollip, (2001)	Learners can e-mail individual learners, instructors or groups from any suitable terminal connected to the Internet at any time of the day or night.
Lee et.al. (1999).	Students who are shy or nervous can take their time about thinking, composing and expressing their thoughts while writing and reading text messages without having to endure the pressures of face-to-face situations.
Britain & Liber (1999); Delport (2003).	Technology offers learners new tools that facilitate learning. Virtual learning environments have the potential to support learning styles that are particularly time-intensive for lecturers who use traditional teaching methods that have always formed a core part of tertiary learning (i.e. collaborative, learner-centred, discussion-led and resource-based learning).
Barker (1994); Alessi & Trollip (2001).	Interactivity is a necessary and fundamental mechanism for knowledge acquisition and the development of physical and cognitive skills.

From the table it is evident that the use of communication tools is viewed as a source of support in web-based teaching and learning. Virtual learning environments support various learning styles and participants can interact 24 hours a day.

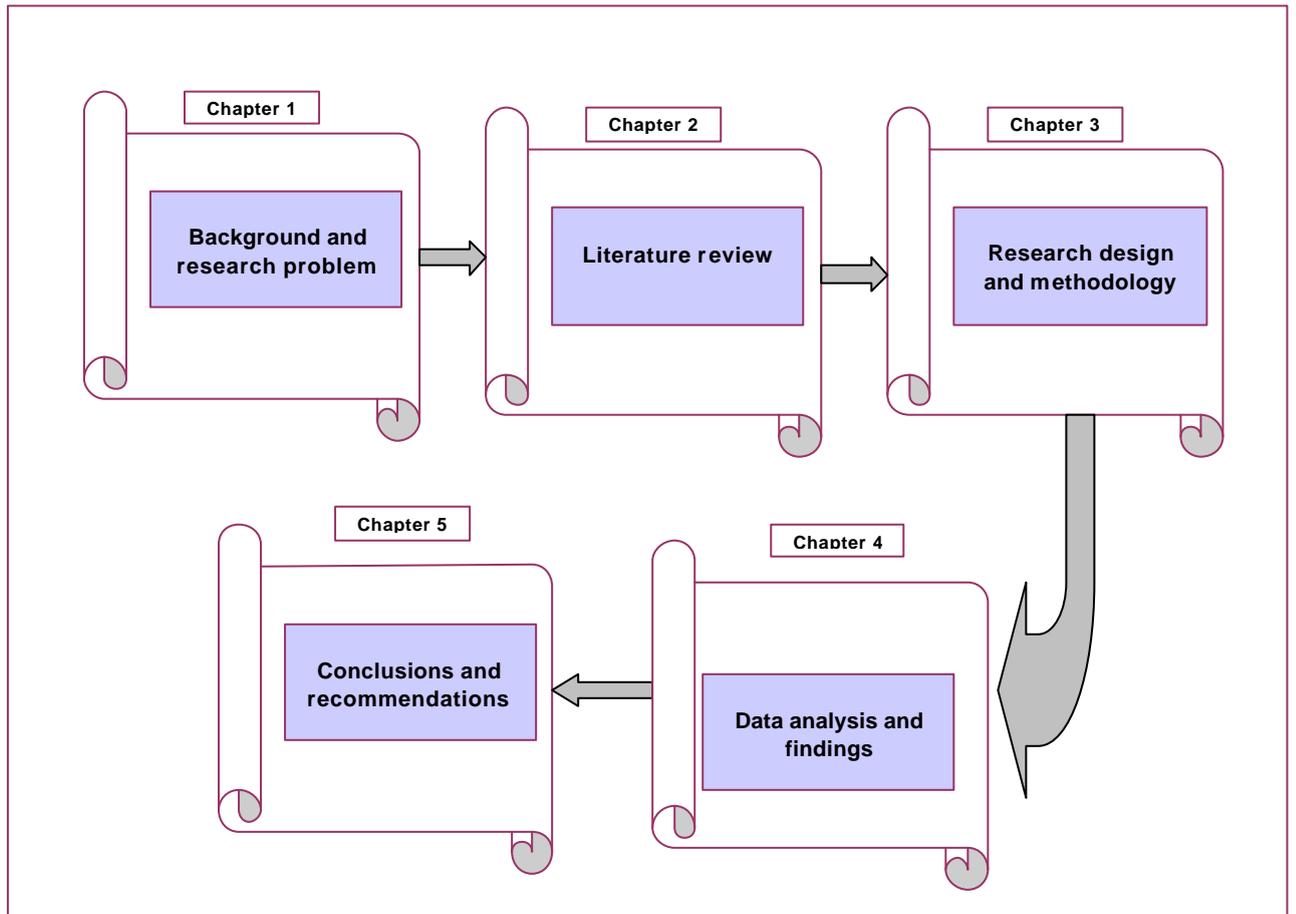
1.10 Summary

This chapter offered a description of the structure of the research project. The aims and objectives of research are focused on interactivity, the features of communication tools that promote and encourage interactivity, and the ways in which cognitive, motivational and learner interface factors affect interactivity.

This was an instrumental case study that investigated the level and frequent use of web-based communication tools in fully fledged course delivery, student guidance and modes of assessment of the format of Web Course Tools (WebCT) at a university that enrolls only full-time students. The unit of analysis was the case study, and the instruments that were used to gather data were interviews, observation, anecdotal notes, communication diaries, and a focus group.

The research will now be presented in the following five (5) chapters that are presented in graphic form in Figure 1.1 below.

Figure 1.1 A graphic presentation of the research



CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

“They know enough who know how to learn”.

- Henry Adams, 19th Century American writer

This chapter is a literature review investigating aspects that influence interactivity and affect learning in a web-based learning environment. The aspects reviewed and discussed in this chapter are informed by instructional and learning theories. The review of literature in this chapter comprises four sections:

- Conceptual framework
- Interactivity with reference to the levels, modes, components, and types of interactivity.
- Features of communication tools that promote interactivity in a web-based learning environment.
- Aspects that influence the use of communication tools.

2.2 Conceptual framework

The theoretical underpinnings of computer-integrated education lie within cognitive psychology where learning consists of individual constructions of knowledge (Delpoort, 2003). This study is not based on a single theory, but on a number of concepts drawn from the literature. Thus the word conceptual framework is used instead of theoretical framework. This conceptual framework consists of three main areas, (a) interactivity, (b) features of communication tools that promote interactivity, and (c) the domains, i.e. cognition, affective (motivation) and psychomotor (learner interface) as

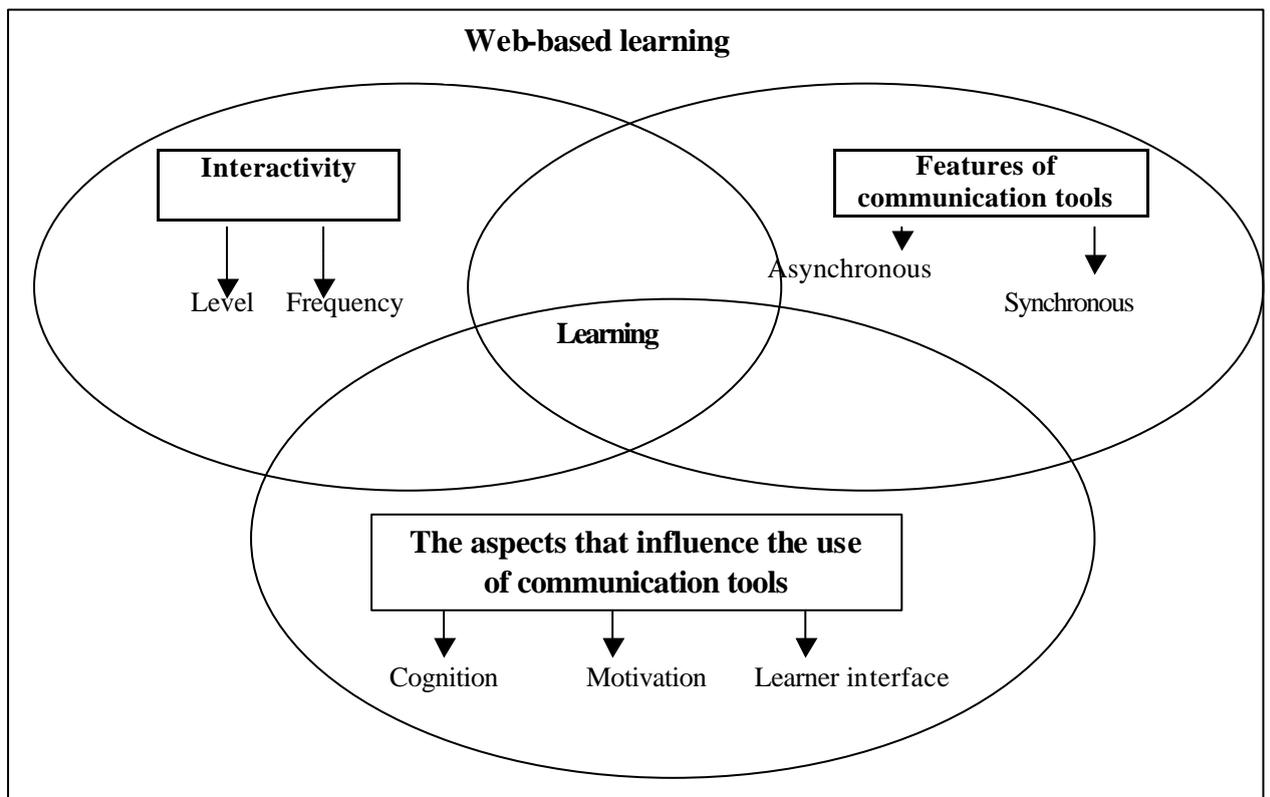
aspects that influence the use of communication tools. The main focus of the research is to answer the following three research questions:

1. What is the frequency and level of communication tools in a WebCT learning environment?
2. What are the features of web-based communication tools that promote interactivity?
3. How do aspects of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning?

Wittrock (1974) and Wetzel (1993) both state that generative learning implies that meaningful learning occurs when the learner actively and consciously relates prior knowledge to new material and creates understanding based on these relationships. Computers are defined as cognitive “artifacts” that enable and promote active and collaborative knowledge building (Lehtinen, Hakkarainen, Lipponen, Rahikainen & Muukkonen, 1999).

The conceptual framework is illustrated diagrammatically in **Figure 2.1**

Figure 2.1 Illustrated conceptual framework



2.3 Interactivity

There are multiple definitions for interactivity provided by various researchers and writers. For the purpose of this study the literature will define interactivity and related issues. The topics discussed are:

- Definition of interactivity
- Benefits of interactivity
- Principles of interactive learning in web-based learning

Definition of interactivity

Interactivity is seen as the connectedness (Repman & Logan, 1996) and interaction that the learners have with their distant lecturer, instructor, the site facilitator, learning content and their fellow learners (Sherry, 1996) in the learning environment.

Merrill's (1994) applied definition of an interactive transaction is:

“The mutual, dynamic, real-time give and take which is possible through a computer and which is not possible through a book... An instructional transaction is a dynamic interaction between the program and the student in which there is an interchange of information”.

According to Von Brevern (2004) learner-centered interaction in e-learning is about actively building knowledge in a learner's memory. He further states that the interactive and constructive process that delivers learning content embraces a multitude of facets and possible scenarios, for example, the roles, types and levels of interactions between the system, the instructor and the learner.

Cronjé (1996) supported by Moore (1998) states that interactivity in a web-based environment involves simulating the interchange between two people who are communicating meaningfully for the purpose of either task and instructional competition or social relationship building. Jonassen and Reeves (1988) explain that interactivity implies an activity between two organisms and with a computer-based application, involving the learner in a true dialogue.

Benefits of interactivity

Web-based tools, bulletin boards, e-mail and newsgroups are used to provide an alternative environment for class participation, group discussion and peer support (Delpoort, 2003).

Britain & Liber (1990) suggest that web supported learning using WebCT as a learning management system seems to afford a learning environment that is conducive to learning as it offers benefits that concord with the recommendations of the Dearing report. This is supported by Lee, Armitage, Groved, & Stephen (1999) when stating the affordances of web-based

communication environments. Table 2.1 compares the benefits of web-based learning environment based on these writers' suggestions.

Table 2.1 The benefits of web-based learning

Lee et. al. (1999)	Britain & Liber (1990)
1. Deep reflection opportunity is allowed, learners can refer back to things that were discussed earlier and they can take time to respond on-line.	<ul style="list-style-type: none"> • Flexibility of time and place
2. A textual, permanent record of interactions is retained which keeps all participants up to date	<ul style="list-style-type: none"> • Learner-centered learning reducing administration burden • Coping with increased learner numbers
3. English second language students can take the time to compose their response without being under pressure as in a face-to-face situation	<ul style="list-style-type: none"> • Flexibility of time and place
4. Opportunities for group-work and peer discussion are provided.	<ul style="list-style-type: none"> • Collaborative work

Table 2.1 shows some benefits of web-based learning. Learners' character and abilities to participate in collaborative learning differ, some participate more than others. South African students for whom English is a second language may feel pressure in a face to face situation. Web-based communication has facilitated the enhancement of learner interaction and participation. Participants are kept up to date by a permanent record of interactions.

Principles of interactive learning in web-based learning

The concepts around interactivity relate as much to the complexity of development and implementation as they do to the quality, effectiveness and engagement of human-computer communications (Sims, 1994).

Clarke & Cronjé (1996) agree that the events of a real classroom can be mimicked with positive pedagogic effect and that the metaphor of a virtual

classroom could motivate students by challenging them and giving them a sense of ownership.

In designing the learning task, Clarke & Cronjé (1996) followed principles adapted from Merrill (1991) as follows:

- *Learning is constructed from the experience of the learner*
- *Interpretation is personal*
- *Learning is an active process*
- *Learning is collaborative and enhanced by multiple perspectives*
- *Knowledge is situated in real life and that is where learning should take place*
- *Testing should be integrated with the task*

According to Merrill (1994), Jonassen (1988) and Alessi & Trollip (2001) the principles of good message design do not only focus on the structure of the physical form of the message which includes layout, visuals and graphics to sustain attention. It also focuses on how to compose the message to stimulate cognitive activity. The latter is supported by Kemp and Smellie (1994) who suggest that participation refers to engaging in mental and physical activity that will assist the learner in understanding and retaining the information presented.

Von Brevern (2004) states that the interactive and constructive process that delivers learning content embraces a multitude of facets and possible scenarios, such as the types and levels of interactions between the system, the instructor and the learner.

Grabowski (2004) argues that in terms of learner-content interactivity, available instructional material indicates that most instructional designers still tend to spend too much time on trying to make the computer do fancy things and not enough time on how to coax the learner into thinking and doing straightforward tasks. He further states that authors of computer-based

instruction should develop transactions, rather than frames. Webster (in Grabowski (2004) supports him by defining a transaction as; “a communicative action or activity involving two parties or two things reciprocally affecting or influencing one another”.

Grabowski’s (2004) assumption which is informed by Merrills’ (1988) model of how to address the issue of creating engaging and motivational instruction, is that one interaction can constitute a complete transaction, but only if it includes higher levels of all three (high-medium-low) criteria, which he cites as follows:

- *Mental activity which extends from being initially curious to composing a complete evaluative response.*
- *Type of learner response that extends from covert to overt.*
- *Computer response extending from the next output information from a linear path to an output that is dependent on learner inputs.*

Although web-based learning has obvious advantages in distance education settings, it can also be used productively for on-campus students. These communication tools allow learners to develop collaboration and idea-sharing skills (Van Ryneveld, 2000). Vygotsky (1987) suggests that learners achieve a higher level of development through interaction with other capable peers.

Oliver & McLoughlin (1996) point out that technologies, such as computer mediated communication, multimedia and television can now all contribute to a more dynamic learning environment. They further state that the pursuit of interactivity has widely become an important goal in the design of distance learning courses. Modern technologies have the potential to overcome the isolation of distance learning through the facility of communication lines that are responsive to an individual’s needs (Oliver & McLoughlin (1996).

2. 3.1 Levels of interactivity

Over the years there have been numerous attempts to identify levels of interactivity, with the underlying assumption that the higher the level of interactivity the better the product. Various authors have suggested different levels of interactivity (Berlo, 1960; Rhodes & Azbell, 1985; Jonassen, 1988; Schwier & Misanchuk, 1993; and Sims, 1994).

Table 2.2 shows the checklist for different levels of interactivity suggested by some authors.

Table 2.2: Checklist for the levels of interactivity

Author	Levels of interactivity						
	1	2	3	4	5	6	7
Rhodes and Azbell, (1985)	✓	✓	✓				
Jonassen, (1988)	✓	✓	✓	✓	✓		
Schwier and Misanchuk, (1993)	✓	✓	✓				
Sims R, (1994)	✓	✓	✓	✓	✓	✓	✓
Berlo (1960)	✓	✓	✓	✓			

The above table depicts clear existence of different levels of interactivity in web-based learning as can be observed. The interactivity ranges from three to seven levels. Comparison can be made on three levels suggested by Rhodes & Azbell (1985) together with Schwier & Misanchuk (1993) which are reactive, coactive and proactive, as well as, reactive, proactive and mutual, respectively. In contrast the latter suggest proactive as the second level and coactive as mutual and the highest level of interactivity. The following paragraphs describe the levels of interactivity as reflected in the above table.

Rhodes & Azbell (1985) identified three levels of interactivity, ranging from reactive (where there is little learner control of content structure with program

directed options and feedback) to coactive (providing locus of control or learner control for sequence pace and style) to proactive (where the learner controls the structure and content). However, Alessi & Trollip, (2001) point out that the underlying structure of a web site is independent of how the site appears structured to users. They further state that whatever is not controlled by the learner is controlled by the program.

Learners are more confident when they have more control. This is supported by Campbell's (1999) perception about interactivity as being extended or improved when the learner has more control, For example, communication tools usage, although that control would appear to refer more to navigation and manipulation than to instruction.

In contrast, Jonassen (1988) identified five levels of interactivity focusing more on the user's involvement with the application and the effect on learning. The five levels include the modality of the learner's response, the nature of the task, the level of processing, the type of program and the level of intelligence in design.

Schwier & Misanchuk (1993) based their detailed taxonomy of interactivity on three dimensions: levels (reactive, proactive, mutual), functions (confirmation, pacing, navigation, inquiry and elaboration) and transactions (keyboard, touch screen, mouse, voice). They further maintain that "...the levels of interaction are based on the instructional quality of interaction" which reinforces the suggestion that the higher the level of interactivity, the better the instruction.

One of the seven levels of interactivity proposed by Sims (1994), the Reflective Interactivity, is the class of interaction (proactive elaboration) where the learner controls both structure and content. Learners can reflect on their response and make their own judgment as to its accuracy or correctness. In addition to Internet-based instruction, Reflective activity as a technique can also be used successfully in an interactive-video project (Farrow & Sims, 1987).

Learners make connections between their experience and the course content. They share their frustrations and expectations and receive encouragement and support from one another. Even when the facilitator is a participant in the discussions, discussions are usually learner-centred and the dialogue continues even when the facilitator is no longer present (Van Ryneveld, 2000). Berlo (1960) provides a useful taxonomy of communicative interdependence that is used in this study.

In Berlo's (1960) taxonomy of communicative interdependence, interaction occupies the highest level. He indicates four levels of interactivity:

- *Definitional physical interdependence* which stresses the presence of a sender and a receiver. This is the lowest form of interdependence noted with limited interactivity.
- *Action/reaction of interdependence* refers to feedback existence which provides the source with information concerning his success in accomplishing his set objective. In doing this it exerts control over future messages which the source encodes. Berlo gives an example that if the audience supplies laughter as a feedback, future messages will be composed to evoke more laughter in the same way. Lack of visual feedback hinders action and reaction interdependence (Berlo, 1960).
- *Interdependence of expectation* involves anticipation, such as inferring meaning based on the activities of the communicating party. This level also needs active participation. Without feedback the lecturer is unable to maintain the level of interactivity (Borsook & Higginbotham-Wheat, 1991).
- *Interaction* The interaction of two people put them into each other's shoes (Berlo, 1960). They attempt to perceive the world the same way, as well as to predict each other's response (Borsook & Higginbotham-Wheat, 1991). Cronjé (1996) maintains that the "talk back" interaction

accentuated by very careful design in interactive television encourages interactivity. He further states that one has to consider the mode of interaction such as, the number of people participating interactively, in what time frame, and by which communication devices.

Even though class discussions and debates are a recognised instructional strategy that allows participants to share information and opinions, some learners (due to their character and abilities) participate more than others in such events. The emergence of web-based communication has facilitated the enhancement of learner interaction and participation.

The understanding of new content and information is enhanced through discussion and interactivity in which ideas are elaborated and challenged. However, research has shown that most teachers do not create a learning environment in which learner collaboration and discussion are encouraged or implemented (Dutt-Doner & Powers, 2000).

Communication involves more than one person and learners need appropriate learning environments and communication tools if the communication process is to take place effectively. In addition to the level of interaction, Cronjé (1996) recommends that one has to consider the mode of interaction such as, how many people participate interactively, by which devices and in what time frame. Modes of interactivity are discussed below.

2.3.2 Modes of interactivity

According to Cronjé & Blignaut (2000) the interaction is mediated through some communication channel and the time frame is specified. Cronjé (1996) cites three modes of interactivity, namely, the participation ratio, synchronicity and symmetry.

2.3.5.1 Participation ratio

Participation ratio is the total number of participants and the way they participate in interactivity. This ratio refers to one-to-one participation, one-to-many participation, group members to other group members, or to members of a group who are communicating and interacting among themselves. It has been noted that when the participation ratio rises, less interactivity occurs (Borsook & Higginbotham-Wheat, 1991).

2.3.5.2 Synchronicity

2.3.5.2.1 Synchronous interactivity:

According to Berlo (1960), this refers to the period in which interactions take place. If all participants are involved in interactivity at once or simultaneously, the form of interaction is called synchronous interaction. For example, when participants are brainstorming together in videoconference, they are engaged in synchronous interaction. Therefore, all participants need to be present in the room at the same time to be able to participate live and actively. Participants can be involved in synchronous interaction from different geographical locations. Gates (1995) argues a general human preference for asynchronous interaction by stating “It is a human nature to find ways to convert synchronous communication into asynchronous forms.”

2.3.5.2.2 Asynchronous interactivity:

Unlike synchronous interactivity, asynchronous interaction need not take place simultaneously. Asynchronous interactivity involves participation through e-mails at different times convenient to the individual participant. An example of asynchronous interactivity would be when a facilitator sends a notice to all the group members via group e-mail, for example, Yahoo groups or when learners send requests for certain information to their teacher or fellow learners via e-mail. The recipient only becomes aware of the request after checking and reading the particular e-mail. This does not guarantee an

immediate response to the sender. This may take some time or even days before the recipient responds at the time convenient for him to do so – depending on the circumstances.

2.3.5.3 Symmetry

Cronjé (1996) explains *symmetry* as the “combination of technology mediating interaction” (Cronjé , 1996:4). This implies that all the participants make use of the same medium during interactivity. This, for example, takes place when a group meets in a chat room.

On the other hand, when teachers teach by means of real-time television broadcasting, the interactivity is referred to as *asymmetrical interaction* (Conje, 1996). The teacher uses all television features (video and sound) and teaches a large audience of students by accepting telephone calls, e-mails, voice mails, cell phone-SMS (Short Message Service) or faxes from students who have specific questions or problems. Cronjé (1996) asserts that in such situations, feedback is provided by means of a technology other than the one that was originally used.

Borsook & Higginbotham-Wheat (1991) base interactivity on seven components. These components are discussed below.

2.3.3 Components of interactivity

According to Malone, (1981) the main objective of instruction should be to promote and guide active mental processing on the part of the learner. He further explains that a well-designed instructional material allows the learner to engage in a task that is similar to the real world and would receive feedback concerning the adequacy of his or her performance. On one hand Malone (1981) emphasises the importance of designing instructional material using metaphors with which learners are familiar. He further suggests that an online teacher must be able to plan, stimulate and manage the key interactions. On the other hand, Sims (1994) argues that for teachers to be

recognised as developers with professional capabilities, and as competent practitioners, it is critical to understand what makes an application interactive, instructional and effective.

Hannafin & Peck (1988) feel that both intellectual skills and learning strategies should be fostered. They emphasise instructional design principles based on cognitive learning theory that instructional media should support orientation and recall of prior knowledge. Liaw & Huang (2000) state that instructional designers should strive to implement web-based instruction with a high quality of interactivity.

Good assignments stimulate learners to become active participants and become successful learners who achieve the outcomes during the learning process, instead of being passive recipients of barely understood instructional material that is later regurgitated without true understanding of the content.

Interactivity based on seven components according to Borsook & Higginbotham-Wheat, (1991) is listed as follows:

- Immediacy of response
- Non-sequential access of information
- Adaptability
- Feedback
- Options
- Bi-directional communication
- Appropriate grain size

Although the *immediacy of response* is highly valued by both teachers and learners it is difficult to ensure immediacy of response within a specific asynchronous time frame in a web-based environment. Therefore, for effective learning facilitation in the Web, learners and teachers make a binding agreement, stating, at least, the minimum frequency for any specific interactivity (Borsook & Higginbotham-Wheat, 1991).

Instant feedback appeals enormously to all participants involved in Internet communication to learners and teachers alike as synchronous web communication tools are becoming more populated. With web-based video conferencing in a synchronous time frame, as Borsook & Higginbotham-Wheat (1991) point out, the response is almost instantaneous.

Non-sequential access of information in a synchronous time frame refers to a situation where learners randomly ask questions during a facilitated group discussion in a web-based conference and the teacher is forced to deviate from his or her planned teaching sequence and respond to those questions and interruptions from the group members.

Asynchronous conditions provide learners with the locus of control. Learners are provided with hyperlinks to browse randomly through the content on a web page (Alessi & Trollip, 2001).

Adaptability in a web-based learning environment refers to flexibility in learning pace. The learning program allows fast learners who have mastered the section of work to proceed to the next section. Slow learners are allowed to complete the tasks at their own pace. Pretests in programs are good examples of adaptability, because they define learners' pre-knowledge and therefore indicate the specific areas of concentration in the course.

Feedback is based on interactivity. The bulletin board can be used by students who may need to submit messages of general interest. Hooper & Hannafin (1988) maintain that feedback provides the source with the information. A teacher may use a bulletin board to post a task and learners may post their solutions back to the bulletin board. The teacher is then able to assess the learner's level of understanding.

Contrary to simple menu selection, clickable objects, or linear sequencing, feedback is an important part of interaction that stimulates cognitive and

physical activity. The learner is an active participant rather than a passive recipient of information in the learning process.

Alessi & Trollip (2001) state that operationally, the designer and programmer provide *options* for learner control; and whatever they do not provide options for the learner, is controlled by the program. Web-based learning material should allow the learner a sufficient number of options. According to Jonassen, (1988), the quality of the interaction in microcomputer courseware is a function of the nature of the learner's response and the computer's feedback. The response is considered meaningful if it is consistent with the learner's information processing needs.

The implementation of interactivity can be perceived as art because it requires a comprehensive range of skills, including an understanding of the learner, an appreciation of software engineering capabilities, the importance of rigorous instructional design and the application of an appropriate graphical interface (Sims, 1994).

According to Sims, (1994) a well-designed course should contain a large number of appropriate graphic representations of content specifically for learners who find it easier to learn the same content by means of graphics, diagrams and cartoons. In addition to allowing learners to have options, learners can also be allowed to choose their preferred medium in which they present their assignments (Sims, 1994). Preferred media may involve e-mailing an attachment, a bulletin board, faxing a word processed document, file transfer protocol, WebCT, or publishing a website. By applying these interactive concepts to multimedia courseware design, the various media elements can be integrated, based on instructional decisions rather than visual appeal. This allows more effective communication and therefore potentially more educational effectiveness.

Bi-directional communication refers to interchange between two people who are communicating meaningfully and involved in a true dialogue. Cronjé, 1996; Jonassen, 1988; Moore, 1989; Cyr & Smith, 1990; and Repman &

Logan (1995) all support the motion that learner-content, instructor-learner and learner-learner interactivity involves two-way communications. While participants are active in bi-directional communication in the main room, they can also participate in the private chat behind the scenes (Van Ryneveld, 2000). This is referred to as *multi-directional communication*.

Grain size refers to a timeframe given to a participant to give further input during discussions in a chatroom. The nature of web-based communication tools encourages two-way communication. For example, in a synchronous communication, “bots” normally kick out the one who floods the communication channel (van Ryneveld, 2000). “Flooding” in a chatroom is when one person sends more than a specified number of messages before anyone else responds. Web-based instructional designers should consider grain size principles for effective interaction.

2.3.4 Types of interactivity

“Ideal teachers facilitate activities, render guidance, clarify expectations, interpret body language, address individual needs, promote discussions elaborate concepts and provide timely and appropriate feedback as they teach” (Hirumi & Ley, 2000).

While both Cyrs & Smith (1990) and Repman & Logan (1995) identified four types of interactivity, Moore (1998) identified three types of interactivity. Kearsly (1995) observes that both synchronous and asynchronous interactivity are also possible in the distant learning environment. Table 2.3 below gives a summary of various types of interactivity as synthesised and adapted by the mentioned authors.

Synchronicity refers to the time of interaction (Cronjé, 1996). Synchronous interactivity occurs simultaneously when both participants are present at the same time. Asynchronous communication takes place when the participants are not present at the same time. The table below indicates two forms of

interactivity: asynchronous and synchronous interactive communication. Possible types of interaction shown in the table include instructor and learner, instructor and instructor, instructor and designer, as well as, learner and the content.

Table 2.3: Types of interactivity

Form of interactivity	Type of interaction	Description
	Instructor → learners	One-way communication (information giving): <ul style="list-style-type: none"> • Instructor gives further instructions for clarity to learners. • Instructor sends messages of encouragement and motivation. Feedback and guidance is also provided. • Expectations and outcomes are clarified.
	Learner → instructor	One-way communication (information seeking): <ul style="list-style-type: none"> • Learner interacts conveniently with the instructor about individual learning problems.
	Instructor → instructor	One-way communication. <ul style="list-style-type: none"> • Instructor interacts with another for support and managing their own tasks and performances.
	Instructor → designer	One-way communication. <ul style="list-style-type: none"> • Instructor interacts for guidance and support in implementation and management of instructional material design.
	Learner ↔ content	Two-way live communication. <ul style="list-style-type: none"> • Learner is cognitively and physically engaged with the learning material.
	Instructor ↔ learner	Two-way live communication <ul style="list-style-type: none"> • Instructor encourages questions and feedback from learners.

<p>Synchronous- interactive when accessing and processing graphical information.</p> <p>Asynchronous- interactive when using online communication tools, e.g. e-mail or posting to bulletin board.</p>	<p>Learner ↔ interface</p>	<p>Ability to make technology transparent for the learner.</p> <ul style="list-style-type: none"> • Online multimedia and other graphical information are accessed.
<p>Synchronous- interactive communication during live communication e.g. video conferencing.</p> <p>Asynchronous- pre- and post instructional design contact e.g. e-mails.</p>	<p>Designer ↔ Instructor</p>	<p>Interactive communication is planned for designers and instructors.</p> <ul style="list-style-type: none"> • Evaluation, implementation and management issues of instructional material design are discussed and addressed.

The table above describes the interactivity as either one-way or two-way communication. One-way communication is asynchronous and it involves information giving by the instructor or information seeking by the learner. Two-way communication is live and synchronous. It occurs when the learner is cognitively and physically engaged with the learning material and the instructor encourages questions and feedback from the learner (Sims, 1994).

According to Sims (1994) educational products will likely require more complex forms of interactivity (including synchronous, asynchronous) depending on the specific strategy employed for the application.

Content and social interactivity involve two types of interactivity such as, on one hand, *instructional content interactivity* which is stimulated through feedback and questioning and, on the other hand, social interactivity which provides potential for social and interpersonal interaction that fosters content and instructional interaction directly (Liaw & Huang, 2000).

Table 2.4 displays the two categories of interactivity adapted from Liaw & Huang, (2000). Each category describes the benefits of interactivity.

Table 2.4: Content and social interactivity

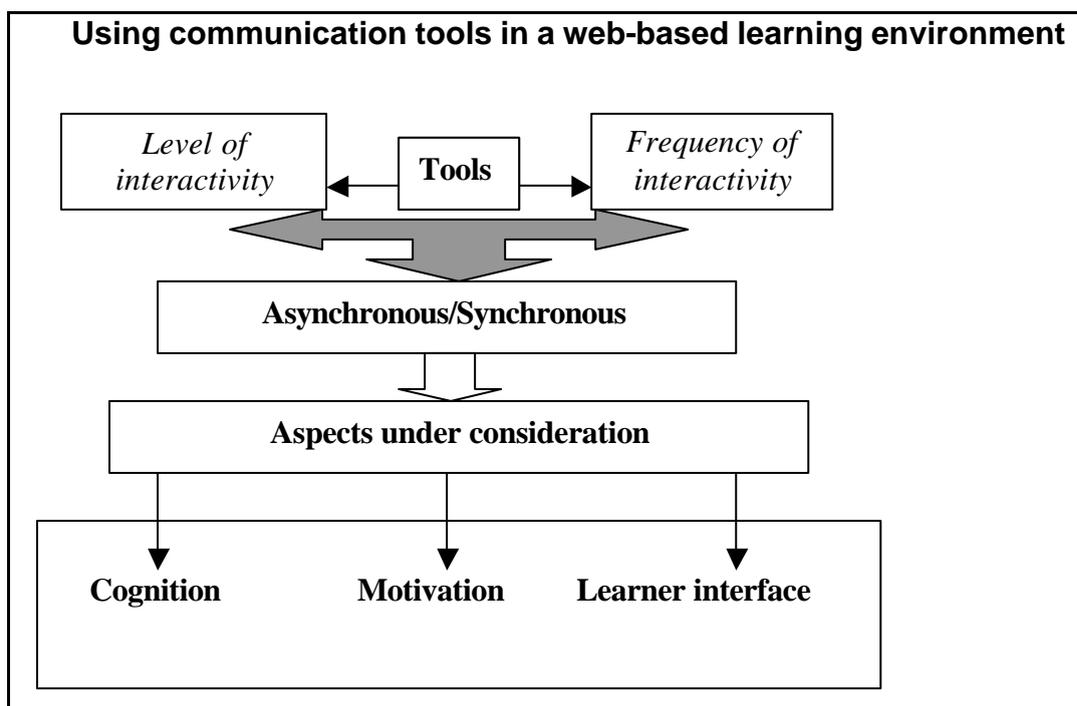
Type of interactivity	Description
Instructional content interactivity	<ul style="list-style-type: none"> • Allows individuals to explore abundant and diverse bits of information their own ways. • Content interactivity may be stimulated through immediate feedback, questioning, and sequencing as well as control of pacing and other interactive controls. • Non-linear content interaction leads learners to reflect more on their own knowledge construction. As a result content interactivity approaches the constructivist epistemology.
Social interactivity	<ul style="list-style-type: none"> • Occur through e-mail, voice mail discussion lists, newsgroups, chatrooms, bulletin boards, online conferences or any other two way communication media that are integrated into web-based communication technology. • 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 negotiating without face-to-face communication. • Fosters content and instructional interaction directly.

While instructional content interactivity approaches constructivist epistemology by allowing individuals to explore diverse information in their own ways, the table above shows that social interactivity is provided by web-based two-way communication tools such as e-mail, voice mail discussion lists, newsgroups, chatrooms, bulletin boards and online conferences.

Participants engage in side-by-side and online questioning, answering, discussion, debate or negotiating without face-to-face communication (Liaw & Huang, 2000).

Figure 2.2 further illustrates how the conceptual framework practically fits in the context of a web-based learning environment. The case study investigates the frequency and level of interactivity, features of communication tools that promote interactivity, such as whether the tool allows synchronous or asynchronous communication, as well as factors that influence the use of such tools. These factors are cognition, motivation, and learner interface. The figure below shows the implication of using communication tools in a web-based learning environment.

Figure 2.2 Level and frequency of interactivity using communication technologies



(Adapted from Van Ryneveld, 2000)

This study acknowledges the existence of other aspects that can influence the use of communication tools; however, the focus of this study considers only the three factors that may influence the use of web-based communication technology to facilitate learning. For the purpose of the case study the figure

above shows cognition, motivational and learner interface as factors to be considered.

Effective learning takes place as parties involved use a medium of communication to create, present, interpret, analyse and critically discuss ideas and information. Internet communication tools can be used to facilitate learning.

Participants may choose to interact more or less frequently at a low or high level of Bloom's cognitive taxonomy. Sims (1994) points out that the way in which the motor, cognitive and collaborative elements of interactivity coalesce with the task being undertaken contributes to the successful engagement of the learner with the activity.

Communication can be asynchronous or synchronous depending on the task being undertaken. The literature states that the requirement for motivating instruction is to gain and maintain the attention of the learner and to meet their personal needs by matching the instruction to learners' goals by keeping the challenge level appropriate (Bohlin, 1999). According to Gilbert and Moore, (1998), two types of interactivity are cognitive or individual interaction (interaction with content) and social or interpersonal interaction. The social view of interactivity places emphasis on a collaborative and cooperative learning environment and encourages active dialogue (Moore, 1991).

Web-supported learning using WebCT as a learning management system provides a conducive learning environment as it offers benefits that agree with the recommendations of the Dearing report (in Britain & Lieber, 1999). These benefits include:

- Flexibility of time and place
- Coping with increased learner numbers
- Collaborative work
- Learner-centered learning
- Sharing and re-use of resources
- Reducing the administration burden

2.4 Research implications

The literature survey addresses the research question about the frequency and level of interactivity in web-based learning. In the case study learners interact with WebCT as a learning management system. WebCT known as MyWebCT at this university was used as a platform in the case study and relates to the recommendations of the Dearing report as follows:

Flexibility of time and place

Students easily upload and download files anytime. Lecturers load and update information and assignment instructions to be shared by all students for example, due dates of work to be submitted.

Coping with increased learner numbers

The site is personalised by the individual's name appearing on the bar.

Collaborative work

Group discussions allow members to participate in forums and debates on given topics. These technologies are helpful in fostering learner interaction among other learners, facilitator/lecturers and other experts.

Learner-centered learning

Students download tasks and upload completed assignments for lecturers to grade and provide individual scores and feedback. Customised feedback and necessary information can be sent to an individual learner.

Sharing and re-use of resources

At least a four-member group can be accommodated in text only, real time discussion or in participation. A shared calendar can be used to note important dates, for example, assignment due dates, test dates as well as consultation dates and times.

Reducing the administration burden

All postings and attachments are stored in an e-mail archive for an unlimited period. Entry is restricted by Authcate password.

2.5 Features of communication tools that promote interactivity in a web-based learning environment

“On a key stroke, the thoughtful have time to think and the shy have courage to speak and the tedious can be deleted by the merciful stroke of a key or two” (Farrington, 1999: 85).

Since interactivity implies the presence of a channel that allows for two-way communication, it is necessary that learner activities be planned in such a way that students are actively involved in the learning process. Certain kinds of web-based communication technology have excellent features that support this kind of activity. The use of communication tools, for example, e-mail, bulletin boards, conferencing systems, whiteboards, chatrooms and videoconferencing is increasing at tertiary level (Cronjé, 1996). The features of modern graphical user interfaces (GUI's) provide convenient methods of giving help (Alessi and Trollip, 2001).

In chatrooms learners participate without the limitation inherent in waiting for one's turn that is unavoidable in face-to-face communication. Hirumi and Ley (2000) suggest that teachers draw up an Instructional Treatment Plan.

The Instructional Treatment Plan describes each learning event and the type of interaction which is informed by the activity outcome. Table 2 also shows the description of the web-based communication tool suggested per learning event.

Table 2.5 presents three examples based on the Problem-based Learning Model developed by Barrow in 1993.

Table 2.5: Example of an Instructional Treatment Plan

Learning Event	Description	Type of Interaction	Web-based communication tool
Information research and summary	Fact-finding. Learner should present their findings.	Learner + content	Learner-generated web page.
Problem solving	Learners are required to discuss and argue the problem amongst them.	Learner + other learners	(Synchronous discussion)
Information giving	Learner is motivated; feedback and guidance are provided.	Instructor + learner	Bulletin boards and e-mails (Asynchronous)

The table shows that the purpose of a learning event can be information seeking, by the learner, information giving, by the instructor or lecturer, or, a learning event can also take place through research and problem solving. Web-based communication tools can be synchronous or asynchronous.

By following the instructional treatment plan, technological tools that support the interaction may be selected. Teachers can also design and sequence the web-based interactions that form the necessary part of their educational programme.

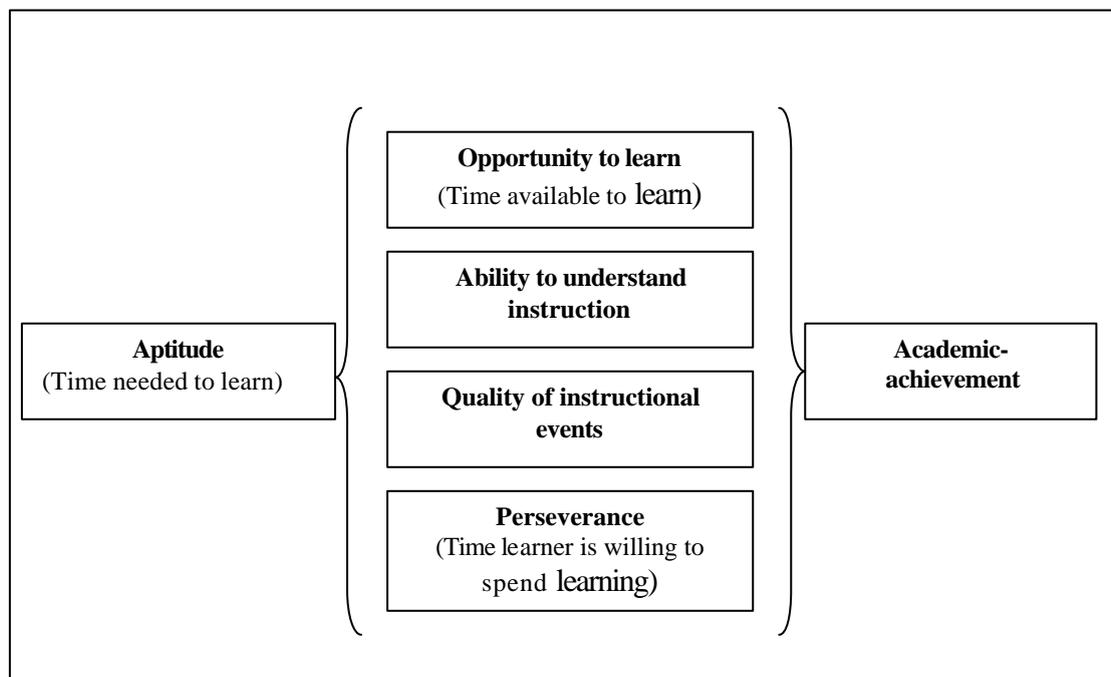
Reeves (1997) developed another model in order to describe what he believes are the effective dimensions of interactive learning on the World Wide Web. The model is based on the Carroll Model of School Learning (shown in Figure 2.1) originally designed by John B Carroll (1963) and then revised by its originator in 1989 (Huiit, 1997; McIlrath & Huiit, 1995).

For the purpose of this study this model is included as a framework for further understanding various factors that account for learning when the web is used

as a vehicle for the design and delivery of a higher education learning environment.

Figure 2.3 shows Carroll's model of school learning.

Figure 2.3: Carroll's Model of School Learning



Interaction involves more than one person. It is mediated though communication technology, and the time frame is specified Cronjé (1996). Carroll's model of school learning shown above emphasizes the importance of time frames during the process of learning in order to achieve the specific learning outcomes.

Reeves (1997) foresaw that the use of the web would grow in higher education: Cronjé (2000) agrees that research has shown that the use of the Web continues to expand in higher education. According to Daniel, (1996) computer-mediated communications enable many universities to enhance intellectual interaction by re-creating a sense of academic community, which may have been eroded by growth and diversifications. Reeves (1997) argues that the use of the web in teaching and learning is underutilised and placing a course on the web does not guarantee learning. Bruce and Shade (1995)

advise that the instructor and the learner should be comfortable with the technology used, if not, the technology becomes a learning barrier.

This case study therefore, focuses on the level and frequency of interactivity in the web-based learning environment between:

- *Learners and content*
- *Learners and teachers*
- *Teachers and designers*
- *Learners and communities*
- *Learners and themselves* (Hirumi & Ley, 2000)

Internet technologies create new possibilities for introducing flexibility for learners in terms of time, place and pacing of independent study (Butcher, 1999). Interaction can either take place synchronously, which is real time interactivity or delayed interactivity which is asynchronous.

The choice of computer-mediated communication according to Moore (1996) and Harrison (1997) depends on the purpose of the communication as well as the factors listed below:

- Availability and level of Internet connectivity and access for all participants.
- Availability of appropriate hardware and software for student and instructors.
- Availability of training and support in the use of the various technologies.
- Copyright and ownership issues for text, graphic, audio and video material.
- Cost of acquisition, support and use of appropriate technology.

A definite differentiation has to be made between synchronous and asynchronous interactivity (Kearsly, 1995).

Synchronous interactivity refers to communication during the actual time between the instructor or subject matter expert and learners at the remote site. It can also involve same time scheduled interaction between learners at different geographical sites Klivans, (1994). Chat systems allow synchronous on-line discussion whereby participants simultaneously communicate with one another.

Most chat systems are text based and these instant messages convey two types of information. One is the message *content*; the other is the indication for the participant's *presence*. Participants more often feel compelled to post messages merely to indicate their presence. That occasionally results in banality of the conversations and all in the cause to maintain presence by constant speech, even when one has nothing to say (Donath et al., 1999). The next section discusses web-based features that support synchronous interactivity.

2.5.1 Web-based features that support synchronous communication

Web-based features that support synchronous communication include:

2.5.1.1 Teleconferencing

- Video conferencing, which requires a computer video/sound, capture card for each participant (*different location*) in the conversation. Common programs for video conferencing are *NetMeeting*, *iVisit* and *CuSeeMe*. They have a large amount of bandwidth and fast network response (Evard, 1993).
- Voice/Audio Teleconferencing. Users must have additional software (*plug-ins*) for their web browser. They must also have speakers and

microphones connected to their computers. This feature allows users to communicate aurally, just like on a telephone (Alessi and Trollip, 2001). Some audio teleconferencing software allows a user to see what is on another user's computer screen, permitting them to view the same files while discussing them orally.

2.5.1.2 Chatrooms

- Internet Relay Chat (IRC) is real time, mainly text-based interaction taking place in chatrooms. This text-only discussion system is delivered via a networked computer chat server.
- Multi-User-Dungeons Domains (MUDs) and MUD Object-Orientated (MOOs), were traditionally used as gaming environments. They are synchronous communication sites in which people take and play roles. MUDs have the potential to set up virtual “places” from all over the world.

2.5.2 Web-based features that support asynchronous communication

Of the various computer-mediated methods, (asynchronous) electronic mail has been most widely used in higher education (Holden and Wedman, 1993). In asynchronous learning interactivity covers the interaction that takes place in other than a real time basis. Learners for example, interact with one another at their convenient time, pace and place. “It is human nature to find ways to convert synchronous communication into asynchronous forms” (Gates, 1995). Asynchronous communication allows students to stand back consciously from their experience and then, having reflected upon it, argue about it (Laurillard, 1996).

Web-based features that support asynchronous learning include bulletin boards, e-mail, and mailing listservs. This section provides a brief description of web-based communication tools that support asynchronous interactivity.

2.5.2.1 Bulletin boards

A bulletin board is a web site that may be restricted to particular users permitted to connect and access or post items such as text messages or pictures. Unlike e-mail that delivers messages to your mailbox, it is the responsibility of a user to periodically visit the bulletin board, browse and check the contents. The most popular type of bulletin board is the Newsgroup.

2.5.2.2 Listserv(s)

A listserv or *mailing list server* is a large mailing list with a single e-mail address that contains a list of other e-mail addresses. Some listservs are moderated by the list owner who must approve every message as appropriate before it is sent to all other members. Unmoderated listservs allow any message by a subscriber to be immediately sent to all other subscribers.

Listservs are created and maintained by a moderator - usually a facilitator where subscribers, i.e. learners and experts, can contribute by sending mail to the listserv address.

Some listservs have open subscription where anyone may become a member and others have closed subscription where the list owner creates the list or approves requests to be included on the list (Alessi & Trollip, 2001).

The challenge with listerv is that there can be an abundance of mail traffic. The messages may not all be of interest to all the subscribers of the list.

2.5.2.3 E-mail

Numerous electronic mail (e-mail) accounts are freely available to anyone willing to put up with commercial advertising, which normally fills the mailbox

with junk mail. Using either a web browser (such as *Netscape Navigator* or *Internet Explorer*) or a dedicated e-mail program such as *Microsoft Outlook*, people can send messages to one another with text, pictures, sound and movies.

Users are connected to the mailing service and have access to a mailbox in which messages are received or sent to other users. This makes electronic mail a convenient and an ideal medium for considered discussions about topics of mutual interest.

2.6 Research implications

This piece of literature survey leads to respond to the second research question about features of communication tools that promote interactivity in a web-based environment. Literature suggests the use of instructional plan to select technological tools that support the interaction (See Table 2). Tools that allow synchronous and asynchronous communication on WebCT in this case study are briefly discussed below:

2.6.1 WebCT communication tools

2.6.1.1 Synchronous communication

Chat tools are organized into rooms, where different groups gather and participate in real time discussions. In chatrooms learners have unlimited participation. Unlike in face-to-face communication there is no need to wait for one's turn.

Video conferencing (CuSeeMe) is synchronous students and lecturers interactivity between Monash Australia and Monash South Africa at the

scheduled real time or live interaction. Students share their opinions and frustrations in learning with their fellow students.

2.6.1.2 Asynchronous communication

2.6.1.2.1 Discussion tools

These are also called Bulletin boards or message boards. This feature allows lecturers and students to post messages which are visible to the entire class. Both original messages and replies are in a chronological order.

2.6.1.2.2 Mail tool

This mail tool is similar to any e-mail package. It allows participants to send and receive e-mails but only within their WebCT unit.

2.6.1.2.3 Student presentation tool (file sharing)

The site is personalised by the individual's name appearing on the bar. Students download tasks and upload completed assignments for lecturers to grade and provide individual scores and feedback. This feature also optionally confirms all uploaded and submitted assignments by e-mail.

2.6.1.2.4 Mailing lists

Mailing list also known as listservs is used by learners to support one another. Students also send their assignments as mail attachments to the lecturers. All messages posted to members are kept for an unlimited period.

2.6.1.2.5 Cellphone messaging

Through free Short Message Service (SMS), text messages are sent from any computer connected to the internet to a mobile phone. Students and lecturers communicate urgently through this communication tool. Users are easily reachable anytime and anywhere.

2.7 Aspects that influence the use of communication tools

“... Don’t Put Your Notes on the Web” (Worthington, 2002).

Rather stimulate cognitive and physical activity instead of clickable objects and simple menu selection. The cognitive approach to educational technology views a learner as an active participant (Saettler, 1990) in the learning process rather than a passive recipient of information. The next section discusses learning theories which inform this study.

2.7.1 Learning Theory: Definition

“In order to achieve any outcome, interaction is required” (Cronjé, 1997).

According to Cronjé (1997), two extremes exist in learning theory. On one hand is a constructivist approach, which is learner-centered and allows learners to construct their own meaning. On the other hand is an objectivist approach which advocates behavioural mastery learning as a method to train the learner.

2.7.1.1 Behavioural mastery learning

Behaviourist learning theory is based on the objectivist theory that knowledge exists outside the learner, and the learner needs to be trained until his/her comprehension of that knowledge is as close to the actual, object (knowledge) itself. Learners have to master certain concepts before being allowed to progress to a deeper level of understanding. The emphasis is on efficiency rather than effectiveness (Cronjé, 1997).

The behaviourist concept of educational technology tends to be focused on the lower cognitive processes with motives being controlled through conditioning, such as reinforcement through stimulus-response (SR) bonds (Saettler, 1990). By the 1970s the behaviourist model was replaced by the cognitive approach that attempts to understand the internal processes of behaviour and emphasises knowing rather than responding (Alessi and Trollip, 2001). The cognitive approach to educational technology views the learner as not passive, but as active, constructive and playful (Seattler, 1990). The cognitive constructivist learning is discussed below.

2.7.1.2 Cognitive constructivist learning

In contrast with the behavioural learning theory, cognitive learning (Merill, 1991) assumes that knowledge is a constructed, rather than a learned response acquired by active mental processing and collaborative interpretation. Hannafin & Peck (1988) emphasise the importance of existing knowledge of learners and suggest that learning may be more efficient when the instruction is adapted to the individual needs of the learners.

For the purpose of this study, three factors that influence the use of communication tools in a web-based learning environment are identified as *cognition, motivation and learner interface*. In 1956 Bloom and his colleagues began development of a taxonomy in the cognitive, attitudinal (affective) and psychomotor domains.

Bloom's cognitive taxonomy includes six categories as explained from Bloom et.al. (1964).

1. *Knowledge* or recall of data, expresses the natural urge to recall previously learned material. It provides a basis for higher levels of thinking.

2. *Comprehension*, the ability to grasp meaning, explain, restate ideas, means understanding the basic information and translating, interpreting, and extrapolating it.
3. *Application*, or using learned material in new situations, involves using information, ideas, and skills to solve problems, then selecting and applying them appropriately.
4. *Analysis* suggests separating items into component parts and showing relationships between parts. It also means breaking apart information and ideas into their component parts.
5. *Synthesis* suggests the ability to put together separate ideas to form new wholes of a fabric, or establish new relationships. Synthesis involves putting together ideas and knowledge in a new and unique form. This is where innovations truly take place.
6. *Evaluation* is the highest level in this arrangement. Evaluation involves reviewing and asserting evidence, facts, and ideas, then making appropriate statements and judgments.

The listed six categories above indicate Bloom's levels of cognitive aspect with description of the skills which will demonstrate achievement of specific outcomes. The theoretical underpinning for computer-integrated education lies within cognitive psychology where learning consists of individual constructions of knowledge (Delpoort, 2003).

2.7.2 Cognitive aspect

Cognitivism, the bridge between objectivism and constructivism, is the key element in the web-based communication tools and the user. In implementing cognitive learning, designers and educators stress aspects such as relating the new learning to prior knowledge and skills.

The adjective *cognitive* is derived from the word *cognition*, which means the process of knowing. The term places emphasis on unobservable constructs, such as the mind, attitudes, thinking, motivation, reflection, memory and other presumed internal processes (Alessi and Trollip, 2001). According to

Reigeluth and Moore (1999), cognitive education comprises methods that help students in recall and recognition of knowledge, as well as developing their understanding and intellectual skills, including metacognition, which is thinking about thinking - the ability of learners to plan, monitor and control their own cognitive processes and performance and to select learning strategies for themselves (Winn, 1990; Osman and Hannafin, 1992).

Critical thinking as the process of collecting information, processing it, and using the information for wise decision making and informed problem solving, De Bono (1999) suggests that critical thinking is a skill that can be developed with time and practice

Reigeluth (1983) encourages instructional theories in a wide variety of different areas and not just in the cognitive domain where necessary theories are for fostering understanding, developing metacognitive skills, building higher order thinking skills. He suggests that instructional theories should also be in the affective domain where guidance for developing “emotional intelligence” and “character education” is needed. The motivational aspect is discussed below.

2.7.3 Motivational aspect

Motivation refers to attitudinal and affective aspects of instruction and learning. The two types of motivation affecting a learner in a web-based learning environment could either be intrinsic (internal) motivation stemming from intellectual curiosity sparked by a certain topic or subject, or extrinsic (external) motivation influenced by the incentives or a reward once a particular task has been successfully completed (Wager, 1998). According to Gagne, (1985) learners with intrinsic motivation exhibit epistemic curiosity that may be caused by incongruous ideas, beliefs or attitudes about the subject,

which suggests that curiosity is based on lack of knowledge about a particular problem.

Keller's (1983) Motivational design entails instructional strategies that motivate learners and do not frustrate them. The Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivation (Keller and Suzuki, 1988) advocates gaining attention, demonstrating relevance, instilling confidence, and providing satisfaction during learning. Norman and Spohrer (1996) emphasise the motivational value of interactive multi-media technology. With reference to web-based learning, Malone (1981) extrapolates the motivational factors of curiosity, fantasy, control and challenge from games theory.

Engaged students are motivated students and computer-based materials have the potential to retain attention by providing information, which is concrete yet perceptually not difficult to process. The rapidity of interaction and timeous feedback engages learners and keeps them motivated. The challenge to instructional designers and educators in general is to synergistically integrate creative, motivational and unconventional approaches to create instructional materials that promote authentic learning (De Villiers, 2002).

2.7.4 Learner interface

According to Piaget (1972), all organisms have cognitive elements that manifest themselves into grasping and thinking behaviour i.e. overt and covert respectively. These sets of behaviour determine how an organism interacts with the environment as it develops. He suggests that the cognitive structure is modified through the dual processes of assimilation and accommodation.

2.7.4.1 Instructional design aspects

Interactive multimedia as an ideal medium that stimulates active learning, involves integrated animation, suitable text style, hypertext, images, sound

and video, and a user-friendly interface. According to Hillman, Willis and Gunawardena (1994) learner-interface interactivity refers to the ability to make the technology transparent for the learner.

Engagement and control involve 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).

2.7.4.2 Locus of control

Locus of control refers to whether control of a program is given to the user or lies with the program. The designer provides options for learner control and the program controls whatever is not provided for the learner.

If both the learner and instructor are not comfortable with the technology, the technology becomes a learning barrier (Bruce & Shade, 1995). It is important that the designers follow an instructional design to ensure that technology-mediated instruction is used properly, because some barriers may be mismatch between technology and instruction and unnecessary emphasis placed on the technology by the instructor (Repman & Logan, 1996). Gagne, (1992) adds that the external requirements of the instruction must match the internal conditions of learning.

In his Flow Theory of Optimal Experience, Csikzentmihalyi, (1990) defines the experience when learners become very engaged and absorbed by certain activities as:

“...the state in which the 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” (Csikzentmihalyi, 1990).

This motivating “flow” is achieved if web-based technologies are designed in a way that they are goal-oriented; grab the attention of learners, offers challenges, and hands control over to learners (Clarke, 1998).

2.8 Research implications

The literature survey intends to answer the research question about the factors that influence the use of communication tools in web-based learning.

This case study investigates whether a student who interacts more/most frequently at the lower/lowest level of interactivity benefits or gets more satisfaction compared to a fellow student who interacts less frequently at the higher/highest level of interaction.

Web alone does not motivate a learner; however, it is the design phase that plays a big role. Good instructional design features in multimedia involve integrated animation, suitable text style, sound and video and a user-friendly interface.

2.9 Summary

The literature leading to the level and frequency of interactivity tells us that to answer the main research question we need to consider the following factors, of the (a) cognitive, (b) motivational, and (c) learner interface.

Interaction can either take place synchronously, which is real time interactivity or delayed interactivity which is asynchronous. . The use of communication tools, for example, e-mail, bulletin boards, conferencing systems, whiteboards, chatrooms and videoconferencing is increasing at tertiary level.

Keller's (1983) Motivational design entails instructional strategies that motivate learners and do not frustrate them. The Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivation (Keller and Suzuki, 1988) advocates gaining attention, demonstrating relevance, instilling confidence, and providing satisfaction.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

“A research design is the logic that links the data to be collected to the initial questions of a study”(Yin, 1989).

This chapter discusses the research methodology of the study. The research approach, research plan, limitations and ethical considerations are discussed.

3.2 Research method

3.2.1 Research approach

The purpose of the study was to investigate the frequency and the level of communication tool usage to facilitate learning at Monash South Africa which enrolls only full-time resident and non-resident students. This interpretive case study employed the qualitative and the evaluation approach. Interviews, questionnaires, observation anecdotal notes, focus group meetings; logbook/journal and communication diaries were used as data-gathering instruments. These multiple data sources allowed for triangulation of the data, enhancing its validity and reliability (Merriam, 1998). The next section describes the qualitative research, and then the evaluation research as research methods used to approach this case study.

3.2.1.1 Qualitative Research

The interpretive nature of the case study involved gathering thick descriptive data. In this manner, I was able to develop conceptual categories based on research themes. I was further able to challenge the assumptions I held prior

to data gathering that the university has abandoned resources, and that communication tools are underutilized. The open-ended interview questions were designed to solicit rich descriptions of the participants' feelings, opinions and perceptions. Qualitative procedures and method was preferred for this study for the following reasons:

- The study involved a sample consisting of a selected small group of typical IT undergraduate students. A typical student refers to an enrolled full time student who attends this university.
- The research took place inside computer laboratories which is a natural setting for Information Technology (IT) graduate students at Monash South Africa, and as a qualitative researcher I was able to be involved in actual experiences of the participants.
- Qualitative findings were developed out of in-depth, open-ended and closed-ended interviews (See paragraph 3.2.1 for further tools). Rich and thick interpretive description was generated in that manner.
- Qualitative research is fundamentally interpretive (Wolcott, 1994). I was able to filter the data through a personal lens that was situated in a specific moment. Although the personal-self becomes inseparable from the researcher-self, it also represents honesty and openness to research, acknowledging that inquiry is laden with values (Tessmer & Richey, 1997).

It was important for the qualitative approach as suggested by Tessmer and Richey,(1997) that I applied complex reasoning that is multifaceted, interactive and simultaneous activities of collecting, analyzing and writing up data. To achieve greater insight into the meaning of the data obtained, qualitative data was assigned meaningful numerical values. That yielded limited quantitative data. The next paragraph explains how quantitative data was obtained from the qualitative data as explained by William, (2006).

3.2.1.1.1 Quantitative data

According to William (2006) all qualitative data can be coded quantitatively. The respondents, in this case study, supplied text-based and qualitative responses to open-ended questions. All qualitative data as reflected in Table 4.3 was coded quantitatively as seen in Figure 4.1. I conducted a simple classification of the text responses by sorting them into labelled simple categories as suggested by William, (2006). Each category label represented the theme in the response. Further example of qualitative coding in Table 4.6 is presented through quantitative coding in Figure 4.2. The latter clearly shows that the use of web-based communication tools was extremely engaging. How the use of web-based communication tools was evaluated is described below.

3.2.1.2 Evaluation research

In order to provide useful feedback which will contribute to improve interactivity in WebCT learning, formative evaluation was embedded within a planning-implementation cycle. The ADDIE model (i.e. Analysis, Design, Development, Implementation, and Evaluation), which is used in instructional design, was used to examine the intervention's analysis, the design, the development, the quality of the implementation, and lastly, the evaluation of interactivity in WebCT learning.

The study evaluated the interactivity and not the lesson or WebCT. A sample was selected as described in section 3.2.1.1. A brief discussion on the research plan explaining how the interactivity on WebCT was evaluated in relation to the three research questions is described in the following paragraph.

3.2.2 Research Plan

Monash has seven campuses and five centers internationally. The WebCT site is created and managed by the webmaster in Monash Australia, the main campus. Units or courses available on WebCT are designed in Monash Australia and can be accessed by other Monash campuses internationally for implementation. Each campus, depending on the size, is assigned one or more designers. A designer can also be a lecturer at that university. A designers' responsibility is to liaise with Monash Australia about other lecturers' intentions and problems encountered on WebCT.

The WebCT course for this study was designed in Australia, modified for the South African context in consultation with other lecturers by the designer who is also a lecturer, and was delivered by two lecturers. Interactivity on WebCT was evaluated in relation to the three research questions which were:

1. (a) What is the frequency of interactivity in a WebCT learning environment?

(b) What is the level of interactivity in a WebCT learning environment?
2. What are the features of web-based communication tools that promote interactivity?
3. How do aspects of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning?

In the next section I describe how the research took place using Dick and Carey's (1978) ADDIE instructional design model. The phases in ADDIE model include

- *Analysis* which involves analysing (amongst others) learner's capabilities, material to be taught, and goals or outcomes to be achieved.
- *Design* phase which reviews the course learning objectives.
- *Development* phase that looks at the strategic processes used to create the course material.
- *Implementation* which deals with course delivery. This phase mainly involves management and logistic issues around the implementation.
- *Evaluation* phase which provides a final review checkpoint. This phase measures how well the project achieved its goals.

3.2.2.1 Analysis

3.2.2.1.1 Target population

A sample of eight and students from different cultural backgrounds was selected from the target population of eighteen IT undergraduate students. Their ages ranged from 20 to 24 years. Three students come from Botswana, two students are South Africans, one student comes from Kenya and the rest come from Zimbabwe. All the students are enrolled full time at Monash South Africa. Additional participants were two lecturers, one designer, who is also a lecturer, and two Information Technology Service (ITS) technicians. All participants can speak and write English.

3.2.2.1.2 Subject matter analysis

In order for students to access the course or unit, they must be enrolled in Information Technology Project Management (CSE2203). A detailed unit outline is available and downloadable on WebCT (See [Appendix C](#)). This unit outline indicates necessary information such as, assessment information and pass requirements, prescribed and recommended text books, as well as the

unit leader's contact details in Australia. The unit outline further provides the thirteen week semester plan. All assessments are administered via WebCT.

The major learning outcomes for the topics handled during the study were the ability to

- plan the project and manage the portfolio
- establish teams and plans
- develop a task plan
- present the finished project

The assessment criteria as outlined in the assessment sheet were as follow:

- *Content*: Comprehensiveness and quality of information.
- *Professionalism*: Dress, manner, and observation of time limit.
- *Clarity*: Whether the presentation is well structured, easy to understand, and effectively delivered.
- *Use of visual aids and multimedia*: Powerpoint is the minimal requirement.

Tasks were undertaken in groups. The project description defined task specifications such as nature of the project team, the implementation of the product, cyclic (phased) deliverables, and quality issues related to building the product. Students were to meet the assessment criteria and present their completed group projects. The project portfolio was established in File manager on WebCT and it was managed online. For team and product manager meetings students were assessed by their lecturers in their commitment to the team's WebCT discussion forums. Recommended reading from prescribed textbooks by Humphrey (2000) and Schwalbe (2002), included Chapters 1, 2, 3 which provide information about "*Introduction to project management*", and chapters 11 to15 provide more information about "*Team building and communication management*".

3.2.2.1.3 *Technology analysis*

WebCT provides several tools for delivering subject information and materials to students. The key content delivery tool is called the Content Module. It is designed to organize a group of hypertext markup language (html) pages or files, and to integrate these with other features of WebCT. The WebCT communication tools allowed synchronous and asynchronous communication.

Tools available on WebCT are *discussion tools* (newsgroup) also known as bulletin boards or message boards used to discuss and debate given topics. The *mail tool* is used to retrieve information and send text messages to a list address. The student *presentation tool* (file sharing) is used to download files and to present completed projects. The *chat tool* is used for sending and receiving instant text messages. The *white board* tool is used for drawing simple diagrams or pasting online images.

The compile tool assists students in printing selected pages from a content module. The glossary tool in WebCT is a searchable online glossary containing keywords and definitions or links provided by the lecturer of the unit. At the beginning of each semester new students are orientated by ITS staff on how to use computers.

3.2.2.2 **Design**

This section explains the lesson design as well as WebCT design features. The actual lesson design explains how it was done to accommodate what was learnt in the analysis. The lesson design included the presentation of the lesson topic, the activities (individual/group), feedback, and evaluation. The course content was divided into topics and it was spread over thirteen weeks of a semester. The first two week sessions after the orientation in the second semester were targeted to conduct the study. The lesson topics for Week 1 and Week 2 were, “*Introduction to Project Management Process Models*” and “*Team building & communication management*”, respectively. Both topics were delivered on WebCT. From the topics various tasks were created to reinforce learning.

To make students comfortable during the first session the lecturer welcomed them and encouraged discussions about the problems students anticipate in learning on WebCT. Students were divided into three groups and tasks were designed to accommodate individual as well as group or collaborative contribution. Students were allocated individual marks for active participation and for the achievement of the set outcomes. Marks were also allocated for group performance. The title of the week's tutorial was "*Project Planning and Portfolio Management*". The second week tutorial required students to "*Establish Teams & Plans*" With every new task or assignment students were encouraged to brainstorm and use available resources such as the internet to search for information which was going to be used during group discussions. Completed tasks or projects were submitted on WebCT for grading. The next section briefly discusses features of WebCT and implementation in the Monash university context.

3.2.2.2.1 MyWebCT

Once the student has logged on he/she will reach the following individual screen with the listed courses you are enrolled in.

Figure 3.1 MyWebCT

The screenshot displays the MyWebCT interface for user SHEILA XAKAZA-KUMALO. At the top, there is a navigation bar with links for Course Functions, WebCTAV Info, Global Calendar, Preferences, and Entry Page. The main content area is divided into several sections:

- Courses:** Lists two courses:
 - [ADP1003 Computer systems and word processing](#) (ADP1003_51_2004) with instructor MICHAEL HUNDERMARK and role Designer. A message states: "There is no news for this course."
 - [Database and Spreadsheet fundamentals](#) (ADP1008_52_2004) with instructor ADMIN ACCESS and role Designer. A message states: "There is no news for this course."
- WebCT:** A section with the heading "WebCT" and the text "WebCT.com: Resources and communities for teaching online".
- Announcements:** A section with the heading "Announcements" and the text "There are no announcements."
- Bookmarks:** A section with the heading "Bookmarks" and sub-sections:
 - Institutional Bookmarks:** Includes links for Monash University Library, WebCT Student Help Index, Click here to get Adobe Acrobat Reader, Ask Dr. C, Subscribe to a free WebCT newsletter, Instructors: Find ready-made content for your WebCT course, and Access WebCT online support.
 - Personal Bookmarks:** Includes links for Purchase Student Access Codes and Find WebCT Student Resources.

WebCT can only be accessed by staff or students with an authorized ID username and a password. Figure 3.1 shows hyperlinks that allow the user to

move from one unit to the other without having to log on again. This individual screen lists all the units (or courses) a student is registered for. Available tools include registered students' name lists/databases, shared files, bulletin boards, white board, chat groups, e-mail, calendars as well as design view options for designers to edit and manage files. WebCT also includes a set of tools that can help staff and students to create a teaching and learning environment over the World Wide Web. Tools available on myWebCT are a chat tool, discussion tool, white board, mail tool, and file sharing tool.

3.2.2.2.2 The Homepage

The homepage as depicted in the figure below contains links to WebCT tools and other web pages with further links.

Figure 3.2 The Homepage

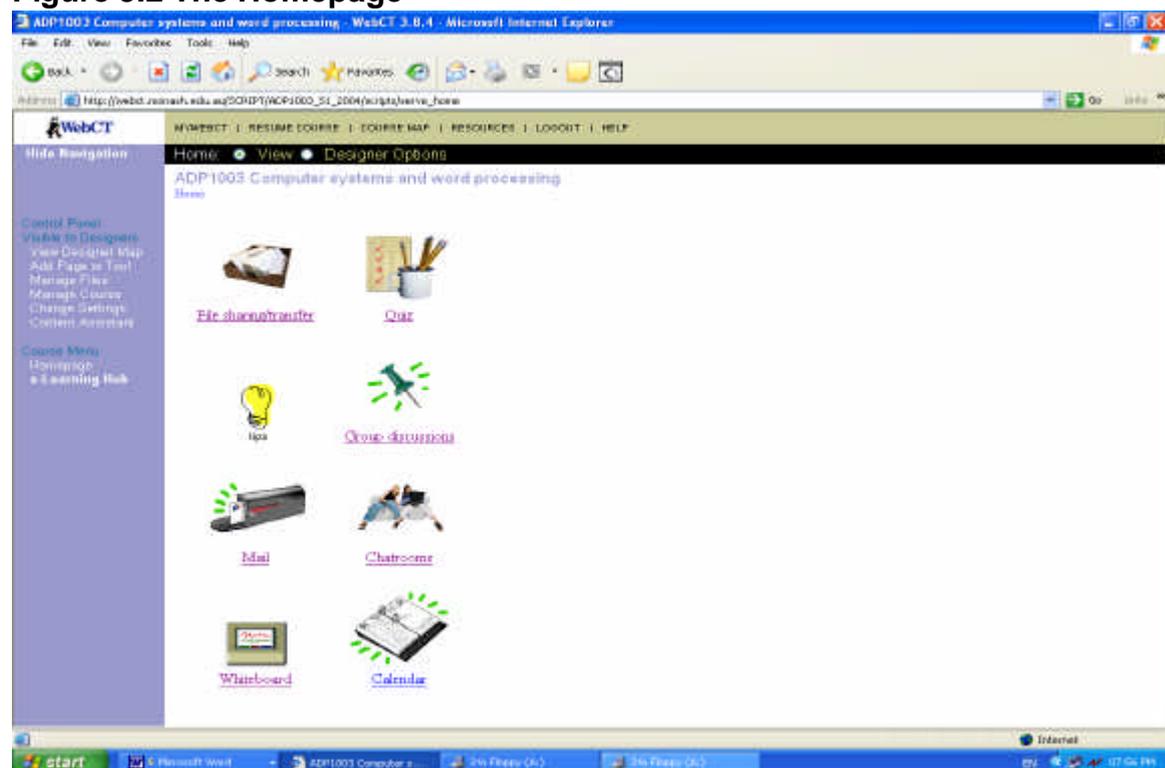


Figure 3.2 shows a number of tools or pages added by the lecturer. The content of the home page will vary in different units, depending which tools an individual lecturer chooses to add to his/her WebCT unit.

3.2.2.2.3 Unit Outline

The syllabus tool is designed to deliver key information to students such as lecturer contact information and textbooks required as well as assessment criteria.

3.2.2.2.4 The calendar tool

This is an online unit calendar or diary used for information regarding assignments and due dates.

Figure 3.3 The calendar tool



Lecturers and students can add information about upcoming classes, or about submission due dates.

3.2.2.2.5 The global calendar

Students are likely to be enrolled in several units at any given time. While students may create entries in a unit calendar to assist in planning their study programme they cannot access that entry from another WebCT unit. The Global calendar collates information from every separate unit calendar that a student has access to.

3.2.2.3 Development

Lecturers have access to design options. They can add or modify the existing teaching matter. All the activities and intentions are coordinated well in advance with the webmaster in Australia for approval before they are implemented. For the first two weeks, the lecturers designed activities varying from small individual tutorials to group/team assignments or projects. Activities were evidently problem-based because students were to search for information and in order to find answers (Dick & Carey, 1978).

The execution of tasks further involved feedback from participants in this study in order to maintain communication (Berlo, 1960). The lecturer intervened by providing guidance during discussions. Lecturers assessed the learning outcomes as stipulated in section 3.2.2.1, and evaluated the students' performance.

3.2.2.4 Implementation

Implementation as type of informative evaluation was helpful in monitoring interactivity on WebCT. Ten sessions over two weeks were identified as learning sessions during which the study could take place. Students broke into three groups. Each session began with the lecturer presenting the lesson's topic and providing clarity on the tasks. He facilitated the sessions by providing guidance during the learning. Students began most tasks with verbal brainstorming before downloading information. Information and ideas were shared through various forms of communication tools depending on the

task given. Several tasks given saw students participating enthusiastically in discussion forums debating given topics such as “*strategies of portfolio management*”. Students followed stipulated instructions for each task.

To execute tasks students used various web-based communication tools such as newsgroups to discuss given topics, mailing tool to send and receive text-based messages, chat tool to send and receive instant messages, file transfer to share files, and listserve(s) to retrieve information and messages and send text messages to a list address. Each student was provided with a communication diary to complete at the end of each session. Any interaction that took place outside the formal session was not recorded. Each student needed to complete the communication diary indicating, among others, the session, the type of communication tool used, the purpose of interactivity and whether interactivity was successful, and the achievement rate in percentage (See Appendix A).

The next section discusses evaluation and the aspects which were considered for the purpose of further explanation of evaluation research in this study. Those aspects involve a brief comparison between the qualitative and quantitative data, sampling, data collection methods, data filtering, and data presentation. Reliability and validity will conclude this section.

3.2.2.5 Evaluation

The case study was instrumental and data were acquired and assessed to provide useful feedback about the interactivity in the WebCT learning environment (William, 2006). The study aimed to answer three research questions. Firstly, what is the frequency and level of communication tools on a WebCT learning environment, secondly, what are the features of web-based communication tools that promote interactivity, and thirdly, how do aspects or factors of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning? To answer the research questions both the quantitative and qualitative data were analysed for the evaluation in this study, and these are reported as the findings.

3.2.2.5.1 Qualitative and quantitative data

On one hand, observations for qualitative research provided an in-depth understanding of the motivations and feelings as aspects that influence the use of communication tools. On the other hand, closed and open-ended interviews and questionnaires provided both qualitative and limited quantitative data. In this manner, quantitative data measured interactivity frequency, while qualitative data was used to interpret both the frequency and the level of interactivity. The next paragraph describes how sampling was conducted.

3.2.2.5.2 Sampling

William (2006) distinguishes two different types of sampling methods, namely probability and non-probability sampling. Unlike non-probability sampling, the probability sampling uses random selection (William, 2006). In probability sampling, the probability of selection of each respondent is known, where as in the probability sampling, the probability of selection is unknown because the boundaries are not known.

According to Cohen, Manion & Morrisen (2000) sampling is a method of selecting some part of a group (sample) to represent the total (population). A **sample** of eight IT students was selected from the target population of eighteen second year, typical IT undergraduate students. A 'typical' student in this study refers to an enrolled full-time student who attends this university.

For this study purposeful sampling was used to select the participants. William (2006) explains that participants in purposeful sampling are selected intentionally so that (Merriam, 1998) the central phenomenon can be understood. Cohen, Manion & Morrisen (2000) point out that non-probability sampling techniques include convenience, purposive (judgemental), theoretical, partial and saturated sampling. It was more convenient to go for IT students as I understood the subject better than Arts and Business, also

offered at this university. Although the sampling satisfied my research needs it does not represent the wider population (Cohen, Manion & Morrißen (2000).

3.2.2.5.3 Data collection methods

For the purpose of gathering valid data, completed **communication diaries** reflected information as explained in paragraph 3.2.2.4. **Questionnaires** contained closed and open-ended questions. Two sets of questionnaires were distributed by the lecturer. The pre-assessment questionnaire was collected by the lecturers and handed over to the researcher. The post assessment questionnaire was collected by the researcher at the end of the last focus group meeting. Interviews were conducted by the researcher individually. **Interviews** included open-ended questions. Interviews provided in-depth responses about respondents' experiences, perceptions, opinions, feelings and knowledge. Data consisted verbatim quotations with sufficient context to be interpreted. **Observations** were incidentally noted by the researcher anytime. **Focus group** meetings discussed a set of questions led by the researcher. The focus group comprised of students and their lecturers. Every extra little piece of information which was considered helpful was collected and entered in the **journal** also known as a **logbook**.

3.2.2.5.4 Data filtering

The qualitative approach allowed data filtering that permitted the researcher to present varying views of the data collected without actually affecting the data. Based on the pattern, information was derived and data was analysed and classified to result sets or categories as explained in section 3.2.1.1.

3.2.2.5.5. Data presentation

Data collected was analysed by the researcher and presented visually in the form of graphs and tables. The information acquired through evaluation was assessed and extrapolated. Rich and thick description was accomplished by collecting data through various instruments as previously discussed in paragraph 3.2.2.5.

3.2.2.5.6. Reliability and validity

For a study to be scientific, readers must regard it as credible, believable reliable and trustworthy. To attain this, Merriam (1998) suggests careful measurement of data by means of reliability and validity instruments. I will define internal validity, reliability and external validity in conjunction with brief explanation of how I ensured that the data collection, analysis and interpretation were reliable and valid.

Internal validity relates to the instrument significant for the study situation (Sarantakos, 1998:78). Based on this view, I got the reality from the respondents through interviews and observations. See paragraph 3.2.1 for more data collection instruments.

According to William (2006) reliability refers to consistency or 'dependability' of the measurement or the extent to which an instrument measures the same way each time it is used under the same condition with the same subjects. Merriam (1998) points out that reliability is not measured, it is estimated. Reliability involves the link between the analysed, interpreted and recorded data, and what actually occurred in the study (Merriam, 1998). The study used reliability with the purpose of obtaining a more accurate reflection of the truth. Data errors were avoided by formulating clear and relevant questions for the interviews with the aim of getting reliable data which was free from measurement errors (Fink, 1995).

Creswell (1994) maintains that in external validity, the researcher depends on participants' responses from which data is collected. The data gathered was accepted irrespective of whether the respondents were positive or negative in their responses (Creswell, 1994).

3.2.2.5.7 Triangulation

According to Patton (2001) triangulation strengthens a study by combining methods or data. Quantitative and qualitative data were used in triangulation

to test the validity and reliability of this study. Rich and in-depth description was achieved in this manner.

3.3 Limitations

The selection of a single study design naturally brings forth a number of limitations as far as the generalisation of results of the study is concerned. In addition to the IT faculty, Monash South Africa has a Business and Economics faculty, as well as an Arts Faculty. It was more convenient to go for IT students as I understood the subject better than arts and business. These two faculties were excluded in the study even though some of their courses are also delivered on WebCT.

To investigate interactivity through multiple case study design, for example, is clearly one of the future research challenges arising from this study. Multiple case studies will benefit researchers to test the conceptual framework of the study further. Difficulties in explaining observations included an individual's own interpretation of incidents, for example, what you think you see is not what someone else sees.

3.4 Ethical considerations

All aspects of the study, including the findings, were strictly anonymous and only the researcher had access to data gathered. The participants were interviewed at settings of their choosing usually at the university. Before the interview began, the procedures involved were explained to the interviewee and they were asked to sign an informed consent form (see Appendix B). The identity of respondents is protected in transcripts. All data were coded and, where necessary, pseudonyms or numbers were used in place of names. Statistical results were published as graphs so that no information about an individual is identifiable. The collected data is stored in line with University regulations. Only if additional permission is granted by the respondent will the information be used in future research projects undertaken by myself. In that case, the data will still be anonymous and the respondent will not be identified in any way.

3.5 Summary

This chapter describes the research methodology used in this study. The study takes a qualitative and an evaluation research approach. The research design is a case study. The study employed qualitative research method using interviews, questionnaires, observation anecdotal notes, focus group meetings; logbook/journal and communication diaries were used as data-gathering instruments.

The purpose of the study was to investigate the frequency and the level of communication tool usage to facilitate learning at Monash South Africa which enrolls only full-time resident and non-resident students. WebCT was used as a platform to investigate interactivity. ADDIE as an instructional design model was used to evaluate the *intervention* of the study. The study evaluated the interactivity and not the lesson or the WebCT.

The research plan discusses each phase in ADDIE instructional model (See section 3.2.2). To ensure reliability and validity data was acquired through qualitative research method. Limitation of the study is outlined and ethical considerations are detailed.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

4.1 Introduction

From the literature we know that we need to consider the following research questions:

1. What is the frequency and level of interactivity in a WebCT learning environment?
2. What are the features of web-based communication tools that promote interactivity?
3. How do aspects of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning?

This chapter will present the findings that were obtained in an attempt to answer the three research questions. After a brief discussion of the demographics of the participants the findings will be discussed as they relate to each research question.

Demographics

All thirteen participants in the case study come from Monash South Africa. A sample of eight students was selected from a group of eighteen undergraduate Information Technology (IT) students. Three students come from Botswana, two students are South African, one student comes from Kenya and the rest come from Zimbabwe. All the students are enrolled full time at the university. The case study group was composed of eight (IT) students, one lecturing instructional designer and two lecturers. In addition to the project there were two Information Technology Services (ITS) technicians.

4.2 Research Question One – Frequency and level of Interactivity

4.2.1 Frequency of interaction

The first sub question driving this section was: *What is the frequency of interactivity in a WebCT learning environment?*

The instrument that yielded the best information to answer this question was the communication diary in Appendix A. For the purpose of gathering valid data, completed communication diaries reflected the date, type and purpose of interactivity, the contact session, topic and time spent, access achievement also indicating the success rate percentage.

Table 4.1 shows the results in terms of the total number of actual interactions that took place per session during ten learning sessions.

Table 4.1 The actual number of interactions that took place for the duration of ten sessions

Communication tools used	Sessions										Total frequency
	1	2	3	4	5	6	7	8	9	10	
E-Mail	10	5				11		5	7		38
Newsgroup	3	4		7	11			6		5	36
Mailing list		4				1					5
Cell phone messaging				12			3	1			16
Chatrooms			4		5		2				11
File transfer	1	8	5	6	2	1	8	5	2	1	39
Total	14	21	9	25	18	13	13	17	9	6	145

The table shows a total number of 145 interactions. Interactions occurred for the duration of ten sessions and were recorded by students in their individual communication diaries. Cronjé (1996) maintains that the "talk back" interaction encourages interactivity. Each interaction shows the type of communication tool, session, and reason for interactivity, time spent, and success/achievement results were recorded in the communication diary by

each student. Some students used a variety of communication tools in one session.



Figure 4.1 shows respondents during brainstorming and information searching

While session 4 shows most interactivity that took place, session 10 shows the least interactivity. The observation notes indicate that the students were more active in session 4 when collecting information and sharing ideas with the members. The last session showed less interactivity because students had all submitted their tasks and were preparing for the next week. File transfer, e-mail and the newsgroup proved to be the most popular communication tools. Mailing list indicated to be the least frequented communication tool. Cellphone messaging and chatrooms are communication tools that enjoyed an average frequency of interactivity.



Figure 4.2 shows one of the group discussion sessions

According to Cronjé (1996) interactivity involves the participation of more than one person. Berlo (1960) supports by identifying four levels of interactivity as discussed in Chapter 2 under section 2.3.1. Berlo (1960) maintains that interaction takes place when two people interact trying to predict how the other will respond.

These results are supported by the following findings from these instruments:

For the purpose of reading it should be noted that **participants** are also referred to as '**respondent(s)**', and for ethical reasons a pseudonym or false name is given to each respondent.

4.2.1.1 Questionnaire

Results from the returned questionnaires indicated the e-mail as the popular used communication tool on WebCT. Responses indicated that e-mail is "easily accessible" and "convenient. Students indicated that file transfer tool on WebCT is convenient for uploading completed assignment. They also regularly use the tool to check their results or grades.

4.2.1.2 Interviews

During the interviews participants indicated various types of tools which they commonly used during learning. For example, most students agreed to have used file transfer tool for "downloading and uploading assignments". They enjoyed interaction with the content. With reference to whether resident students benefited more in accessing university resources, non-resident students indicated that they feel they have more internet access at various internet cafés after hours while the university library and sometimes the computer laboratories are closed. Resident students supported the statement by saying even though their rooms have twenty four hour internet supply connection, "the university does not provide computers in our rooms", indicated one student. "One has to buy their own" added another student. Non-resident students feel they cannot stay after university class times for longer hours of Internet access due to distance needed to travel home and transport problems. They "borrow friends' computers" to complete their assignments after hours. They use their "cell phones or an internet café to send text messages and e-mails".

4.2.1.3 Observation anecdotal notes

In the ten sessions the frequency of interactivity varied. Students were encouraged to use various tools to complete tasks given. For example, for the first two sessions students were welcomed to their different groups and brainstorming began on given topics under "Project planning" and Portfolio management". Students uploaded and downloaded files sharing assignment

information with their group members. The internet was searched for more information. Cell phone messaging was introduced by students during the fourth session. Students used web-based Short Message Services (SMS) to send text messages from their computers to other students' cellphones of the same network. The SMS account information itemised the statement, showing the transaction made, date and time as well as destination of the message. A total of 16 SMS transactions were obtained from the students who used the service.

It was observed that during the sessions there were fewer oral conversations but students were mostly "glued" to their computers. This was evident from the results of actual frequency of interactivity which totalled 145. Students enjoyed using communication tools on WebCT See Figure 4.4. They also explored and initiated other web-based communication tools such as chat tool where one student stole a moment and invited a friend to play a game. Notes also indicated that at some point one or two students struggled to upload an assignment on WebCT. File transfer was used during all ten sessions; however, session 2 and session 7 indicate the highest frequency with this tool. Observation notes explain session 2 as the session where students had been given an assignment and they downloaded information. During session 7 students uploaded completed assignments for grading.

It was observed that when using an e-mail, students generally preferred to interact with their personal friends. Despite the availability of communication tools such as e-mail, chat tool and mailing list, in addition, students preferred contact consultation with their lecturers. When asked about the consultation, student responded, "I go for consultation most of the time" another student explained "...with consultation you get your individual, one-on-one time with the lecturer". According to one respondent, students felt "less intimidated" because "...during the consultation, unlike on WebCT, there is no pressure in asking only clever questions." and "...the explanation goes on until I am clear," added another respondent. Lecturers were quick to indicate that consultation visits are habitually ignored by students until towards the examination pressure period or when assignments are due.

4.2.1.4 Focus group meetings

The focus groups revealed the views and perceptions of the participants in the case study on the use of communication tools to facilitate learning on Webct.

A concern about “the inconvenience” caused by South Africa/Australia seven hour time differences was raised. One student explained that he “had problems uploading” despite the impending due date on WebCT. He then opted to e-mail it to the lecturer to “avoid late submission penalty.” The record kept by this tool was commended by the group as “valid evidence” that the assignment was sent on time.

The type of interactivity effected by each communication tool, such as, student-student, student-content, student-lecturer and lecturer-students was identified as e-mail, chat tool, cellphone messaging, file transfer, mailing list and discussion group. Researcher’s comments based on observation as well as participants’ feedback are included in the table. Table 4.2 shows comments yielded by the focus group meetings.

Table 4.2 Using communication tools for interactivity

Type of Tool	Type of Interactivity	Actual frequency of interactivity in 10 sessions	Comments
E-mail	Student-student + student - lecturer + lecturer-student + lecturer- lecturer+ student content	38 times	<ul style="list-style-type: none"> This tool was recommended by the participants as the most convenient asynchronous communication technology.
Chatrooms	Student-student + student - lecturer + Lecturer-student + lecturer- other lecturers	11 times	<ul style="list-style-type: none"> WebCT chatrooms were enjoyed. Other chat tools were also visited and utilised for fun chats and games.
Cell phone messaging	Student-student + student-lecturer + lecturer-student	16 times	<ul style="list-style-type: none"> The most frequently used tool and was recommended by participants for Short Message Service (SMS). Various ring tones buzzed each time the message was received.
File transfer	Student-content + lecturer-content + lecturer-student	39 times	<ul style="list-style-type: none"> WebCT allows the uploading and downloading of various files. For various reasons, attachments for file sharing on mailing listservs were more favoured than on the bulletin board.
Mailing list	Student-student + student-content + student-lecturer + lecturer-students + lecturer-content	5 times	<ul style="list-style-type: none"> This tool was mainly used for education purposes. Students post their questions for clarity and the lecturers respond with detailed explanation. Further explanation and examples are sent as attachments. Students are also provided with relevant informative links to assist their learning.
Newsgroup	Student-student + student-content + student-lecturer + lecturer-students	36 times	<ul style="list-style-type: none"> Bulletin was also recommended by lecturers to be very convenient as information and notice bases for students. It is a one-to-many communication tool. <p>This was an effective learning effort; topics discussed in the group-mail were mainly educational.</p>

From the table it is evident that communication tools can facilitate web-based learning. Interaction can take place between student and student, student and lecturer, lecturer and student, lecturer and lecturer as well as student and content.

Interesting results were obtained when participants used a variety of communication tools in one session (see Table 4.1). In addition to

communication tools available on WebCT other communication technologies were explored. Cellphone messaging is not part of WebCT, such usage was not anticipated. However, it was utilised for learning purposes during the study. The table below indicates the use of types of communication tool per session. Qualitative data was classified into communication tools used indicating communication tools used, the sessions which indicate the duration of ten sessions. The last column shows the total usage of each tool over ten sessions. This qualitative data will be assigned numeric values to provide quantitative data (See Figure 4.3).

It can easily be assumed that the structure of an activity or task could channel the use of a certain communication tool, however, the table shows that while most students submitted their assignments by file transfer, submission options such as e-mail attachments were also initiated by students.

From these findings the following tentative answers can be given to the first sub research question:

Interaction is possible between student and student, student and lecturer, lecturer and student, lecturer and lecturer, as well as, student and content. Internet communication tools can facilitate learning.

Section 2.3.2 describes the modes of interactivity as explained by Cronjé (1996) that an increase in participation ratio and a decrease in synchronicity and symmetry leads to a decrease in interactivity. Interactions shown in Table 4.1 display varying usage of different communication tools. Some WebCT tools were used more frequently than other tools. Some sessions benefited more interactivity than other sessions.

4.2.2 Level of Interactivity

The second sub question driving this section was,

What is the level of interactivity in a WebCT learning environment?

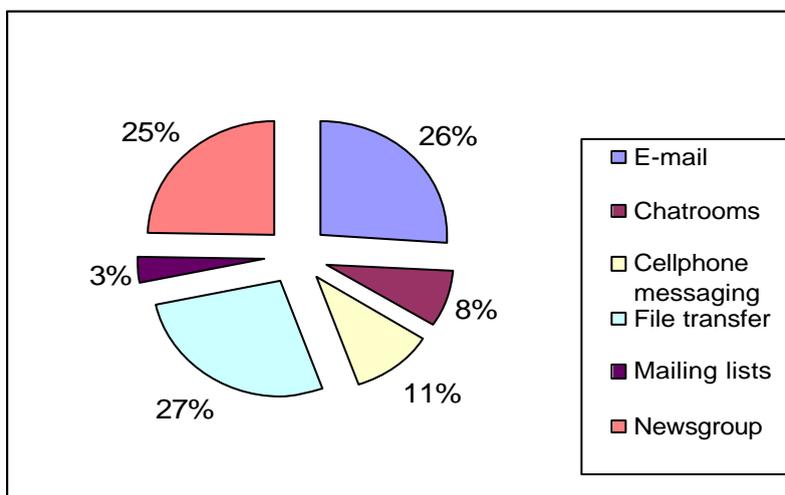
Communication diaries yielded the best information to answer this question and these were the results:

Students seemed relaxed and engaged especially during peer interaction when using communication tools such as e-mail, chatrooms and group discussions. Data revealed the high interactivity achievement percentage ranging between 70% -100%.

During the case study, the cellphone Short Message Service (SMS) was initiated by students and it occurred in three learning sessions. One example was an information seeking SMS from Suzie to her lecturer saying “.../ couldn’t open the attachment you sent for Tutorial One.”

According to William (2006) all qualitative data can be coded quantitatively by assigning numeric values. For further in-depth analysis the qualitative theme coding, as explained in the previous chapter (See section 3.2.1.1), reflected in Table 4.3 is coded quantitatively in Figure 4.3 in order to achieve greater insight into the meaning of the data (William, 2006). Figure 4.3 graphically displays the results based on data gathered by communication diaries. The graph shows varying usage of communication tools during ten learning sessions as follows:

Figure 4.3 Graphic display of communication tools used during interactivity for the duration of ten sessions



The most occurred interactivity was *file transfer* at 27% rate followed by e-mail at 26% rate. Data collected reveal that the *newsgroup* was closely popular, frequently used at 25% for the duration of ten sessions. The communication tools that frequented at the rates of 11%, and 8% were *cellphone messaging* and *chatrooms* respectively. The least frequented communication tool was *mailing listservs* at 3%.

According to literature reviewed, various levels of interactivity are defined by the purpose of interaction, for example, while cognitive and physical engagement during learning describes the highest level of interactivity, only receiving information without engaging is described as the lowest level of interactivity. Literature suggests Berlo's (1960) taxonomy of communicative interdependence to answer this question. Table 4.4 shows the matrix in which communication tools were used against each level of interaction as suggested by Berlo.

Table 4.3 Taxonomy of communication interdependence

Tool	Definitional physical interdependence	Action/reaction interdependence	Interdependence of expectations	Interaction
E-mail	✓	✓	✓	✓
Chatrooms	✓	✓	✓	✓
Cellphone messaging	✓	✓		
File transfer				
Mailing lists	✓			
Newsgroup	✓	✓	✓	✓

From the table it is evident that interactivity took place because there was a sender and a receiver Berlo (1960). All communication tools featured from the lowest to the highest level of interactivity except file transfer.

Listserve(s) also known as mailing list was used by both students and lecturers as one-to-many text messaging tool. A message of “welcome...” from the lecturer included “...instructions about the next two weeks’ tasks...”

E-mail, chatrooms and Newsgroup were communication tools that were used at all four levels of interactivity.

The *e-mail* was used as direct prompt responses that provided clear visual feedback in anticipation by students as well as lecturers. Unlike the discussion tool which facilitates one-to-many communication, the e-mail tool facilitates one-to-one communication. The e-mail facilitated communication between two lecturers and a designer during their planning and implementation. The e-mail sent to the lecturer by the designer indicated that “...have forwarded a response from Australia concerning Ron’s request...” Students received formative feedback as form of encouragement from their lecturers. One message from the lecturer read, “...get more information on Bluetooth...” One of the e-mails was for the lecturer from Joe who failed to upload the assignment, “...have problems with WebCT...”

The *chat tool* was engaged in all Berlo’s levels of interactivity. Interaction as the highest level of interactivity takes place when two people put themselves into each other’s shoes (Berlo, 1960). Although the chat tool used was not part of WebCT, the interaction occurred when a student extended an invitation to a fellow student for a game challenge.

Newsgroup allowed group discussions on a given topic. Interdependence was evident when the lecturer provided guidance during discussions and he intervened, “*Actually, Bluetooth is not an ISP...*” As shown in Appendix C the discussion tool allowed students various options such as selecting the topic they wished to post the message to, and attaching files of any type to their discussion messages. Students had an option to “reply” to public where everyone who has access to that WebCT unit could read the message or to “reply privately” to the sender of the message instead of posting a public reply in the discussion area.

File transfer was used as information receiving tool. File transfer did not feature in any level of interactivity. Uploading and downloading of files does not involve a sender and a receiver Berlo (1960), therefore, no feedback can

be received from file transfer. This tool was also used to present completed assignment project.

Cellphone messaging was frequented at 11% above the other two communication tools; however, it was used at the first two lowest levels of interactivity. It was noticed that while the group discussion was taking place a SMS cellphone messaging was sent by a student to a fellow student asking, “Bluetooth is wireless, right? Sindi.” It was later discovered during the focus group meeting that the student wanted to “verify the fact” with a friend before posting her contribution into newsgroup during the discussion.

These results are supported by the following findings from these instruments:

4.2.2.1 Observation anecdotal notes

The activities of interactions were observed and entered in the observation anecdotal note book. Observations noted that e-mail and chat tools were used to send and retrieve messages. Mailing listserves and Newsgroup were effectively used to retrieve information and send text messages to many recipients. It was noticed during the observation that a web-based chat tool was initiated to play a game. Games are challenging and mentally engaging; therefore, this tool occupies a high level of interactivity. However, the interaction in question was for entertainment purposes. It can be argued whether the game in question was challenging.

4.2.2.2 Focus group meetings

This instrument yielded information on the choices of selected tools for various specific purposes. Participants agreed on chatrooms and newsgroup as “engaging” and “challenging” interactions. Combination usage of tools was evident when a student, during group discussion, quickly sent a cellphone message to a friend before posting her contribution into the newsgroup. Mr Ben Jacobs, the designer/lecturer indicated that since all intended activities with WebCT at Monash South Africa should first get a “go ahead” from Monash Australia it consumes more time and sometimes causes frustration.

He was very “satisfied” with the resources and support the university provided.

From these findings the following tentative answers can be given to this question:

In Berlo’s (1960) first two levels communication tools were used by participants for exchanging information and possible feedback. According to Borsook & Higginbotham-Wheat (1991) the lecturer is unable to maintain the interdependence of expectation, which is the high level of interactivity, without feedback. The lecturer was able to maintain active participation by continuous intervention and providing guidance and probing questions which is necessary during *interdependence of expectations*. Figures on frequent usage of tools indicate that certain tools were used from the lowest up to the highest level of interactivity, *Interaction* as the highest level of interactivity only occurred because participants interacted repeatedly using various communication tools while inferring meaning and experiencing the same perceptions during their discussions Berlo (1960).

Some web-based tools explored by students were not part of WebCT. Those tools are yahoo messenger which was used to invite a friend for a game challenge, and Short Message Service (SMS) which included web-based cellphone text messaging from a computer into a cellphone which uses the same network.

4.3 Research question 2 – Features of web-based communication tools

The second research question was,

What are the features of web-based communication tools that promote interactivity?

The instrument that yielded the best qualitative data to answer the second research question was the focus group meetings and these were the results:

The focus group meetings acknowledged asynchronous and synchronous communication as two forms of communication. Various synchronous and asynchronous communication tools were used to facilitate learning for the duration of ten sessions on WebCT. Tools that allowed communication and collaboration on WebCT were

- *Discussion tools* also called Bulletin boards or message boards in this study are referred to as Newsgroup(s).
- *Mail tool* refers to e-mail and mailing listserve(s).
- *Student presentation tool* (file sharing) refers to file transfer.
- *Chat tool* refers to chatrooms.
- White board tool

The White board was not utilised. Table 4.5 displays and describes each purpose of interactivity that occurred for the duration of ten learning sessions.

Table 4.4 The frequency and purpose of interactivity using communication tools in percentage

Type of communication tool	How often (Frequency) was the tool used?	For what purpose was the tool used?
E-mail	26%	- Send and retrieve messages and attachments
Chatrooms	8%	- Send and receive text-based instant messages. - Play games
Mailing listservs	3%	- Access Web mail - Retrieve information and messages - Send text messages to a list address.
Newsgroup	25%	- Download information files - Upload tutorials and assignments - Retrieve: information, test scores/grades and bulletin board notices. - Group discussions - Previous question papers and answers
Cell phone messaging	11%	- Send and receive text and picture messages
File transfer	27%	- Uploading and downloading of various files. - For presentations and file sharing

The table shows the highest usage of file transfer at 27%. This tool was used to upload and download files. E-mail and newsgroup were relatively most frequently used communication tools. Besides sending and retrieving information group discussions took place by newsgroup discussion tool.

Six types of web-based communication tools were used for the duration of ten learning sessions.

Next is a brief explanation of each type of communication tool and how it was utilised.

E-mail (asynchronous): Participants sent and retrieved their messages and attachments. This tool proved to be an alternative when WebCT file transfer failed to upload an assignment for one student.

Chatrooms (synchronous): A chat tool on WebCT allowed text-based messages to be sent and received instantly. Respondents “liked to see the names” of people who were logged on during the chats. Other chatroom tools on the web were explored by the students “for fun.”

Mailing listservs (asynchronous): Data revealed that participants were not very keen to use this type of communication tool. Results show that this tool was the least favourite by 3%. It was mainly used to retrieve information sent to a list address by the lecturers. Respondents explained that they preferred sending messages through their e-mails and they used mailing listserve(s) to retrieve information.

Newsgroup (synchronous): Group discussions allowed members to participate in forums and debates on given topics. Lecturers viewed and downloaded messages from different threads. Compiling and downloading messages is popular with lecturers who wish to download key questions and the best answers for questions file for subsequent classes of students.

Cell phone messaging (asynchronous) Even though the tool is not part of WebCT students felt this tool was “very convenient.” One can send and receive text and picture messages anytime and anywhere” they explained.

File transfer (asynchronous): The tool was popularly used during each session for the duration of ten sessions. Group members were allowed to download and share files already uploaded in the shared area. Information about the assignment was downloaded while completed assignments were uploaded for grading. Presentations were also conducted through this tool. This feature optionally confirms all uploaded and submitted assignments by e-mail. Although the tool was popularly used it does not meet the criteria for

interactivity. Uploading and downloading files, as described in Table 4.4, do not constitute interactivity as explained by Berlo, (1960) and Cronjé (1997).

4.3.1 Interviews

Although e-mail only allowed sending and receiving of messages within the WebCT unit, students could forward mail messages out of WebCT to an external e-mail account. It was also raised by the participants that WebCT site is “strictly accessible by authorised users with a password.” The site is personalised by each participant’s name appearing on the bar. During the interview most participants agreed that WebCT does not hinder their learning; however, it is sometimes confusing to keep up with the time difference for submission of assignments. Australia is seven hours ahead of South Africa. Since WebCT is created and managed by Monash Australia timelines are in line with Australia. To meet the due date students at Monash South Africa submit their assignments on WebCT seven hours before the stipulated time.

During an interview the designer/lecturer interestingly mentioned his experience with video conferencing where the meeting was set up with colleagues in Australia. According to him, the meeting went well although there was a measure of “speech delay” during the meeting; and “...some panel members would all talk at the same time making it difficult to hear what was said.” He felt that video-conferencing was the fastest and most convenient communication tool that “works like a phone” and yet you see the people you are talking to.

The ITS technician mentioned that video- conferencing is one of advanced technologies for communication. He stated that this kind of technology system is expensive. Video conferencing can use Internet that is faster and more convenient but very costly. Telephones are cheaper but could be problematic in cases of bad weather and limited bandwidth.

4.3.2 Communication diaries

The evident usage of e-mail, chatroom and newsgroup and the purpose for which each tool was used is clear indication that these tools occupied all four levels of interactivity as suggested by Berlo (1960) in his taxonomy of communicative interdependence.

4.3.3 Questionnaire

Although there are many complicated communication tools available on the internet, participants indicated that they found all tools that are available on WebCT “user friendly.” All returned questionnaires indicated that WebCT does not hinder students’ learning. Data (See Figure 4.4) revealed that respondents were highly engaged and were excited by the interactivity in WebCT.

4.3.4 Observation anecdotal notes

Although chat tool was less frequented by 8% it was involved at Berlo’s (1960) highest level of interactivity. Participants were obviously physically active and mentally engaged during the interactivity. Similar to the chat tool, the white board tool as a graphical tool is also synchronous. However, this tool was not used for the entire duration of ten sessions.

From these findings the tentative answer to be given to this question is:

According to Gates (1995) it is human preference to find ways to change synchronous communication into asynchronous forms. Respondents enjoyed using both synchronous and asynchronous communication tools during interactions. Tools available on WebCT support either synchronous or asynchronous communication. WebCT does not hinder learning, most

communication tools used to facilitate learning on WebCT are utilised by the students and lecturers. In addition to available tools, students are keen to explore additional communication technologies.

4.4 Research question 3 - Aspects that influence the use of communication tools

The third research question was,

How do aspects of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning?

The instrument that yielded the best results to answer the third research question was the questionnaire. The questionnaires were distributed towards the end of the project. Participants responded individually about their experiences during learning on WebCT. All questionnaires were collected. Four questionnaires were not completed. The table below indicates thirteen questionnaires (Q1-Q13) received with each questionnaire's response to each aspect question. These were the results:

Table 4.5 Responses from the questionnaire

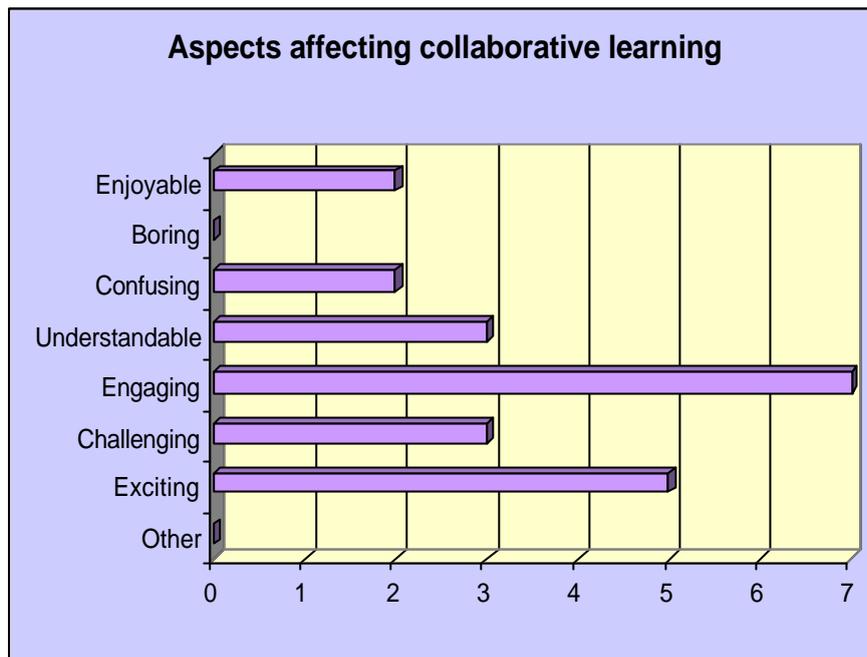
Aspects that influence the use of communication tools for learning													
How do you find collaborative learning in WebCT?													
ASPECTS	Questionnaire results												
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Enjoyable			✓				✓						
Boring													
Confusing	✓			✓									
Understandable		✓			✓	✓							
Engaging		✓	✓		✓	✓	✓			✓	✓		
Challenging		✓	✓				✓						
Exciting		✓	✓		✓	✓	✓						

Participants reflected varying emotions when asked about their experiences in learning collaboratively in WebCT. The first and fourth questionnaires that the researcher came across reflected confusing experience. Further more, these did not indicate any other emotions except “confusing”. The third and seventh questionnaires indicated more positive feelings, such as, enjoyable, understandable, engaging, challenging and exciting experience. It was also noticeable that the tenth and eleventh questionnaires did not indicate any other emotions except “engaging” experience.

Based on the responses shown in the table this was the interpretation followed by a graphic display:

How do you find collaborative learning in WebCT?	
Enjoyable	2
Boring	0
Confusing	2
Understandable	4
Exciting	5
Challenging	3
Engaging	7
Other	0

The chart serves as visual presentation of responses received against each aspect that can influence the use of communication tools in web-based learning.

Figure 4.4 Graphic display of the responses from the questionnaire

More than half of the entire group (7 out of 13) thought that collaborative learning on WebCT was engaging. Five thought it was exciting. Six participants understood the challenge while two out of thirteen indicated some confused experience during the interactivity and no one was bored.

If the learner interface is transparent, less confusing, and the learner has locus of control the learner gets challenge and as a result, he/she engages at a higher level of interactivity and the interactivity is prolonged. Alessi & Trollip (2001) emphasise the learner control of the interface. They further state that whatever is not controlled by the learner will be controlled by the program.

If using communication tools for learning is less boring, interactivity becomes more exciting and enjoyable. The more cognitive the learning is, the higher the level of interactivity and the longer the engagement during the interaction.

Bohlin states that in order to sustain motivation instruction should provide individual satisfaction. Data revealed that when there is less confusion learners enjoy and engage more during interactivity because they understand the process. Based on the explanation above, these aspects influence one another because they are integrated.

Table 4.6 shows how these aspects are integrated

Table 4.6 The integration of aspects that influence the use of communication tools

Aspects	Cognition	Motivation	Leaner Interface
Enjoyable		✓	
Boring		✓	
Confusing			✓
Understandable	✓		✓
Engaging	✓		
Challenging	✓		
Exciting		✓	

From the table the *cognitive* aspect involves physical and mental engagement which is created by a challenging and a perceived meaningful communication. Bloom's (1964) taxonomy of cognitive thinking supported by Sims (1994) points out that the way in which the motor, cognitive and collaborative elements of interactivity coalesce with the task, contribute to the effective engagement of the learner with the activity. Interactivity at this level is exciting and prolonged. It was evident in one of the group discussions that participants shared the same concerns about difficulties encountered when using the "chat facility" on WebCT.

The *motivational* aspect indicated that participants enjoyed interacting with one another. Advocated by Keller, (1988) participants gained attention shown by relevant and meaningful responses posted during the interactions. The ability of engaging at the highest level of interactivity instilled confidence and provided obvious satisfaction. The motivating "flow" was achieved and maintained through constant feedback by the participants. In groups respondents were faced with problem-solving and challenging tasks. In order to achieve the outcomes the respondents searched and analysed the information which was used in discussions. Activities as suggested by Clark, (1998) were designed in a way that they were goal-oriented, attempted to grab the attention of learners, offered challenges, and handed control over to learners.

The *learner interface* involved transparent technology that caused less confusion thus more understanding of options available. The designer provided simple options for learner control. Both the learners and lecturers were comfortable with the communication technologies that were available for use. Since there was control during the interaction, participants became curious and became motivated to explore more tools, such as a “game challenge” and cellphone messaging.

These results were supported by the following findings from the following instruments:

4.4.1 Focus group meeting

The feedback from the focus group meetings indicated that e-mail and the chat tool was used in this case study to provide guidance and feedback. The anticipation and excitement by participants was shown at some point by using more than one communication tool at the same time where cellphone messaging was also used during group discussions. An e-mail attachment was used as an alternative to a failed file sharing tool for the submission of an assignment.

4.4.2 Observation anecdotal notes

Notes indicated that, “Active participation...” was “...not even.” Discussions were dominated by a certain group of students. Students who could not type fast managed a few postings as compared to those who could type fast. Observations noted that lecturers have privileged site navigation while students had limited navigation. Only authorised staff and students with Authcate passwords, had access to the WebCT.

4.4.3 Interviews

In spite of the problems, participants generally felt that WebCT does not hinder their learning. Students enjoyed interacting more with fellow students. They enjoyed using communication tools available on WebCT because they were “orientated” on how to use the tools in the beginning of the semester.

4.4.4 Communication diaries

Communication diaries reflected a repeated usage of one tool while other tools were less utilised. Based on the achievement rate shown between 70%-100% students were satisfied.

From these findings the tentative answer to be given to this question is:

The aspects that influenced the use of communication tools were emotional. The usage of various communications tools during interactivity was influenced by different emotional aspects derived from the transcript such as, enjoyable, boring, confusing, understandable, engaging, challenging, and exciting. These aspects are integrated and they can influence one another, For example, cognition involves understanding, engaging and challenging. This is supported by satisfaction (ARCS) model of motivation (Keller & Suzuki, 1988) discussed in Chapter 1.

Motivation was driven by the fact that participants enjoyed what they were doing as detailed in Section 4.4. They could predict how the other would respond as suggested by Borsook et.al. (1991) and Cronjé (1996) explains that created an excitement to prolong the discussion. Results show extreme engagement during the interactivity, hence no one was bored. Only effectively designed instructional learning can explain that level of interactivity called interaction.

4.5 Summary

Data revealed the existence of *interaction* at the highest level where participants interacted repeatedly and meaningfully.

WebCT communication tools supported either synchronous or asynchronous communication. Five communication tools available on WebCT and Short Message Service (SMS) were used by participants to exchange information and possible feedback. File transfer (*asynchronous*) enjoyed the most frequency for the duration of ten sessions. Students mainly downloaded and shared assignment files already uploaded in the shared area. E-mail (*asynchronous*) was used to send and retrieve messages and attachments. In Newsgroup (*synchronous*), members participated in forums and debates on given topics. *Cell phone messaging (asynchronous)* was never part of WebCT communication tool, however, students initiated sending short messages from their computers into cellphones of the same network. In *Chatrooms (synchronous)*, a WebCT chat tool was used to send and receive text-based messages instantly. *Mailing listserv(s) (asynchronous)* was the least popular used communication tool at 3%. Information was retrieved from, and text messages were sent into a mailing list address.

The aspects that influenced the use of communication tools were emotional. The usage of various communications tools during interactivity was influenced by different emotional aspects such as, enjoyable, boring, confusing, understandable, engaging, challenging, and exciting. These aspects are integrated and they can influence one another, For example, cognition involves understanding, engaging and challenging. Motivation was driven by enjoying what participants were doing. They could predict how the other would respond and that created an excitement to prolong the discussion. Transparent learner interface provided locus of control with less confusion and more understanding of using communication technology for learning. Simple options were provided for learner control as supported by Alessi & Trollip (2001).

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the dissertation by attempting to find answer the main research questions. This final chapter will firstly present, the summary followed by the discussion of what can be learnt from this research. Finally, recommendations will conclude the chapter.

5.2 Summary

An increasing number of universities are turning to the Internet as a medium for facilitating learning. This case study investigated whether communication tools in WebCT at Monash South Africa, which is a university that enrolls only full time students, are underutilised. A qualitative and evaluation research approach was used for this instrumental case study. The case study focused on three aspects that follow one another naturally. These aspects are interactivity, features of communication tools that promote interactivity, and the aspects that influence the use of communication tools such as cognition, motivation and learner interface. The study attempted to answer the three main research questions as discussed in the first chapter under section 1.7.1. The next section briefly summarises the rationale, conceptual framework, research design, limitations of this study, as well as, the value of this study.

5.2.1 Rationale

The study builds on the research conducted by Delpoort (2003) who indicated a relationship between a varied and challenging learning environment with frequent interaction. The practical problem is the assumption that Monash South Africa abundantly provides state of the art communication technology around campus that is underutilized. This case study focused on interactivity in WebCT.

5.2.2 Conceptual framework

The study was based on a number of concepts drawn from the literature. This conceptual framework consisted of three main areas, (a) interactivity, (b) features of communication tools that promote interactivity, and (c) the domains, i.e. cognition, motivation and learner interface as aspects that influence the use of communication tools.

5.2.3 Research design

This instrumental case study investigated the level and frequent use of the web-based communication tools in a full-fledged course delivery, learning guidance and assessment through WebCT at a university that enrolls full-time students. A sample of eight students from different backgrounds was selected from the target population of eighteen IT undergraduate students. In addition there were two lecturers, a designer who is a lecturer and two ITS technicians.

5.2.4 Limitations of the study

The selected focus group does not represent the whole population of Monash South Africa therefore; results from this case study cannot be generalized. This case study is conducted on a small group of typical IT students. Typical students refer to enrolled students who attend full-time classes at this university.

5.2.5 Value of this study

The literature in general acknowledges the benefits of interactivity for learning. This study will support designers and practitioners (lecturers) in the pursuit of facilitating effective learning.

5.3 Discussion

This section discusses the benefits of this research. This reflective section contains methodological, substantive, and scientific reflections.

Methodological reflection refers to how the research approach influenced the results. The analysis of the research data presented in Chapter 4 was done in accordance with the illustrated conceptual framework (see Figure 2.1). In this way the researcher was able to determine whether the aims of this study had been met. However, a sample of a selected small group of IT students did not promote enough nuances such as comparative research comprising bigger samples. The exclusion of Business and Economics, and Arts students in the study resulted in qualitative and very limited quantitative data.

Substantive reflection compares results of this particular research with other research on same topic/area. The outcomes of this study confirm that interaction in WebCT is possible between student and student, student and lecturer, lecturer and student, lecturer and lecturer, as well as, student and content. This is supported by Cronjé (1996) and Moore (1998) by explaining that interactivity in a web-based environment involves simulating the interchange between two people who are communicating meaningfully for the purpose of either task/instructional competition or social relationship building.

Scientific reflection is related to substantive reflection, but focuses on what this research has contributed to the 'scientific body of knowledge'. Participants were motivated to explore more communication tools other than the tools that were available on WebCT. More communication tools need to be added for effective learning on WebCT units. The evaluation research results may provide useful feedback that could contribute to possible further research to improve interactivity not only on WebCT but in other web-based course management system tools or in web-based learning in general.

5.4. Findings

Data were obtained by data collection instruments such as interviews, questionnaires, observation anecdotal notes, communication diaries, focus group meeting and a journal/logbook. The main research questions and a summary of the results were as follows:

5.4.1 Research question 1:

1. (a) What is the frequency of interactivity in a WebCT learning environment?

A total of 145 frequencies was the recorded number of interactions that occurred in using web-based communication tools for the duration of ten sessions. File transfer, mail and news group tools were more frequented than other tools that were available in WebCT.

- (b) What is the level of interactivity in a WebCT learning environment?

The literature reviewed suggests that various levels of interactivity are defined by the purpose of interaction. While cognitive and physical engagement during learning describes the highest level of interactivity, only receiving information without engaging is described as the lowest level of interactivity. Although File transfer was frequently used, it involved none of any interactions explained by Berlo (1960) in section 2.3.1. Activities such as posting messages to discussion forums during the learning sessions proved to reach Berlo's (1960) *interaction*, which is the highest level of interactivity in his taxonomy of communicative interdependence. Berlo, (1960) classifies the *interdependence of expectations* as the highest level of interactivity. This level was maintained through continuous guidance and probing questions during discussions in the forum and in the chatrooms.

5.4.2 Research question 2:

What are the features of web-based communication tools that promote interactivity?

The WebCT communication tools supported either synchronous or asynchronous communication. File transfer, e-mail and mailing listserve(s) were used as asynchronous communication tools, chatrooms and newsgroups were used for synchronous communication. Internet communication tools were used by participants to exchange information and possible feedback. Cellphone messaging is a web-based communication tool and was not part of WebCT tools but was initiated by students. It was evident that communication tools can facilitate web-based learning. Interaction is possible between student and student, student and lecturer, lecturer and student, lecturer and lecturer, as well as, student and content. Listed in order of frequency rate (see Figure 4.1), the tools used were; file transfer (27%), E-mail (26%), Newsgroup (25%), cellphone (11%), chatrooms (8%) and listserv(s) (3%).

5.4.3 Research question 3:

How do aspects of cognition, motivation and learner interface influence the interactive use of communication tools in web-based learning?

The *cognitive* aspect involved physical and mental engagement which was created by a challenging and a perceived meaningful communication. Students worked in groups to find solutions to their tasks. Activities were problem based as suggested by Barrow's (1993) Problem based Model (See table 2.5). The *motivational* aspect showed the motivating "flow" (Clarke, 1998) when participants gained attention shown by relevant and meaningful responses (Keller, 1988) during the interactions. The *learner interface* was

transparent and provided simple options for learner control. Students therefore, were motivated to explore more communication tools.

5.5 Recommendations

Three sets of recommendations are drawn out of each research question. Recommendations are made for policy and practice, improvement of the intervention and for further research.

5.5.1. Recommendations for Policy and practice

5.5.1.1 Frequency and level of interactivity

With continuous advances in information and communication technology and with ever-increasing student numbers at resident universities, more tertiary institutions should offer on-line courses. This is supported by McNeil, et. al. (2000) who identified key-concepts of change in tertiary education as follow

- Transformation of students from being passive recipients to participants in an active learning environment.
- The use of the internet communication tools has provided teachers and learners new flexibility and has fostered a climate where learning takes place as and when it is convenient.
- Traditional occurrences in face-to-face classrooms are replaced by new, available social and instructional interactions.

A course management system tool should be evaluated against institutions' policy prior to the implementation. Monash South Africa should look into creating independent WebCT from Monash Australia in order to avoid delays in solving problems encountered during implementation.

5.5.1.2 Features of communication tools that promote interactivity

It is recommended that Monash South Africa encourages web-based learning in all the units offered at this university. Designers should always consider instructional design principles when developing and modifying web-based learning materials. Although White board allows graphic presentations and internet images, File transfer was used in stead, for complete project presentations designed in PowerPoint. It should not be assumed that the structure of an activity or task could channel the use of a specific communication tool. Alternative communication tools should be considered.

5.5.1.3 Aspects that influence the use of communication tools

Effective information and communication technology policies need to be developed, revised and be implemented by tertiary institutions in South Africa. Since students come from different cultural backgrounds cultural awareness programs should be put in place at Monash South Africa. This will improve social and interpersonal interaction.

5.5.2. Recommendations for Further improvement of the intervention

5.5.2.1 Frequency and level of interactivity

A total number of 145 interactions were recorded. To allow more frequency and a high level of interactivity Monash South Africa should add a variety of communication tools on WebCT. The intensity of interactivity is defined by the purpose of interaction. It is therefore recommended that activities afford the usage of all communication tools available on WebCT. For example, the White board was added on WebCT and the tool was not utilised. Although the

web-based cellphone messaging was not part of WebCT communication tools it was initiated by students.

5.5.2.2 Features of communication tools that promote interactivity

Interactivity was possible in a WebCT learning environment (see Table 4.1). Synchronous and asynchronous communication took place as described in Table 3. Most teachers do not create a learning environment in which learner collaboration and discussion are encouraged or implemented (Dutt-Doner & Powers, 2000). It is therefore, emphasised that activities on WebCT encourage interaction since *interaction* is the highest level of interactivity in Berlos' (1960) taxonomy of communicative interdependence.

5.5.2.3 Aspects that influence the use of communication tools

The lecturers maintained active participation by providing guidance and probing questions to students during discussions. This is necessary in order to maintain the *interdependence of expectations* as the level of interactivity that requires an active participation. Undergraduate students also like to learn through play, it is recommended that games with suitable communication technology is considered for WebCT learning environment.

5.5.3. Recommendations for Further research

5.5.3.1 Frequency and level of interactivity

Web-based tools such as, Yahoo messenger and short message service (SMS) are not part of WebCT and they were not anticipated during the study. Students used the game chat tool for synchronous communication and SMS for asynchronous communication. The white board tool was added on

WebCT, however, it was not creative enough to be utilised during learning. For further research, quantitative research in comparative study with bigger samples involving other institutions is recommended for more informative study of this nature.

5.5.3.2 Features of communication tools that promote interactivity

Different tertiary institutions use different course management system tools to deliver courses on-line. It is recommended that the prospective course management system tool is evaluated prior to selection. An efficient tool supports various synchronous and asynchronous web-based communication tools. It can easily be assumed that the structure of an activity or task could channel the use of a certain communication tool; however, Table 4.2 suggests that alternative communication tools can be used for different purposes.

5.5.3.3 Aspects that influence the use of communication tools

For the WebCT to adequately facilitate learning, the web-based course should provide students with learning materials, models and metaphors (see Table 1.3). in order to save time and to minimise frustrations Monash South Africa should enjoy equal design authority as Monash Australia.

6 Conclusion

The study shed light on the interactivity in WebCT learning environment at a university that enrolls full time students. It was clear that communication tools on WebCT were not underutilized. In addition to using various web-based communication tools, including discussions on WebCT during formal sessions, students make individual appointments for one-on-one consultations with the lecturers. The researcher would therefore like to conclude by emphasizing the recommendations for policy implementation, interactive intervention, and further research as discussed in this chapter.

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Appendix B

Consent Form



Consent Form – Students selected for interview

Investigation title:

Using internet communication tools to facilitate learning

NOTE: This consent form will remain with the Monash University researchers for their records
Researchers may be contacted at 950 411 and 950 4105 or in their offices during office hours

I agree to take part in the case study, Monash South Africa research project as specified above. I have had the project explained to me, and I have read the Explanatory Statement which I will keep for my records. I understand that there is no coercion on the part of the researcher for me to take part in this study. I understand that in agreeing to take part means that I am willing to do the following:

I agree to be interviewed by the researcher Yes No

I agree to allow the incidental observations to be recorded. Yes No

I agree to allow the interview / focus group to be recorded. Yes No

I agree to allow my questionnaire, communication diary/ interactions during ten learning sessions to be used for statistical analyses Yes No

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalized or disadvantaged in any way.

I understand that any data that the researchers extract from the interview / discussion for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

I understand that data from the interview transcript will be kept in secure storage and be accessible to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

The researcher may have occasion to use the data collected in this project for future projects. This will only be done with your consent. Please tick one of the following:

<input type="checkbox"/>	The information I provide may be used in further research projects that have ethics approval as long as my name and contact information is removed.
<input type="checkbox"/>	The information I provide may not be used by other researches without asking me first.
<input type="checkbox"/>	The information I provide may not be used, except for this project.

Name

Signature **Date**

Appendix C

M O N A S H U N I V E R S I T Y



Wk	Wk Beg	Topic	Lecture	Tutorials	Reading	Assessment Due	
1	21/7 /03	Intro to project management process models	PMBOK, PM intro, process models	Project planning, portfolio management	Humphrey, Ch 1,2. Schwalbe Ch 1,2,3		
2	28/7/03	Team building & communication management	Project teams. Getting started	Establish teams & plans	Humphrey Ch 3, 11-15, Appendix E. Schwalbe Ch 8,9		
3	4/8/03	Detailed project plans	Task plans	Develop a task plan	Humphrey Ch 5, 7 Schwalbe Ch 4, 13		
4	11/8/03	Controlling a project	Quality and risk management. Monitoring plans	Update risk and quality management. Determine initial status	Humphrey: ch 4,5,6, Appendix C Schwalbe: ch 7, 10, 14, 15	Project Definition; Draft Functional Specification (<i>Hurdle</i>)	
5	18/8/03	Project status, reviews and reports	Cycle 1 review. Writing the report	Reviews and report writing	Humphrey page 246, Ch 10. Schwalbe page 278		
6	25/8/03	Change management	Change control process and requirements change	UNIT TEST Change of requirements assessment	Humphrey Appendix B Schwalbe Chapters 3,4	UNIT TEST	
7	1/9 /03	Preparing for Cycle 2	Revisit PMBOK and process models. PIPs	Product manager meeting. View Alpha product	Humphrey Chapters 9, 16,17,18. Revisit Ch 3,4	Cycle 1 Project Deliverables	
8	8/9/03	Teams, communications	Team and Client communications	Communication activity		Change Request	
9	15/9/03	Project Close-out	Closing processes	User Meeting	Schwalbe Ch 16		
10	22/9/03	Project management tools	Intro to project management tools	Using a project management tool	Schwalbe Ch 5		
Break	29/9/03	MID SEMESTER BREAK					
11	6/10/03	Putting it all together	Industry perspective (guest lecture)	Product evaluations		Product evaluation	
12	13/10/03	Project wrap-up	No lecture scheduled	Project audit		Cycle 2 Project Deliverables	
13	20/10/03	Revision	Revision	No tutorial scheduled		Individual Interview	

Appendix D

Compose Discussion Message

The screenshot shows a web form titled "Compose Discussion Message". It includes the following fields and options:

- Topic:** A dropdown menu with "Math" selected. A "Post anonymously?" checkbox is present.
- Subject:** A text input field containing "Welcome to WebCT".
- Message:** A large text area containing the text: "welcome to using WebCT. Use this discussion forum to post messages to your fellow students and your lecturer."
- Equation:** A section with a "Create" button and a "Preview" button.
- Height of edit area:** A numeric input field set to "12" and a "Preview" button.
- Options:** Radio buttons for "Don't wrap text" and "Wrap text".
- Attachments:** A section with a paperclip icon, a "Browse" button, and a text area containing "There are no files attached".

Addendum A

Personal observations

Anecdotal record of incidents that take place at the site within the period of the research project

Date:

Place:

Session:

Name of the researcher:

Description of the incident:

(Single incident, factual non-inferential description of the observed incident taking place at that particular moment, description of the situation. Include all the important details).

Interpretation:

(Own interpretation and feelings about the anecdote).

Formative review logging communication tools used for WebCT learning

Description	Challenges/Comments/Questions	Action taken
Describing the part of the session under review.	The researcher's observations and reactions.	Actions taken or suggested.

Addendum B

Questionnaire: Using Internet communication tools to facilitate learning process

Kindly take time and respond to the following questions. There is no wrong or right answer. Your opinion is highly appreciated.

1. Do you own a computer?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

2. Do you have Internet access after school?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

3. Do you ever use the Internet for communication?

If yes:

Please check (✓) applicable choice(s).

E-mail	<input type="checkbox"/>
Mailing lists	<input type="checkbox"/>
News group	<input type="checkbox"/>
Chat-groups	<input type="checkbox"/>
Other	<input type="checkbox"/>

4. In what ways does WebCT:

(a) Help your learning?

Make a (✓) in the box next to the answer:

Not Helpful	<input type="checkbox"/>	Helpful	<input type="checkbox"/>	Very Helpful	<input type="checkbox"/>
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(b) Hinder your learning?

Never:	<input type="checkbox"/>	Hinders:	<input type="checkbox"/>	Strongly:	<input type="checkbox"/>
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5. How do you find collaborative learning in WebCT?

Put (✓) next to your choice(s).

Enjoyable	Boring	Confusing	Understandable	Engaging	Challenging	Exciting
<input type="checkbox"/>						

6. Do you think it makes any difference if you were:

(a) Non-resident student?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Why?

(b) Resident student?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Why?

Addendum C

Focus group meeting: Session

Duration:

AGENDA

1. Feedback on the project: Outstanding questions and issues

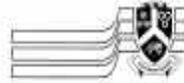
1.1 Group discussion

2. Interview: Guiding questions and issues

- 2.1. Which communication tool do you find particularly useful? Why?
- 2.2. What limits do the various communication tools have and what would you like to mention about those tools?
- 2.3. What aspects of collaborative learning process we have just been through did you find helpful and why?
- 2.4. In your teaching context, what tools do you adopt as first preference to facilitate and assist with learning?
- 2.5. Does WebCT help to facilitate teaching and learning? Why?
- 2.6. Using communication technologies for teaching and learning in the same institution (e.g. Monash South Africa university) that enrolls full-time students. Do you think it makes any difference if students were:
 - Non-resident student? Why?
 - Resident student? Why?
- 2.7. Any additional comments in the context of using communication technologies to facilitate learning process you would like to add?

(Martin T, 1999)

Addendum D



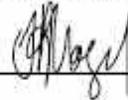
UNIVERSITY OF PRETORIA

FACULTY OF EDUCATION

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	CLEARANCE NUMBER : <input type="text" value="CS06/11/06"/>
<u>DEGREE AND PROJECT</u>	M.Ed Computer Integrated Education Using Internet communication tools to facilitate learning.
<u>INVESTIGATOR(S)</u>	Sheila Xakaza - 94014672
<u>DEPARTMENT</u>	Curriculum Studies
<u>DATE CONSIDERED</u>	16 January 2007
<u>DECISION OF THE COMMITTEE</u>	APPROVED

This ethical clearance is valid for years and may be renewed upon application

CHAIRPERSON OF ETHICS COMMITTEE	Dr S Human-Vogel 
DATE	16 January 2007
CC	Prof J C Cronje Ms Jeannie Beukes

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.