The Application of Computer Technology in South African Distance Education

by

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ABSTRACT

The advent of on-line Computer-Assisted Instruction and Computer Mediated Communication may improve instruction and communication in distance education in South African universities. On-line Computer-Assisted Instruction in distance education makes the reinforcement of knowledge both systematic and immediate. With instructional media such printed text, audio-cassettes, radio and television broadcasts the student at a distance is an isolated and passive recipient of knowledge.

On-line Computer-Assisted Instruction supported by Computer Mediated Communication for interaction and feedback could close the gaps in time and distance between the teacher and the student in distance education. The current network capabilities of the computer makes it possible for such a student to interact with peers and lecturers before, during and after instructional episodes. Computer Mediated Communication can facilitate the use of electronic messaging such as Electronic Mail, Internet Relay Chat, List Servers, Multi-User Domains and Bulletin Board Services for interactions and feedback.

This thesis investigates whether instruction and communication in South African universities with a distance education option can be improved using on-line Computer-Assisted Instruction and Computer Mediated Communication respectively.

The thesis also makes proposals for their implementation in South Africa by analysing the applications of computer technology in degree awarding distance education institutions in some developed and developing countries that use on-line Computer-Assisted Instruction and Computer Mediated Communication.

Preface

This thesis is the original work of the author carried in the Department of Computer Science, University of Natal, Durban from August 1994 to August 1996, under the supervision of Mrs J. J. Meyerowitz. Where use has been made of the work of others, its has been duly acknowledged in the text

Parts of chapters 2, 3 and 4 were presented in a paper, "Closing the gap between the learner and teacher in African distance education universities using CAI", at *The Third Natal Computer Science and Information Systems Conference, University of Natal, Pietermaritzburg, 20th Ooctober 1995.*

Parts of chapters 2, 3 and 4 have also been published in the paper, "Computer Mediated Commuincation as a Means to Enhance Interaction and Feedback for Distance Education", co-authored by Professor R. C. Branch, in the *International Journal of Educational Telecommunications, 1996, Vol 2(2/3), pp199-227.*

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I certify that the above statements are correct.

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Mrs J. J. Meyerowitz

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CHAPTER ONE

Introduction

The purpose of this study is to investigate whether the face of instruction and communication can be improved in South African distance education universities using on-line Computer-Assisted Instruction (CAI) and Computer Mediated Communication (CMC).

Definition 1.1: "Computer-Assisted Instruction is the direct use of the computer for facilitation and certification of learning - that is using the computer to make learning easier and more likely to occur (facilitation), as well as using the computer to create a record (certification) that learning has occurred"[BUAK85].

Definition 1.2: On-line Computer-Assisted Instruction is Computer-Assisted Instruction that can be accessed through a network from any location using the appropriate software [OWUS95].

Definition 1.3: Off-line Computer-Assisted Instruction refers to Computer-Assisted Instruction that is available on the local drive of a personal computer or on a server which can be accessed within the immediate environment of a LAN but not from a remote location.

Definition 1.4: "Computer Mediated Communication is the combination of word processing and telecommunications via personal computers, telephone lines and central computer conferencing systems"[LEVI90].

The thesis focuses on the role that computer technology could play in improving or supplementing some methods of instruction and communication in South African universities with a distance education option.

At present the primary vehicles of instruction in South African distance education universities are printed text, radio and television broadcast and audio cassettes. These media do not facilitate effective interactive instructional episodes and thus the re-inforcement of knowledge is not systematic and immediate. The student becomes a passive recipient of knowledge. Interactive instructional episodes could facilitate higher-level learning skills such as problem-solving and decision-making rather than lower-level skills such as memorisation or concept learning.

Interaction and feedback between students and teachers is normally through postal mail, telephone and personal visits which are often infrequent with delays in time. Answers to students' questions are delayed because of communication constraints that span the distance between them. There is little or no form of interaction among students due to the lack of sufficient formal channels for any contact between different locations.

Computer technologies have the potential to provide the equity in terms of interactive instruction, effective communication channels and remote access to learning resources but the technological infrastructure has to be in place.

This thesis postulates that:

(a) On-line Computer-Assisted Instruction could provide students in distance education universities with remote access to interactive and quality instruction.

(b) Computer Mediated Communication through its electronic messaging such as Electronic Mail, Internet Relay Chat, List Servers, Multi-User Domains and Bulletin Board Services may close the gap in time and distance between the lecturer and the student to enhance quality interaction and feedback.

(c) On-line Computer-Assisted Instruction and Computer Mediated Communication can facilitate remote access to and retrieval of materials from learning resources such as libraries, databases and publications that are available to the students in residential universities.

To investigate these issues, research was undertaken to analyse on-line Computer-Assisted Instruction and Computer Mediated Communication in other developed and developing countries in order to propose a system for implementation in South Africa.

1.1 Objectives

The objectives of the research undertaken and reported in this thesis are as follows:

(a) To establish whether the face of instruction in South African universities with a distance education option can be improved via on-line Computer-Assisted Instruction.

(b) To establish whether the gap between the lecturer and the student in South African distance education universities can be closed in terms of time and distance, via Computer Mediated Communication.

(c) To establish whether the gap between conventional and distance education universities in South Africa can be closed in terms of learning resources.

1.2 Outline of Thesis

The rest of the thesis is discussed under appropriate chapter headings. A brief outline of each chapter is as follows:

Chapter 2 Review of Distance Education and its Application in South Africa

This chapter is a review of the literature on distance education and its application in South Africa. The review discusses distance education practice in general and the advantages and disadvantages of some of the current instructional media. The chapter also discusses some of the current distance education practises in South African universities and the need to improve instruction and communication in these institutions. The requisite for effective instruction and factors that must be considered in the selection of instructional media are also discussed.

Chapter 3 Computer-Assisted Instruction

Chapter three is a review of the different types of Computer-Assisted Instruction, the effectiveness of Computer-Assisted Instruction, and its advantages and disadvantages. The use of Computer-Assisted Instruction in South Africa is reviewed and the limitations of the current implementation practises, as well as the need for change, are discussed.

Chapter 4 Computer Communication and Instructional Technology

In this chapter Computer Mediated Communication and its role in distance education is discussed. The different types of Computer Mediated Communication such as Electronic Mail, Internet Relay Chat, List Servers, Bulletin Board Services and Multi-User Domains that could used for interactions and feedback in South African distance education universities are analysed. Technologies such as the World-Wide Web, Lotus Notes and the Integrated Services Digital Network infrastructure that could be used to develop and implement on-line Computer-Assisted Instruction in South Africa are also discussed in this chapter.

Chapter 5 Surveys, Results and Analysis

In this chapter the methods and procedures that were used to gather data on the implementation practices of Computer-Assisted Instruction and Computer Mediated Communication in degree awarding distance education institutions in some developed and developing countries are discussed. This data is analysed and the results are discussed and are used to formulate guidelines in proposing a system of implementation in South Africa.

Chapter 6 Proposals for Implementation

The chapter makes proposals for implementing on-line Computer-Assisted Instruction and Computer Mediated Communication in South African universities with a distance education option, based on the review of literature and the findings of the research. The proposals are made using various instructional and communication media scenarios which are discussed with respect to access points for students, hardware requirements, software requirements, training requirements for academic staff and students, cost implications and possible constraints.

Chapter 7 Conclusions

In this chapter conclusions are drawn on the results of the research undertaken.

CHAPTER TWO

Review of Distance Education and its Application in South Africa

This chapter reviews distance education practice and its applications in South Africa in terms of instruction and communication. The chapter discusses the requirements for effective instruction and the factors that must be taken into consideration when an instructional medium is being selected for instructional episodes in distance education.

Definition 2.1: "Synchronous communication is the establishment of a common timing between a sender and a receiver" [CISC92].

Definition 2.2: "Asynchronous communication is the establishment of an infrequent or irregular timing between a sender and a receiver"[CISC92].

2.1 General Distance Education Practice

Distance education has typically been used as an alternative to face-to-face instruction because it is flexible and can accommodate a wider spectrum of people. Students who undertake distance education can be categorised as follows:

(a) Full-time employees who want to pursue higher degrees.
(b) Students who are economically disadvantaged but want to pursue higher education with well established universities but due to financial constraints cannot relocate.
(c) People who are geographically remotely located from degree awarding institutions or learning centres.
(d) Physically disabled and home bound students who want to further their education but cannot use the residential system of education.

2.1.1 Defining Distance Education

Distance education accommodates all these categories of people who with their constraints cannot be enrolled in the conventional system of education. According to [ROWN92], "Distance education has evolved to mean both distance learning and teaching."

Definition 2.3: "Distance education is the various forms of study which are not under continuous and immediate supervision of tutors present with their students in lecture rooms or on the same premises, but which nevertheless benefit from the planning, guidance and tuition of tutorial organisation" [HOLM81].

Definition 2.4: "Distance education is the family of instructional methods in which the teaching behaviours are executed apart from the learning behaviours including those that are performed in the students presence, so that communication between the teacher and the student must be facilitated by print, electronic, mechanical or other devices" [KEEG88].

Distance education can facilitate increased participation in higher education that might not be achieved in an on-campus or conventional situation especially when educational resources are limited. Distance education can be characterised by:

(a) a separation of the teacher and the student,
(b) the extensive use of media such printed text, audio cassettes, radio and television broadcast and now augmented by on-line Computer-Assisted Instruction for presenting high quality teaching materials,
(c) two-way communication so that the student may initiate or participate in dialogue.

2.1.1.1 Separation of the Teacher and the Student

Distance education is designed to allow students to learn while at a distance from their teachers. Usually the students are separated from their teachers in time and distance but

are still guided by them. Feedback is sometimes delayed due to communication constraints that span the distances between them. This results in the isolation of students who need tutorial support in terms of interaction and feedback which make the reinforcement of knowledge systematic and immediate. Students should be able to interact with the lesson materials in the absence of the teachers to facilitate quality instruction.

2.1.1.2 Extensive use of Media for Producing High Quality Teaching Material

The various models of distance education can be identified by the technical media they choose for their learning material. The majority of the programmes are print-based, a few are audio-based, fewer are still video-based. The "first generation" of distance education in the late 1940s was available through mail order courses. Through the 1960s and 1970s, a "second generation" of distance education emerged which was characterised by extensive use of open broadcast by either radio or television, supported by correspondence instruction and print materials. The "third generation" of distance education has been characterised by the use of teleconferencing systems [BARK92]. Initially audio conferencing was used but this progressed to more sophisticated audiographic conferencing systems which support telephone audio conferencing with visual and text material.

Another parallel development has been video conferencing. Until recently this was a somewhat expensive alternative to audio conferencing but due to developments in digital computer-based desktop video conferencing, it is becoming accessible to an ever larger section of the educational community [PARK84];[TREM92].

A fourth phase of distance education is emerging which is based on new developments in telecommunications and computing, and is characterised by the integrated use of remote study materials supported by computer-based multimedia teleconferencing [STEI92]. On-line Computer-Assisted Instruction is used for instructional episodes, and is supported by electronic messaging for interaction and feedback. These developments may provide the

platform to bridge the gap in distance and time between students and teachers. For effective learning to occur, the student must interact with, and operate on, the learning material and available resources at his or her disposal.

2.1.1.3 Two-way Communication

Communication between the teacher and student in distance education usually takes the form of written comments on assignments and occasional phone calls or letters. There are also different forms of audio-conference and video-conference, and varying amounts of face-to-face tuition in a group situation. The type of communication media in distance education varies from one programme to another but is an essential component of a quality instructional episode. The easy availability of two-way communication media may reduce the isolation of the student who might have problems in making progress in his or her work. The student can present a problem and receive feedback from instructors or peers. Such a two-way communication medium that is both available and accessible to students will reduce feedback delays.

2.1.2 Open Learning

This thesis focuses on distance education which has philosophies that are similar to open learning. According to [ROWN92], distance education is not different from open learning since the latter involves some degree of the former. The philosophy of open learning is to do with improving access and learner-control, thus the method (a set of techniques for teaching and learning) usually involves some element of distance education. The teaching and the learning methods may involve any variety of media, such as print, audio cassettes, television, video cassettes and Computer-Assisted Instruction [ROWN92]. These instructional media can be used either on-campus or at a distance. The students using them are provided with various amounts and kinds of help from tutors or facilitators.

Some authors have defined open learning as follows:

Definition 2.5: "'Open learning' is a term used to describe courses flexibly designed to meet individual requirements. It is often applied to provision which tries to remove barriers that prevent attendance at more traditional courses, but it also suggests a learner-centred philosophy"[LEWI86].

Definition 2.6: "Open learning is a wide range of learning opportunities that both aim to assist learners in gaining access to knowledge and skills they would otherwise be denied and to give learners the optimum degree of control over their own learning"[DIXO87].

The teaching and learning materials are designed to enable the student to learn with less support than is usually available from an instructor in a classroom-based environment. They can contribute to openness by:

(a) enabling more people to learn by minimising the amount of teacher time required,
(b) using a variety of media for different students,
(c) enabling students to study at their own pace, time and convenience,
(d) making the students responsible for their own progress [ROWN92].

In comparing the definitions and characteristics of open learning with distance education, they share similar philosophies. They provide learners wider access to knowledge and control over time, place and pace of learning. However, while open learning may involve distance education, not all distance education systems are particularly open [ROWN92]. It is possible to use the method without the philosophy.

2.2 Instructional Media in Distance Education

Distance education utilises a variety of instructional media in the delivery of instruction. Most degree awarding institutions with a distance education option combine more than one instructional medium in the production and delivery of instruction. Lack of choice of instructional media can impoverish the learning environment. There is the need to make a wide range of instructional media available to students without any assumption that one medium can cope with students' varying learning needs and styles.

2.2.1 Print

Printed text comprises text books, study guides to already published materials, specially written self-teaching materials and workbooks [ROWN92]. Print has been the basis of distance education and has always been the dominant medium. Print is still considered the most important medium in the presentation of learning materials by distance educators [BATE84].

Advantages

Most students are familiar with printed text. It is inexpensive and portable. Its format allows readers to access any section, for any length of time. Distribution is easy if the postal service is well developed, and it can be used without additional equipment.

Disadvantages

Some parts of reality cannot be expressed in writing and audio and visual presentations that are described in print are reduced to a few important observations. The student cannot interact with the learning material or receive instant feedback on performance.

2.2.2 Radio

Radio is the medium that allows the broadcast transmission of the human voice through an audio signal to a number of listeners [BATE84]. The number of listeners may vary depending on the size of the class. The use of radio for educational purposes includes direct listening by students and recorded broadcast to be used at a later stage.

Advantages

Advantages of radio include easy access, relatively low cost, immediate availability and the possibility of changing the contents quickly. The cost of a radio broadcast is independent of the number of listeners, so the broadcast cost for one thousand listeners would be the same as for one hundred listeners.

Disadvantages

Some people do not learn well by radio as they find it difficult to concentrate on words alone without any visual or other cues. After about twenty minutes of listening and learning, students may lose concentration. If the pronunciation of words is not simple and clear, many students will find it difficult to follow. Students have no control over the time and pace of a broadcast that is done at the same pace for all students. The student can only go over lessons if he or she has access to a recorder.

2.2.3 Television Broadcast

The television broadcast is the transmission of audio and video signals through the air to a wide area. The signals beam through the air to television receivers without the use of wires or cables [BATE84]. Educational broadcast through television has been one of the traditional forms of delivering instructional episodes at a distance.

Advantages

Television broadcast programmes can provide an overview of subject matter dealt with in more detail in texts. For example television broadcast incorporates visualisation which is good for encouraging individual interpretations and providing contextualisation, hence stimulating critical thinking, and allowing knowledge to be applied in different situations. Television receivers are widely accessible.

Disadvantages

Television broadcast is weak with respect to students control over the time and pace of learning. The student cannot go over the same material several times until it is understood unless the student has a video recorder to record the lesson for future use. As with radio,

it is not possible for the student to pursue a line of thought during a programme without losing track of the lesson itself. Television is also limited in terms of feedback and self evaluation.

2.2.4 Telephone

The telephone offers two-way, interactive communication across distance. The means of providing the link may be terrestrial wire or cable, high frequency radio waves, micro-waves or satellite [BATE84]. Irrespective of the method used to provide the link, people can talk to parties beyond their immediate boundaries.

Advantages

The telephone is effective when used to clarify student difficulties during instructional episodes. It can be used to promote student discussion of specific issues and topics, present short case-studies and role-play on exercises. It is also useful for checking through previously circulated problems [BATE84]. Telephones can be used for lectures or for tutorials via conference call systems or through a loud speaker. Telephone is good for synchronous communication.

Disadvantages

Telephones lack a visual display and are thus not effective for diagrams. Telephones cannot be used to present some scientific and mathematical courses that require the exchange or production of spontaneous or dynamic visuals such as a visible chemical reaction. The cost of teaching via the telephone depends very much on geographical factors, but could be very expensive for both students and institutions.

2.2.5 Audio cassette

Audio cassette has two aspects: audio, the sound element; and cassette, the storage medium. It is used for commenting on diagrams, charts, tables or text; for backing up or commenting on other media; and for recordings of real-life situations, conversations, interviews etc., which can be played back and analysed.

Advantages

Audio cassette allows students to learn at their own time and pace. It is flexible and easy to manipulate; students can review lesson materials by rewinding and replaying the cassette. They can also be used to learn languages, and for step by step discussion of problems. They are preferred by academics because of the control they have over their use, and the ease with which they can be integrated into course design.

Disadvantages

Production and delivery systems are needed if it is used as an instructional medium. Students must have audio cassette players. The problem of voice only makes it difficult for the student to break monologues up into important points that need to be answered. Rapid movement from one section of the audio cassette to another is not easy. It is not possible to construct diagrams and equations on an audio cassette. Due to the lack of interaction and feedback, mastery learning cannot be ensured by using audio cassettes.

2.2.6 Video cassette

Video cassettes are similar to television broadcast in that they combine moving pictures with sound, but unlike television they can be viewed in ways which are independent of the pre-arranged transmission periods.

Advantages

Video cassettes offer students control in that they can be watched with pauses and partial replays as necessary. Unlike television broadcast which some students find too fast or slow, video cassettes give individual students the flexibility to adjust the pace of the material's presentation.

Disadvantages

As with printed text, radio and television broadcast, and audio cassette, effective interaction is not possible with the lesson materials. Video cassette can only be used by students who have access to a video recorder. Picture and sound quality could degrade over time.

2.2.7 Interactive Videodisc

Interactive videodisc requires a videodisc player, a monitor, and a microprocessing unit. A simple video disc can incorporate many forms of instructional media such as text, charts, graphs, audio, and video motion into a single medium. In additions, the video player provides easy access to the information stored in the disc. The user can randomly search for a frame or chapter, can vary the direction of play (forward or reverse) and can vary the speed (normal, fast, slow, or still frame) [BATE84]. When the capabilities of a videodisc and player are combined with the power of a computer the system becomes a tool for delivering individualised interactive instruction and illustrative lecture material.

Advantages

Interactive videodisc permits individualised, self-paced learning and student interaction with the lesson materials. Random access to the lesson material is possible, and it is more flexible to use than video cassettes. The quality of its freeze-frames and slow-motion ability is higher than video cassettes. Videodiscs can last a long time with proper care.

Disadvantages

The main drawback to video disc is cost. Students require a player, a computer and a suitable monitor. Making a master disc is expensive.

2.2.8 Teletext Systems

Teletext is an electronic data distribution method using broadcast or cable transmission media. The data are organised into pages which may contain text and graphic symbols. A computer terminal and appropriate software is used to create the pages. The computer-stored versions of the pages are then transmitted one after the other through the chosen medium, usually a television, in an electronically coded form [BATE84]. The receiver has decoding and data storage facilities to display the pages of Teletext information. A numerical reference is used to identify each page, and a user can select a page of interest from a stream of transmitted pages using a keypad.

Advantages

Teletext is good for instantaneous delivery of text and graphics, but random access to specified pages may involve some waiting time. It is compatible with computing facilities available in schools and homes.

Disadvantages

At present, teletext uses a one-way transmission medium that limits the degree of direct interaction. The amount of information per page is limited. The television screen is not a particularly suitable medium for text-based learning due to problems with resolution and the lack of portability.

2.2.9 Audio Conferencing

Audio conferencing uses telephone technology to link more than two conference sites. To link more than two sites requires a 'bridge'. The 'bridge' is a device that connects or transmits analogue signals between two or more locations. Bridges are installed at conference sites to provide connections that are user-controlled [TIFF95]. Large numbers of telephones are linked together via a central hub.

Advantages

Audio conferencing is good for collaborative learning at a distance. Interaction and feedback are possible during conferences, debates and seminars.

Disadvantages

Audio conferences that involve a large number of telephones can be very expensive. Transmission costs can be high if nodes are widely distributed. Another problem with audio conferencing is the sound quality, for example echo formation and noise increases when more lines are connected [TIFF95]. There are no visual cues in audio conferencing, hence when the telephone system distorts a voice it can be difficult to follow a discussion.

2.2.10 Video Conferencing

Video conferencing uses monitors, video cameras and control panels at each centre so that participants can see as well as hear each other [TIFF95]. Some video conferences use two or more computers linked via the Internet. During conferences and other instructional episodes, students and teachers can see each other as well as the images and text relevant to the subject that is being studied.

Advantages

Interaction and feedback are possible during instructional episodes. Collaborative learning can take place where students can see how people react to what is being discussed. It is also good for synchronous meetings such as seminars and debates.

Disadvantages

Video conferencing is expensive. Equipment such as video cameras, monitors and control panels are required.

2.2.11 Audiographic Conferencing

Audiographic conferencing uses two telephone lines, one transmitting data between computers and the other for sound. The data can appear as text or graphics. Audiographic conferencing uses data bridges, and the telephone line costs are double that of audio conferencing. Every audiographic centre not only provides the means to talk to and listen to every other centre, but also has a video display unit linked to a personal computer that acts as a common white board and can be written to and viewed at each centre [TIFF95]. Written messages can be keyed in, and with a graphic package it also possible to draw pictures and diagrams. An electronic pen can be used to write directly onto the visual display unit.

Advantages

Text, diagrams and video frames can be prepared as files and down-loaded to the different centres before the audiographic conference starts. Files that have previously been down-loaded can be called up during a session. Audiographic conferences are good for

collaborative learning and debates, as well as interaction and feedback.

Disadvantages

Audiographic conferences are expensive to run. Equipment such as computers, video display units and telephone lines are required.

2.2.12 Computers

Computers can be used to present educational material and to perform many other functions in the process of instruction. Computer application in distance education can be classified as Computer-Assisted Instruction (CAI), Computer-Managed Instruction (CMI) or Computer Conferencing. Computer-Assisted Instruction will be discussed in detail in Chapter 3. Computer-Managed Instruction is designed to produce a course structure with built-in testing, prescriptions that guide the student during learning activities, as well as monitoring and reporting on students performances. Computer Conferencing systems enable a participatory style of communication by enabling users to submit contributions themselves [TIFF95]. Additional facilities are conference security features, special selection and search function for each individual user.

Advantages

Computers facilitate self-paced, individualised learning. Users have control over time and length of study, as well as the potential for a degree of interactivity during instruction depending on the software design.

Disadvantages

Computers could be an expensive instructional medium as compared to printed text, audio cassette and video cassette. A large amount of time and effort are required to design learning materials that cannot be purchased elsewhere.

2.3 Requisites for Effective Instruction

Whether learning sessions are conducted on-site or at a distance, effective instruction requires interaction, feedback, motivation, learner control and confidence to enhance quality instructional episodes.

Interaction during instructional episodes is essential since it encourages relationships among the learning community while stimulating previous knowledge and prior learning experiences. Interactions can take place at different levels between the student and the courseware, among peers, and between the students and their lecturer on a one-to-one or one-to-many basis [KELL84]. All these forms of interaction are necessary for quality instructional episodes whether in a face-to-face environment or at a distance. Interaction provides students with the opportunity to express their ideas and to receive response from their peers. When opportunities for interaction exist in learning situations at a distance, it helps the students to make progress in their understanding which is unlikely to occur when working in isolation.

Interaction in a networked environment can be a forum for discussions that can exist for an entire semester, and as a result, students can understand the course content in a more meaningful way. The student is motivated by the fact that he or she has some information as to why the response to a question is right or wrong, and can proceed with learning.

Feedback can be positive or negative and both are typically needed to guide the student during instructional episodes. Feedback gives information about the quality of the student's response to a presentation. According to [HOLM81], the success of distance education is enhanced if students receive feedback after responding to stimuli in the form of a test or an assignment. The feedback students receive from tests and assignment results enable them to judge how well they have understood a topic and could lead to the reorganisation of their thoughts as well as mastery of skills.

Motivation is necessary for the active participation in instructional episodes. [KELL84] define motivation as "a comprehensive set of actions that stimulates meaningful learning." Maintaining students' motivation during instructional episodes is vital for quality learning. Firstly, the students' motivation can be kept high if the instructional media available to them enables to them make progress during instructional episodes. Secondly, students' motivation could also be kept high if they have reasonable access to lecturers and peers with whom they can discuss learning problems.

The term *learner control* has different aspects. The student studying through distance education should have the opportunity to control the pace, place and time of learning [ROWN92]. Instructional episodes that are done in asynchronous mode benefit the student who cannot cope with the academic schedule of a conventional institution due to the various reasons listed in 2.1. User friendly instructional media could reduce students' frustration if different learning styles are accommodated. Students should be able to progress at their own pace and time.

The *confidence* of the student during and after instructional episodes is relevant to his or her progress. The student's confidence could be maintained if there is sufficient interaction and feedback with instructors and peers [MASO90]. A low level of confidence could lead to overall poor performance of the student or a high dropout rate. Thus students studying in the absence of lecturer and peers require effective instructional media which meets most of their learning needs and also provides evidence of their progress.

2.4 Instruction and Communication at South African Universities with a Distance Education Option

Distance education at university level was introduced in South Africa in 1946 when the University of South Africa was established. It was the only university offering distance education courses [DUPL92], but has recently been joined by Rand Afrikaans University

and Vista University. Technikon South Africa offers national diplomas and certificates via distance education and has recently been empowered to award degrees, but was not included because the focus of this study was on universities.

The philosophy behind distance education at a university is to provide educational opportunities for people who cannot be accommodated by the current residential universities for various reasons. Distance education also provides students with control over the time, place and pace of their learning which cannot be realised in a classroom-based situation.

2.4.1 Instructional and Communication Media at University of South Africa

University of South Africa (UNISA) is a distance education university and has a student population of about 130 000. It has four regional centres in South Africa which handle administration, and provide library facilities, computer laboratories and lecture rooms for circuit lectures. Undergraduate and Postgraduate degree courses are offered via distance education in the faculties of Arts, Business Economics, Education, Nursing, Engineering, Law and Science.

The delivery of instruction at UNISA is based on the traditional distance education model. The current mode of instruction is largely by means of printed text augmented by the use of audio cassettes, circuit lectures and some radio broadcast on a limited scale. The written study materials dispatched to students consist of study guides, tutorial letters and assignments. These written materials are sometimes augmented by other instructional media.

Figure 2.1 shows the type of instructional media used at UNISA.

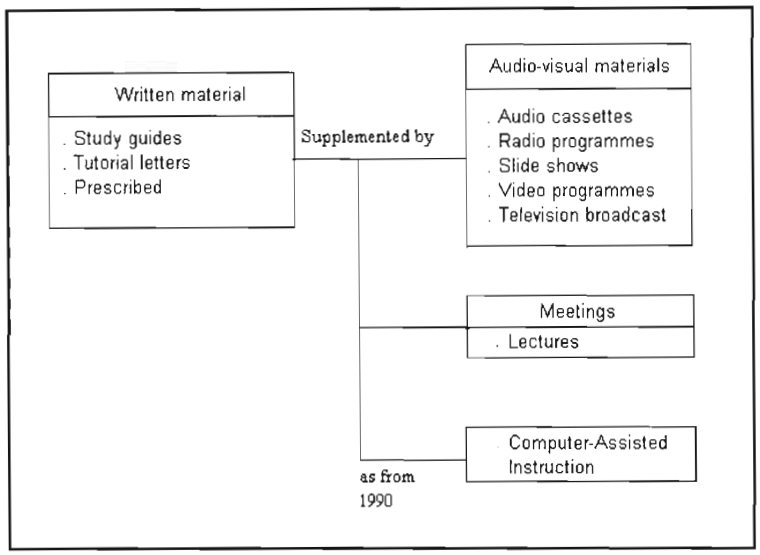

Figure 2.1 Instructional and Communication media at UNISA

The use of Computer-Assisted Instruction at UNISA is on a small-scale on stand-alone computers, which is in contrast to some of the distance education universities in some developed and developing countries (see Chapter 5), where electronic media features more prominently in instructional episodes. Interactions that exist between students and lecturers are [DUPL92]:

(a) discussions classes, which take the form of lectures or workshops, and are held at the regional offices of UNISA periodically,

(b) a student may contact the lecturer personally either by visiting him or her in the office, or by phone,

(c) the student may correspond with the lecturer and address queries to him or her in the form of a letter, which is answered individually by the lecturers,

(d) E-Mail has recently emerged as a fourth means of communication.

2.4.2 Instructional and Communication Media at Rand Afrikaans University

Rand African University (RAU) is primarily a residential university but has a distance education programme. It has a total student population of about 10 000. Unlike UNISA and Vista universities, it does not have regional centres in other parts of South Africa but offers distance education programmes based on guided self-study teaching models. RAU offers undergraduate and postgraduate programmes in Education, Liberal Arts, Natural Sciences, Engineering, Law and Economics.

At the Rand Afrikaans University (RAU) the current mode of instruction is based on printed text, periodic study schools at the main campus and informal study groups.

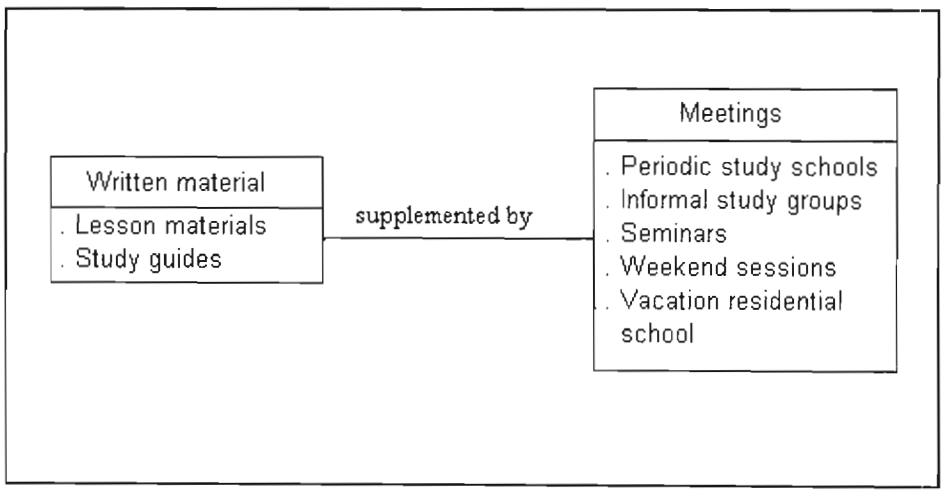

Figure 2.2 Instructional and Communication media at RAU

The printed materials are usually augmented by periodic meetings such as seminars, weekend sessions and vacation residential school. Interaction between students and lecturers at all levels is usually by postal correspondence and telephone. Some of the postgraduate students correspond with their lecturers using Electronic Mail.

2.4.3 Instructional and Communication Media at Vista University

Vista University has seven residential and distance education campuses and has a student population of about 50 000. Degree courses are offered in Education, Sciences and Humanities. Instruction is based on written study materials dispatched to students which comprise study guides, prescribed books and references.

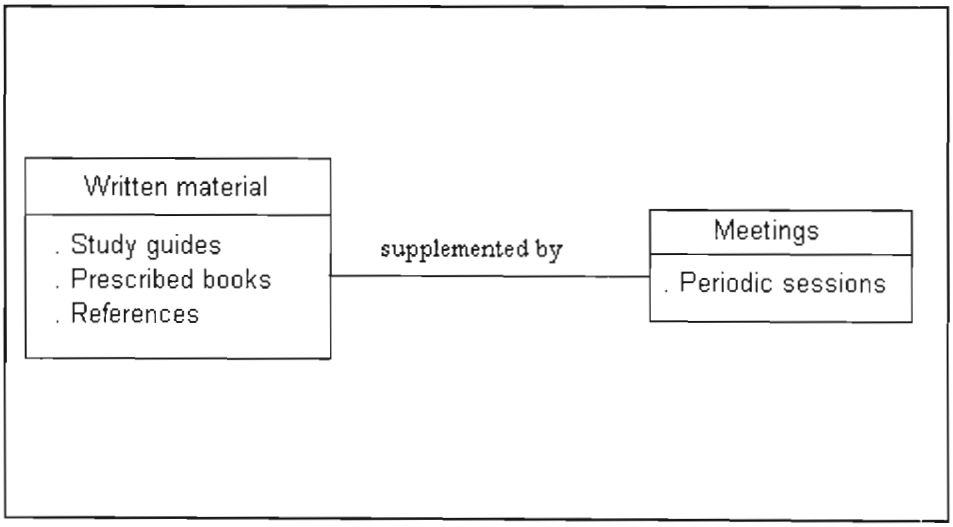

Figure 2.3 Instructional and Communication media at Vista

There are periodic sessions that take place at the university's premises to augment the printed text. Students and lecturers communicate via postal correspondence and telephones.

2.4.4 Limitations of current Instructional and Communication Media in South African Universities with a Distance Education Option

The three universities in South Africa with a distance education option depend heavily on traditional instructional media which offers the student little or no form of interaction. Distance education in South Africa at present does not offer an effective alternative to classroom-based instruction in terms of interaction, instant feedback and remote access to facilities such as databases, libraries and journals that facilitate quality learning and knowledge building.

There is lack of immediate feedback. Most students have to use the postal mail or telephone to get in touch with their lecturers. Students who live far away have to wait for long periods for marked assignments. According to [VAND87], students complain that it is extremely difficult to contact lecturers. The time when many students are free to study (for example, in the evenings and early mornings) is exactly the time when lecturers are not readily available. Communication among students, and between students and the university, is rather limited. Students need access to a communication network [KOTZ89]. There is generally a very long timespan between the submission of assignments and the receiving of feedback on them. "Lecturers communicate with their students by means of postal mail, which is fairly reliable but cumbersome and time consuming" [DUPL92]. Increasing participation in tertiary education implies that degree awarding institutions with a distance education option will be dealing with very a large student population and the problem of immediate feedback may become worse. There is the need to provide an infrastructure that enhances immediate feedback during instructional episodes at a distance.

There is a lack of effective interaction. Lecturers find it almost impossible to give students detailed comments on submitted assignments. "Even though lecturers try their best, the number of students is so overwhelming that individual comments on an assignment become almost impossible (especially in the present situation with increasing student numbers and

very few teaching staff appointments). This is frustrating to the student and the fact that he or she is 'only a number' reduces his or her motivation"[VAND87]. An infrastructure that facilitates effective interaction on a one-to-one, one-to-many or many-to-many basis during instructional episodes conducted at a distance has to be in place for effective communication. There is also the need for student-centred courseware that promotes critical thinking.

Insufficient lesson materials and assignments. The number of lessons and assignments are reduced compared to on-campus courses due to large student numbers. Fewer lesson materials and assignments also affect the quality of work. "In larger departments it is almost impossible to mark more than a certain number of assignments. Multiple choice assignments have their own problems" [VAND87]. There should not be much difference in terms of the quality of instruction between face-to-face instruction and instructional episodes that are conducted at a distance. The volume of course work that is done at a distance should be at least the same as in a classroom-based situation if not greater, in order to provide equity in terms of instructional content.

Deadlines for submission of assignments. Students often do not comply with deadlines for submission of assignments. This delays the marking process and as a result, lecturers refuse to grant extensions to assignments [VAND87]. The method of submitting assignments may have to change to a more modern one whereby an electronic medium is used. This could reduce the feedback delay which characterises postal mail.

There are limited learning resources. Most students do not have remote access to learning resources that allow the access and retrieval of information. Students must travel to libraries in the major urban areas for study materials such as references, journal publications, databases and research materials. Students in distance education need remote access to learning materials during and after instructional episodes.

Despite the current limitations of instructional and communication media in universities in South Africa with a distance education option, distance education has a number of advantages that must be looked at and strengthened to make it a good alternative to face-to-face instruction. [ROMI93] contend that "Research on distance education has shown that, when appropriately planned, distance education can be as effective as conventional classroom based education." Instructional episodes that are conducted in distance education could simulate classroom based instruction if the limitations of instructional and communication media in traditional distance education are identified and addressed. According to [LAN86], "Assuming that we do not want distance education to be a cheap and inferior version of on-campus instruction, but rather a system of offering an equal quality of education both on and off-campus, we must remember that the same methods do not necessarily give equal quality. On-campus education is designed to suit the needs and abilities of those involved in face-to-face situations; off-campus must be specially designed to meet very different conditions." The various factors such as physical disabilities, job and family commitments as well as financial disadvantages that hinder people from enrolling in a conventional degree awarding institution could be accommodated in a distance education institution.

The challenges posed by distance education are countered by opportunities to reach a wider student audience. [BORK81] contends that several critical problems that confront educational institutions including serious resource limitations and cutbacks, increasing demands for a skilled workforce, and greater diversity in student populations, merge to create an opportunity for innovative and creative changes in the delivery system employed by educational institutions. Many lecturers feel the opportunities offered by distance education outweigh the obstacles. Lecturers often comment that the focused preparation required by distance teaching improves their overall teaching ability and response to their students.

South African universities are currently confronted with a high demand for enrolment. The demand cannot be met by the current conventional universities due to limited human and infrastructural resources. Distance education also suffers from these limitations. This thesis is proposing that they can however be overcome in some respects by the use of computer technology. If this can be done it could make distance education an effective alternative to classroom-based education.

Computer-based and computer-supported education has not only begun to clarify many of these limitations, it is beginning to find some cost-effective ways to vary teaching styles to suit both the material and individual learning styles [ENTW82]; [SLEE82] and [PAPE80]. Computer-Assisted Instruction provides the needed interactive instructional episodes in some subject domains which cannot be achieved via printed text, radio broadcast and audio cassettes.

2.5 Changing the Face of Instruction and Communication

The use of on-line Computer-Assisted Instruction supported by Computer Mediated Communication is yet to be utilised in South African degree awarding institutions with a distance education option. Students pursuing higher education through distance education in South Africa require a system based on a new model whereby they can:

(a) benefit from effective interaction and feedback episodes at a distance, such that clarification and integration of knowledge can take place,

(b) participate in collaborative discussions in asynchronous and synchronous modes at a distance,

(c) have remote access to facilities and learning resources,

(d) interact with the learning materials such that the reinforcement of knowledge is systematic and immediate.

The student using mostly print-based text, radio and television broadcasts and audio cassettes cannot receive immediate feedback, thus the reinforcement of knowledge is not systematic and immediate. The student becomes a passive recipient of knowledge during instructional episodes.

There is a need to shift from largely passive learning where the student memorises facts to active interactive instruction. Interactive distance education that uses on-line Computer-Assisted Instruction can allow the student to participate in the teaching-learning process. Many educators today evaluate the quality of education by the degree of interaction students are involved in, which in turn has a direct impact upon improving their learning experience. Electronic forms of instruction such as Computer-Assisted Instruction that focuses on higher-level learning skills involving problem-solving and decision-making may have to be considered instead of lower-level skills promoting memorisation of concepts.

The changing face of instruction in distance education is gaining world-wide attention. The United Nations is considering helping countries in Africa of which South Africa is not an exception to fully participate in changing the face of instruction in distance education. At a joint meeting of commissions II, III, IV,and V of United Nations Educational, Scientific and Cultural Organisation (UNESCO) held on the 4th November 1995, discussions were held on the relevance and interest regarding the impact of information superhighways and multimedia technologies on distance education. It was concluded that:

> "Many students cannot be reached by conventional or face-to-face instruction due to the constraints of time and space, age, socio-cultural environment, work schedules and various physical and mental handicaps. Similarly, many specific learning needs cannot be satisfied due to the limited flexibility of formal education systems. Both these constraints can be minimised by a modern distance education which is based on adequate communication infrastructure and interactive methodologies and tools. Such a system, of which the UNESCO 'learning frontiers' initiative is a forerunner, would not only give students access to knowledge but also ensure dialogue, the main factor of effective learning, both among students and between students and teachers (human or non-human). Moreover, the new technologies create new possibilities for reaching the unreached and for making lifelong education for all feasible, provided determined efforts are made to share the benefits with less fortunate countries and marginalised groups" [UNES95].

Factors such as interaction, feedback, motivation, learner control, and confidence that constitute the characteristics of effective instruction must be identified when curriculum developers contemplate changing the face of instruction.

Currently there are two consortia which have been formed by degree awarding institutions in the Free State and KwaZulu Natal which could be used for pilot projects in changing the face of instruction and communication in distance education. The Orange Free State Open Learning Distance Education Access Programme (OLDEAP) comprises the following institutions: Technikon Free State; Technikon South Africa; University of the North; University of the Orange Free State; University of South Africa; South African Institute For Distance Education; and Vista University. The purpose of this Consortium is to provide students with support, and quality learning and to promote educational and training links in South Africa [OLDE96].

The Eastern Seaboard Association of Tertiary Institutions (TESAOTI) comprises: Technikon Mangosuthu; University of Natal, Durban; University of Natal, Pietermaritzburg; University of Durban Westville; University Of Zululand, Ongoye; University of Zululand, Umlazi; Technikon M. L. Sultan; Technikon Natal, Durban; Technikon Natal, Pietermaritzburg. TESAOTI has purposely established a Central Applications Office in KwaZulu Natal to provide a cost-saving convenience to prospective students and tertiary institutions [TESA96]. TESAOTI has plans to establish distance education at tertiary level through its members.

These consortia have plans to:

(a) pilot the regional delivery of courses through distance education,
(b) establish a viable framework for the design and development of courses in line with the National Qualification Framework,
(c) establish two units: Material development and distance student support, and Systems delivery,
(d) eliminate services which leads to wastage and inefficiency,
(e) review poor articulation and transfer possibilities between institutions.

Given these goals, these consortia could spearhead the implementation of distance education models in South Africa that allow the student to participate in interactive instructional episodes, as well as providing sufficient interaction with instructors and peers.

2.6 Summary of Chapter

Distance education has the potential to address some of the educational crises in South Africa's universities in terms of the higher demand for enrolment. The current instructional and communication media need to be improved to bring about quality instructional episodes which can make distance education as good as or even better than classroom-based education. Universities with a distance education option need to involve students in the teaching-learning process, as well as providing reasonable access to learning materials. Communication channels that make students and lecturers easily accessible to each other are required for effective interaction and feedback.

CHAPTER THREE

Computer-Assisted Instruction

This chapter discusses Computer-Assisted Instruction and analyses Computer-Assisted Instruction in South African universities with or without a distance education option. Some limitations of the current implementation practices are mentioned.

3.1 Computer-Assisted Instruction

3.1.1 Definitions

Definition 3.1: "Computer-Assisted Instruction is the direct use of the computer for facilitation and certification of learning - that is, using the computer to make learning easier and more likely to occur (facilitation), as well as using the computer to create a record that learning has occurred" [BUAK85].

Definition 3.2: "Computer-Assisted Instruction is pre-stored instructional units, often called frames, which encodes lessons prepared by human experts. These units contain small portions of the curriculum and are successively displayed on the screen for presentation and questioning. Their sequence is determined by fixed branching decisions based on a pre-defined set of possible answers expected from the student" [CARB70].

Definition 3.3: "A Local-Area Network (LAN) is a network of computers covering a relatively small geographic area" [CISC92].

3.1.2 Background to Computer-Assisted Instruction

Computer-Assisted Instruction (CAI) is only one of the many didactic models for instructional computing. Other models equivalent to CAI include Computer Based

Instruction (CBI), Computer Assisted Learning (CAL) and Computer Based Education (CBE). CAI was introduced about three decades ago but initially was not widely accepted, both because it was viewed as a threat to the lecturer and because it was very expensive to develop. The first instructional use of computers occurred at the University of Illinois in 1960, with the birth of Programmed Logic for Automatic Teaching Operations (PLATO), a versatile CAI system in which student terminals were connected by telephone lines to a large mainframe computer. The speed and power of the mainframe computer allowed many users to access the computer at the same time. PLATO terminals could be connected to peripherals such as videodisc players, slide projectors, and speech synthesisers that could be activated at the appropriate time in instructional sessions by the central computer. This allowed students to use combined media without additional effort and at the proper pace. One drawback to the PLATO system is that it is now outdated mainly due to the mainframe platform on which it runs and the old-fashioned user interface.

Nowadays most CAI systems involve the use of software programmes on personal computers. The promise of CAI prompted some manufacturers to create specialised languages for CAI authors. While CAI courseware had previously been written in assembly language, many authors switched to CAI authoring languages [BUAK85]. These authoring languages are preferred since they save a great deal of time, and allow authors to focus their activities on instructional logic and the writing of lessons rather than on computer programming [BUAK85]. Examples of some of the software programmes are Toolbook, Macromedia Director, GUIDE, Quest and Authorware Pro.

The fact that all early CAI authoring languages employed a behaviourist model implies that most of the pioneers in the field were originally programmed instruction practitioners. According to classical behavioural psychology [SKIN68], instruction consists primarily of

the shaping of desirable behaviours through the scientific arrangement of stimuli, responses, feedback and reinforcement. First, a stimulus is provided, often in the form of a short presentation of content. Second, a response is demanded, often in the form of a question. Third, feedback is given as to the accuracy of the response. Fourth, positive reinforcement is given for accurate responses. Fifth, inaccurate responses result in either a repetition of the original stimulus or a modified version of it, and the cycle begins again. Programmed instruction was an application of behaviourist principles to learning needs. Noting this relationship, some early critics of CAI contended that it amounted to little more than using the computer as an "electronic page turner" [BUAK85]. Some drill-and-practice CAI was described as "electronic flash cards".

3.1.3 Types of Computer-Assisted Instruction

There are several types of CAI that represent the various designs and presentations of the subject domains. CAI that is used to supplement as opposed to being the main mode of instruction is referred to as *adjunct CAI.* Concepts can be discussed in the regular classroom or in a distance education environment and then adjunct CAI (one to two hours of lesson) is used to support or reinforce what has been taught.

CAI that provides the main source of instruction is usually of longer duration and is referred to as *primary CAI.* Primary CAI is being considered world-wide as part of distance learning [HOWE79]. Currently there are many degree awarding institutions in both developed and developing countries with a distance education option that are using on-line CAI as a primary mode of instruction. [CHAM80] also contends that: "Primary CAI, and distance learning in general, may achieve results similar to those of face-to-face instruction as long as there is sufficient human interaction accompanying the use of the Computer Assisted Instruction." CAI when well designed can simulate or be better than face-to-face classroom-based instruction.

CAI can be made available off-line in a stand-alone environment whereby the courseware is available on the the local drive of a personal computer or on a server which can be accessed within the immediate environment of the LAN but not from a remote location.

On-line CAI is CAI which is available on a network that can be accessed both locally and remotely in a real-time mode using the appropriate software. It is delivered using a client-server application, whereby a user could use his or her client programme to access or navigate the lessons. Users of on-line CAI may require a full multimedia computer (depending on the application development software) to be able to use sound, video, animations, and full colour graphics in the courseware. CAI courseware can also be accessed on a server via a dial-up connection link which enables the courseware to be down-loaded for interaction in a stand-alone mode.

The design of CAI, whether primary or adjunct, on-line or stand-alone, takes various forms and can be used in different learning situations. Different pedagogical strategies such as tutorial, simulation, drill and practice, problem-solving and didactic designs can be used to develop CAI courseware.

Tutorial design - In this mode the computer controls the process, by presenting material to the student for him or her to read and periodically giving the student a question to answer or a problem to solve [BUAK85]. The student communicates his or her answer to the computer through the keyboard, mouse, touch sensitive screen or input device.

In effect the computer tutors or drills the student on the lesson material, keeping a record of the student performance and producing a grade, if necessary. It works best with highly verbal material that lends itself to narrative description and question-and-answer techniques.

Simulation design - A pre-programmed model of some real-life situation or object is provided [BUAK85]. The student is able to access the model and manipulate it by varying input data, selecting different equations, carrying out sensitivity analysis and in general exploring and simulating the reality that the model represents.

Drill and practice design - This provides students with an opportunity to practise problem-solving skills and, where necessary, guides them through this process [BUAK85]. Questions are selected from a question bank either randomly or sequentially and students' responses are accepted and analysed.

Problem-solving - Problem solving design involves the student using a microcomputer to actually solve problems. The process used by the student is analysed at each step and the feedback is given to the student immediately [BUAK85]. The problem-solving model can sometimes be used as the design for complex technical material such as mathematics or science. This system is a complete tutorial track, which is reinforced by drill-and-practice and timed problem sets. The timed problem sets are based on the mastery learning concept and the students are expected to produce "x" answer digits per minute.

Didactic - Didactic designs refer to lesson designs in which the student is presented with information and then asked to respond to questions which basically give the same information back. Normally the student is presented with information in small "steps" and asked to do minimal synthesis or manipulation of the material [BUAK85]. The purpose is to convey information to the student, to provide him or her with minimum opportunity for practice, and then check positive feedback.

Different lesson structures such as linear, branching and multitrack can be used in the design of CAI courseware.

Linear Designs - In linear designs, each student is presented with the same material as every other student - that is, each student takes exactly the same route through the lesson [BUAK85]. Linearly designed CAI fails to exploit the branching decision making of the computer fully, but it is applicable in some situations. It is the easiest to design, revise and validate.

Branching Designs - A branching lesson is based on an instructional design which includes alternative tracks through the lesson, depending upon the student's performance. Normally, the branching occurs following a criterion question frame. Students who make incorrect responses take one or other alternative track depending on the exact nature of their incorrect response [BUAK85]. A student who is capable of moving quickly through a lesson is enabled to do so. Branching takes advantage of the power of the computer to individualise the lesson and to provide a personalised learning experience for each student.

Multitrack - Multitrack or multilevel designs have material that is written on various distinctly different levels to permit the individualisation of lessons. The highest level is normally the shortest [BUAK85]. The material is sometimes written abstractly with few explanations, not many examples, the use of mnemonics, and with fewer and more difficult questions. The lowest track is likely to be written with more thorough explanations and more prompting, and it is therefore likely to be much longer. Lesson logic for the multitrack design will normally include a strategy for branching to another level or elsewhere on the same level, depending upon a student's performance.

Different lesson strategies can also be used to design CAI courseware.

Generative Design - Generative designed CAI models generate a different set of problems for each student or for each iteration a student makes. In this way the student sees new examples during interactions [BUAK85]. The advantage of this is that the student can use the same lesson over and over to strengthen his or her skills in the subject domain.

Adaptive Design - Adaptive designs are quite uncommon. They use data that accumulates during usage as a basis for the self-improvement of the lesson. In effect, they "learn" from experience [BUAK85]. For example if a lesson that is based on this design does not have the information to answer a question from a student, it is able to update its knowledge base if the information is subsequently provided. Thus the package can answer the same question if it is presented by a student at another time.

Discovery Design - Discovery design can be very effective when used with material to which it is well suited. It involves creating the conditions within which students can reach insights of their own [BUAK85]. Usually students are supplied with as much material as is needed to determine the relationship among a set of facts.

EGRUL Design - EGRUL is an acronym for lesson design in which the instructional logic proceeds from example (EG) to rule (RUL). Typically the student would be provided with training and the opportunity to practice using sets of examples in order to determine some property which all the members of the class have in common [BUAK85]. EGRUL designs are in effect a form of discovery learning.

RULEG Design - RULEG is an acronym for lesson design in which the instructional logic proceeds from rule (RUL) to example (EG) [BUAK85]. A student is typically taught to apply a law, principle or other form of rule to a set of examples.

Fading Designs - Fading refers to the fading of prompts. It starts with frames containing very strong prompts and then changes gradually to frames with weaker prompts as the lesson progresses [BUAK85]. The fading design is particularly useful for content that has to be memorised, such as poetry or anatomy terms.

All these CAI designs are not mutually exclusive but can be combined in one way or another in CAI courseware design and development. For example, Didactic design can be combined with Discovery or Problem-solving designs.

3.1.4 Effectiveness of Computer-Assisted Instruction as an Instructional Media

CAI, whether on-line or stand-alone, can be effective for instructional episodes. The effectiveness of CAI has been defined differently by researchers. Some researchers have defined the effectiveness of CAI according to the immediate learning that takes place determined by pre-test and post-test scores of students exposed to CAI. Other researchers evaluate the effectiveness according to the degree of learning retention over a period of time. Another group of researchers evaluate the effectiveness of CAI as dependent on students' attitudes. Learning time and cost effectiveness are also criteria used to evaluate CAI. Whatever is used, it is reasonable to state that no single measure of effectiveness is adequate and that multiple measures should be used.

A comprehensive review of literature [CHAM80] that evaluated the effectiveness of all forms of CAI in instructional episodes concluded that:

(a) The use of CAI reduced learning time when compared to the regular classroom-based instruction.

(b) The use of CAI either improved learning or showed no differences when compared to regular classroom-based teaching.

(c) The use of CAI improved student's attitude toward the use of computers in the learning situation.

CAI can also be effective in enhancing interaction, feedback, motivation, learner control and confidence during instructional episodes [OWUS95].

Interaction can be at three levels when incorporated into CAI courseware. These are reactive, proactive and mutual interaction [LUCA92]; [THOM89]. Reactive, proactive and mutual levels of interaction can be combined in an instructional episode.

Reactive interaction is considered to be a response or an answer given to a question where the student and the courseware are involved in a preordained responsive session. A preordained response in CAI courseware could feature branching options dedicated to specific student responses. The type of feedback and branching the student receives has been pre-designed and depends on the student's response to a stimulus. For example, if in the course of interaction with some particular courseware the student selects the Joule instead of the Newton as the unit of Force, the courseware may branch to another screen to explain why the answer is wrong. A correct answer will cause the courseware to proceed to a different screen.

Proactive interaction requires the student to construct and generate activities that are unique. For example, the virtual dissection of a frog would require proactive interaction. Proactive interaction goes beyond mere selection and response to preordained discussions within well-defined limits [LUCA92]. This might involve a virtual designed environment whereby the student can observe the results of his or her interactions with the virtual object.

Mutual interaction is based on artificial intelligence or virtual reality designs where the student becomes involved in the teaching-learning process. Courseware that has mutual interaction capabilities is adaptive. The student and the courseware can both initiate dialogue during instructional episodes, as for example in GUIDON, an Intelligent Computer-Assisted Instruction (ICAI) program used for medical diagnosis. The different types of interaction are not achievable using other instructional media such as printed text, radio broadcast and audio cassette.

The different types of interaction can facilitate the immediate and systematic reinforcement of knowledge during instructional episodes and can speed up knowledge building and mastery of skills.

Feedback can be incorporated in CAI courseware for instructional episodes and the type of feedback provided depends upon the learning needs of the student [SCHI83]. There are different types of feedback such as confirmation, correct response and explanatory.

Confirmation Feedback confirms whether a student has answered correctly or not. For example after a stimulus has been responded to correctly, the courseware can respond "*that is right*", "*correct*", "*yes*" or "*your answer is correct*". Feedback after a wrong response to a stimulus can include "*wrong*", "*no*", "*you are wrong*", "*Your answer is wrong*". Some

courseware may provide an audio signal or a verbal message after a correct response or incorrect response.

Correct Response Feedback presents the correct answer which can be combined with confirmation feedback such as, "You are wrong. That is a tricep muscle." Correct responsive feedback is more explicit than confirmation feedback and is given only after an incorrect response or answer.

Explanatory Feedback can be given during step-by-step problem-solving situations when a student provides an incorrect answer to a question. The student is guided through a step-by-step process of obtaining the correct answer.

Confirmation feedback, correct response feedback and explanatory feedback can be combined in CAI courseware to provide the instant feedback that is needed to make the building of knowledge during instructional episodes immediate and systematic. The timing, nature, amount and sequence of feedback can be determined by the lecturer or the courseware designer. Feedback can be imposed on the student or be available as an option depending on the instructional situation. Imposed feedback should be concise, helpful and straight-forward. The amount of feedback provided in a learning situation can be determined by the lecturer or be dependent on the student's request. In all situations, the format of the feedback is dependent on the learning situation.

Motivation is necessary for students using CAI for instructional episodes. The student's motivation is derived from the interest in the task and the tool, in this case the computer, and could remain high as long as a goal is accomplished. Enhancing motivation should be a primary factor when developing instructional models. Instructional media that do not

motivate the student may result in an overall poor performance at the end of the course or the student dropping out of the course due to frustration. [KELL84] and [LEPP87] contend that attention, confidence, satisfaction, challenge, curiosity and control are vital for motivation.

Regaining or refocusing the student's attention during instructional episodes is one way of maintaining or sustaining the student's motivation. The use of unexpected sound, animation or the system response to the student during instructional episodes can arouse his or her curiosity. Presenting paradoxes, puzzling questions, incomplete information and other surprising topics that require an explanation can arouse his or her cognitive curiosity [LEPP87]. Progress made by the student in the absence of the lecturer, through interactions with the lesson material, helps in keeping his or her focus, interest and motivation.

Lesson material or courseware that generates a progress report after a student's interaction with it helps him or her to interpret his or her progress. Outcomes that are consistent with a student's expectations instill satisfaction and motivation. Reinforcement of knowledge, feedback, intrinsic rewards and cognitive evaluation are factors that determine the level of satisfaction in the student during instructional episodes [MAEH76]; [MART86]. Motivation remains high if the rewards are relevant to the student.

Learner Control can take various forms when incorporated into CAI courseware. The learner may be given one or more options from which he or she can choose a topic, have the option of selecting different presentation modalities, select topics in a preferred sequence, decide on the amount of time to devote to lesson drill and select the level of difficulty.

Some students become very motivated if they feel they have control over the instructional media on how and when to learn. There are other students who may lose interest if they are not guided [LEPP87]. The student should be given control, but with guidance on how to navigate through the lesson materials to achieve his or her goal. Lack of flexibility for preferences may lead to frustration in using the instructional medium and hence may reduce motivation. Providing the student with control and with guidance could enhance progress during a learning situation. CAI allows the student to control his or her pace of learning as the computer can store lessons that can be accessed at his or her convenience.

The *confidence* of success felt by a student can be increased if a complex problem can be organised in terms of subgoals to be achieved [KELL84]. Students who are less confident can be made to experience success through the hints that are provided by the courseware. The solving of closely related problems can facilitate success as a student is able to achieve mastery of skills and knowledge. CAI can improve the confidence of a student through interaction and feedback with the courseware. Feedback received as a result of a response to a stimulus maintains the confidence of the student who knows how he or she is progressing.

3.1.5 The Advantages of Computer-Assisted Instruction

CAI is an instructional medium that is known to involve the student in the teaching-learning process during instructional episodes. It is impossible for the student to become a passive recipient of knowledge during instructional episodes, and this very activity and involvement facilitates learning [MCKE78]. The active involvement of the student in the teaching-learning process is not well accomplished using traditional instructional media such as printed text, audio cassette, radio and television broadcast and video cassettes. CAI allows the student to proceed at his or her pace during instructional episodes. This has strong implications for both the slow student and the gifted person. The ability of a

student to proceed at his or her own pace during learning situations at a distance is one of the key characteristics of distance education that instructional media should satisfy.

CAI facilitates the immediate and systematic reinforcement of knowledge that might result in more effective learning, according to established theories of instruction. CAI designed in a simulation mode allows the student to perform experiments in a simulated laboratory without the hazards and costs of a real life situation. For example, a student can observe the outcome of the nuclear fusion of two uranium atoms which can be dangerous in a real life situation. CAI is of much benefit for second language teaching, and for disadvantaged students who need improved subject skills as a requirement for entering tertiary institutions [CHAM80]. Computer tutorials, especially in these areas, appear to be both educationally sound and reasonable in cost, if approached in an appropriate manner.

3.1.6 Disadvantages of Computer-Assisted Instruction

The drawbacks of CAI can be classified into four main categories [CHAM80]. Some of the developments in the field have gone a long way in improving upon traditional approaches. In every learning situation where CAI is introduced, lecturers must move from accepted methods that work, to an untried method in which most individuals have little expertise, or which arouses considerable fear and apathy owing to its technological base [CHAM80]. The fear and apathy that arises in lecturers may be due to their non-involvement in the design and development of CAI. Lecturers have to be involved in the CAI development process to enable them to exploit ways and means by which they can use it effectively during instructional episodes, whether in a face-to-face situation or at a distance. The number of man hours involved in developing courseware is high: estimates are that it takes two hundred and fifty to three hundred hours to develop one hour of interactive lesson [KOTZ89]. This contributes to the resistance from some lecturers towards the development of CAI.

CAI that is designed commercially has a short life span and leaves little or no room for alteration or modification to accommodate changes that occur in subject domains. [CHAM80] states that, "A variety of CAI languages and authoring packages have been completed with little consultation from academic experts in the educational world on the subject matter and many of the available CAI course materials are poorly constructed, largely undocumented, and able to be run on only select computers for which they were written." There is the need for a variety of platforms for consultation between specialists that develop commercial CAI courseware and the Academia. Such consultation could facilitate the development of quality CAI courseware that can be used by most degree awarding institutions.

Programming skills are also required in order to use the general purpose authoring languages. This lack of skills hinder some lecturers from developing Computer-Assisted Instruction courseware. With the advent of template-based packages the technological base of CAI is becoming less sophisticated because these packages eliminate programming skills. The template-based authoring packages can be used by lecturers who have little or no previous experience in programming to develop interactive CAI based on the design models discussed in section 3.1.3. Lecturers are thus able to design their own courseware by translating their lecture notes into interactive lessons using templates and can update them without any computer programming knowledge. The use of template-based packages does however require authoring skills, as is the case with general purpose packages. Lecturers require the authoring skills to structure their notes and link them into a logical pattern for instructional episodes.

The cost of implementing CAI can be very high, especially if it is on a large-scale basis and in a network environment. According to [CHAM80], "cost accounts to a significant extent for the lack of use of CAI in some learning institutions." [KEAR77] has pointed

out that although CAI may be perceived as instructionally effective, educators may be reluctant to utilise it if it is perceived as being prohibitively expensive.

The accepted method for determining the cost of CAI is to total all expenses for computing hardware, software, telecommunications, courseware, and implementation, and then divide by the total number of student hours used. However, in practice, many "hidden" cost are seldom considered [AVNE78]. For example, personal computer terminals and line costs are frequently considered user costs and are omitted. Also, the life-span of courseware is seldom considered, and implementation costs (staff to develop teaching guides for use of programmes, etc.) are often ignored. Cost estimates for CAI are highly variable and only recently have patterns been emerging which permit comparison of costs for complex CAI on very large computers with more simplistic programmes running on mini or microcomputers [CHAM80]. "User payback, in the form of qualitative and quantitative results, addresses cost factors directly. CAI costs relative to its unique components should also be considered: hardware, software, user training, and maintenance and installation"[PRES78]. "Beyond the normal quantitative spectrum, realistic cost analysis must address such factors as increased motivation, topic comprehension, active participation, and involvement. These key factors do not easily translate into economic benefits, but often take some time to become discernible within the organisation" [BETL86]. According to [KOTZ89], "CAI is a long-term investment yielding real returns." In the long-run the benefit of CAI outweighs the cost of investment.

Another drawback of CAI is that it is unable to respond intelligently during instructional episodes. This has stimulated interest in Intelligent CAI, in which an attempt is made to apply Artificial Intelligence techniques to overcome these shortcomings in traditional CAI. Intelligent CAI can allow mixed initiative dialogue in a learning situation where both the student and the courseware could initiate a dialogue.

The instructional styles used in CAI do not recognise the wide variety of learning strategies that may be employed in any given instructional setting depending upon the type of knowledge to be constructed. Learning strategies include memorisation, direct instruction, drill and practice, deduction and induction. Deduction and induction are difficult to implement using traditional CAI, but these can be achieved in intelligent CAI through heuristic decision rules based on common-sense rules for controlling the process of student-computer interactions.

3.2 Computer-Assisted Instruction in South Africa

The pedagogical use of on-line CAI is new in South Africa but CAI on stand-alone computers is being used in adjunct mode in some degree awarding institutions with and without a distance education option. The use of adjunct CAI for learning has been demonstrated in universities in South Africa, but not on a large-scale due to the lack of suitable and applicable courseware [MEHL91]; [HSRC83A]. The rationale behind the pedagogical use of CAI in South African degree awarding institutions lies with the quality of instructional episodes it can offer in terms of interaction, which is essential for effective instruction.

The importance of the use of the computer as primary and adjunct instructional media is emphasised by [HSRC91], "The use, and increasing use of the computer as an instructional aid can really no longer be postponed." The pedagogical use of computer designed courseware such as CAI will not absolutely replace the lecturer but will provide the needed interaction and feedback essential for quality instructional episodes conducted in distance education. [HSRC83A], [HSRC91] and [ENGE82] contend that the computer indubitably makes a vital contribution to the solution of South Africa's distinctive situation of educational crisis. [MEHL91] asserts that the success of CAI in general in South African education will depend primarily on the ability of teaching staff in degree awarding

institutions to develop and design suitable, effective and educationally sound courseware relevant to the conditions that prevail in South Africa. Encouraging lectures to develop their own CAI courseware will eliminate their resistance and doubts arising from the contention that they cannot trust their work to a CAI package.

There is the need for collaboration between teaching staff in different institutions to investigate how the full potential of CAI as an effective pedagogical tool can be utilised in distance education. [MEHL91] proposes that "we need to realise that, given the educational imbalances in this country, computer-based education not only supplies us with real hope, but also the very opportunity to do it right. It is incumbent on all of us to combine our talents in this direction to improve the quality of education for all in this beautiful country." "By the year 2000 CAI will be the most important way in which we will learn at all levels and in almost all subjects" [DEWE81]. There are already degree awarding institutions who have some experience in the development and implementation of CAI. Such experience could be worth sharing in a large-scale implementation of CAI.

Table 3.1 in Appendix A shows universities in South Africa without a distance education option which use adjunct CAI. The list is not exhaustive, there are a number of other activities at various institutions, and there is more emphasis on mathematics and science than portrayed by Table 3.1. University of South Africa (UNISA) is the only degree awarding institution with a distance education option that supplements its instructional episodes with adjunct off-line CAI although there is the potential for on-line CAI as well. Universities with a distance education option such as Vista University and Rand Afrikaans University do not use any form of CAI as an instructional medium in their distance education programmes.

3.2.1 Computer-Assisted Instruction at University of South Africa

Adjunct CAI for instructional episodes is already being used at University of South Africa (UNISA). Before 1990 the method of tuition which was mainly printed text, was seen as not being effective in terms of interactive communication between students and lecturers, and hence there was a need for methods or approaches that could improve the situation.

Curriculum developers at UNISA decided on a time-independent instructional medium that could allow the students to work at their own convenience [ALEX92]. The medium had to be dynamic with visual capabilities that could allow students to see and understand what was happening during instructional episodes. The medium needed to have an interactive interface that could allow students' to participate in the teaching-learning process thereby breaking out of the passive learning that was so deeply entrenched in the educational system.

The instructional medium had to be responsive in such a way that students' individual needs were addressed. The curriculum developers considered ways and means of designing the instructional medium to make it attractive and non-threatening to students and also encouraging. Finally the instructional medium had to be such that it did not depend heavily on infrastructures outside the control of the student and also be able to reach as many students as possible [ALEX92]. CAI produced on diskettes was seen the most appropriate medium that could meet the requirements stated above.

In 1987 the department of Computer Science and Information Systems at UNISA started researching the possibility of developing courseware for distance education based on electronic media. The purpose of CAI at UNISA was to supplement the prescribed books. The first package that was developed was a training package for

administrative staff in the use of mailmerge functions on the word-processing package DW4. The experience gained by the designing team led to the development of a new course for first-year students on Computer Concepts, using CAI as part of the study material. Subsequently other lessons have been developed using CAI on a small-scale [ALEX92].

Figure 3.1 shows CAI projects that have been developed so far at UNISA.

Department	Topic
Students Services Bureau	Memory strategies for students
Computer Science	Computer concepts
Chemistry	A set of basic concepts for chemistry
Psychology	A set of statistical methods
French	A set of lessons on direct and indirect speech

Figure 3.1 UNISA's CAI projects

Most of the departments are using adjunct CAI to supplement their teaching. In a report [ALEX92] that discusses CAI in the Computer Science Department, P. M. Alexander writes,

> "The introduction of CAI in the Computer Science Department brought some results. Several students said explicitly that they felt that using the CAI lessons as the first exposure to computer usage minimised computer

phobia. Numerous students made a point of saying that they liked the graphics and felt these had a definite positive influence on their attitude to the lessons. Most of the students also referred specifically to the fact that they had not completely understood concepts after reading the book and that the lessons had, either by analogy or dynamic examples, clarified the issue. The intention was that CAI lessons should be supplementary to written study material and these comments showed that we had, in, fact attained this objective."

Figure 3.2 gives the summary of the results reported in [ALEX92].

Response	**Number of Respondents, n = 28**
Very positive	4
Positive	9
Half-hearted	4
Negative	0
Very negative	1
No response	10

Figure 3.2 The impact of CAI at UNISA [ALEX92]

Students registering for programming modules in Computer Science which are compulsory modules for a degree or diploma in Computer Science are required to have access to a personal computer make use of computers in the computer laboratories of UNISA at the main campus in Pretoria and the regional offices. The CAI courseware is delivered on diskettes to students and also installed on stand-alone computers at study centres [ALEX92].

3.2.2 Limitations of current Computer-Assisted Instruction delivery at UNISA

The delivery of CAI at UNISA is done using diskettes and this system of distribution is limited by the capacity of diskettes. Secondly, a student might receive a faulty diskette that might need replacement, thus delaying the pace of learning. Thirdly, students who receive CAI on diskettes might find themselves in a situation where their computer is incompatible with the software supplied. Fourthly, updating CAI delivered on diskettes could be cumbersome and expensive. Any changes in curriculum would mean retrieving diskettes or delivering updated courseware on new diskettes.

Making lessons available on a network that can be accessed by students could remove the restriction on the number of lessons for instructional episodes. There will not be the need to make multiple copies of courseware as in the case of diskettes and updating on-line CAI courseware would be faster and cheaper because there would not be the need to retrieve diskettes or make new copies. However students will require access to a network environment to be able to learn on-line. On-line CAI could be accessible in any location that has the infrastructure and technology.

3.3 Summary of Chapter

Good CAI courseware may take time to develop and implement but it can play an active role in changing the face of instruction in distance education if supported by sufficient human interaction. Despite the high cost in implementing CAI in distance education, it is a long-term investment that yields benefits that outweigh the cost of the investment.

CHAPTER FOUR

Computer Communication and Instructional Technology

This chapter discusses communication tools such as Electronic Mail, Internet Relay Chat, List Servers, Bulletin Board Services and Multi-User Domains that are available via the Internet. These communication tools can be implemented in distance education for interaction and feedback. The chapter also focuses on the technologies and infrastructure that can be used via the Internet to develop and implement on-line CAI in South African distance education institutions.

Definition 4.1: "A *Client* is a computer or software programme that requests files, print, database, or communication services from a server"[HOUL91] .

Definition 4.2: "A *Server* is a computer or software programme on a network that make files, print or communication services available to other network devices or users" [HOUL91].

4.1 The Internet

The Internet consists of thousands of interconnected networks and hundreds of thousands of computers linked to these networks. The Internet is known by many names, including 'the Net', 'the information superhighway' and 'Cyberspace'. The Internet serves as a means of communication enabling people all over the world to interact with each other via their computers. Communication is quicker, easier and more efficient compared to traditional methods such as telephone, fax and postal mail [DEAL94]. Through the Internet, individuals can search for and transfer information on almost every subject. Long before the World-Wide Web had reached wide acceptance, the Internet was being used for educational purposes, mostly via mailing lists, Bulletin Board Services and Usenet news

[OLIV94]. Users could join discussion groups that discuss various subjects, enabling them to ask questions and learn on-line.

The Internet can be slow during times of heavy use. Communication delays in minutes can be experienced in contrast to generally acceptable delays in the order of seconds.

Since the Internet is composed of different networks and computers, they must be able to communicate with each other. They do so by means of communication protocols. A protocol is a formal description of the set of conventions that govern how devices on a network exchange information. The Internet uses protocols such as Internet Protocol (IP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Telnet, File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), and Simple Network Management Protocol (SNMP).

Internet Protocol (IP) allows hosts connected on different types of networks to communicate. A host is a computer on a communication network that is the source or destination of messages. IP defines two primitives at the user-IP interface. These primitives are the *Send* and *Deliver* primitives. The Send primitive is used to request transmission of a data unit. The Deliver primitive is used to inform a user of a data unit arrival. IP is expected to inform a user of failure in providing a request service but this is assumed not to be reliable; that is, there is no guarantee that errors will be reported.

"Transmission Control Protocol (TCP) is designed to provide reliable communication between pairs of processes (TCP users) across a variety of networks" [STAL94]. TCP decides when sufficient data has accumulated for transmission to a specified destination user. TCP uses urgent data signalling as a means of informing a destination user that sigificant or "urgent"data is in the upcoming data. The appropriate action is determined by the destination user [STAL94]. TCP provides reliable, flow-controlled end-to-end

service between two hosts of arbitrary processing speed using the IP mechanism for communication.

User Datagram Protocol (UDP) is part of the TCP/IP protocol suite. UDP provides a mode of communication over networks with different protocols and different communication architecture without the existence of a virtual circuit. UDP sits on top of IP and when it has data to send it creates a UDP segment and gives it to the IP for delivery [STAL94]. At the receiving end, UDP gets the data from the IP and does error checking. If there is no error UDP passes the data to its user; if there is an error UDP discards the data.

Telnet is an Internet protocol that enables a connection from a user's computer to a remote computer site and emulates a terminal that is connected to that remote system [DEAL94]. To access the remote computer the user has to type "Telnet" followed by the IP address and Telnet port of the host computer (which looks like an E-Mail address) and access is usually obtained. Most public Telnets require a user to use a token identity (id), usually *anonymous* or *guest*.

File Transfer Protocol (FTP), also known as Anonymous FTP, is a protocol that governs the exchange of files on the Internet. It is used to transfer files of all types from a remote computer site to a user's computer and vice versa [DEAL94]. The 'anonymous' refers to the fact that access to the files in question does not require user identification. To retrieve a file from a remote site a user would have to type:

FTP> Get /path/ filename

The user will then be prompted to give a local file name, which is the name the file will have on the home computer.

Simple Mail Transfer Protocol (SMTP) provides a basic Electronic Mail facility in that it provides a process for transferring messages among separate hosts. Features of SMTP include mailing lists, return receipts, and forwarding [STAL94]. The SMTP protocol does not specify a mechanism for creating the data, but once a message has been created, SMTP accepts the message and makes use of TCP to transmit it to an STMP module on another host [STAL94]. The target SMTP module will make use of a local Electronic Mail package to store the incoming message in user's mailbox.

According to [STAL94], "most applications require a reliable end-to-end protocol and thus make use of TCP." Some special-purpose applications such as Simple Network Management Protocol (SNMP) do not need the services of TCP. SNMP uses UDP and IP. SNMP has been developed as a standard under the auspices of the Internet Activities Board (IAB) for the management of devices such as bridges and routers attached to the Internet. Figure 4.1 shows some of the key protocols commonly implemented.

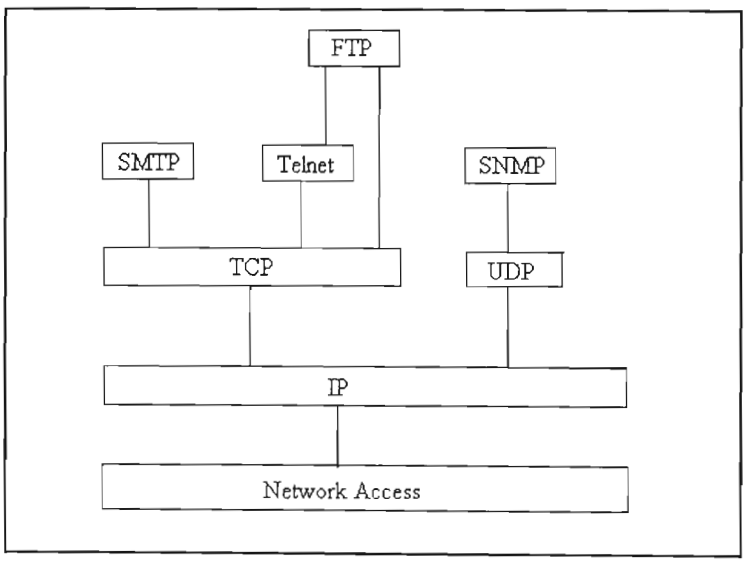

Figure 4.1 Protocol dependencies [STAL94]

There is software that has been developed to help navigate the Internet to locate and retrieve information, namely Archie, Gopher and Veronica. "Archie is indexing software with a query feature that makes it possible to locate files stored at remote computer sites. In order to use Archie, a user must first Telnet to a site that has an Archie server" [DEAL94].

Gopher is software that organises files at various Internet sites and makes them available through a system of hierarchical menus. Gopher software has search and retrieval capabilities and most Gophers are able to deliver requested information. Gopher sites can be accessed using a Gopher client or Telnet [DEAL94].

Veronica stands for Very Easy Rodent Oriented Software. It is software used for searching and retrieving files found in Gopher menus [DEAL94]. Veronica shows up as an option on most Gopher sites and can be used for searches.

There are applications such as the World-Wide Web and Lotus Notes that enable the development and delivery of learning materials. Technological infrastructures such Integrated Services Digital Network (ISDN) can also facilitate a user's access to the Internet. Integrated Services Digital Network, the World-Wide Web and Lotus Notes will be discussed in detail in the sections 4.4, 4.5 and 4.6 respectively.

The Internet serves as a platform for communication tools such as Electronic Mail, List Servers, Internet Relay Chat, Bulletin Board Services and Multi-User Domains. These Internet communication tools enable Computer Mediated Communication between users with the required software and technological infrastructure.

4.2 Computer Mediated Communication in Distance Education

Computer Mediated Communication (CMC) refers to the combination of word processing and communication tools such as Electronic Mail, Internet Relay Chat, List Servers, Bulletin Board Services, and Multi-User Domains. It facilitates interaction and feedback, and hence encourages the development and reorganisation of a student's knowledge structures. CMC can encourage internal reflection and reorganisation through dialogue, argument and debate [MASO90]. Distance education students who often have little or no form of interaction can broaden their understanding if they have reasonable access to their lecturers and peers via CMC. CMC capabilities are being utilised for tutor support, communication and accessing information. Effective learning occurs when the student interacts with educational resources at his or her disposal [MASO90]. The student can decide on the format and the speed of interaction and feedback if there is a wide spectrum of channels of communication. CMC cannot be a substitute for voice communication or face-to-face interaction, hence there is a need for the availability of various communication methods to suit the preference of the student [OWUS96]. Students and lecturers can use different forms of electronic messaging to communicate from a distance in both synchronous and asynchronous modes thus closing the gap in terms of distance and time.

The time spent by students waiting for interaction and feedback opportunities via postal mail could be minimised if they have access to a computer that can store their communications. An E-Mail message can be sent to a lecturer who might not be present at the arrival of the message but can respond to the student at the earliest convenience. The availability of computers with E-Mail facilities that link students and lecturers could reduce some of the visits to access points such as study centres or the institution's campus for interaction and feedback, provided these students have computers and telephones at home.

According to [BOYD85], CMC provides a real sense of community and affiliation through its networking potential, which in turn gives access to other students' experiences and opinions. Some students can assimilate the lessons faster when they collaborate with other students in a group. CMC can supplement occasional meetings such as weekend sessions, seminars, face-to-face tutorials and workshops that encourage collaborative learning and socialisation. Students are able to maintain their contacts with peers after face-to-face meetings.

4.3 Electronic Messaging

Electronic messaging is a form of communication that can take place via computer networks for the purpose of interaction, group discussion, debates, teaching, learning, group learning and dialogue. Electronic messaging comprises the use of communication media such as Electronic Mail, Internet Relay Chat, Lists Servers, Bulletin Board Services, and Multi-User Domains [OWUS95].

4.3.1 Electronic Mail

Definition 4.3: *Multipurpose Internet Mail Extensions (MIME)* defines a number of different internal file formats whose names take the form *file-type/sub-type*. MIME enables messages to include images (in various formats), audio files, and other non-textual data. [JOY94]; [MANG95].

Definition 4.4: "*Serial Line Internet Protocol (SLIP)* is a communications protocol used over telephone lines via a dial-up connection from the user's computer" [CISC92].

Definition 4.5: "*International Organisation for Standardisation (ISO)* is an international organisation that is responsible for a wide range of standards, including those relevant to networking. ISO is responsible for the most popular network reference model: The OSI reference model" [CISC92].

Definition 4.6: "*The Open System Interconnection (OSI)* reference model is a network architectural model developed by ISO. The model consist of seven layers, each of which specifies particular network functions such as addressing, flow-control, error control, encapsulating and reliable message transfer" [CISC92].

Electronic Mail or E-Mail is a store and forward technology. This means that when a mail server receives a message, it stores a copy of the message and then forwards it. The server will only delete its copy after the receiving server has acknowledged receipt of the message. If the receiver is on-line when the messages is received it can be accessed instantaneously, or viewed later at the receivers' convenience, like postal mail. The message can be entered directly from the keyboard or by including a previously composed file.

An effective E-Mail system runs on three components [NCDI93]. Firstly, an end-user application should be available to assist the user compose messages and manage his or her incoming mail. Secondly, a backbone for the delivery of messages must be in place to move messages around a network and deliver them to other destinations. Thirdly, the end-user application should be able to submit messages to the messaging backbone for the delivery, and access messages when they have been delivered.

To facilitate interpretability with other computers, most E-Mail software is designed with two separate components: a Mail User Agent (MUA) and a Mail Transport Agent (MTA). The user interacts only with the MUA, which plays the role of an electronic manager. The MUA allows the user to view, reply, store messages and perform other E-Mail actions.

The MTA fulfils the function of mail delivery to the specified address, normally to another user. The MUA prepares the message for processing and then hands it over to the MTA for delivery.

Figure 4.2 shows a model for Open System Mail that runs on a variety of network protocols. The Open System Mail can communicate with any mail system in the world.

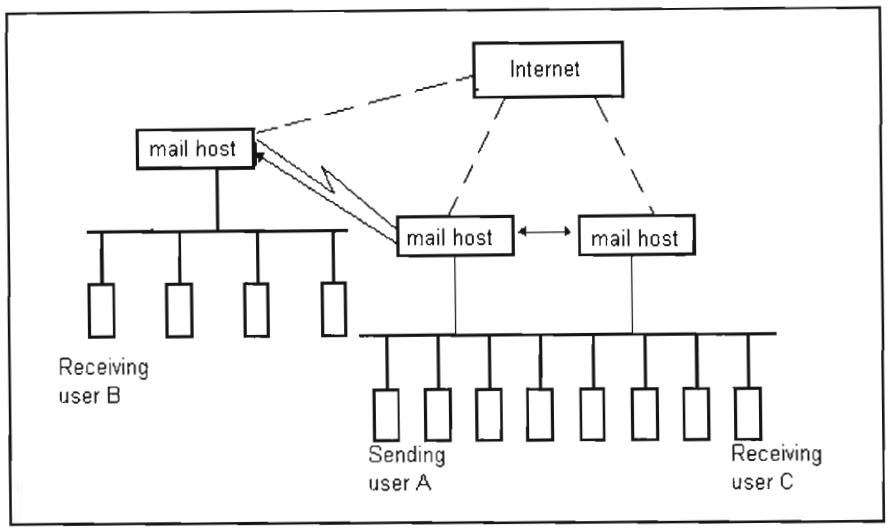

Figure 4.2 Open System Mail Model

The Open-System E-Mail runs on any hardware or operating system. The Open-System Interconnection (OSI) reference model provides the basis for connecting "open" systems for distributed applications processing [STAL94]. The term "open" refers to the ability of two systems conforming to the reference model and the associated standards to connect [STAL94]. The OSI model provides a frame-work for defining these standards using a seven-layer architecture. This E-Mail system uses peer-to-peer communication that allows a network architecture to avoid incompatibility at messaging servers.

Advantages

E-Mail can be used to improve the level of interaction in traditional distance education institutions which offer their students little or no form of interaction. E-Mail increases the opportunity for expressing one's idea in a group without feeling intimidated by the presence of others. The turn-around time of assignments via E-Mail can be in a matter of hours compared to postal mail that could take weeks to get to the student. With the use of Multipurpose Internet Mail Extension as a new mail standard it is possible to include images (in different formats), audio files, and other non-textual data into messages [JOY95]. Lecturers can provide feedback for their learning audience using multimedia to make their explanation more meaningful.

Disadvantages

E-Mail was generally designed for one-to-one use and the maximum number of people that a user can transmit messages to per dispatch is often limited. This implies that E-Mail limits the number of people that can be communicated with in a one-to-many communication situation. It is not possible for groups of students or people with individual E-Mail accounts to hold conferences, although multiple messages can be sent and received among a group in a type of pseudo-conference.

4.3.2 Internet Relay Chat

Internet Relay Chat (IRC) is a multi-user communication system where people convene on "channels" for discussions, debates and to talk privately or in groups. There are two types of IRC networks, Efnet and Undernet. Efnet is larger with 6 000 to 10 000 users who can participate in a chat session and Undernet has 1 500 to 3 000. Undernet is normally for beginners [FLEX96].

A channel is a group of one or more clients that will all receive messages addressed to that channel. A channel is controlled by a channel operator who has control over a specific channel. The first person to join the channel automatically receives channel operator status which can then be shared with anyone. Usually when a channel is opened the operator is asked for a nickname and the name of the server to be used [FLEX96]. Some programmes log operators onto a default server with a specific nickname, and whichever operator gets on IRC first in a day "owns" that nickname as long as they are logged into the IRC. Once the operator has chosen a server and a nickname, he or she can run the IRC software.

The IRC concept works as follows, the user runs a "client" IRC programme that connects to the IRC network via another program called "server." The server passes messages from user to user over the IRC network. The servers provide the point of contact to which clients may connect to chat with each other. Figure 4.3 is an example of small IRC network. A, B, C, D and E show servers and 1, 2, 3 and 4 clients in the network.

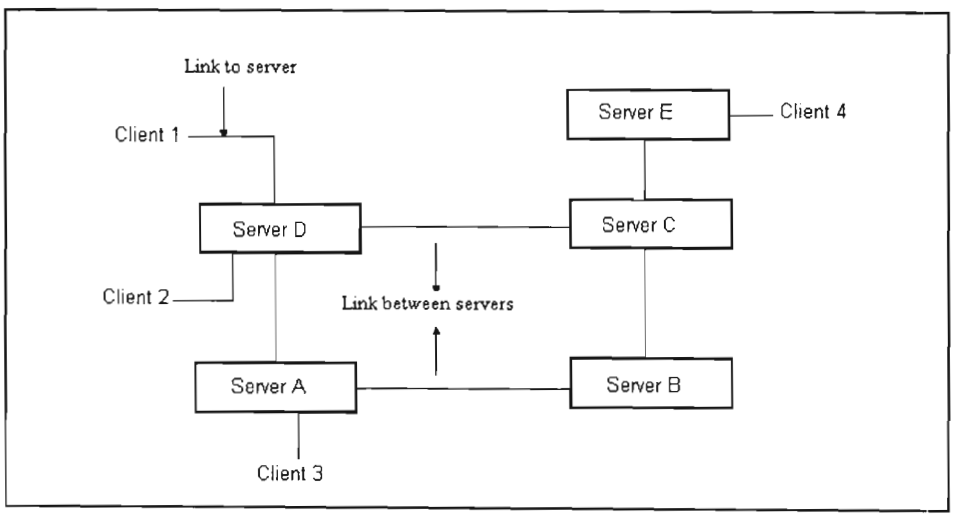

Figure 4.3 Internet Relay Chat Network

For example, in Figure 4.3, a message sent by client 1 will be delivered to client 2 by server D, client 3 will receive the message via servers D and A and client 4 will receive the message via servers D, C and E.

The IRC protocol is a text based protocol with the simplest client being any software programme capable of connecting to the server. Communication on a one-to-one basis is normally performed by clients who send messages through a server in exactly one direction only in order to get to any of the clients. The shortest possible path between points on the spanning tree is used to deliver messages.

In delivering a message to a list of clients at different destinations, the server dispatches a separate copy of the message to each given destination. Such conversational messages are sent only once to a server which supports multiple users in the same channel. The server then sends the message to each client on the channel. This action is repeated for each client-server combination until each member of the group receives the original message. One-to-many communication through the IRC network provides an environment that can facilitate easy and efficient debate, dialogue and conversation in a distance education environment.

Advantages

The one-to-one communication facility offered by IRC can make it possible for students and lecturers to hold personal discussions on their progress and also to receive feedback, whether complaints or clarification of a task.

The one-to-many communication on the IRC can be used by lecturers to broadcast messages to a class or conference session. Group learning and discussion are also possible on the IRC.

Disadvantages

Discussions on IRC must be in synchronous mode thus meeting times might not always be convenient for students.

4.3.3 List Servers

A List Server (Listerv) is designed to act as a mailing list server, maintain a database for each mailing list and also play the role of an information server [ZAN93]. A List server holds many lists of E-Mail addresses and instructions about what to do with incoming and outgoing mail. Users who wish to subscribe to a particular discussion group are required to send their E-Mail addresses to the Listserv to enable the server to add them to its mailing list. Each server maintains a number of mailing lists of different interest groups that each discuss a specific area of interest. The discussion groups can be likened to having a newspaper subscription or to listening to a discussion on a radio, in that many people read or listen but only a few choose to write to the editor or to call in. Those who choose to participate often do so frequently.

Discussion groups handled by Listservs on the Internet are similar to Usenet discussion groups. The difference between newsgroups of Usenet and Listserv discussion groups lies in the distribution method [DEAL94]. "Listserv postings are sent to individual subscribers while Internet sites that offers Usenet receive a news feed of all Usenet groups, which are then accessed from a single central location"[DEAL94]. If you are following a discussion group on Usenet, you will sign on to a Usenet service and read the message from a central location rather than having it sent to your 'mailbox'.

Figure 4.4 shows the relationship between members subscribed to a particular a discussion group.

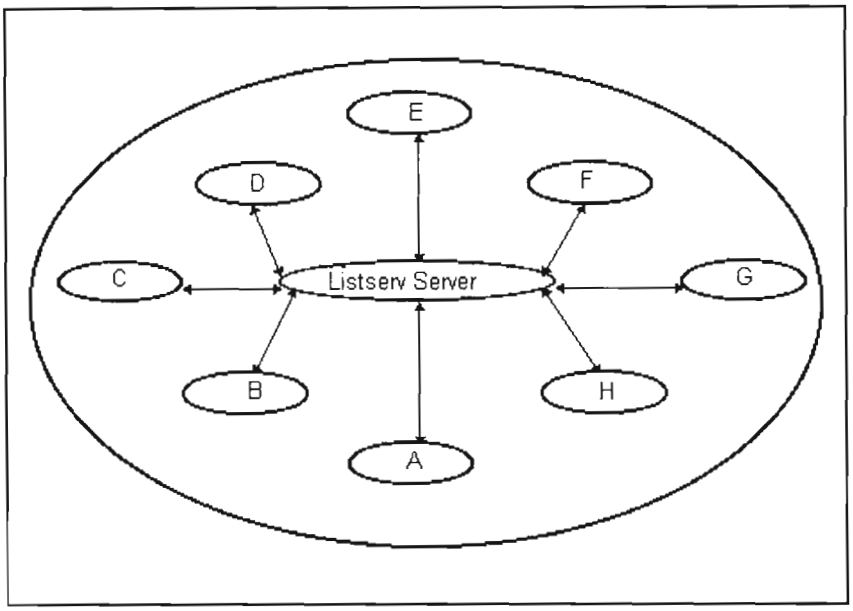

Figure 4.4 Listserv Interactions

A, B, C, D, E, F, G and H represent members of a group and the pattern of interaction that can take place. For example if A sends a message to the Listserv, it is distributed to all members of the group.

Students and tutors who have subscribed to a particular Listserv can use it for group discussions, debates, and exchange of ideas between members of any class. A discussion group requires a moderator whose role can take on any or all of the following functions: a facilitator; an administrator; a filter; an expert; an editor; a participant [ZANE93].

The role of the moderator as a *facilitator* will be to keep the group or class discussion focused and serve as a group leader, promoter of useful discussions and a helper. As an *administrator*, the moderator can provide solutions to technical problems, archiving files, and may market the list. The role as a *filter* will require the selection of appropriate postings to the discussion group. An *editor* will edit text, and may review and format the postings, or request the author to modify a contribution before posting, and a *participant* will act just like everyone else who subscribes.

The Listserv keeps a database for each mailing list and a copy of every mail message that is distributed on a mailing list [ZANE93]. In distance education institutions, students and lecturers can search for and retrieve old messages, debates, conference discussions and solutions to assignments using the database functions of the Listserv. Another function of a Listserv is the role of information server. This allows users or members of a group to receive and update network information. For example, members can be informed about new members of the group or a new moderator, and new educational materials that have been added to the database. New debates, discussions and on-line conferences as well as any important information that might be beneficial to the group may be dispatched by the moderator. There are three ways to communicate with Listservs: via E-Mail, by interactive message and by file transfer.

Communication via Electronic Mail: This is the most common method of communicating with Listserv and may be used by any user from any network. There are two forms of communication: commands such as instruction to join or leave the Listserv; and mail for distribution. Sending commands via E-Mail is not the same as sending to mailing lists. Command mail must be sent to the server itself (i.e. Listserv at Institution A) and should contain a series of Listserv commands in its text. Mail messages intended for distribution to the members of a mailing list is sent to the name of that list (i.e. The Educational Technology list, EDTECH at institution A).

Distance education institutions require suitable software and space to install the list and for archiving messages and files. A discussion list file will consist of a header and a list of subscribers. When a message is received by the Listserv, the programme will check the header to determine what should be done with the incoming message.

Advantages

Listserv can be useful for group discussion in distance education where students log in from various remote locations. E-Mail access is all that is be required. Discussions via a Listserv need not be synchronous because students can participate at their convenience [ZANE93]. This type of interaction facilitates knowledge-building. Different classes of students in a distance education institution can establish their own mailing list to discuss topics for periods of time in an asynchronous mode. Users can send commands directly to the Listserv to be subscribed to or unsubscribed from the group.

Access to remote databases for the retrieval of knowledge and information is a facility that does not exist in traditional distance education. Students have to make trips to libraries and study centres to gather supplementary educational materials such as references, journals and textbooks. Students who have access to a Listserv can retrieve journals, references and learning materials using the database function of the Listserv. Members of a Listserv discussion group can receive feedback that could take weeks or months using postal mail.

Disadvantages

Moderation of a Listserv can take a lot of time. Potential drawbacks to users of moderated discussion groups could be the possibility of censorship and lack of standardised ethics. Using E-Mail is the only method of communicating with a Listserv.

4.3.4 Bulletin Board Services

Bulletin Board Services (BBS) offer fundamental capabilities for communication and the sharing of information; they are an example of a discussion group in which people post their opinions or questions and other people post their conflicting opinions or answers to the questions [LEMA95]. BBS tends to be organised by topics, with each topic containing a set of postings. Depending on the BBS system, users might be able to create their own topics, or the moderator of the BBS system might have to do it for them. BBS requires a moderator as in the case of Listserv discussion groups. The moderator helps to keep the discussion in focus.

BBS for a large user base can be obtained through commercial services or software packages that run on personal computers or mainframe computers. BBS can be divided into three general categories: (a) communications, (b) data access, and (c) running of application programmes. In this section the discussion of BBS will focus on communications and databases. BBS offers facilities for private E-Mail, public E-Mail (usually referred to as forums) and various real-time conferencing capabilities [LEMA95]. Private E-Mail facilitates one-to-one communication in interactive situations that involve peers or the student and the lecturer.

Public E-Mail is suitable for one-to-many communication such on-line conferences and debates. Databases are provided by BBS system which may include electronic archives (historical) as well as current data such as copies of postings that might be updated weekly, daily, or continuously. Methods for locating the desired items are usually provided.

For example, if a distance education institution wants to set up BBS on the Internet for a class or school that requires a subscription, it will require a combination of scripts, a profile database for students, and authentication. The setup can contain directories such as: (a) a directory that contains the initial subscription manager page and the scripts for

adding a subscriber, (b) a directory which is only accessible by users in the subscription database, containing all the files for documents such as postings and discussions.

Scripts can take the user information from a form that can be available on a BBS for posting contributions to discussions [LEMA95]. The script will then create a user profile in the subscription database, an entry in the appropriate password file for the authentication, and then send a message back to the given E-Mail address for verification.

A BBS set up for students in a distance education environment can be used for asynchronous communication on one-to-many basis. Students will require software to access a BBS system on the Internet. The BBS will contain an index page listing all the topics available for discussion. At the bottom of the BBS page a form for adding a new topic may be available for submitting postings. This form can contain fields for typing in names and E-Mail address as well as buttons to post or clear the form. Figure 4.5 depicts using BBS for discussions such as conferences and debates, information sharing and communication between members of a group.

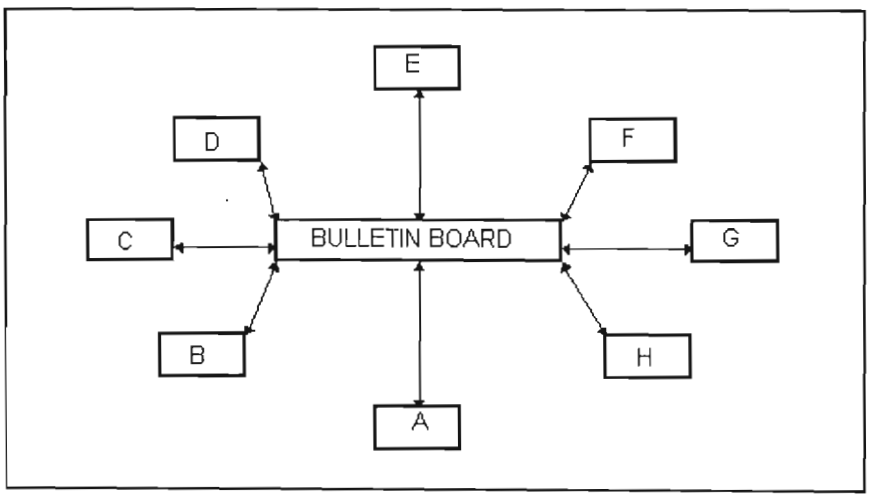

Figure 4.5 Bulletin Board Services Interactions

A, B, C, D, E, F, G and H represent members of a discussion group who can access the BBS system for information sharing. Any of the members can post an item on to the BBS for the attention or reaction of the group.

Advantages

Conferences and forums that are held on BBS can be asynchronous and the student learning through distance education can participate in any form of discussion at his or her own convenience, provided that he or she has access to the technology. Through debates and conference sessions via BBS students can discover new ideas. BBS can provide students and lecturers with access to the databases provided that have archival or current data. BBS provides a fairly sophisticated method for locating desired items. Students can also retrieve copies of old documents and class discussions.

Disadvantages

Communication via a BBS on the Internet can be slow during times of heavy use. As in the case of Listserv, moderation of a BBS can take a lot of time.

4.3.5 Multi-User Domain Object Oriented (MOO)

Multi-User Domain Object Oriented (MOO) software and similar programmes are network-based applications initially developed for role-playing games in which players interact with each other and a computer-created environment complete with a variety of simulated objects and characters [NEW95]. "Originally named MUDs, for Multi-User Dungeons, these virtual worlds blur the notion of identity, allowing human users to adopt different personalities, move around, explore, and emote with real and virtual creatures, and role-play scenarios and simulations"[NEWB95]. Any MOO can be accessible to anyone with MOO-client software such as *tkMOO*, *Telnet*, or *Phoenix*.

A MOO can combine with other Internet tools such as the World-Wide Web. "The powerful configurability and interactivity provided by MOO is no longer restricted to text only, but also the use of full hypertext and hypermedia capabilities of the World-Wide Web" [NEWB95]. The output of a MOO would include the usual text but could also include graphics showing the results of a student's actions.

There are educational MOOs whose main purpose is to provide templates for lecturers for tutorial support, collaboration and experimentation. The most well known is the Diversity University [NEWB95]. Existing facilities on educational MOOs can be used to build commands or add functions by programming.

The lecturer does not have to create his or her own educational MOO to teach. MOOs, unlike E-Mail, Listservs and BBS are suitable for meetings that must be synchronous, such as weekend sessions. As in the case of IRC systems, MOOs can be used by lecturers to arrange for meeting at a "site" on the Internet. Instructional episodes that are done at a distance using MOOs stand to benefit the student who wants the social environment of a class and may not do well with independent study. A student can view a page displaying an ongoing problem discussion for a class and can participate in the class by typing a question and responding.

Using MOOs for teaching in distance education can give the student a real life situation using virtual reality designed lessons. Virtually designed objects can respond directly to students' commands thus giving them the opportunity to view the outcome of their actions that cannot be accomplished using printed text or audio cassettes.

Advantages

The connect time for MOOs is cheaper than telephone calls [NEWB95]. There are people who learn better in groups and a MOO provides the opportunity for the student learning

through distance education to take part in classes without travelling any distance. On-line discussions can be held among students who are geographically dispersed. Students can meet with their lecturer or peers on the Internet for discussions, debates and consultation on academic tasks. A student can send E-Mail to a lecturer requesting a meeting on the Internet, and then meet to resolve academic problems. The fact that feedback and interaction can be faster on a MOO than through the postal mail can enable a determined student to keep to his or her pace of learning.

Disadvantages

It is not possible to include graphics, sound, animations and video in presentations when using MOO alone. On-line discussions via MOOs must be synchronous.

Figure 4.6 shows a summary of the various communication technologies.

	Features	**Communication**	**Educational Uses**
E-Mail	Internet, plain text or multimedia	one-to-one, asynchronous	personal discussions
IRC	Internet, plain text, file transfers, client/server	one-to-one, one-to-many, synchronous	personal and group discussions
Listservs	Internet, databases file transfers, plain text, electronic archives	one-to-many, asynchronous	group discussions
BBS	Internet, databases, plain text, electronic archives	one-to-many, asynchronous	group discussions
MOOs	Internet, telnet, plain text, client server	one-to-many, synchronous	personal and group discussions

Figure 4.6 Summary of communication technologies

BBS and Listservs can be used for asynchronous communication and students can participate in group discussions at their convenience. The use of BBS and Listserv for CMC will depend upon which technology is available to an institution. IRC and MOOs can be used for communication that is synchronous, such as live tutorial discussions. The use of MOOs is still being researched but IRC is popular and by prior arrangement can be used for meetings if the technology is available.

4.4 Integrated Services Digital Network (ISDN)

Definition 4.7: *Point-to-point* is the transmission of data between a single sender and receiver.

ISDN as a technological infrastructure is designed to allow high speed transmission of digitally encoded data instead of analogue signals to and from subscribers' premises [TELK95]. ISDN transmissions can incorporate text, sound and image files using a standard telephone interface [SABA89]. The binary ones and zeroes are collected in packets and transmitted in strings through existing twisted copper pair telephone wires.

With the current telephone system, analogue signals are transmitted down a twisted copper pair wire to the phone company's switch, where they are turned into a high speed digital signal, typically at 64000 or 56000 bits per second. In contrast, ISDN transmits digital information right from the start. ISDN devices operate as normal phone devices and a point-to-point links can be established by dialling the number of the device on the other end.

4.4.1 Types of Integrated Services Digital Network

Integrated Services Digital Network is delivered from a digital switch through two types of interfaces: the Basic access and Primary access.

Basic Access is also referred to as the Basic Rate Interface (BRI) or BISDN. It consists of two Bearer (B) channels at 64 Kilobits per second and one Data (D) channel at 16 Kilobits per second. For this reason it is also called 2B + D. The B channels are used for voice, data, text or image calls. The D channel is used for signalling for the two B channels. Towards the exchange the D channel sets up, controls, maintains and releases calls, and from the exchange it gives calling line identification, call waiting and cost of call information [COET95]. Via ISDN lines a user can transmit up to 144 kilobits per second on a normal twisted copper pair wire. Twisted copper pair wire comprises two insulated wires arranged in a spiral pattern made of copper or steel coated with copper.

Primary Access is also referred to as the Primary Rate Interface. It consists of thirty B channels and one D channel, all at 64 Kilobits per second. The Primary Access is therefore commonly known as 30B + D. The function of the D channel is the same as in BRI. A user can transmit up to 2048 Kilobits per second or 2 Megabits per second. Virtually all modern telephone and computing systems can be connected by means of a PRI or BRI ISDN interface to a LAN or WAN.

The features are made possible by ISDN (BRI and PRI) are as follows:

(a) Multimedia presentations.

(b) PC conferences.

(c) File Transfers.

(d) Document Archival and Retrieval.

(e) Video Conferencing.

ISDN is capable of carrying all types of messages such as audio, video and text through the same channel and in the same digital format. These messages can be integrated at an end user computer as *multimedia* presentations. For example, CAI courseware that has been developed using a multimedia package can be transmitted to students through ISDN.

PC conferences can allow the student learning through distance education to have access to a remote computer terminal, view its screens, perform searches in its directories and exchange graphics and documents [TELK95]. Suitable software can allow students and lecturers to set up a PC conference where each participant can view the same images and use their keyboards to enter their contributions to discussions.

Students and lecturers can do *File Transfers* of data between digital links instead of a physical transfer using diskettes. This ensures high speed transfers, and the security of the data. High speed ISDN services are more efficient and cost-effective than postal mail, messengers or modems [TELK95].

Document Archival and Retrieval can be done on ISDN communications architecture [TELK95]. For example, a distance education institution could keep old copies of CAI files in its electronic archives and students can go through ISDN lines to retrieve CAI files for reference.

Video Conferencing is the most popular application of ISDN. Video conferencing allows the simultaneous transmission of high volumes of information in whatever form (data, voice, image and/or video) on a dial-up basis through the public network [TELK95]. The electronic meetings can be held at any times over ISDN lines and can be used to supplement the occassional weekend meetings for distance education students.

Distance education institutions that deal with large classes can use BRI for a Video Conference via ISDN lines whereby different locations that have the technological infrastructure are linked, instead of meeting at one location. BRI could be appropriate for distance education institutions as compared to PRI due to cost effectiveness. "The PRI installation will cost just short of R18 000, while a BRI installation would cost R233. PRI

costs so much because additional wires need to be laid" [TELK95]. Figure 4.7 shows a typical BRI installation [COET95].

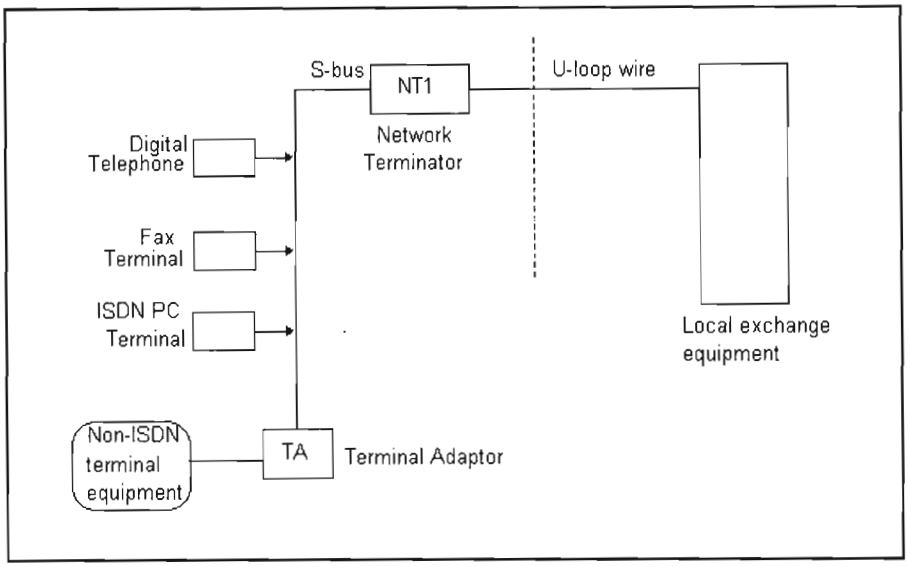

Figure 4.7 A typical Basic Rate Installation

The U-loop wire which is a connection from the local exchange equipment is terminated by a Network Terminator (NT1) device which is provided by Telkom at the customer premises. The U-loop normally has a maximum length of 5.5km. An S-bus into which a maximum of eight terminal devices can be plugged is connected to the NT1. The S-bus can be a maximum of 150m long and usually consists of 4 wires, but in some cases it may be 6 or 8 wires. The terminal equipment such as a fax machine, telephones or computers can be either analogue or digital. The digital terminal equipment is connected directly to the S-bus. Analogue terminal equipment such as an ordinary telephone is connected to the S-bus via a terminal adapter (TA) [TELK95]. The Terminal Adapter serves as an interface for the analogue and digital environment.

4.4.2 Integrated Services Digital Network as an Instructional Medium

The main contribution of ISDN technology to education and training is to integrate and simplify the use of different communication services and terminal equipment. Its most useful application is to combine the basic media, for example voice, text and video, and to make them available to student and lecturer on a computer. A broad range of distance education institutions are beginning to use ISDN as the backbone for integrated voice, data and video transmissions [GOLD95]. "This is the impetus for most of the developments in distance education" [ROMI93]. ISDN is not a CAI tool but a technological infrastructure that can be used to deliver CAI courseware using point-to-point or point-to-multiple point connections. For example, a lecturer can transmit multimedia CAI courseware to access points through ISDN lines. Students who receive the file containing the courseware can use it for instructional episodes on a computer. Figure 4.8 below shows a typical distance education configuration.

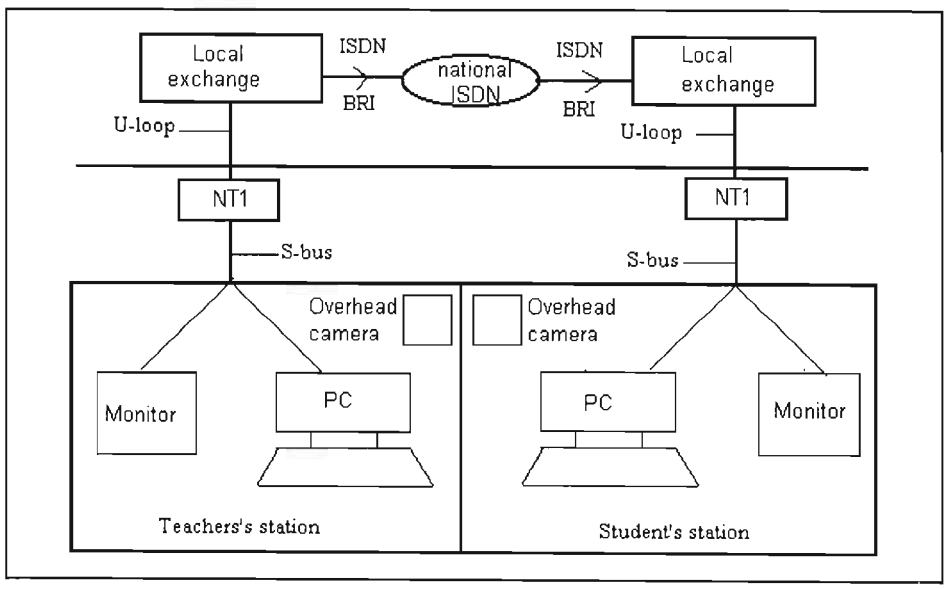

Figure 4.8 ISDN distance education configuration

Students' personal computers can be connected to a Terminal Adapter or an S-bus which is terminated by a NT1 at access points such as home, places of work, library or community centres. The NT1 is connected to the local exchange equipment by a U-loop wire and a point-to-point transmission will go through the local exchange equipment and then via the national ISDN to the assigned destination. For example, a lecturer in a distance education institution can originate a lecture on chemistry, physics, or mathematics for students working at home or their places of work. The lecturer, using a computer, can supplement the lesson with written materials, graphics, and pictures. Using a video in conjunction with the computer allows the lecturer to see students and the students can see the lecturer. Databases, previously established and saved in a file, can be shared with students. The lecturer can monitor students as they enter new data or manipulate databases to do an exercise. The lecturer can intervene to provide immediate feedback. Students when by themselves can use the modem to dial up intelligent databases for interaction on a course material in the absence of a tutor for tuition or explanation [SABA89]. Students can access a computer to take a CAI lesson, watch a video segment or take a test. Students who want to take a test can access a file with the appropriate test, respond to questions, and receive immediate feedback on how well they have done.

ISDN supports multitasking. Several windows can be opened simultaneously for students and their lecturer to examine and manipulate several files at the same time. "The screen can be divided into several areas with one area only devoted to video, bearing the image of the lecturer, and other areas used for text, graphics, or data"[SABA89]. The video camera can be supported by a moveable arm so the lecturer can use the camera to show an experiment, scanned images from a magazine, or display information extracted from a CD-ROM or an ordinary video tape player. "The strength of ISDN is in making all such media, as well as the instructor, accessible to students through the telephone line"[SABA89].

A pre-arranged synchronous meeting can be held for students to ask questions, share concerns, deliberate about issues and solve problems [SABA89]. Through interconnected LANs or other networks, interactions among students and with lecturers can take place in much the same way they would in a face-to-face learning environment. Students can read recommended texts and then receive tutorial support via ISDN's Video Conference. ISDN can bring expertise in many subject domains to a number of geographical areas that are affected by the lack of higher education if the technological infrastructure is available.

ISDN relieves lecturers in distance education institutions from the burden of full scale television production. An ordinary lecture or short conference will not require that a lecturer goes to a television studio where the control of equipment is in the hands of a director and technical staff [SABA89]. A lecturer can use a computer to effectively communicate with students through voice, text and video. This provides the lecturer with more control over the distance teaching process as compared to the production of studio-centred telecourses [SABA89]. The efficiencies and economies of scale of an integrated network allow these services to be offered at a lower cost than if they were provided separately. The user needs to bear the expense of just a single access line to these multiple services.

ISDN is currently being used in South Africa by the business fraternity and it can also be used for instructional episodes by distance education institutions. According to [TELK95], "ISDN services are available in the following areas in South Africa: Western Cape,Transvaal, Eastern Cape, Orange Free State, Johannesburg and Pretoria."

Advantages

ISDN is reliable for data transmissions. It is not affected by noise which characterises analogue transmissions, especially over long distances and older telephone lines. ISDN offers quiet, static-free voice conversations and virtually error-free data connections

[TELK95]. ISDN carries data at significantly higher speeds. The dialing plan is the same for voice and data.

Disadvantages

ISDN can only be used in locations that have access to the technological infrastructure.

4.5 The World-Wide Web (WWW)

On-line CAI can be implemented using the World-Wide Web. The World-Wide Web usually abbreviated "WWW" but also known as " W^3 " is a project that was initiated by CERN (the European Particle Physics Laboratory in Geneva). The World-Wide Web allows Internet publishers to link information in multiple direction and layers [MANG95]. Publishers are able to present information in a multimedia context. The World-Wide Web has the following features:

(a) Multimedia Presentations
(b) File Transfers
(c) Bulletin Board Service
(d) Electronic Mail
(e) Hypertext/Hypermedia
(f) Networking

The World-Wide Web enables Internet publishers to use the required tools to develop on-line *Multimedia* documents. A World-Wide Web page may be a combination of text, graphics, audio and even video clips.

File Transfers can also be done on the World-Wide Web using the File Transfer Protocol (FTP) of the Internet. File Transfers allow students to move files from one computer to another at different locations. When the FTP programme is invoked on a user's computer

it in turn invokes the FTP programme on the remote system. Any response will then be relayed back and forth, such as a request for directory listing. To reference an exact file from an FTP site one must know: (a) the name of the FTP site; (b) the directory where the file resides; and (c) the name of the file.

Bulletin Board Services (BBS) can be created on the World-Wide Web for information exchange or group discussions. Students and lecturers can post their conflicting opinions to the BBS and receive answers or responses from members of a class. A form at the bottom of a BBS can be used to submit contributions. Different BBS can be created according to topics or class.

The World-Wide Web has an E-Mail interface and students can send out *E-Mail* messages to peers and lecturers while they are using their on-line CAI lessons on the World-Wide Web. They need not exit from the World-Wide Web.

The *Hypermedia* feature of the World-Wide Web can be used to organise a large quantity data, using keyword searchers and click graphics to link the user to more information. Large presentation can be broken down into smaller presentations. Interactive lectures which can contain graphics, text, sound, and video can be distributed by means of HTTP, so an HTML document can be similar to a face-to-face classroom-based instruction using transparencies [BERT95]. CAI produced using HTML can contain links to other stored documents on servers around the country. It is very common during face-to-face instruction that human lecturers often refer to their previous explanations. Links to previous on-line CAI enables the student to review an explanation and related information that can enhance the learning of a task.

The World-Wide Web uses distributed *network* architecture supported by communication protocols [MANG95]. A distributed network may be spread over many separate locations, each of which may have several separate LANs [GEE83]. These LANs can be linked to facilitate an effective way of handling large quantities of traffic between LANs. Inter-site communication requires the use of Wide Area Networks linked to LANs by means of a gateway. A Gateway is a device for connecting two networks that use different protocols, and is used for communication between two or more local networks across a Wide Area Network.

4.5.1 Accessing information via the World-Wide Web

Definition 4.8: "*Wide Area Information Server (WAIS)* is an on-line database of information updated regularly from the world. It is accessible through most Gopher sites or through Telnet" [MANG95].

Definition 4.9: "*HyperText Transfer Protocol (HTTP)* is the principle protocol used by the World-Wide Web. HTTP is responsible for many things, such as interfacing with other Internet tools using an appropriate URL, as well as actually making requests for formation and carrying the information between the client and server" [MANG95].

The *Uniform Resource Locator (URL)* is used by the World-Wide Web to specify the location of files on other servers. A URL includes the access method (Protocol) of the server, hostname and the location of the file on the server.
The URL syntax is:

Protocol: //host domain [port]/path/filename [DORE94].

where protocol is one of the following;

File	:	For a file on a user's local system.
FTP	:	For a file on an anonymous FTP server.
HTTP	:	For a file on a WWW server.
Gopher	:	For a file on a Gopher server.
WAIS	:	For a file on a WAIS server.
News	:	For an Usenet newsgroup.
Telnet	:	For a connection to a Telnet-based Service.

When a host has been located using the URL, a World-Wide Web client programme (browser) is used to access information on the Web. There are sites that provide browser access via Telnet. There are two types of World-Wide Web browser, text-based and graphics-based.

Text-based browsers cannot display anything other than text. An example of such a browser is a UNIX text-based browser called Lynx [DORE94]. It uses full-screen, arrow keys and highlighting. It is much faster than a graphics-based browser as it does not download any graphics images that often slow down the graphics-based browsers.

Graphics-based browsers run under windows and they support full range of hypermedia capabilities [DORE94]. They display images files, play animation and sound. Examples of graphical browsers are Mosaic, Cello and Netscape.

4.5.2 Pedagogical Role of the World-Wide Web

The pedagogical uses of the World-Wide Web centre around the use of the technology for the delivery of hypermedia at a distance as well as the organised structure of links to educational materials. The World-Wide Web and other Internet-based tools have

significantly enhanced the ability to educate electronically and also provide new functionality in transmitting information to students and providing forums for exchange. The World-Wide Web is also revolutionising some areas of study through increased opportunities for learning and alternative formats for information [DWYE95]. The World-Wide Web as a pedagogical instrument has the ability to present information clearly, attractively and practically.

The potential for the World-Wide Web is to create a distance education environment for a broad range of students, thus involving them in high interactive participation. Instructional episodes at a distance can address the current emphasis towards interactivity in the learning process. Students can interact with peers and lecturers during instructional episodes using the BBS or E-Mail feature of the World-Wide Web.

"Recent expansion of the World-Wide Web into academia has given educators the opportunity not only to create their own complex learning environment but also to share their experiences with their peers" [BERT95]. When lecturers begin to explore the World-Wide Web and develop on-line CAI for distance education, the quality and creativity of their World-Wide Web sites could improve through modifications made as a result of suggestions, criticism and encouragement which may transform into further development sites. Browsing through the World-Wide Web is an educational experience in itself.

Many students and lecturers have lived the phenomenon by which they start browsing through the World-Wide Web with a specific goal in mind and end up diverted from their initial goal for a while because of something interesting on the way, that they were not explicitly looking for. Student can use the World-Wide Web in their process of knowledge appropriation.

Advantages

The World-Wide Web can integrate some of the Internet communication tools such as MOOs and IRC. These communication tools can be used for real-time discussions on the World-Wide Web. Real-time discussions can provide students and lecturers in distance education with the opportunity to interact with each other live when necessary. Students can have remote access to educational resources such as databases, virtual libraries and electronic journals for quality research and distance education. Volumes of educational materials and on-line CAI courseware can be stored on different World-Wide Web servers. Free server and client software is available over the Internet.

Students can use the "form filling" feature to submit assignments that are transmitted to a server when the reader clicks a "submit" icon or button. This fill-out form capability is essential in allowing interactive use of the World-Wide Web, where the student becomes more active than just clicking on the hotspots areas of a document [BERT95]. There is the availability of public-domain client and server software for many different platforms.

Disadvantages

There is no centralised register of documents, thus retrieval of information could be very slow when the demand for Internet services are high. Security on the World-Wide Web is still evolving.

4.6 Lotus Notes

Lotus Notes can be used to develop on-line CAI. Lotus Notes is a client-server platform for developing applications that can automate processes using a variety of data types such as numerical data, text, graphic image, sound and video clips [LOTU95]. Lotus Notes includes a set of design templates that are complete applications in themselves. These custom applications could be accessed using a Lotus Notes client. Users with no formal programming experience could modify these templates to build a custom application that

meets their specific needs [LOTU95]. Lotus Notes messaging and directory services enable the routing of information among users and databases [LOTU95] and [SHEA95].

The features offered by Lotus Notes are as follows [LOTU95]:

(a) Multimedia presentations
(b) Internet/World-Wide Web
(c) Newsgroups
(d) Bulletin Board Service
(e) Listserv
(f) Network
(g) Databases

Lotus Notes allows the integration of text, graphics, video, sound into *Multimedia presentations.* This multimedia feature can be used to develop on-line CAI for instructional episodes.

Lotus Notes supports Simple Mail Transport Protocol gateway that can give student direct accesses to the *Internet* Mail service without switching from the Lotus Notes user interface to compose or read their E-Mail messages.

Lotus Notes application documents can be converted into HTML using the InterNotes Web Publisher to produce *World-Wide Web* pages that are complete with graphics and document links. The converted documents can be viewed using a Lotus Notes client application as well as World-Wide Web browsers to navigate the documents [LOTU95]. A Lotus Notes document cannot be viewed with a World-Wide Web browser unless it has been converted to a HTML document.

Students using Lotus Notes can have access to newsgroups created by an institution. Students and lecturers can browse articles from various *Newsgroups* in Lotus Notes discussion databases. The databases can be accessed using newsgroup names as a key [SHEA95]. Students and lecturers can participate in newsgroup discussions by posting a response from Lotus Notes or mailing it directly to the author of the newsgroup.

Students and lecturers can post questions and answers as well as make contributions to *BBS* databases in Notes. Different BBS can be created for various groups in an institution.

Listserv databases can be created in Lotus Notes by lecturers for class on-line debates and discussions. Students can subscribe to different Listserv groups of their choice.

Lotus Notes has inbuilt *network* capabilities for both local and wide area networks. The network consists of a Lotus Notes server and a number of clients [LOTU95]. Lotus Notes databases can be stored either on the client or server. Lotus Notes also supports various network protocols including TCP/IP.

Lotus Notes has database facilities that can reside on a server and or on a stand-alone client. A person can copy a database or part of it on to their labtops or notebooks computers, allowing them to work (contribute to a database) with information even while disconnected from a server and to copy the completed work back when they reconnect.

4.6.1 Pedagogical Role of Lotus Notes

The development and delivery of on-line CAI using Lotus Notes could facilitate the retention of knowledge of the student because of the feedback and interaction that can be available through BBS and Listserv databases. Students can work in groups by setting up their own databases [SHEA95] for discussions, group projects and submission of assignments. The electronic discussion allows students who struggle verbally to make

contributions to on-going discussions or debates. Debates and discussions can take place throughout a semester without face-to-face meetings.

Students could get timeous feedback from lecturers and peers. Lecturers can evaluate discussion databases and verify the understanding of students. Assignments can be submitted electronically and may include text, graphics, video or audio [SHEA95]. The lecturer can grade the assignments with feedback and send them back to the students via databases.

Advantages

Lotus Notes database saves students and lecturers time in working with remote locations. "Lotus Notes is a reliable and established technology, it has the capability of meeting the distance educational needs of students. Notes has a solid and a growing track record in higher education, good models exist and it is also cost effective for distance education" [SHEA95]. Lotus Notes allow lecturers to create custom applications, and send and receive messages from students. Students and teaching staff can access multiple databases of documents and security mechanisms to these databases are integrated and very developed [LOTU95]. It is easy to produce documents in a single database, including simple creation, editing and updates. Documents can also be viewed or browsed without the need to look up key words or links.

Disadvantages

The number of clients is normally restricted in number thus administrative overheads could be very high if more servers have to be purchased for bigger classes [LOTU95]. A Lotus Notes network is a closed network and is limited to servers with the software installed.

The similarities and the differences between Lotus Notes and the World-Wide Web are presented in Figure 4.9.

Feature	Lotus Notes	World-Wide Web
1. Achtecture	Client-Server achitecture.	Client-Server achitecture.
2. Networking	Inbuilt networking capabilities for both local and wide area network. Network is closed and restricted to servers with the software.	Distributed network achitecture supported by the communication protocol.
3. Database access	Acts as a front end to a variety of databses such as Dbase, SQL, Paradox, Oracle and Informix.	A client can query databases by executing scripts on server's operating system.
4. Security	Security is highly developed and supports multi-level access controls.	Supports open access.
5. Document manipulation	Provides word processing facilities in its documents.	Documents are read only and need to be constructed by author in HTML.
6. Mail	Lotus Notes Mail is provided with the software.	Mail is provided as part of the WWW browser software.
7. Platforms	Notes clients running on PC's, Macintosh or Unix platforms can all access Notes servers	WWW translates messages to and from computers that use different communication protocols.
8. Administration	High overheads	Cheaper than Lotus Notes

Figure 4.9 Similarities and differences between Lotus Notes and the World-Wide Web

Lotus Notes and the World-Wide Web are competing technologies because they overlap in their features. For users seeking information such as electronic journals, virtual libraries and databases the World-Wide Web gives a good flexible support. For individuals working on group projects, Lotus Notes provide the opportunity to comment, edit and update documents in databases [LOTU95]. They can both be effective tools for changing the face of instruction in distance education.

4.7 Summary of Chapter

On-line CAI can be developed and implemented using the World-Wide Web, Lotus Notes and a technological infrastructure such as ISDN, all of which are available in South Africa. The technologies have the features of providing interactive instructional episodes in distance education. Interaction can be improved and feedback delay can be reduced in distance education using communication tools such as E-Mail, IRC, BBSs, Listservs and MOOs. The technologies are used via the Internet which sometimes performs poorly during times of heavy use.

CHAPTER FIVE

Surveys, Results and Analysis

This chapter discusses the methods and procedures employed to gather data on the implementation practises of CAI and CMC in degree awarding distance education institutions in some developed and developing countries in the world. The analysis of the data and results are also discussed in this chapter.

Definition 5.1: Developing countries are low-income and middle-income economies as defined by the World bank [WBS91].

Definition 5.2: Developed countries are high-income economies as defined by the World bank [WBS91].

5.1 Research Design

The purpose of this study is to analyse the implementation practises of on-line CAI and CMC in degree awarding distance education institutions in developed and developing countries, in order to make proposals for implementation in South Africa. The research design used in the study was a survey of degree awarding tertiary institutions with a distance education option in developed and developing countries that are using or contemplating the use of on-line CAI and CMC to improve the face of instruction and communication. The degree awarding institutions with a distance education option were selected from countries whose whose first and second languages is English. The findings of this analysis are used as guidelines in making proposals for implementation in South Africa.

The study was carried out in three phases. The first phase of the study, which was an initial fact finding survey, was carried out on the Internet to identify:

(a) the current technologies and tools for developing and implementing CAI;
(b) how CAI courseware was delivered to students;
(c) the extent to which CAI was being implemented in different institutions: whether on a small-scale, medium-scale or large-scale;
(d) the type of access points that the degree awarding institutions with a distance education option provide for their CAI courseware;
(e) the impact of CAI on students' performance;
(f) the attitude of students towards CAI in general;
(g) the constraints that the institutions face in the implementation of on-line CAI and CMC.

A more detailed survey was carried out among universities with a distance education option in developed and developing countries based on the responses of the first survey. This second survey also had some of the objectives of the first survey. The purpose of the second survey was to ascertain:

(a) the technologies and tools for developing and implementing on-line CAI in degree awarding distance education institutions;
(b) the types of technological and infrastructure being used to implement CMC for interaction and feedback in distance education;
(c) the facilities that degree awarding distance education institutions provide for their students in on-line CAI and CMC environments;
(d) the academic level at which on-line CAI and CMC are used.

Some of the questions on CAI in the first survey were repeated in the second to enable institutions to provide more information on their implementation practises. For example, questions 6, 8, 9 in the first survey were expanded to questions 10, 11, 12, 20, 21, 22, 23 in the second survey.

Additional questions were included in the second survey to obtain detailed information in terms of instructional media, software, hardware, impact of CAI courseware, academic level of CAI usage, facilities available to students, opinions on CAI usage, communication channels and constraints that institutions experience in the usage of computer technology. The information obtained from these questions was needed in order to propose a system for implementation in South Africa.

The third phase of the study was carried out in degree awarding institutions in South Africa who are currently running distance education programmes or contemplating the option in the near future. The purpose of the survey was to determine:

(a) how they intend to incorporate on-line CAI and CMC into instructional and communication media for distance education,
(b) how these technologies might be implemented,
(c) any constraints that might hinder the implementation of on-line CAI and CMC.

Open-ended and guided questions were asked about how the degree awarding institutions would implement computer technology to improve instruction and communication in distance education. Questions were asked about the computer technologies that were used by institutions that participated in the first and second surveys. The third survey also contained questions on some of constraints that might be encountered by institutions in the implementation of computer technology for instruction and communication.

5.1.1 Sampling of Degree Awarding Distance Education Institutions

For the first survey, institutions were not specifically targetted but were drawn from universities worldwide with a distance education option. These universities were those who had participated in discussion groups on the Internet or were known to be involved in distance education.

For the second survey research sample was drawn from the International Centre for Distance Learning [1CDL95] database at the United Kingdom Open University. The database currently contains the following information on:

(a) over 28,000 distance taught courses and programmes, most of them offered by institutions in countries of the Commonwealth in Africa, Asia, Australasia, the Caribbean, Europe and North America,
(b) degree awarding distance education institutions world-wide and their practises.

The institutions selected from the developed and developing countries were:

(a) those that award degrees via distance education,
(b) from countries whose first and second languages is English,
(c) institutions that use traditional instructional and communication media, or a combination of traditional media and computer technology, or contemplating the use of computer technology for some forms of instruction and communication.

The sample size comprised 45 degree awarding institutions with a distance education option from developed countries and 51 from developing countries.

The third survey focused on distance education at South African universities. A list from the ICDL database identified a number of South African institutions involved in distance education including universities, technikons, colleges of education and private institutions. The questionnaires were mailed to M. L. Sultan Technikon, University of Pretoria, Technikon Natal, University of Natal, University of Cape Town, University of Fort Hare, University of South Africa, Vista University, Technikon Mangosuthu, Rand Afrikaans University and Technikon South Africa. Colleges of Education were not included in the survey because they do not confer degrees.

In the second and third surveys, institutions that did not respond were sent a reminder.

5.1.2 Research Instruments

The questionnaire used for the first survey was drawn up with guidance from the literature review in terms of the different forms of CAI, the effect of CAI in improving students' performance, the required software, and the hardware needed for implementation. The questionnaire consisted of the thirteen open-ended questions which appear as Appendix B.

The second survey was also carried out in both developing and developed countries based on the objectives in section 5.1. The twenty-three guided and open-ended questions which were used in the second survey appear as Appendix C.

The questionnaire used for the third survey consisted of the fifteen open-ended and guided questions which appear as Appendix D.

The language of communication in which questions were asked was English as this is a universal language. The researcher realises that the sample size and the number of respondents could have been larger if other languages had been used to design the first and second questionnaires.

The reliability of the instruments in this study could not be tested but this was not considered a major disadvantage as this was a case study. Bias was eliminated by (a) carrying out the first and second surveys in developed and developing countries, (b) using institutions with different student populations and (c) using standard questionnaires for the surveys.

5.2 First Survey

Questionnaires (Appendix B) were sent via E-Mail to registrars, educators, lecturers, coordinators and curriculum developers in degree awarding institutions with a distance education option in both the developed and developing countries. An introductory message explaining the nature of the study and requesting consent for participation was included.

Of the forty questionnaires mailed only 16 (40%) were E-Mailed back. Although these returns were not sufficient for significant conclusions, they gave the necessary information for the first survey.

5.2.1 Data Collection

The institutions were located in the United States of America (10), Australia (1), Canada (3), Netherlands (1) and Puerto Rico (1). Six of the institutions are primarily distance education institutions and the other ten institutions run conventional and distance education programmes. Below are the details of the degree awarding institutions with a distance education option that participated in the survey.

United States of America

University of Colorado, Boulder has a student population of 35,000. CAI courseware is used on a small-scale in a course module, Principles of Macroeconomics, which is available on the World-Wide Web. Computers are available to students at home as well as on campus. Students submit assignments through postal services and E-Mail.

Syracuse University, Syracuse has a distance education programme using a combination of E-Mail, correspondence study, and short term stays on campus each summer. Apart from CAI, many kinds of audio and visual devices are used. CAI forms 5% of their teaching media and two courses are usually taught each year using CAI. CAI is also used to supplement other teaching media in many of the major courses. Most students seem to like CAI. Students have E-mail accounts as well as access to the World-Wide Web. Most assignments are submitted over the Internet using E-mail or File Transfer, but some students use postal mail.

Indiana University, Bloomington has a student population of 36,000 in residence and more in their distance education programme. Most schools and departments use CAI as a teaching medium. CAI courseware is delivered to students on diskettes, World-Wide Web and through ISDN. Funds for CAI projects are from the university or from educational foundations. Some students like the CAI courseware but the main constraint that hinders the development of CAI is the difficulty in getting some lecturers involved. Some lecturers see the use of CAI as a job threat; others are divided in their attitudes towards the design of CAI lessons. No evaluation on the effectiveness of CAI has been done yet but a recent report in July 1995 lamented the lack of such an evaluation. Computers are available to students at institutions and while others have personal computers at home. Assignments are submitted by students on diskettes by post and through E-Mail.

St Edwards's University in Austin, Texas has a student population of 3200. CAI courseware was introduced in 1993 and is currently being run on a small-scale. The only course that is completely on-line is an ethics course. The Computer Science department teaches some of their courses using CAI on the World-Wide Web and on stand-alone computers. In general the students' reaction towards CAI courseware has been positive. The major problem has been getting the Instructional Technology staff to work with students when they have problems with the technology. Students who hear about this

become discouraged from enrolling. The second difficulty has been in getting other faculties involved in using CAI, though this is slowly changing. Submission of assignments by students is done via E-Mail.

Texas A.M. University has a student population of 44,000. It has created the Trans-Texas network, a high speed cable system that links all the major cities and many colleges and universities. Interactive video courses are delivered every day of the week. Some of the subjects being taught are Wildlife Science, Neuroscience, and various educational technology courses. The students like the freedom in asynchronous learning that CAI offers them.

The Regent University in Virginia has a graduate student population of 2100. The University offers distance education at Masters and Doctorate levels. The main subject taught using CAI is Communication Studies for Ph.D students. CAI currently accounts for 10% of their teaching media, and there are interdisciplinary Doctoral courses starting in 1996 that will use CAI courseware as well. Students' attitude towards CAI is generally positive. Permanent documents such as syllabi, procedures, processes and list of courses can be found on the World-Wide Web. Temporary documents use E-mail and its attached documents function. Students provide their own hardware. The main constraint is the recticence of faculty to change the teaching mode.

The Northwestern University of Louisiana has a student population of 9000. Two-thirds are undergraduates and one-third graduates. It offers distance education by satellite, Internet and audio-graphics. CAI is run on a full-scale throughout the university. CAI courseware is developed using Toolbook software and HTML, and is delivered to students on diskettes and the World-Wide Web. Subjects that are taught using CAI include English, Education, Communications, Music and Computer Science. Some students like the CAI courseware and others hate them. Funding for CAI projects normally comes from

grants from private donors. The constraints that the university faces are money, traditionalism, and the reluctance of some staff members to change their method of teaching. Some students have their own computers and the university also provides computer laboratories for students' use. The Northwestern University's system is available through dial-up (modem-facilitated) communication, and many school systems and public libraries communicate with the University's system for public access. Assignments are usually submitted via E-Mail.

The State University of New York offers distance education to about 20,000 students. It started teaching using CAI courseware in 1988. The authoring tools or languages are Authorware Pro, Lotus Notes and HTML. It offers a Masters course in Certified Nurse Midwifery using CAI which is delivered to students via diskettes and computer networks. In addition CAI is used for tutoring on several small projects. The university has 40 study centres that are equipped with computers (at least 1 multimedia PC and often others for students' use). Home users vary from high end multimedia (few) to no computer access (about 30% of students). All students in their distance education programme are required to have access to a computer at home or be willing to go to the study centres. Assignments are submitted by students via E-Mail, some post them to Lotus Notes databases and also through postal mail. The main constraint has been students' access to computers which is frequently not sufficient.

Edmonds Community College, Lynnwood is a tertiary institution that offers distance education to about 17,000 students in various subjects. The college has been using CAI since 1984 to teach History, Horticulture and Mathematics. CAI forms 10% of the overall teaching media and is growing. Authorware Pro is used to develop CAI courseware which is delivered on diskettes, on networked CD-ROMs/hard drives and on the World-Wide Web. Communication between all students and faculty is done through Internet resources. 28% of the students have computers in their homes but the university also

provides computer facilities for students.

University of South California School of Film has between three and ten courses from a variety of CAI courseware providers. These courses are designed in conjunction with Interactive Multimedia Learning Technologies, Inc. (IMLearn). E-Mail connects the student with the staff and allows easy filing of homework assignments. On-line forms are also available to students which allow them to take time-limited quizzes and tests.

Canada

Assiniboine Community College, Brandon, Manitoba is a degree awarding institution in Canada with a student population of 2000. It started using CAI as a teaching medium in 1995. CAI courseware is designed using Authorware Pro and distributed over the Internet. CAI is used on a small-scale in Business Administration and in Economics. The students have both positive and negative attitudes towards CAI. It works for some, not at all for others. At the moment assignments are submitted via the postal services. The main constraints are the high cost of hardware and the man-hours required to develop CAI.

University of Manitoba, Winnipeg has a student population of 25,000 and has a distance education option. The university has been using various forms of CAI since 1985. CAI courseware is developed using Quest which is used to teach various Agricultural courses. The university is in the beginning phases of using the World-Wide Web for distance education delivery. The students have a very positive attitude towards CAI and the ability to view the visual aids outside the classroom is considered the most useful feature. Funding for CAI projects comes from Alumni innovation funds and the university administration. Lack of quality software and hardware access are some of the constraints that confront the university.

Memorial University of Newfoundland has a student population of 17,000 offering distance education at undergraduate and postgraduate levels. CAI is used on a small-scale by the university and a course is currently being developed on the World-Wide Web. Most of their courses are print-based and are supplemented with video tapes, E-Mail and audio cassette. The main problem for the students is lack of equipment in rural Newfoundland; most of them do not have computers and modems at home.

Netherlands

University of Amsterdam has been using CAI as one of its teaching media since 1989. CAI is used in almost all the departments to supplement other instructional media. At the moment the university designs courseware using Authorware Pro, C and Pascal. They also use Toolbook, and TAIGA (a Dutch authoring package). Students currently use computers at study centres to work with CAI courseware but the university is contemplating distributing CAI courseware on diskettes to students. Students are quite positive in their attitudes towards CAI courseware. The high cost of CAI development and implementation has been the main constraint.

Australia

Central Queensland University offers distance education to 10,000 students. The university has been using CAI courseware since 1990. CAI is being run on a small-scale but the university has developed a large-scale programme for the mining industry. Courses that are being taught using CAI are Engineering, Arts and Languages. CAI courseware is developed using Authorware Pro and Macromedia Director. The university uses both diskettes and Lotus Notes to deliver CAI courseware to students. Students' reactions to CAI courseware are generally positive and the university is currently carrying out a survey on the effect of CAI on students' performance. Students in Queensland have access to study centres which have computer facilities. The main constraint is a lack of sufficient access time for students.

Puerto Rico

The University of the Virgin Islands in Puerto Rico runs a distance education programme on a small-scale and has a student population of 2100. CAI forms 5% of the overall instructional media. The university uses CAI for Computer Science and Mathematics. CAI courseware is delivered to students on stand-alone computers. Students' attitudes towards CAI vary widely, but it is generally accepted well. About 10% - 15% of the students have computers at home and the ratio of students to computers at study centres is 20/1. The constraints that the university faces in the development of CAI are lack of funds and quality software.

5.2.2 Data Analysis

Data obtained from the thirteen open-ended questions asked during the first survey were analysed qualitatively. Depending on the nature of the response, either sentences or paragraphs were used as units. Emphasis was mainly on contextual analysis. The responses were further analysed using counts to identify the outcomes which were mentioned by more than one institution. Detailed results of the analysis are shown in Appendix E.

The names and student populations of institutions that participated in the survey are listed in Tables 5.1 and 5.2 respectively. The years in which CAI was introduced in the various institutions appear in Table 5.3.

Question: Which Authoring languages/tools do you use to design Computer-Assisted Instruction courseware?

(Appendix E Table 5.4)

Most of the institutions used more than one authoring tool or language to design CAI courseware. The HTML was the most popular authoring language followed by Lotus Notes and Authorware Pro and Quest. The institutions also used Toolbook, Macromedia Director and computer programming languages such as C and Pascal. Figure 5.1 shows the different CAI languages used.

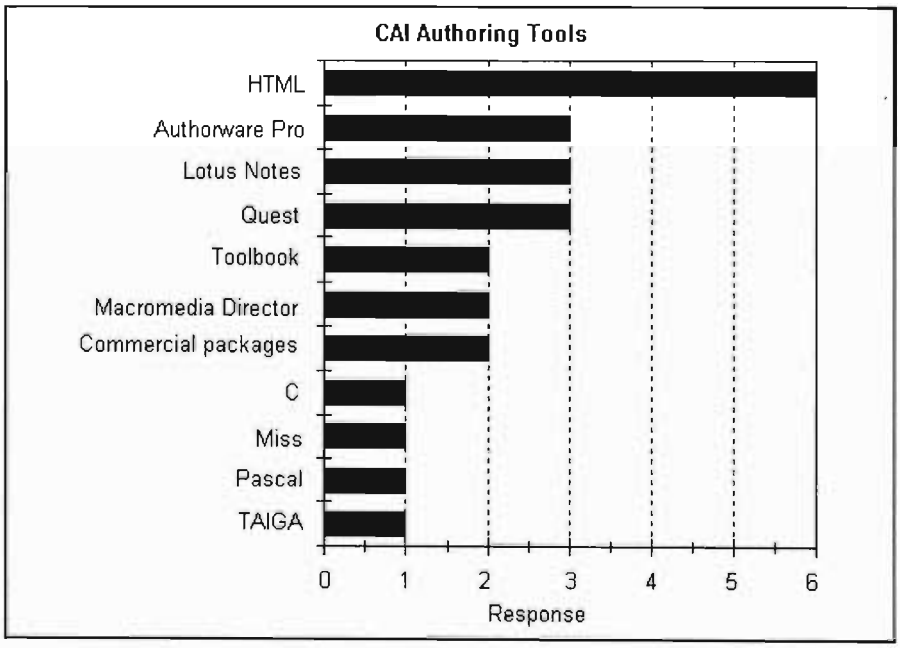

Figure 5.1 CAI tools

On-line CAI is being developed using the HTML of the World-Wide Web and Lotus Notes, though Authorware Pro documents are also being converted to HTML documents. The rest of the CAI tools listed in Figure 5.1 are used for CAI on stand-alone computers.

Question: Is Computer-Assisted Instruction being run on a small, medium or full-scale? (Appendix E, Table 5.5)

Most institutions use CAI on a small-scale in some of their departments. At this level CAI is used to supplement instruction or is used as a primary mode of instruction in only a few subjects or some in aspects of curricula. At medium-scale level 18.8% of the institutions use CAI in about half of the departments to supplement instruction, or as the primary mode of instruction for part of the curricula. At a full-scale level 18.8% of the institutions use CAI as a supplement to other forms of instructional medium in most departments.

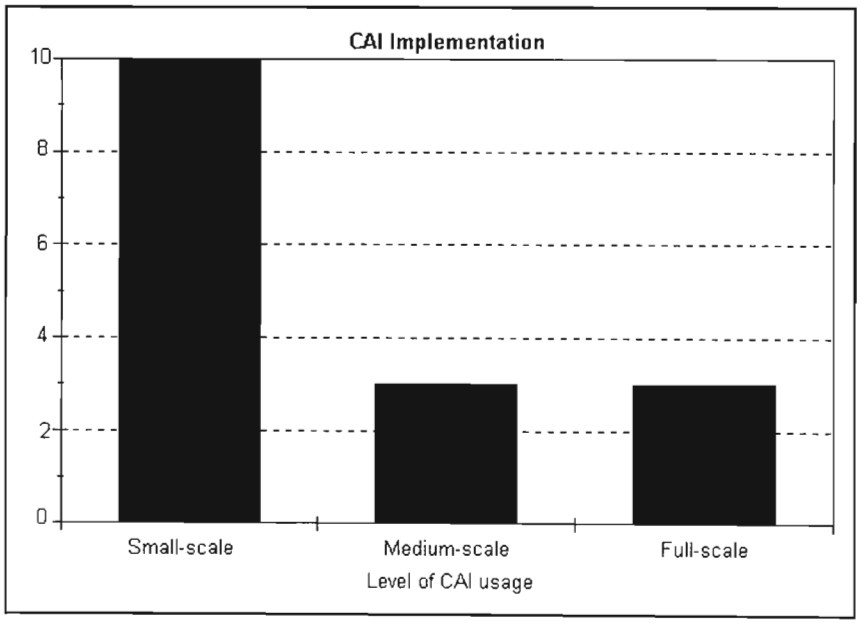

Figure 5.2 Level of CAI implementation

Question: What are the subjects being taught using Computer-Assisted Instruction? (Appendix E, Table 5.6)

The institutions listed various subjects that are being taught using CAI either in primary or adjunct mode, depending on the needs of students.

Question: How do you deliver Computer-Assisted Instruction courseware to students? (Appendix E, Table 5.7)

The institutions surveyed used more than one technology to deliver CAI courseware to students. The most common method of making CAI courseware available to students was by posting them on diskettes, followed by delivery via the World-Wide Web. A few institutions installed the CAI courseware on stand-alone computers at study centres and others used Lotus Notes databases. The delivery of CAI via conferencing systems and ISDN were the least common.

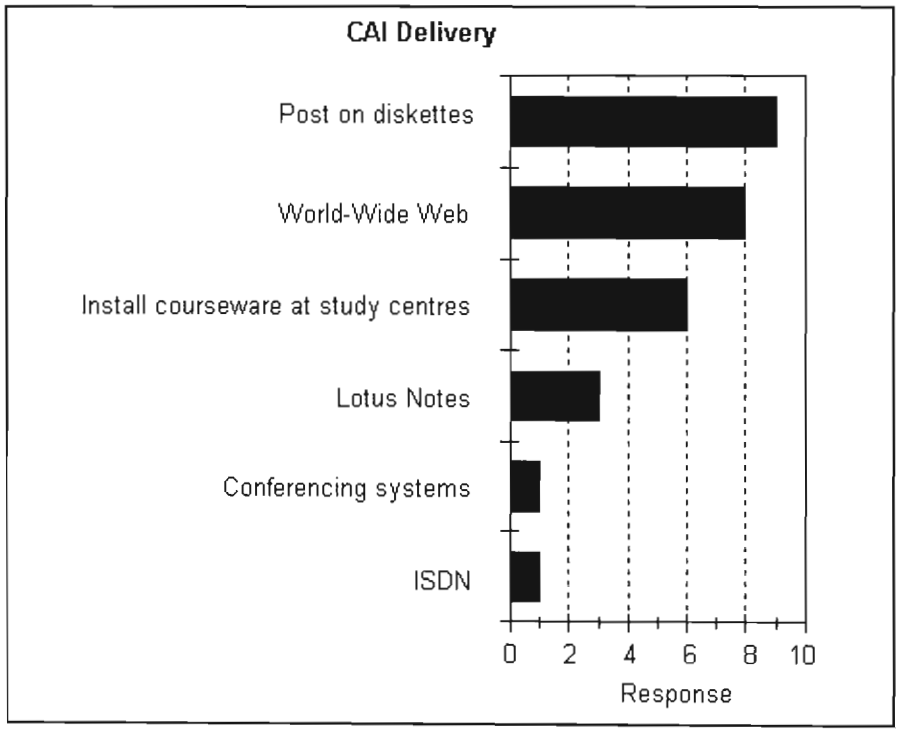

Figure 5.3 Technologies for delivering CAI

Question: To what extent are computers available to students in homes and institution? (Appendix E, Table 5.8)

The degree awarding institutions had more than one option of making CAI available to their students. Most of the institutions had computer laboratories at study centres where students could go and interact with the CAI courseware. Students in some of the institutions had computers at home which they could use for instructional episodes via CAI. Students in a few other institutions accessed CAI courseware via public libraries, community centres and places of work.

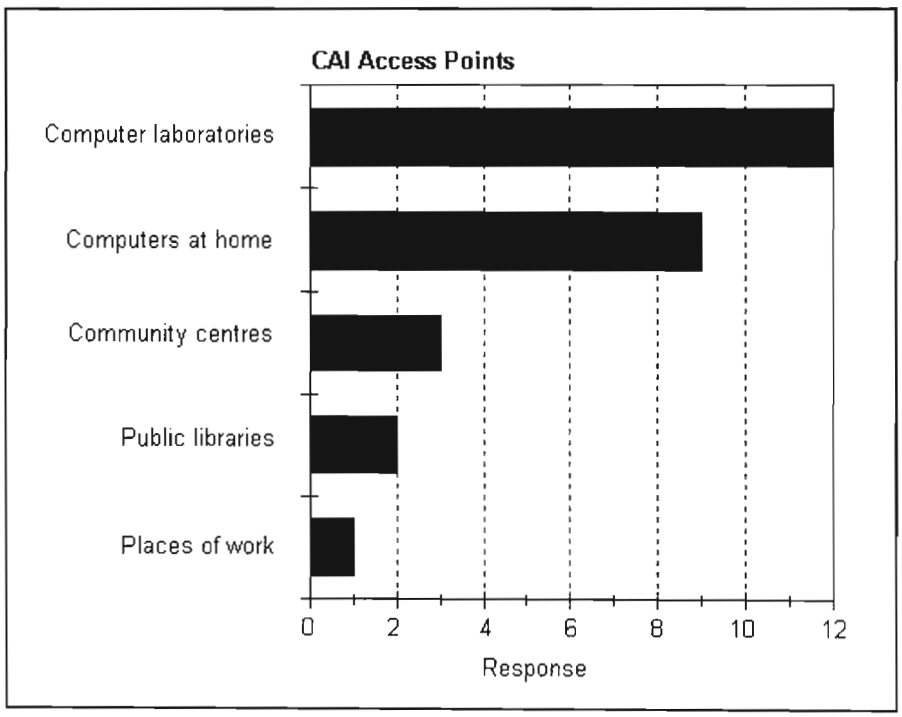

Figure 5.4 Access points

Question: How do students submit assignments?

(Appendix E, Table 5.9)

Submitting assignments on paper was the most popular method, followed by E-Mail. A few institutions used computer diskettes and Lotus Notes databases. Submissions via file transfers and other softwares such as FORUM (a LAN-based package) were the least common methods.

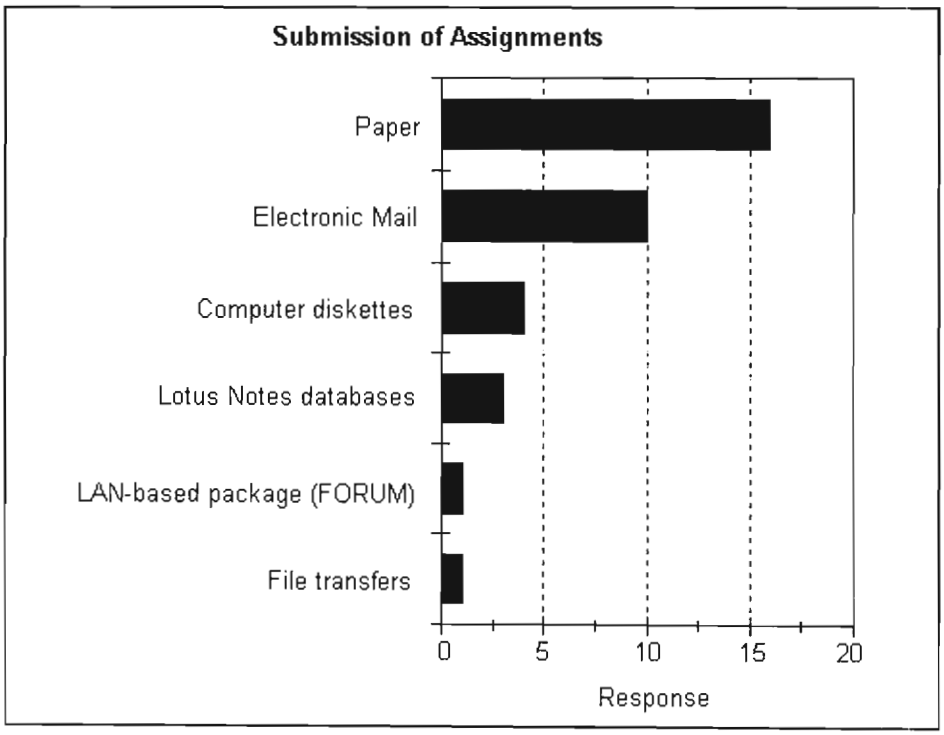

Figure 5.5 Methods for submitting assignments

Question: How do students react to Computer-Assisted Instruction in general (Appendix E, Table 5.10)

In general most students in all the institutions that participated in the survey had a positive attitude towards CAI.

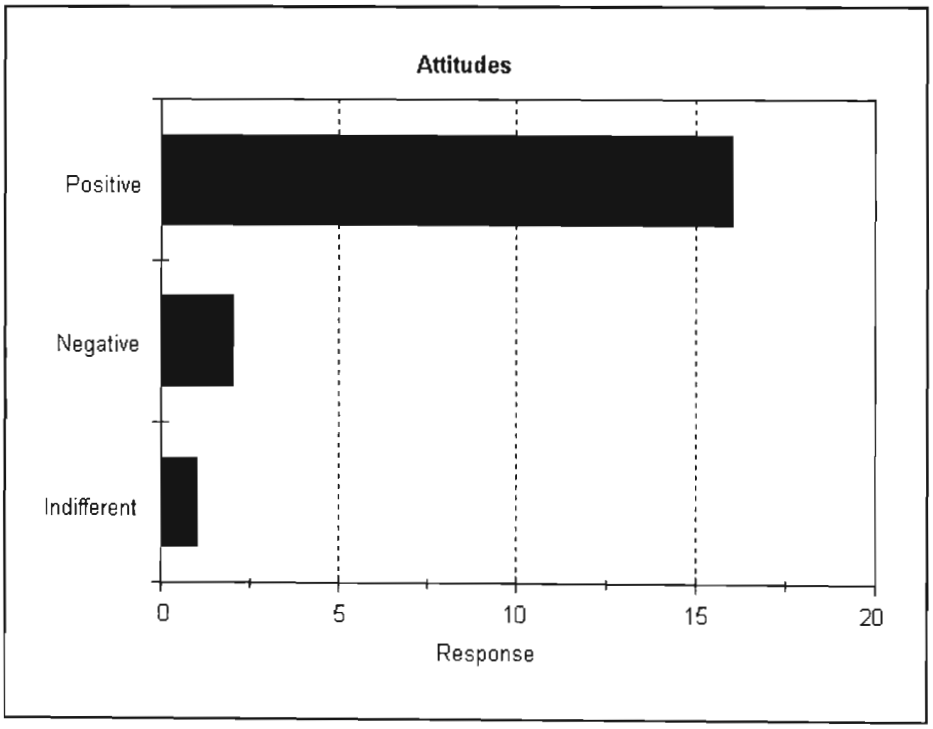

Figure 5.6 Attitudes towards CAI

Question: Do you have any statistics on the effect of Computer-Assisted Instruction on students' performances?

(Appendix E, Table 5.11)

One institution indicated that statistics showed that students' performances had improved since CAI was introduced, while another indicated that from experience they knew that students' performance had improved since CAI was introduced. More than half of the institutions did not have any statistics on the effect of CAI on students' performance and a few others stated that they were still carrying out an evaluation study.

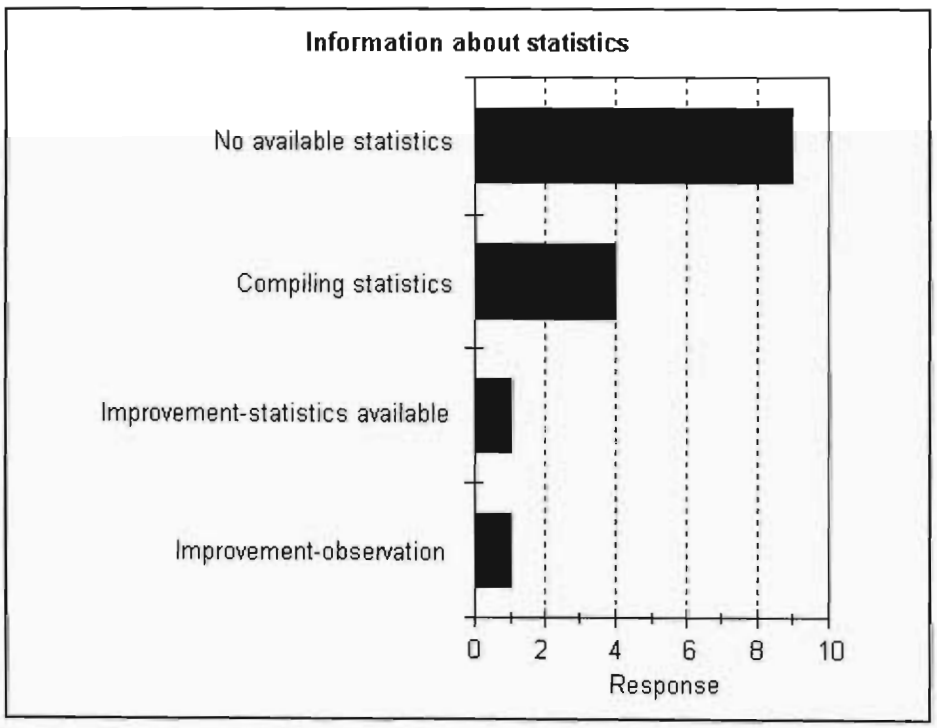

Figure 5.7 Response on performance statistics

Question: What are the constraints that you face in the implementation of Computer-Assisted Instruction?

(Appendix E, Table 5.12)

The institutions that participated in the survey reported many constraints in the development of CAI. The lack of funds was the predominant constraint that hindered institutions. Other constraints were the lack of sufficient hardware for students to perform instructional episodes and also the lack of lecturers' time to devote to the development of CAI courseware. Other institution-specific constraints were also reported.

Question: What are the sources of funds for Computer-Assisted Instruction projects

(Appendix E, Table 5.13)

Grants from educational institutions towards the development CAI projects were the predominant source of funding. A few other institutions used existing institutional resources for CAI development. Other institutions depended on government funds. Most institutions had some sources of external funding.

5.3 Second Survey

A total of fifty-one questionnaires (Appendix C) were mailed to developing countries in Africa, Asia and South America. Forty-five questionnaires were mailed to developed countries. The questionnaires were mailed with a covering letter stating the purpose of the survey and requesting their participation. The questionnaires were sent to heads, principals, lecturers, coordinators and registrars who are directly involved with distance education in the various degree awarding institutions surveyed. Of the fifty-one questionnaires sent to the degree awarding institutions with a distance education option in the developing countries, only seven (13.7%) were returned. Twenty-four (53%) of the 45 questionnaires were returned from the developed countries. Nine of the degree awarding institutions in the developed countries that participated in the first survey also

took part in the second survey. An attempt was made to follow up on those who did not respond, but it was not successful.

The questions used in the second survey were designed to elicit data about how degree awarding distance education institutions in both developed and developing countries were changing the face of instruction and communication. The findings of the first survey such as the different CAI tools, delivery methods, technologies and facilities available to students using CAI courseware, were used to formulate questions for the second survey. The purpose of the questions was to find out how different technologies are being used alongside traditional instructional media, and the communication technologies that are being used to close the gap in terms of time and distance.

5.3.1 Data Collection

The institutions in developed countries that participated in the second survey were located in United Kingdom (1), Australia (3), Canada (4), Netherlands (1), United States of America (15). Degree awarding institutions in developing countries that participated in this survey were located in Malaysia (1), Thailand (1), India (1), Argentina (1), Israel (1), Namibia (1) and Pakistan (1).

5.3.1.1 Developed Countries

United Kingdom

The Open University has distance education students from Britain and around the world who can enroll to study selected undergraduate and postgraduate courses. On-line CAI is being used to teach some undergraduate and postgraduate courses via the World-Wide Web and Lotus Notes. There are two computing courses with tutorial support available on the Internet to students anywhere in the world. The courses are Fundamentals of Computing and Programming of Computer Languages. These courses can be studied using a range of hardware and software, with a minimum specification of a personal computer running

under DOS. Students who do not have Web browsers can use other instructional media and participate in tutorial discussions via conferencing systems, but they must at the very least have facilities to send and receive E-Mail. There are other courses that are being taught via printed course books, television programmes (which are supplied on video cassettes), audio cassette tapes and CAI on diskettes. Some of the forms of communication used are via connections to the Internet such as IRC, BBS and Listservs.

Australia

The University of Wollongong offers distance education in some undergraduate and postgraduate degree courses using the World-Wide Web and Lotus Notes. Listservs, IRC E-Mail, MOOs and BBS are used for communication and tutorial support. Distance education students can connect to their host universities using a services provider or by dialing the university directly. The Australian Telecom provides students with an AUSPAC account where they pay a fixed fee, regardless of where they are located. The Federal Government has announced a service called Open Net which has several aspects - one is the establishment of Local Access Points and Terminal Access Points in schools, community centres, shopping malls, libraries and colleges. Distance education students who do not have computers or modems are able to access their university servers from access points for a nominal fee. Another initiative of the Australian Government is the establishment of a network called EDNA which stands for Education Network Australia. The purpose of this network is for all educational institutions to eventually be on-line to the Internet. Schools are already being equipped with computers and links to the Internet.

Central Queens University is using computer technology to deliver a considerable amount of primary instruction to access points. The World-Wide-Web and Lotus Notes are being used for some degree courses through distance education at both undergraduate and postgraduate levels. The courses are Business Administration, Computer Science and Chemistry. The percentage usage of the World-Wide Web and Lotus Notes for instruction

varies in the various courses. E-Mail, IRC, Listserv, postal mail and telephone are used for communication, with usage varying according to the communication needs of students.

Deakin University offers on-campus and distance education degree courses in Humanities, Education, Management, Law, Psychology, Engineering and Social Sciences. These courses can be studied at both undergraduate and postgraduate levels. CAI is used as a supplement to printed text, audio cassette and video tapes in some courses. Some CAI courseware is also available via Lotus Notes databases and the World-Wide Web. Communication is via Computer-Mediated Communication using a range of network tools. Students have the option to use E-Mail, Listserv and Computer Conferencing Systems although some students and staff still communicate through telephones and postal mail. Deakin has a sophisticated menuing system that offers all of these technologies and access to library catalogue services, library book ordering facilities, on-line CD-ROM servers, as well as to specific information services. The menuing system has the ability to check a user's version of software and automatically upgrades the software if new versions are released.

Canada

Memorial University of Newfoundland has a credit course in Biology available on the World-Wide Web. Certain sections of the course are taught using other instructional media. There is one course in Education at postgraduate level which is taught using CAI on diskettes. Communication between lecturers and students is via Listservs, E-Mail, telephone and postal mail. For the the past few years, students have been given the option of using E-Mail for interaction but only about 10% have taken advantage of this. The provincial network has no connection charges for students. The main problem for students is lack of equipment in rural Newfoundland; most of them do not have computers and modems at home.

Assiniboine Community College uses instructional media such as print, audio conferencing and interactive television. Authorware Pro documents have been converted to HTML documents for World-Wide Web access. Students and teachers communicate using E-Mail, BBS and Listservs in different learning situations.

University of Manitoba offers some courses through the World-Wide Web which are available to students at study centres and through dail-up access using a modem. Communication between students and teachers on a one-to-one basis is via E-Mail. Audio-graphic conferencing and Listservs are used for group discussions and for one-to-many communication.

Simon Fraser University offers distance education courses in Biological sciences, Business Administration, Computer Science, Mathematics, Psychology and Statistics. There is CAI courseware that can be accessed on World-Wide Web and CD-ROMs. Some forms of instruction are via printed materials, audio cassettes and video cassettes. Access to a microcomputer and a modem are required for communication which uses Listservs and E-Mail.

<u>*Netherlands*</u>

The Open University of the Netherlands offers undergraduate and postgraduate courses in economics using the World-Wide Web in both primary and adjunct mode. Students interact with their peers and teachers using E-Mail and BBS on the World-Wide Web. The Open University of the Netherlands has a computer network facility that is used for students' guidance and for providing information to students. The network has a study tracking system that enables the students to keep track of how they are progressing as well as having facilities for submitting assignments and receiving feedback on them. The network facility enables students to interact with peers in group discussions and on a one-to-one basis.

United States of America

The Indiana University, Bloomington offers credit postgraduate and undergraduate courses using the World-Wide Web, Integrated Services Digital Network and Lotus Notes. Students are normally given introductory lessons on how to use E-Mail, World-Wide Web, Listserv techniques, IRC, BBS and MOOs at a basic level. Courses are broken down into units and students complete a series of tasks using these technologies before beginning the course units. Normally pre-units are done a week before students start the lessons so that they can work out the problems with their own systems before encountering class materials. Assignments are turned in and returned through E-Mail or by filling in forms on the World-Wide Web. Students are given E-Mail account on the university's network as well as graphical browsers to enable them to access courses. At a distance, students need service providers through whom they can Telnet into the university servers.

The City University in Washington offers an MBA degree through distance education. The university serves more than 14,000 students via the World-Wide Web in their distance education programme. Courses taught on-line are 11 core MBA courses on the World Wide Web, 6 courses for both BS and BA degree programmes and 2 computer courses. There are other instructional media that are used such as printed text, audio cassettes and video tapes. Students communicate with peers and teachers using E-Mail. There is also a graphical BBS that allows real time communication while telephones, fax and postal mail supplement these communication modes. Students feel more connected to each other and the teacher through CMC. There is also a substantial increase in the efficiency of passing information between students and teachers. Students who register for courses have to find a local service provider that has Internet connections and offers Telneting to the university's local BBS. Students can download assignments to their teacher and also have BBS communication (questions and answers) as part of their course assignments.

Sycrause University offers distance education courses in Education, Science, Arts and Mathematics at both undergraduate and postgraduate levels. The University has facilities for group discussions via MOOs and Listservs. Some students do not engage in interactions over the CMC systems, hence the role of the facilitator in the learning process is constantly being tested and pushed. Students are encouraged to find educational resources over the Internet for research using the university's virtual reality library. Assignments are submitted over the Internet using File Transfers or E-Mail, but some students use postal mail.

The Virtual College in New York delivers distance education to students at home. The college has four credit graduate courses. Students and their teachers collaborate on-line to analyse, design and build "corporate cyberspaces" for case study organisations. Instructional and communication media include video conferencing, satellite and interactive television. Students have access to on-line databases and library search services. Interactions are via Computer Conferencing and E-Mail. On-line laboratories provide access to simulation and applications software.

Cerritos Community College is a fully accredited community college that offers Bachelors degrees in Humanities via the World-Wide Web. Introductory lessons on the use of Internet tools are held as soon as a student enrolls for a course. Interactions are via BBS and E-Mail. The content of on-line courses is just the same as on-campus lessons.

Webster University offers distance education Liberal Arts courses by way of the Internet. Courses are taught exclusively on the Internet and all materials used are delivered via the Internet. Commentaries and responses to student's writings are posted to the classes via E-Mail. Some of the students' writings are posted on various appropriate newsgroups and responses are normally both from members of the class and non-members as well. Interactive lessons on the World-Wide Web are supplemented with regular class meetings

using MOOs and these meetings are mandatory. Students require full, interactive Internet access, and must have access to E-Mail, news groups, File Transfer Protocol and the World-Wide Web. Most of the courses are run on time guidelines that allow the student to maximize his or her own time choices as long as a general deadline is met.

State University New York uses Lotus Notes to deliver Clinical Psychology at postgraduate level. CAI is used as the main mode of instruction. Communication between students and teachers is via E-Mail and BBS.

Texas A.M. University offers some degree courses at postgraduate level using FORUM, a LAN-based system. Neuroscience is taught using CAI. Students attend a regular lecture each week, and the rest of the week is spent learning via CAI courseware. Interactions are done using E-Mail and FORUM.

Athena University is a comprehensive, fully on-line university offering degrees via an interactive, electronic campus based on the MOO and the World-Wide Web which is accessible to everyone on the Internet. Orientation courses on how to use the World-Wide Web and MOOs effectively in a virtual environment are held once a student has enrolled. Most learning materials are exchanged electronically. Athena University maintains an office of students' services to aid the student in finding his or her way around an environment that may be very foreign.

Antioch University is a national university that offers distance education programmes in the four state areas of Washington, Oregon, Montana and Idaho. The university offers on-line courses on the World-Wide Web at undergraduate and graduate levels. The only pre-requisite to the courses is that participants must have a computer at their disposal with World-Web Web access. Interactions are done through the BBS on the World-Wide Web, E-Mail and MOOs. Despite the on-line nature of the courses, some correspondence is by

postal mail and fax.

University of Florida has 57 courses available through E-Mail. Some of the courses are available through the World-Wide Web as well. Audio cassettes and video tapes are used to supplement instruction in some courses. The university has a Department of Independent Study that allocates students E-Mail accounts as soon as they have officially registered for their courses. There are computer laboratories at many locations for students who do not have their own computers. Students can also call at local libraries, schools and local business organisations to use their E-Mail facilities to enter lesson responses. It is the responsibility of the student who cannot use any of the access points to find a computer with a modem in order to register for any of the courses. Students submit their assignments through E-Mail. Communication is currently via E-Mail and Listservs.

Oregon State University offers two distance education degree courses in Physics and Philosophy using the World-Wide Web. Students require access to a Web browser to have lessons on-line. Communication between students and teachers is via E-Mail, Listservs and Fax. The university also provides access for students to these on-line courses from computer laboratories at study centres. Some students have their own computers at home.

Rogers State College (RSC) is a state supported community college. RSC has offered distance education since 1985, initially through television broadcast, and most recently based on interactive television and wide-area computer services support. A typical distance education paradigm used at RSC includes presentations on broadcast, cable, or video tape; printed text; and CAI on diskettes given to students. CAI courseware is now delivered using CD-ROMs and the World-Wide Web. Tutorial support and communication are via E-Mail and BBS on the World-Wide Web. RSC currently has four degree programmes which are established using this paradigm: Business, Computer Science, Humanities and Liberal arts.

University of Phoenix offers on-line courses in Law, Computer Science, Economics, Accounting and Business Administration through distance education. Through a Computer Conferencing System electronic classrooms have been created in which students who have access to a personal computer equipped with a modem are able to engage in interactive exchanges with their teacher and peers regardless of location or time. Before each week of class begins, the teacher submits a lecture and reviews the assignments for the upcoming week. Throughout the week the teacher is involved with interaction and feedback on-line with students in both one-to-one and one-to-many mode, depending on the learning needs of the students.

California State University offers degree courses in History, Literature, Philosophy, Music and Art through distance education. Students are given the option of taking the courses through periodic meetings with their teachers or taking selected courses by the World-Wide Web, E-Mail and Computer Conferencing. Students with access to a personal computer and modem or other telecommunications linking devices may use the system to contact their teachers or peers. Students interact and exchange ideas using BBS Services and IRC as well.

5.3.1.2 Developing Countries

Malaysia

Universiti Pertanian is a distance education university in Malaysia. The University offers undergraduate degrees in Computer Science through the Internet, known as the Malaysian Jaring (a local name for the network). When a student registers for a Computer Science course, he or she is provided with a password to access Computer Science courseware using Netscape. Universiti Pertanian utilises instructional media such as radio broadcasts, audio cassettes and printed text. Interactions and feedback between students and teachers are by E-Mail, postal mail, and face-to-face meetings.

Thailand

Sukhothai Thammathirat Open University is a distance education university in Thailand which offers some undergraduate courses in Humanities and Computer Science using the World-Wide Web. Adjunct CAI on stand-alone computers is used in courses that have low student pass rates. There are courses which are still being run using radio broadcasts, audio cassettes and printed text. Students use E-Mail, telephone, postal mail and weekend sessions for interactions and feedback.

India

Indira Ghandi National Open University is a distance education university. All CAI courseware is available at study centres but some students have their own computers at home. The CAI courseware is used for degree courses in Computer Science, Business Administration, Engineering and Construction Management. The University has plans for putting some of the courses on-line using the World-Wide Web in the near future. There are courses which are still being run using media such as radio broadcasts, audio cassettes and printed text. Tutorial support is provided by the university through weekend sessions and periodic meetings.

Argentina

Instituto Universitario Aeronautico is a distance education university. The university uses CAI courseware to supplement some of its instructional media. CAI courseware is available on stand-alone computers for Engineering and Science students at study centres and those who cannot travel to these centres use computers at home. Tutorial support is offered through postal mail, personal contacts, Fax and E-Mail.

Israel

The Open University of Israel is mainly a distance education university. The university is using the World-Wide Web and Integrated Services Digital Network to deliver CAI

courseware to distance education students in Computer Science and Human Resources. The university also utilises printed text, television broadcast and satellite transmissions. The university lends computers to students and there are also computers at study centres. Students interact with peers and teachers using postal mail, personal contacts and E-Mail.

Namibia

University of Namibia has a centre for distance education which offers degree courses in Music, Physical Education, Education, Speech and Drama. All students receive correspondence materials as well as student support through the use of radio, audio cassettes and organised face-to-face tutoring. Printed text forms 80% of the overall instructional media, telephone 5% and vacation schools 15%. Assignments are presented personally and also by post. More regional centres are being developed to facilitate tutor and peer face-to-face supports for students.

Pakistan

The Allama Iqbal Open University in Pakistan is a distance education university which consists of three faculties: the Faculty of Basic and Applied Sciences, the Faculty of Social Science and Humanities, and the Faculty of Education. The university does not use any form of CAI for instruction. The instructional media used by the university includes printed text, radio and television broadcasts, video tapes, slides, audio cassettes and periodic workshops. Interactions are done through postal mail, personal visits and telephone.

5.3.2 Data Analysis

The data obtained from the second survey were analysed quantitatively to ascertain the implementation practises of computer technology in degree awarding distance education institutions in the developed and developing countries. The responses received from the developing countries were low, despite the second reminder with questionnaires. The poor

response reduced the sample size. This makes the determination of the statistical significance between the developed and developing countries impossible.

The poor response from the developing countries could be attributed factors such as:

(a) Unreliable postal systems, thus some of the questionnaires never got to their destinations.

(b) Most of the degree awarding institutions from the developing countries use traditional instructional and communication media (Table 5.17 in Appendix E, and Appendix H) hence the survey might not have been relevant to them.

An effort was made to find out the type of instructional and communication media used by the institutions that did not respond from the ICDL database at the Open University, United Kingdom. The information obtained appears as Appendix H.

The study will discuss the differences in implementation practises of CAI and CMC in developed and developing countries using graphical bar charts. Detailed results are tabulated in Appendix F.

The names of the degree awarding institutions with a distance education option that participated in the survey in both developed and developing countries appear in Table 5.14 in Appendix F. The type of higher education (distance education, conventional or both) offered by the institutions is shown in Table 5.15 The student population of the various institutions is listed in Table 5.16.

Question: What type of media do you use to deliver lessons to your students? (Appendix F, Table 5.17)

The institutions in the developed countries used more than one instructional medium. All the institutions in the developed countries that participated in the survey used CAI as one of their instructional media. Printed text was also popular among the institutions and audio cassettes were used by more than half of the institutions. In general the institutions used other instructional media as well. In the developing countries, printed text and audio cassettes were the most popular (100%) instructional media in the institutions, followed by CAI. Some institutions used television and radio broadcast as well as weekend and vacation sessions.

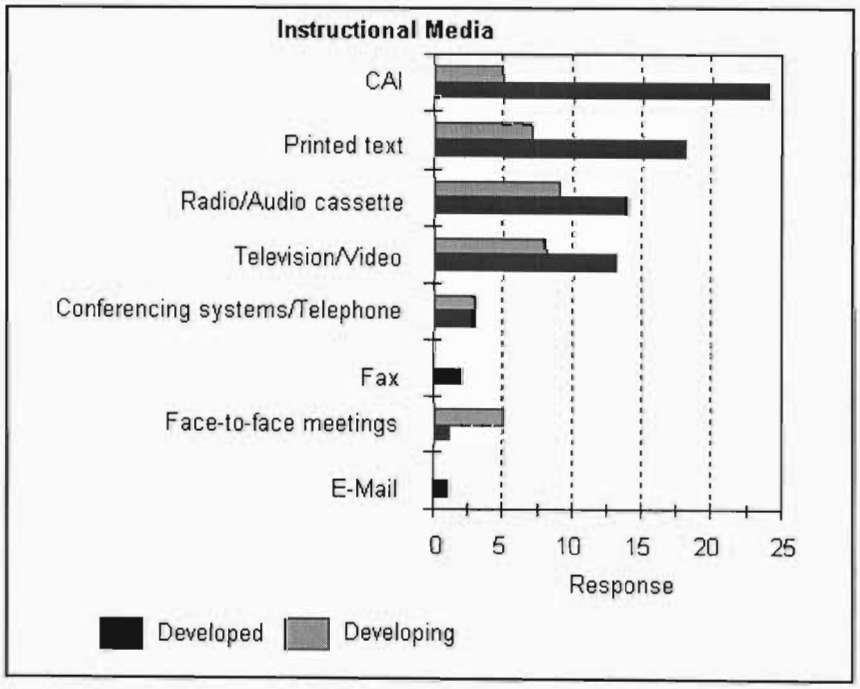

Figure 5.8 Technologies and methods used for instruction delivery

Question: What percentages do these media form of the overall teaching media you use? (Appendix F, Table 5.18)

In developed countries, all the institutions used CAI for amounts ranging from 5% to 80%. Printed text is used in most institutions ranging from 30% to 80%, while radio and audio cassette were used between 40% to 60%. Television broadcast and video cassette were used up to 40% by some institutions, while others used conferencing systems and telephone up to 20%. Face-to-face meetings were used up to 20%, and E-Mail was used between 70% and 80% by one institution. Fax was used for less than 5% of instruction by one institution.

In the developing countries the predominant medium is printed text which is used in all institutions for 70% to 100% of instruction. Radio and audio cassette were used up to 40%, while television broadcast and video cassette were used up to 40% in most institutions. Conferencing systems and telephone were used up to 20% by some institutions, and face-to-face meetings were used up to 40% by others.

Question: How do students submit assignments?

(Appendix F, Table 5.19)

Students in some institutions in the developed countries had more than one method of submitting assignments. The most popular method was via E-Mail followed by postal mail. Submission of assignments on computer diskettes was a method used in half of the institutions. File transfers were used in other institutions.

In the developing countries the most popular methods of submitting assignments were via postal mail and in person. E-Mail was used by a few institutions.

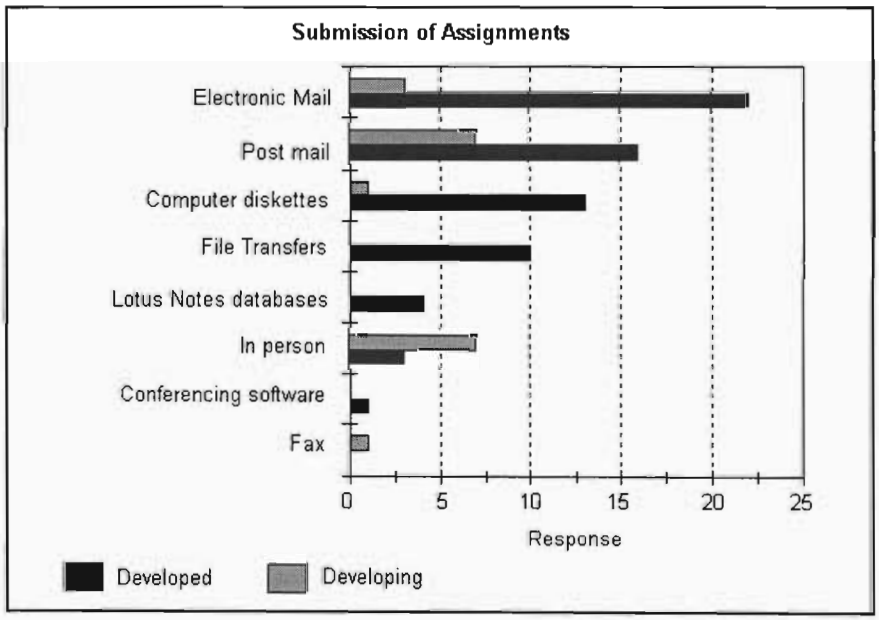

Figure 5.9 Submission of assignments in developed and developing countries

Question: If you do not use computers as a teaching medium in your school then provide the following information. What are some of the hindering factors?
(Appendix F, Table 5.20)
None of the institutions in the developed countries answered this question but institutions from the developing countries stated that lack of funds, lack of computer hardware and software were the common drawbacks to the use of computers for instructional episodes.

Question: If you are using computers as a teaching medium, do you have Computer-Assisted Instruction courseware?
(Appendix F, Table 5.21)
All twenty-four institutions from the developed countries that participated in the survey have CAI courseware for either primary and adjunct instruction. Most of the institutions that participated in the survey from the developing countries also used CAI as one of their instructional media, but in adjunct mode.

Question: If YES, why did you introduce Computer-Assisted Instruction courseware?
(Appendix F, Table 5.22)
The institutions in the developed countries introduced CAI for various reasons. The most popular reason was to make some aspects of instruction effective for their distance education students. Some institutions introduced CAI to help their students develop critical thinking during instructional episodes while others hoped to provide their students the opportunity to interact with lesson materials in the absence of the teacher.

Institutions in developing countries introduced CAI to facilitate drill and practice during and after instructional episodes, and to improve students' performance. Providing feedback to students in the absence of the teacher was another reason for introducing CAI.

Question: What is your opinion on the effectiveness of Computer-Assisted Instruction as an instructional medium?

(Appendix F, Table 5.23)

Institutions from the developed countries were of the opinion that CAI improves learning in some courses, is the same as face-to-face instruction in some courses and can change learners' attitudes towards computers. Institutions from the developing countries were of the opinion that CAI can change learners' attitudes towards computers, improve learning in some courses, and also reduce learning time in some courses.

Question: In what mode (primary or adjunct) is Computer-Assisted Instruction being used in your institution?

(Appendix F, Table 5.24)

More institutions in developed countries used CAI as the primary mode of instruction. In some institutions both primary and adjunct CAI are used. In the developing countries adjunct CAI was more common.

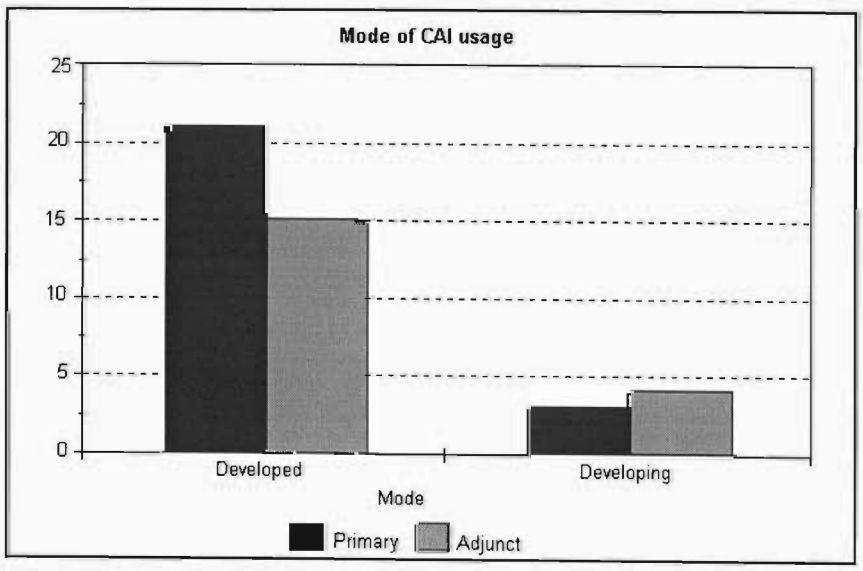

Figure 5.10 Mode of CAI usage

Question: How do you deliver Computer-Assisted Instruction courseware to students (Appendix F, Table 5.25)

The institutions had a wide variety of methods of delivering CAI courseware to students. The World-Wide Web was predominant, followed by supplying CAI on diskettes or at study centres for students to use on stand-alone computers. Making CAI courseware available via Lotus Notes databases or on CD-ROMs and CD-ROM servers was also used. In the developing countries the most common method was installing CAI on stand-alone computers at study centres, followed by making CAI available via the World-Wide Web.

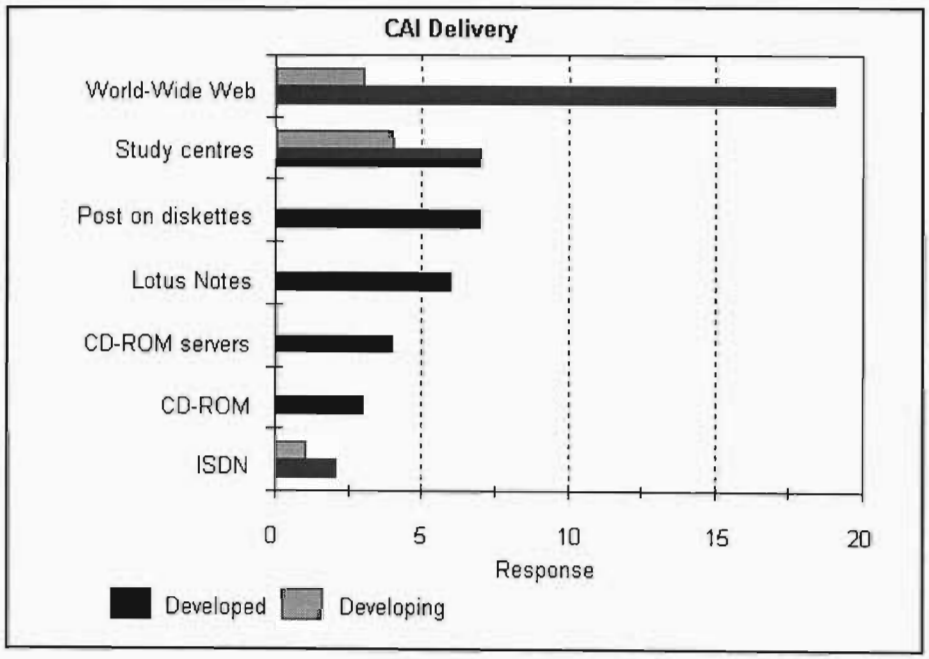

Figure 5.11 Technologies and methods for delivering CAI

This confirms some of the technologies mentioned in the first survey. In addition to these, CD-ROMs and CD-ROM servers were used by some institutions in the developed countries.

Question: At what level (postgraduate or undergraduate) do you use Computer-Assisted Instruction via the World-Wide Web, Integrated Services Digital Network and Lotus Notes? (Appendix F, Table 5.26)

In both developed and developing countries, the use of CAI via these technologies was higher at undergraduate than postgraduate level.

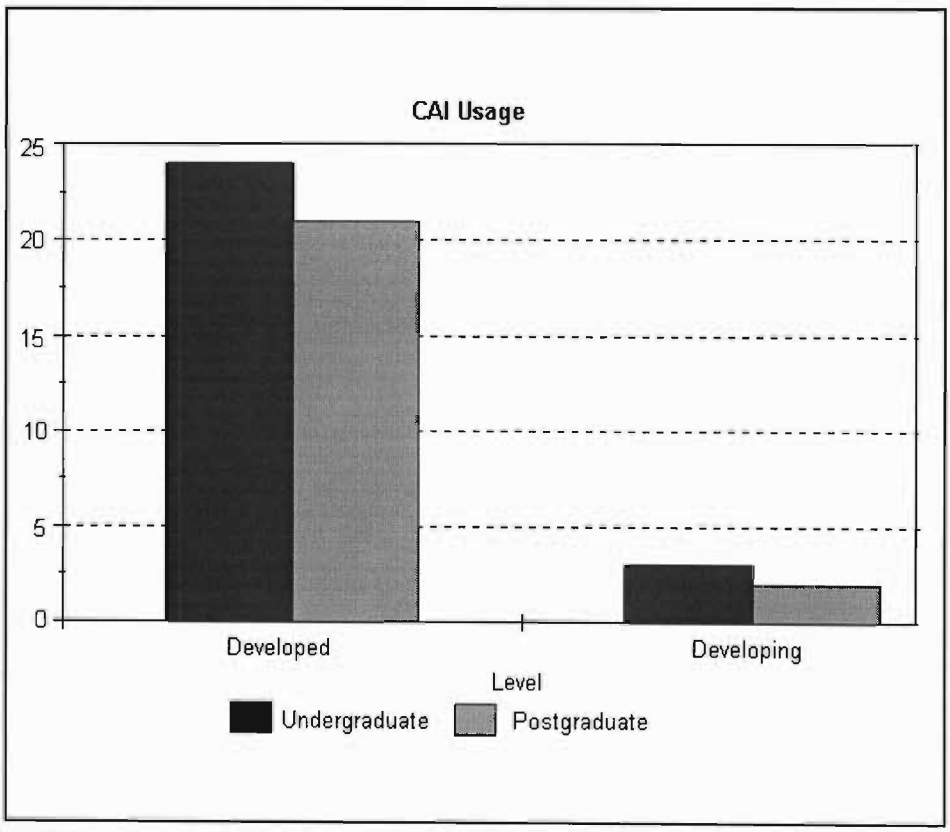

Figure 5.12 Level at which CAI is used

Question: What type of communication technology do students and teachers use for interaction and feedback in your institution?

(Appendix F, Table 5.27)

In developed countries the most common means of communication among students and with their teachers was E-Mail. Postal mail and telephone were the next common media of communication though more than half of the institutions utilised Bulletin Board Services and Listservs as well. Others used IRC, MOOs and computer conferencing systems. In developing countries the most common methods of communication were personal visits, postal mail and telephone. Some institutions utilised E-Mail for interaction and feedback.

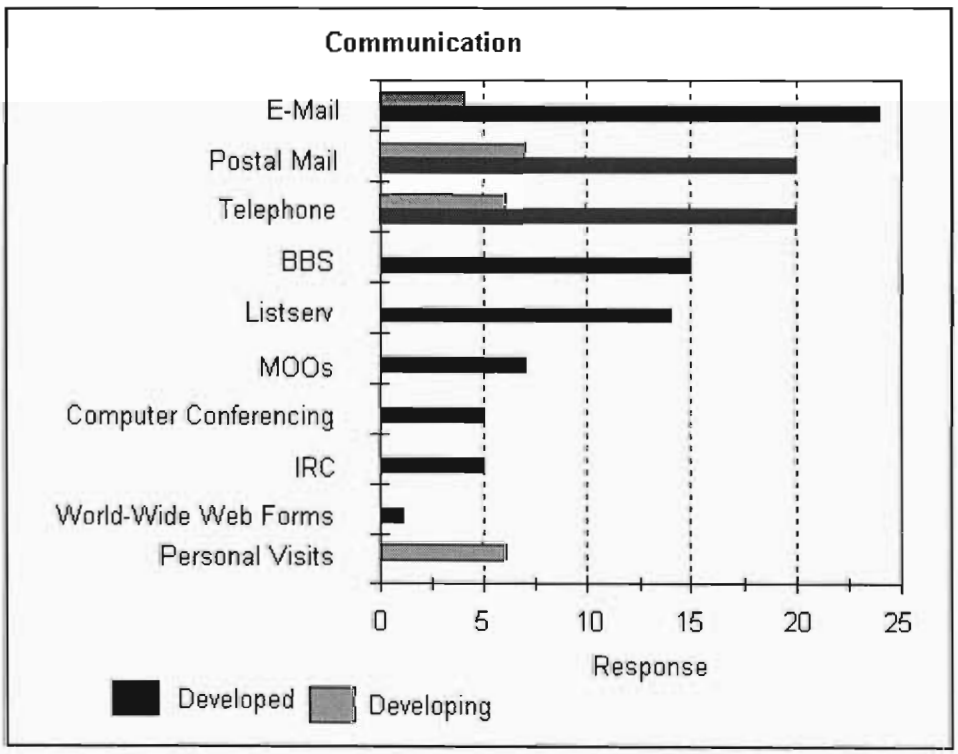

Figure 5.13 Communication technologies and methods

Most institutions used more than one communication channel or method. The developed countries used different types of electronic messaging but still utilised postal mail and telephone for interaction and feedback as compared to institutions in the developing countries that depended on postal mail, telephones and personal visits. The only form of electronic messaging available in the developing countries is E-Mail which is accessible to some students.

Question: Do students buy their own computers?
(Appendix F, Table 5.28)
Most students in the institutions from the developed countries provide their own computers, while in developing countries' responses were evenly divided between students having their own computers and the institution providing computers.

Question: Do you have computer centres for your distance education students?
(Appendix F, Table 5.29)
Most institutions in both the developed and developing countries provide computer centres for their distance education students.

Question: What percentage of the students have experience with computers?
(Appendix F, Table 5.30)
The percentage of students that have experience in using computers in the institutions from the developed countries ranged from 30% to 80% while in the developing countries the range is from 30% to 60%.

Question: Which subjects do you teach using Computer-Assisted Instruction courseware?
(Appendix F, Table 5.31)
In the institutions from the developed countries the most popular subject that was taught using CAI courseware was Computer Science followed by Mathematics. In general, a

wider range of subjects were taught using CAI courseware. In the developing countries, teaching Computer Science using CAI courseware was the most popular.

Question: Has there been any improvement in students' performance since you introduced Computer-Assisted Instruction courseware?
(Appendix F, Table 5.32)
Most of the institutions from the developed countries stated that there has been improvement in students' performance since CAI was introduced but one institution indicated that there has not been any significant progress. Most institutions in the developing countries stated that the performance of their students have improved since CAI was introduced.

Question: What was the dropout rate in these subjects before you introduced Computer-Assisted Instruction?
(Appendix F, Table 5.33)
Half of the institutions from the developed countries were not sure of the dropout rate in subjects before CAI was introduced. A few institutions stated the dropout rate was low, less than five percent. In the developing countries, most institutions that use CAI were also not sure of the dropout rate in the subjects for which CAI was introduced.

Question: What was the dropout rate after Computer-Assisted Instruction courseware was introduced?
(Appendix F, Table 5.34)
About half of the institutions stated that no evaluation has been done yet and some also stated that evaluation was in progress. The institutions from the developing countries have not done any evaluation on students' performance since CAI was introduced.

Question: How do your students react to Computer-Assisted Instruction in general? (Appendix F, Table 5.35)

Students' attitude towards CAI was generally positive in both developed and developing countries.

5.4 Third Survey

A third survey was carried out using the questionnaire in Appendix C. Degree awarding institutions in South African with a distance education option or contemplating distance education were selected for this survey. The purpose of the survey was to find out how they intend to implement on-line CAI and CMC for instruction and communication in their institutions. The questions used in this survey were based on the findings of the first and second surveys in terms of instructional and communication technologies, constraints such as lack of funds, and the high number of man-hours in CAI development.

Six (54.5%) of the eleven institutions contacted responded to the survey. Three of the institutions that responded to the survey are offering distance education and the other three are contemplating it in the near future.

Follow-up questionnaires were sent to these institutions that did not respond, but no additional replies were obtained. In particular there was no response from the Technikons which could be attributed to the fact that they have just begun offering degree courses, some via distance education.

5.4.1 Data Collection

University of Cape Town does not offer distance education programmes at present but there are plans to do so in the near future. The distance education courses will be at postgraduate level using the World-Wide Web. The university has a model of an interactive lesson on their World-Wide Web home-page. Tutorial support will be provided

using E-Mail and BBS on the World-Wide Web. Many departments in the University of Cape Town have CAI courseware on stand-alone computers (listed in Table 3.1 in Appendix A). The University has full Internet access that can be used to implement on-line CAI and CMC projects provided students have access.

Rand Afrikaans University offers degree courses through distance education. Presently the University does not use on-line CAI for instructional episodes but has plans to offer postgraduate courses using the World-Wide Web and ISDN. Tutorial support will be provided using E-mail as well as face-to-face meetings. They would like to collaborate with other South African degree awarding institutions to share the costs of implementation.

University of South Africa offers degree courses via distance education. The university uses CAI for instructional episodes in some Computer Science courses (Figure 2.1 in Chapter 2). The university is carrying out short and long term contract research and development projects on CAI. Presently UNISA runs a database on the World-Wide Web as well as an on-line tutoring lesson, "User guide on how to use the Internet". The university has plans to offer some distance education courses to both undergraduate and postgraduate students using the World-Wide Web. Tutorial support will be provided using study centres, E-Mail and BBS on the World-Wide Web.

University of Fort Hare does not offer distance education but it is contemplating the option in the near future. The university would collaborate with other South African universities in this venture. Tutorial support will be provided using E-Mail, postal mail, telephones and periodic meetings. Lack of funds and personnel are some of the factors that might hinder the implementation of these technologies.

Vista University is currently offering degrees via distance education but does not use CAI as one of its instructional media. The University has no plans to offer distance education to either undergraduate or postgraduate courses using the World-Wide Web or ISDN but it has full Internet access. The university's study centres are used for periodic meetings such as seminars and weekend sessions.

University of Natal does not offer degree courses via distance education at present but is contemplating introducing such a programme in 1997. Most of the instructional material would be print-based, though the university has full Internet access and plans to offer some distance education courses using the World-Wide Web in future. It is not certain yet of the level (undergraduate or postgraduate) at which this type of instruction might take place. Tutorial support will be provided using study centres, E-Mail, postal mail, telephone and periodic residential sessions.

5.4.2 Data Analysis

Question: What is the mode of interaction between your students, and their instructors/teachers/facilitators at a distance?

(Appendix G, Table 5.36)

All the institutions that offer distance education at present use postal mail and telephones for interactions between students and teachers. Two distance education institutions have begun using E-Mail as well.

Question: What percentage of your students have access to Electronic Mail?

(Appendix G, Table 5.37)

Two of the distance education universities stated that 10% - 20% of their students have access to E-Mail which is not provided by the universities.

Question: Does your institution use Computer-Assisted Instruction courseware to teach your students at a distance?

(Appendix G, Table 5.38)

CAI is used by one distance education institutions for teaching students. The rest do not utilise the medium.

Question: Does your institution have the resources to deliver Computer-Assisted Instruction using any of the following: Lotus Notes, World-Wide Web, Integrated Services Digital Network?

(Appendix G, Table 5.39)

Some of the distance education institutions and the institutions contemplating distance education have the resources to use the World-Wide Web and ISDN to deliver CAI.

Question: Do you intend to use the World-Wide Web, Integrated Services Digital Network and Lotus Notes at undergraduate or postgraduate level?

(Appendix G, Table 5.40)

Most of the distance education universities and those contemplating distance education intend to use these technologies at postgraduate level, though one institution has plans to use the technologies at undergraduate level.

Question: How would you provide Internet access for your students at a distance?

(Appendix F, Table 5.41)

All the distance education universities have access to the Internet but most of them will use the existing study centres to provide wider access for students. There is also a possibility of collaborating with other degree awarding institutions to provide Internet access to students. The institutions contemplating distance education also have Internet access and intend to use study centres, or to collaborate with other degree awarding institutions or the local business community to provide Internet access for students.

Question: What type of communication technology do you intend to use?
(Appendix G, Table 5.42)
Most of the distance education universities will continue to use postal mail but might supplement it with E-Mail and BBS on the World-Wide Web. The universities contemplating distance education will use postal mail as well as E-Mail and BBS.

Question: What are the likely constraints that your institution might face in teaching students at a distance using on-line Computer-Assisted Instruction?
(Appendix G, Table 5.43)
Both distance education universities and institutions contemplating distance education consider the lack of funds as the main hindrance to introducing on-line CAI. The lack of personnel, disinterest and sufficient time of lecturers to devote to on-line CAI development are also possible constraints.

5.5 Discussion

The analysis of the responses received from the degree awarding institutions with a distance education option in developed and developing countries revealed different methods for implementing on-line CAI and CMC which may be relevant to the South African situation. A discussion of the most significant findings of this research is presented to assist in making proposals for implementation of on-line CAI and CMC in South African degree awarding institutions.

In changing the face of instruction and communication to make distance education as effective as or better than conventional education, institutions in both developed and developing countries that participated in the survey are integrating technology into the teaching-learning process. The technologies enable the use of CAI and CMC for different forms of interaction and feedback. Despite the use of computer technology with traditional instructional and communication media, the developed countries have not done away with

instructional media such as printed text, audio cassettes and periodic meetings (Table 5.18, 5.19 in Appendix F). None of the institutions that participated in the survey stated that they use only CAI courseware for instruction. In learning situations where CAI is used as a primary mode of instruction, there are certain section of the syllabi where students have to read recommended text books or use other instructional media before they carry on with CAI interactions. Most of the degree awarding institutions in the developing countries that have a distance education option use traditional methods such as printed text, personal visits, radio and television broadcasts and vacation school as the primary means of instruction (Table 5.19, Appendix H).

The institutions have different technologies for delivering CAI to students. With institutions in the developed countries on-line CAI is made available on the World-Wide Web, Lotus Notes databases and CD-ROM servers. ISDN is also used to deliver CAI at remote locations for students. For CAI on stand-alone computers courseware is installed in homes or study centres for students. The availablity of a technological infrastructure for CAI gives students in the developed countries the opportunity to select the appropriate medium that suits their learning environment.

Lotus Notes and the World-Wide Web are suitable for asynchronous learning, while the ISDN infrastructure is also appropriate for synchronous instructional episodes. For students studying at their own pace, asynchronous learning is recommended since it gives them the opportunity to proceed at their own pace. Currently the use of ISDN for face-to-face meetings such as video conferencing is restricted to locations that have the technological infrastructure in place.

87.5% of the institutions in the developed countries designed their own courseware as opposed to buying commercially designed packages because it is possible for them to update their own CAI courseware. Authorware Pro documents are being converted into

HTML documents which makes it possible for them to be on-line for remote access. Lotus Notes databases, and HTML are also used for on-line CAI design. CAI authoring packages and tools such as Toolbook, Quest, Macromedia Director and the C and Pascal programming languages are used to design CAI on stand-alone computers.

The degree awarding institutions in the developed countries have different communication channels available to their students. The availability of new communication channels has not fully replaced the use of telephones and postal mail which are sometimes necessary. One of the findings of the study was that most the institutions in the developed countries that participated in the surveys provided E-Mail access for the students which facilitated a high frequency of interaction and feedback between students and with their teachers, a necessary factor for quality learning. For one-to-many communications the institutions in developed countries are also using Listservs, IRC and BBS. This facilitates group learning, discussions and on-line conferences. In some institutions MOOs and IRC sessions are replacing trips to study centres for face-to-face meetings.

The developing countries on the other hand still depend on postal mail as a primary source of communication which may delay the process of interaction and feedback. The degree awarding institutions in the developing countries may soon be able to implement communication technologies such as BBS on the World-Wide Web, Listservs and IRC systems because access to the Internet is becoming more widespread. The pace of implemention of new communication technologies in the developing countries will depend on how rapidily this communication infrastructure is put in place. The availability of E-mail to distance education students should reduce the delay in time that seems to hinder effective interaction and feedback.

Students in the developed countries had different access points at which they can perform instructional episodes via CAI and interaction via CMC. This helped distance education

students to adopt the culture of learning via the computer. The most common method of making CAI accessible to students was through study centres where students go to interact with the courseware and this could be the most suitable approach for the institutions in the developing countries. Many students in the developing countries cannot afford to buy computers, and providing machines at an accessible venue would alleviate this. Students in developed countries also had the option of performing instructional episodes from home on stand-alone computers or on-line using dial-up modems. Performing instructional episodes at home via on-line CAI and interacting via CMC would depend on whether students can afford to buy their own computers and the availability of the technological infrastructure in their location. Certain institutions in the developed countries made access to a computer a pre-requisite for admission to certain courses, especially for postgraduate courses.

Providing dial-up (modem facilitated) access from community centres and public libraries is another option that was used by some institutions, but this depends on the availability of such learning resource centres in a location. Community centres and public libraries that are used for academic activities will require electricity, computer facilities and access to gateways. Using computer facilities at the institution or the students' place of work were the least common. Studying from places of work might not be convenient for some students due to demands of their jobs and interruptions from colleagues.

Most degree awarding institutions in the developed and developing countries that participated in the survey stated that their students had a positive attitude towards CAI courseware but there were students in some institutions who were negative and indifferent towards CAI. These factors should be taken into consideration in the implementation of CAI. Students have different learning styles and should be given the option to select the medium they find comfortable to use. The lack of choice of media creates a poor learning environment. At best, instructional technologies should not be imposed on students, but

they could be given the option to choose whatever media they find comfortable for instructional episodes. However making all forms of instructional or communication media available to students could be a very expensive venture for degree awarding distance education institutions in developing countries.

Most institutions did not disclose statistics on the dropout rate of their students as well as the impact of CAI on students' performance. The survey drew the attention of some of the institutions for the need of such an evaluation. Information on students' performance or progress with the introduction of CAI in these institutions was based on experience or observation. Evaluating students' performance over a period of time when they have interacted with CAI courseware may help in keeping the courseware updated and will also assist in determining whether the purposes for which the courseware was developed have been achieved.

The third survey which was carried out in South African universities with a distance education option or contemplating distance education revealed that these institutions intend to experiment with on-line CAI using the World-Wide Web and ISDN, which have the technological infrastructure in some locations in South Africa.

In terms of communication technologies, the degree awarding institutions in South Africa are contemplating using E-Mail and BBS on the World Wide Web. This might not replace communication via postal mail and telephone but could reduce the gap in terms of time and distance between the lecturers and students. Communication via IRC, Listserv and MOOs is still being investigated in degree awarding institutions in South Africa.

The South African universities that participated in the survey have access to the Internet and intend to provide access for their students using the existing study centres in the country. Relying on the facilities of the local business community who have Web servers

to provide Web space for instructional episodes is an option which some institutions are considering. Some institutions expressed an interest in coordinating their efforts and working in collaborative ventures. Constraints such as lack of funds and lecturers' commitment might hinder the degree awarding institutions in their bid to change the face of instruction and communication. These constraints should be addressed to enable pilot projects to be implemented.

CHAPTER SIX

Proposals For Implementation

This chapter discusses proposals for implementing on-line Computer-Assisted Instruction and Computer Mediated Communication in South African distance education. The chapter will discuss factors such as the possible options that could be used to improve instruction and communication, access points for students, hardware and software requirements, training needs for teachers and students, cost implications, and possible constraints.

Firstly, the second survey revealed that most of the institutions in developing countries depend on traditional instructional and communication media, which might be attributed to the fact that:

(a) Traditional instructional and communication media are affordable for them as compared to computer technology,
(b) There is lack of sufficient computer hardware and software in most of the countries,
(c) There is lack of basic technological infrastructure which serves as platform for computer technology.

Institutions from developing countries (e. g. Malaysia, Israel and Thailand) that use computer technology do so on a small-scale, alongside traditional instructional and communication media. Students normally use the computer technology provided by institutions at study and resource centres.

Secondly, the institutions from the developed countries used a combination of traditional and computer technology for instruction and communication. Students have the option to use different types of CAI (on-line and stand-alone) and communication channels, depending on their need or preference. Most institutions from developed countries continue to use traditional instructional and communication media as well as computer technologies because each has a role to play.

The conclusions that one can draw from the surveys in proposing a system for implementation in South African degree awarding institutions with a distance education option are that:

(a) It is not possible to use computer technology for instruction and communication in distance education if the technological infrastructure that serves as a platform is not in place.
(b) The use of computer technology for distance education also depends on the resources of the institutions in terms of funds, personnel and computer facilities.
(c) Academic staff have to be committed to the development of computer-based application for instructional episodes.

The implementation of on-line CAI and CMC will depend on whether the existing technological infrastructure of a degree awarding distance education institution in South Africa can support instructional episodes and communication via computer technology. For example, the Internet serves as a platform for computer technologies such as the World-Wide Web, BBS, IRC, MOOs and E-Mail. Thus access to the Internet is necessary for electronic communication.

The current instructional media such as printed text, audio cassette, and radio broadcast cannot be replaced completely because there are certain locations that do not have electrical power and the basic communication infrastructure such as telephones, thus on-line CAI and CMC could only be used in locations with the required facilities.

Technologies such as the World-Wide Web, Lotus Notes, ISDN, BBS, IRC and E-Mail which are available in South Africa can be used alongside traditional instructional and communication media for distance education for quality education.

Degree awarding distance education institutions may have to evaluate their educational programmes to see whether CAI and CMC could provide additional benefits to what is currently being achieved through traditional instructional and communication media. For example, if students in an institution can easily get access to peers and teachers through personal visits and phone calls such that there is sufficient interaction and a reduced feedback delay, then the role of CMC will have to be examined critically before being implemented.

The cost implications of the various technologies must be taken into account. Some degree awarding institutions with a distance education option might not have the resources to finance such projects and may want to collaborate with other degree awarding institutions or organisations with similar interests. The issue of personnel will have to be considered, and whether they have the required expertise and time to devote to the development and implementation of CAI and CMC.

6.1 Options for delivery of Instruction and Communication Support

There are a number of possible scenarios that could be adopted by South African degree awarding institutions with a distance education option or contemplating distance education. They could continue using traditional instructional media such as printed text, audio

cassette, radio broadcast and television broadcast as a platform for CAI. The different forms of CAI as discussed in Chapter 3 could be used to provide interaction for various sections of the syllabi that require further clarification in the absence of the teacher. CAI could provide the required factors such as interaction, feedback, motivation, student control and confidence during instructional episodes. The low frequency of interaction and feedback delays that characterise postal mail and telephone could be improved via some form of CMC such as E-Mail, BBS and IRC. Distance education students could also benefit from collaborative learning and discussions via CMC.

Considering each of these options in turn:

(a) Delivering instruction using traditional instructional media with postal mail, telephone and visits to study centres for communication support.

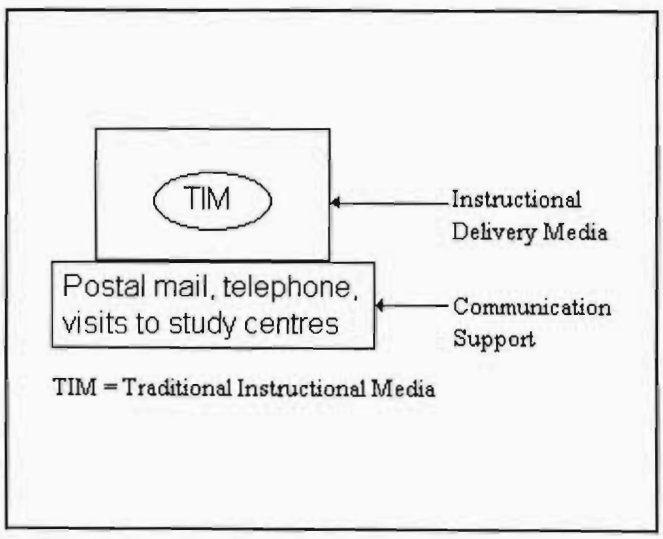

Figure 6.1 Option A

Degree awarding institutions with a distance education option could continue using the current traditional media such as printed text, radio and television broadcast for instructional delivery if students have easy access to peers and lecturers. These traditional instructional media are currently the primary vehicles for instructional delivery in South African degree awarding distance education institutions. The drawback of Option A is that the distance education student lacks effective interaction with lesson materials as well as the instant feedback that is required during instructional episodes. For example, if visits to study centres are frequent such that students have reasonable access to peers and lecturers or teaching assistants, then the gap in terms of time and distance will be considerably reduced through this interaction. Sufficient interaction and multiple feedback through the exchange of ideas with peers can be effective and could also lead to the restructuring of the student's knowledge conceptions in a particular subject domain. Formal and informal collaborative learning in groups is sometimes necessary for quality learning if there are some students who cannot learn in isolation.

This option could be the least expensive for an institution using the existing infrastructure and equipment, but is dependent on student population. There are costs such as producing and delivering printed text, producing lessons on audio cassettes, and transmitting radio and television broadcasts for supplementary instruction. Costs would also be incurred in mailing lesson materials and marked assignments by post to students, sending of fax messages and telephone calls. This option will also require salaries for a sufficient number of teachers and teaching assistants to attend to students' learning needs. An adequate number of study centres would be needed to provide students with the required interaction and feedback within a reasonable distance. For institutions starting a distance education programme for the first time there may be costs incurred in building new study centres or renting premises to use as study centres.

(b) Delivering instruction using traditional instructional media supplemented by CAI in a stand-alone environment where the courseware is available on a server in a LAN but cannot be accessed from a remote location. Communication support could be via postal mail, telephone, and visits to study centres.

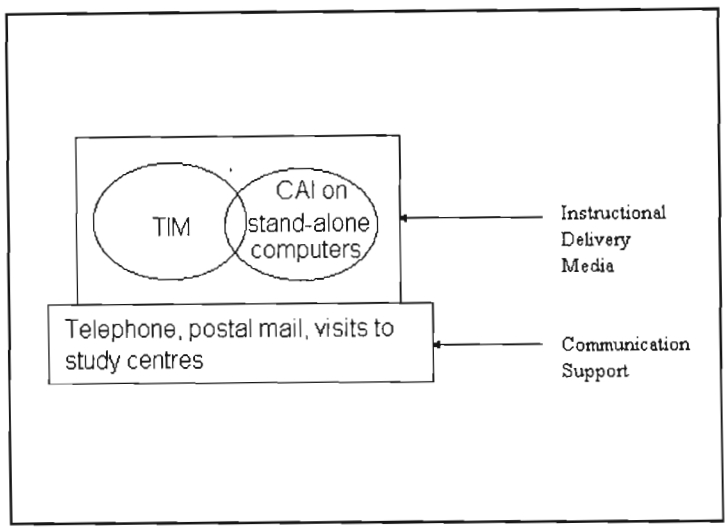

Figure 6.2 Option B

Institutions with option A might like to adopt option B to provide their students with the opportunity to interact with lesson materials, reinforce learning through drill and practice, simulation and problem solving, and to provide sufficient student interaction with teachers and peers. Option B is similar to that currently being used by UNISA, but the CAI courseware is restricted to Computer Science students who have access to personal computers. Some of the institutions from both the developing and developed countries that participated in the second survey also supplement traditional instructional media with CAI on stand-alone computers at home or at study centres. This option would benefit students who do not have access to personal computers at home and have to use those at study centres.

After students have read the required printed material they could use the CAI courseware on computers in a stand-alone environment to reinforce what they have learnt. Students who perform poorly could improve their performance through coaching, drill and practise using CAI courseware. Degree awarding institutions in South Africa with a distance education option or contemplating distance education could adopt Option B by installing CAI courseware at currently existing study centres.

Communication support could be via postal mail, telephone conversations, and visits to study centres. Students may have to communicate with peers and lecturers using postal mail and telephones, or make trips to study centres for interaction and to receive feedback.

The cost items of Option B would include developing and delivering lesson materials via traditional instructional media using study centres for some instruction and communication, plus the additional cost of developing and delivering CAI courseware. Courseware would have to be installed at study centres or delivered on diskettes for students to use at home. Degree awarding distance education institutions will have to consider increasing the number of computers at their study centres to provide students with sufficient access.

Possible constraints with this option are the lack of lecturers' time to devote to CAI development, lack of funds for additional computers and resistance from teachers to change some of their teaching methods.

(c) Delivering instruction using traditional instructional media, CAI on stand-alone computers and Lotus Notes for on-line CAI. Communication support could be via E-Mail, IRC, BBS, postal mail and telephone.

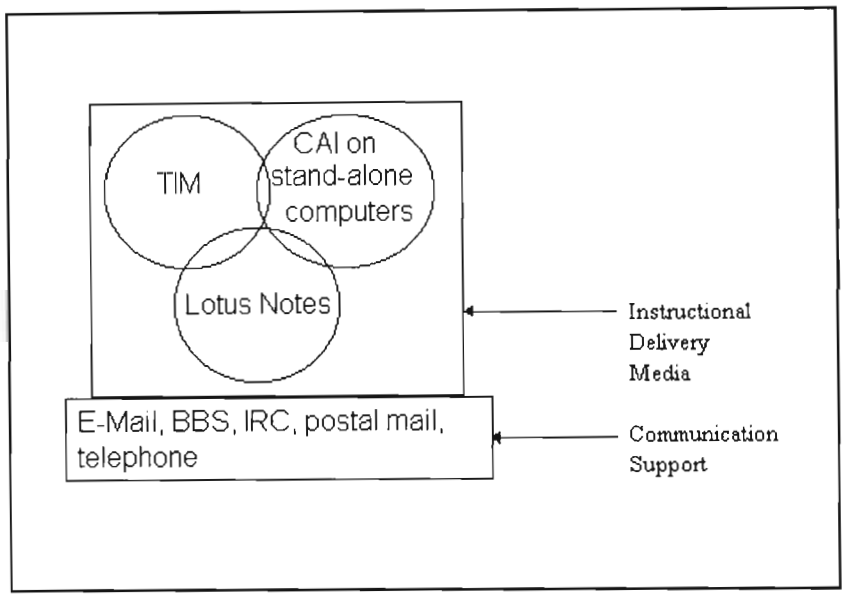

Figure 6.3 Option C

Institutions would opt for option C instead of B if they want to provide their students with remote access to CAI courseware for use in adjunct mode, and to support interaction and feedback from a distance. The use of Lotus Notes databases would allow students to learn and collaborate on projects from a distance. Lotus Notes databases could be used for the submission of assignments thus reducing feedback delay.

Students could use the traditional instructional media and then reinforce what they have learnt using CAI. For example, students could read the recommend printed material or use other instructional media and then interact with CAI on stand-alone computers or use on-

line CAI via Lotus Notes to have interactive instructional episodes from a distance. Lotus Notes can be used to store research materials and other academic materials which might be needed by students for revision. Updating CAI courseware on a Lotus Notes server can be faster and cheaper than retrieving diskettes from students to update, or supplying new diskettes with revised courseware to students. Access to CAI courseware on Lotus Notes could be restricted to users with the required client software and password.

Communication support could be provided for distance education students using BBS in Lotus Notes databases, E-Mail and IRC to supplement telephone conversations and postal mail. E-Mail, BBS and IRC would provide students with access to peers and teachers and thus reduce the isolation of the distance education student. BBS could be used for asynchronous discussions in a many-to-many or one-to-many format, while IRC could be used for on-line debates, conferences or arranged class sessions. South Africa has facilities for E-Mail, BBS and IRC but these could only be implemented at locations that have the infrastructure and communication support. Using IRC for synchronous communication implies there must be sufficient computers available for students to use, which some institutions may not be able to afford.

Option C will incur costs such as developing and delivering lesson materials using traditional instructional media; developing and delivering completed CAI courseware on diskettes for students, plus the additional cost in installing Lotus Notes servers and the required client software. On-line CAI courseware will have to be developed, as well as BBS databases for group discussions. There might also be the need to purchase additional computers to ensure sufficient student access. Institutions that do not have access to the Internet may have to install the required facilities such as LANs, routers and gateways to be able to use the Internet for electronic messaging. There are cost items such as the maintenance of LANs and equipment and the upgrading of computers and LANs. The lack of funds and lecturers' time could be hindering factors.

(d) Delivering instruction using traditional instructional media, CAI on stand-alone computers and the World-Wide Web for on-line CAI. Communication support could be via E-Mail, IRC, BBS, postal mail and telephone.

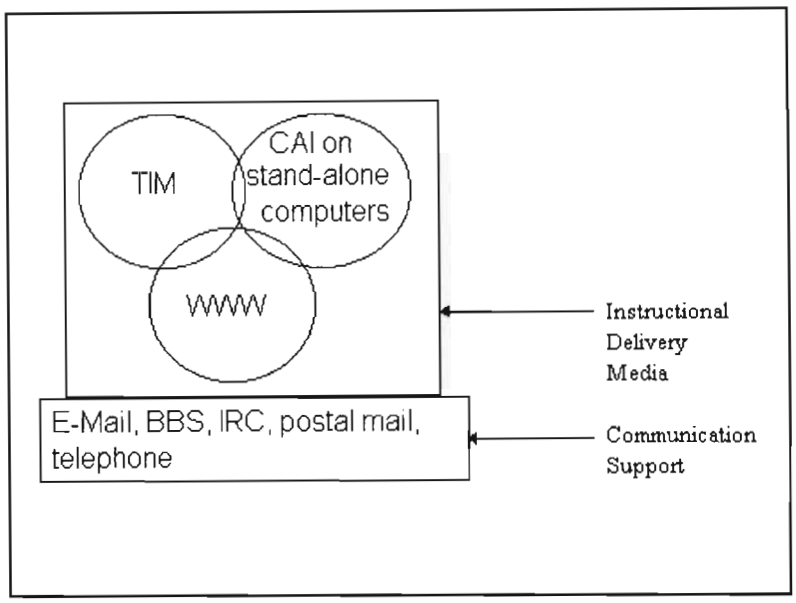

Figure 6.4 Option D

Institutions using option A or B may opt for option D instead of C if they want to provide their students wider access to other educational materials such as electronic journals, virtual libraries and databases world-wide. These educational materials can be obtained via the World-Wide Web. Students can interact with CAI courseware at study centres on stand-alone computers and then use the World-Wide-Web to access other educational materials world-wide. Students at remote locations can also use CAI via the World-Wide Web in adjunct mode to reinforce what they have learnt using other traditional instructional media (e.g. printed text).

As in the case of Lotus Notes, updates of CAI courseware could be faster on a World-Wide Web server as opposed to retrieving old diskettes or producing courseware on diskettes. The hypertext feature of the World-Wide Web enables the student to view related lesson materials that are stored on other servers. Option D is being used by some of the developed and developing countries that participated in the second survey.

One possible drawback with using on-line CAI via the World-Wide Web is that the retrieval of files for instructional episodes could be slow at certain hours when the demands for Internet services are high. Students could wait for some minutes before accessing information and this could be frustrating for a student who wants to learn at that particular period.

The communication support for this option would be the same as Option C. Using Option D would give students the opportunity to interact via BBS on the World-Wide Web or IRC. Students can hold conferences using the IRC or group discussions on topics in an asynchronous mode. Such discussions could supplement some of the periodic meetings.

The use of the World-Wide Web to deliver on-line CAI requires the purchase of a server to develop and install on-line CAI courseware. On-line CAI development via the World-Wide Web would require training and employing Web masters. This option would incur the cost of purchasing additional computers to enhance student access; increasing access points; and training of staff and students to use Internet tools. LANs and gateways may have to be installed at access points for CMC. As in the case of the Option C technicians may have to be employed to maintain LAN equipment. It may be more cost effective for degree awarding distance education institutions to form consortia to share the cost. Some of the drawbacks of this options could be the lack of funds, lack of infrastructure at certain locations and the many man-hours in developing the on-line CAI courseware.

(e) Delivering instruction using traditional instructional media, CAI on stand-alone computers and ISDN. Communication support could be via E-Mail, telephone, postal mail and visits to study centres.

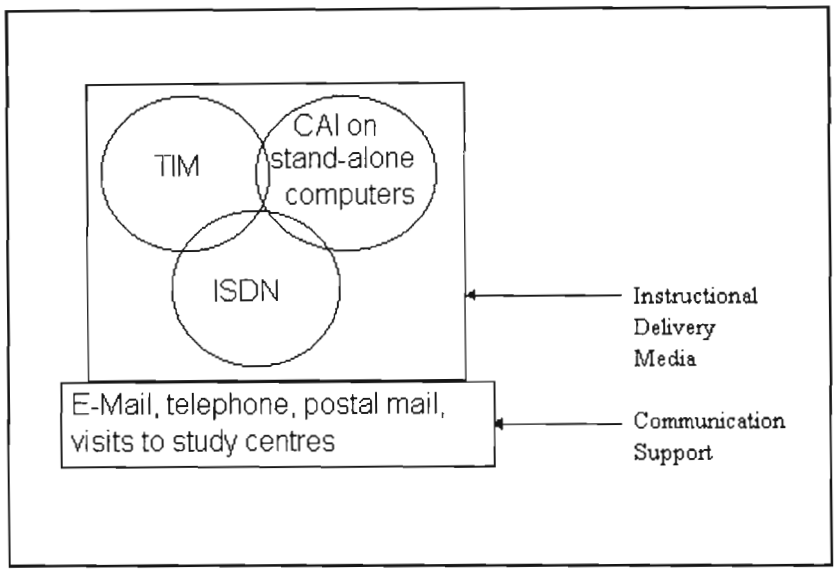

Figure 6.5 Option E

Institutions who cannot provide remote access to CAI courseware via Lotus Notes and World-Wide Web can use CAI on stand-alone computers at study centres or home to supplement their studies via other traditional instructional media. ISDN lines can be used to hold point-to-multiple-point video conferencing for tutorial support and clarification of lesson materials. Such conferences could link different access points instead of over-crowding a particular study centre. Weekend sessions and some periodic meetings could be supplemented with video conferencing. The use of ISDN would be restricted to locations in South Africa with the technological infrastructure.

The installation of ISDN lines for on-line teaching will depend on the demand for ISDN services at a particular location. If there is no reasonable demand for the services then Telkom's exchange equipment might not be available for connection. The connection to the ISDN exchange would also depend on the quality of existing telephone cables in an institution and the distance from the ISDN exchange [TELK95]. Degree awarding distance education institutions that cannot afford to finance the use of ISDN facilities could share the cost with other institutions with similar interest in their region or metropolitan area. Communication support on a one-to-one basis would be via E-Mail, telephones, visits to study centres and postal mail.

The costs of Option E would include developing and delivering lesson material via traditional instructional media and developing CAI courseware. LANs may have to be installed or upgraded at study centres with ISDN facilities. Extra computers may have to be purchased for sufficient student access as well as to provide for a fair amount of participation from students during video conferences. There are expenses such as training staff to use their personal computers for on-line discussions. As discussed in previous options, technicians may have to be employed to run and maintain LANs at various study centres.

The drawbacks to Option E are that not all students could benefit from on-line discussions using ISDN because certain locations in South Africa do not have ISDN. Lack of funds could hinder the upgrading of LANs to use ISDN facilities as well as the purchase of additional computers for students' access. The cost arising from the use of ISDN lines would have to be borne by institutions.

6.2 Implementation Factors

The purpose of changing the face of instruction and communication is to allow the distance education student to participate in quality instructional episodes. Distance education students require sufficient feedback and interaction from teachers and peers which could be achieved through an effective instructional delivery system and reliable communication support. Some forms of CMC such as E-Mail and BBS in Lotus Notes databases at access points could supplement communication via postal mail or telephones and assist in closing the gap in terms of time and distance. The feedback delays between students and their teachers that characterise traditional distance education could also be reduced via E-Mail and BBS because both are much faster than postal mail. The implementation of any of the various options or a combination of them will require instructors or teaching assistants, access points at a reasonable distance from the students locations, and new infrastructural and communication technologies to supplement existing ones.

Depending on the resources of a degree awarding institutions, collaboration at regional or provincial level with other degree awarding institutions may be possible to facilitate the sharing of the cost in implementing new instructional and communication technologies as well as providing more access points for students. Institutions could collaborate to form consortia that can facilitate the use of common technological infrastructure such as ISDN facilities for on-line conferences and seminars, as opposed to each institution having its own facility. Sharing some facilities could prove to be cost effective. Degree awarding institution in South Africa with a distance education option could also form links at regional or provincial levels in such a way that each is equally able to provide accreditation, material and delivery. Enrolment at any of the institutions could be equivalent to enrolment at another.

Figure 6.6 shows how degree awarding distance education institutions may be linked in the sharing of their resources.

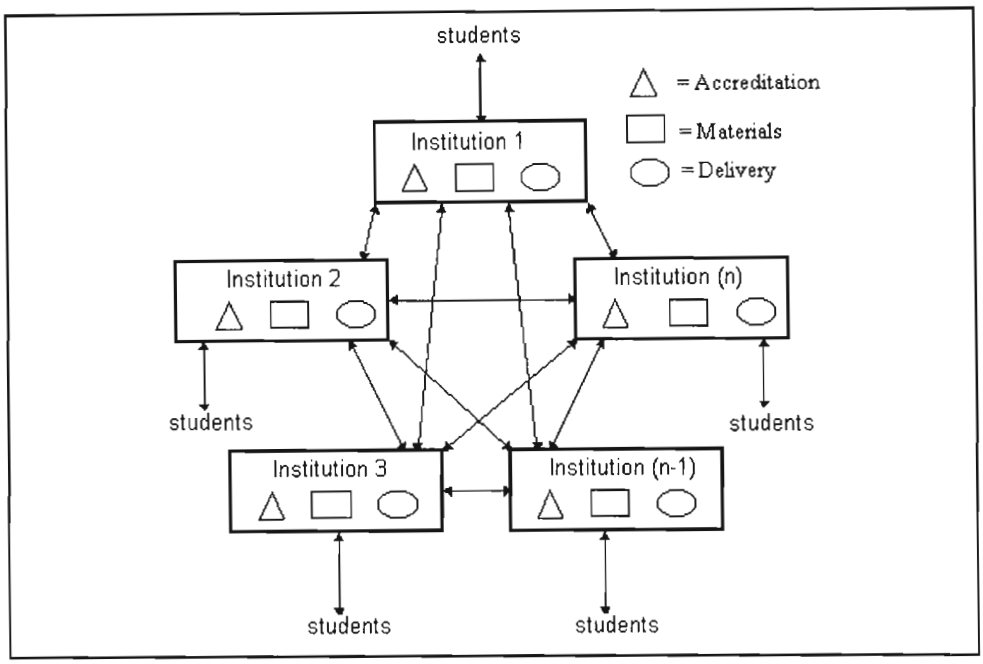

Figure 6.6 Linked degree awarding institutions

6.2.1 Community Networks and Access Points

Community network support at regional or provincial levels may have to be set up to provide sufficient interaction and feedback for distance education students. Community networks involve the use of access points such as study centres, libraries, community centres, community colleges and learning resource centres at locations that have the technological infrastructure or facilities in South Africa.

Figure 6.7 shows how the access points could be linked to provide students with sufficient communication support.

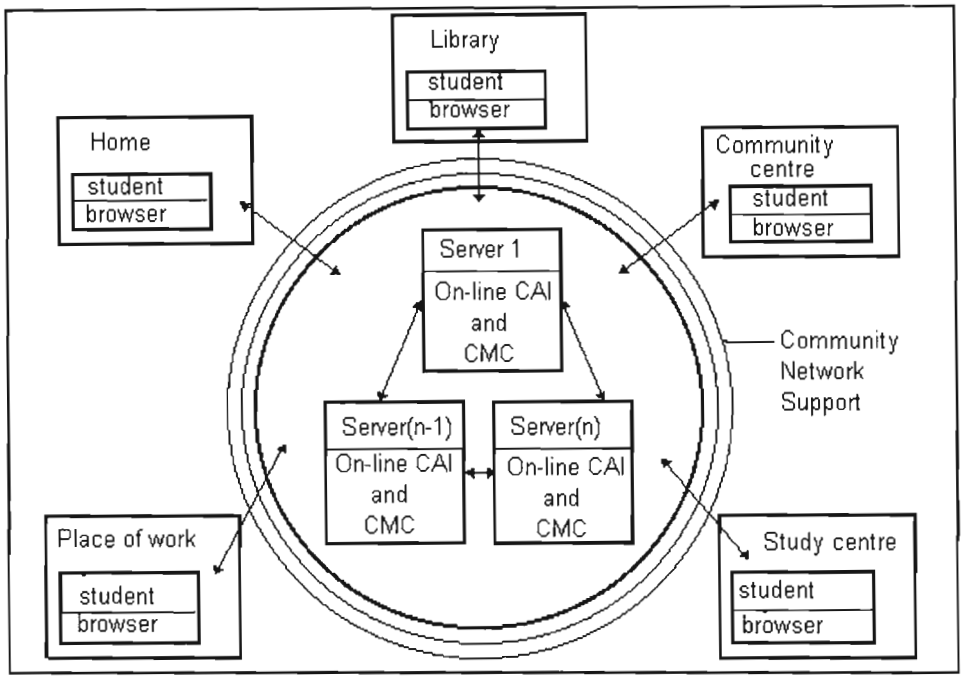

Figure 6.7 Access Points

Students with the required client software at any of the access points could perform instructional episodes on the servers. The servers could be Lotus Notes or the World-Wide Web servers situated at any of the degree awarding institutions. The community network could provide students with the opportunity of holding electronic discussion forums among themselves and with their teachers, using BBS and E-Mail. Students and teachers could interact on a one-to-one, one-to-many and many-to-many basis for formal and informal discussions. The electronic community network could be a collectively owned or cooperatively owned infrastructure. Low cost or free access should be

considered as the first step in creating a growing pool of users which might be essential in generating a sustainable network.

6.2.2 Hardware Requirements

There are certain hardware requirements for the successful implementation of on-line CAI and CMC. Some of the technologies proposed for the various implementation options are only available if a network is used. For example, electronic communication such as BBS and E-Mail or the downloading of CAI courseware from a central point during on-line instructional episodes may require a server and a gateway to the Internet. These servers may have to be accessible at any time to allow students to use them for instructional episodes and CMC.

As an alternative to purchasing a Web server, institutions could rent Web space, that is, hard-disk space from Internet service providers. Institutions could place their on-line CAI courseware on this rented Web space or create BBS for interaction and feedback. Currently, there are Internet service providers in South Africa such as Data Tec, Internet Solutions and Telkom that have reliable dedicated hosts (a computer system on a network) for handling Web traffic. Telkom, for example, is in the process of making its Internet services available in all major centres in South Africa, with at least one modem being available for every thirty registered user [GOLD95]. It may be possible to approach Telkom to provide subsidised accounts on their servers for pilot projects on CMC and on-line CAI via the World-Wide Web.

LANs at some access points may have to be upgraded to allow the use of ISDN facilities. For example, a standard ISDN terminal adapter would be used to link a server to a BRI or PRI interface.

6.2.3 Software Requirements

The results of the first survey revealed some of the different types of software that are currently being used to develop CAI courseware. For CAI on stand-alone computers software such as Authorware Pro, Macromedia Director, ToolBook, Quest, and the Pascal and C programming languages are being used. HTML is being used to develop on-line CAI on the World-Wide Web as well as converting Authorware Pro documents for on-line access. InterNotes Web Publisher is being used to convert Lotus Notes documents into HTML, producing World-Wide Web pages complete with graphics.

Some of these software packages are already in use in South African degree awarding institutions but there is the need for studies into creating on-line CAI courseware because it is not generally used in South Africa. Degree awarding institutions could develop their own CAI courseware or buy commercial packages from the shelves. Institutions that develop their own CAI courseware would be able to design and develop them according to the learning needs of their students, as well as to the specification of the institution. Updates and changes could be made as and when required.

Institutions that cannot cope with the many man-hours involved in the development of CAI courseware could opt for commercial packages. One drawback to buying commercially available CAI courseware is that it may not comply with certain sections of syllabi of an institution although some authors may allow a percentage of customisation. Clearinghouses could be established to evaluate commercial courseware in South Africa.

Students require graphical browsers for on-line CAI as well as CMC via BBS on the World-Wide Web and Lotus Notes databases. The new generation of World-Wide Web browsers are completely graphical and they can be operated through the use of a mouse device and within a GUI (Graphical User Interface) or WIMP (Windows, Icons, Mouse, Pointer) environment.

Applications software such as NCSA (National Centre for Supercomputing Applications) Mosaic, Cello, Lynx, Phoenix, MacWeb and Netscape are navigational tools that enable the student to access on-line CAI on the Web through a series of mouse clicks. Images and sound could be viewed or played respectively. The use of Lotus Notes requires InterNotes News which is a Lotus Notes server based application, to perform instructional episodes and also browse articles from multiple newsgroups in discussion databases. Electronic Mail software such as Eudora and Pegasus Mail could be installed.

6.2.4 Training Requirements

The training of teaching staff and specialists in the development and implementation of CAI and CMC will be of primary importance in order to develop locally relevant courseware.

6.2.4.1 Training for Lecturers

Persuading lecturers to change some of their methods of teaching in distance education might not be very easy because of varying levels of background, experiences, interests and apprehension about incorporating technology into education. Introducing CAI as an instructional medium in distance education would require the training of the teachers or staff concerned, especially those that lack programming and authoring skills. Training sessions such as workshops or introductory demonstration sessions on the use of the World-Wide Web, Lotus Notes, BBS, FTP, Telnet and ISDN could be organised. Follow-up support would enable teachers to integrate these technologies with their own teaching methods. Lecturers could also be provided with incentives for their time and effort.

6.2.4.2 Training for Students

Introducing CAI as an instructional medium for distance education requires hands-on introductory lessons for students. Students would require some level of computer literacy, for example how to use a keyboard, mouse and interact with pull-down menus and icons.

Introductory courses should be developed on how to use E-Mail, Telnet, FTP, BBS for interaction and feedback and the World Wide Web for on-line CAI at a basic level. Hands-on sessions incorporating supervised task assignments with individual assistance could be a regular feature for students joining the study programmes at different times. Help in using technologies could be available on-line or from an E-Mail account helpline.

6.3 Cost Implications

The cost of implementing the different options discussed will vary according to the extent to which the instructional and communication media are used. For all options the production and the delivery of lesson materials using either a particular traditional instructional medium or a combination of them will incur costs. Thus Option A could serve as a base for the rest of the options since adjunct CAI, whether stand-alone or on-line, could be used to reinforce what students have learnt via traditional instructional media (e.g. printed text). Option A would be the cheapest because it does not involve the additional cost of developing and delivering any form of CAI.

Option B would be more expensive than Option A because CAI courseware would have to be developed, delivered and updated on diskettes for students or installed in LANs at access points. The LANs will require gateways to enable the use of E-Mail. The LANs will require maintenance.

Option C would be more expensive than options A and B because, in addition to developing and delivering lessons via traditional instructional media and CAI on stand-alone computers, Lotus Notes servers have to be installed at access points which need to equipped with LANs. CAI courseware and other applications (BBS databases) may have to be developed for educational use. Teaching staff and students will have to be trained in the use of Lotus Notes applications for instructional episodes and communication.

As in the case of Option C, Option D would be more expensive than Options A and B because, in addition to developing lessons via traditional instructional or CAI on stand-alone computers, Web servers will have to be purchased for World-Wide Web application development. LANs must be connected to gateways to enable the use of Internet for E-Mail and IRC. Training would have to be offered to students on the use of the World-Wide Web and other Internet tools. Teaching staff will require training in developing educational applications on the World-World Web.

Depending on the number of students enrolled for a course, Option C may be more expensive than Option D because Lotus Notes servers limit the number of users to about 1200 per server [SHEA95]. When using a distributed network for the World-Wide Web there is no limit to the number of users but access have to be provided.

Option E would also be more expensive than options A and B because, in addition to developing and delivering instruction via traditional instructional media and CAI for stand-alone computers, ISDN equipment has to be set up at access points. Costs will be incurred for the use of ISDN lines.

The cost implications of the various options can be classified under the following categories: pre-production costs, production costs, pre-delivery costs, delivery costs, and running costs. These costs will help in determining fixed and variable costs for budget purposes.

Pre-production costs would be incurred during initial feasibility studies on which sections of curricula should be developed for CAI as well as training courseware designers, programmers and graphic artists. They would involve consultation costs with experts in subject domains, Web masters, networking and instructional technologists.

Production costs would be incurred in developing lesson materials via traditional instructional media and writing CAI courseware for stand-alone computers from the scratch or converting existing CAI on stand-alone computers to on-line CAI using the HTML of the World-Wide Web. For example, CAI designed using Authorware Pro on a stand-alone could be converted to a HTML document for on-line access. Production costs would also involve purchasing and adapting commercial packages.

Pre-delivery costs would involve the setting up of the delivery project. Fully equipped access points may have to be set up with LAN facilities and gateways to other networks. Pilot projects may have to be set up to evaluate courseware and communication technologies before usage and the period over which the courses will run will have to be determined. Students and teaching staff would need training in using on-line CAI, BBS, FTP, Telnet and E-Mail.

Delivery costs would include the cost of providing different forms of support for students. The cost of support services will depend on whether a degree awarding institution is using existing staff or engaging part-time or temporary staff for technical support at the various access points. The support staff, whose duties will include counselling, supplying package materials, attending to students technical problems at access points, on-line assistance and tutoring, will attract salaries. The delivery costs may also include renting Web space, ISDN lines and premises to use as access points, buying or renting computers and other necessary equipment.

Running costs will include the salary costs of staff administering the on-line CAI and CMC programmes. There are cost items such as maintaining the LANs, equipment and software, providing security at access points and upgrading computers. Other specific running costs are the costs of using ISDN lines, the cost of obtaining feedback to evaluate the application of technology in instruction and communication, and the cost of having 24-hour on-line

access for students.

All these cost factors could be grouped as variable and fixed costs to determine the overall total cost of a pilot project. Variable costs are cost items that attract an additional cost in providing for each extra student. The fixed costs are cost items which are independent of the number of students that are registered for a course. Figure 6.8 shows how the total cost in running of the options may vary with the number of students

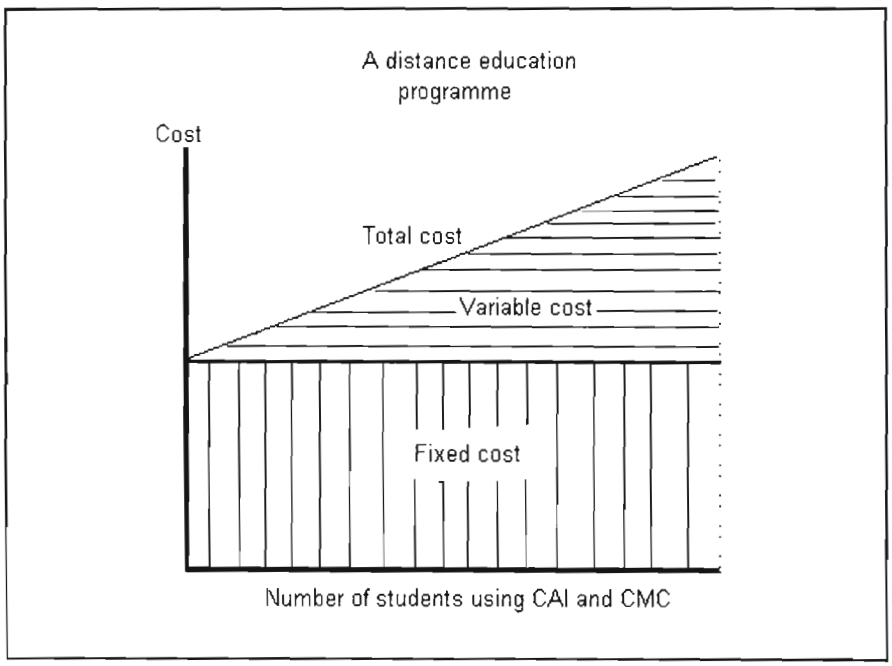

Figure 6.8 Costs versus number of students

The cost per student will reduce as more students enroll for courses. The average cost per student could be determined by dividing the total fixed cost by the number of students and adding on the variable cost for each student.

A formula for average cost per student could be expressed as follows:

Cost per student = (Total fixed cost/Number of students) + variable cost per student

Students may have to pay for consumables such as diskettes and stationery, with the institutions providing the facilities and personnel. Equipment costs could be split with major equipment provided by the institutions and minor equipment costs such as personal computers and modems borne by students who cannot use any of the study centres. Economically if equipment costs are to be borne solely by the institutions, then use of the study centres may be the only cost-effective answer.

6.4 Constraints

Implementing any of the options discussed will have drawbacks or limitations. There could be limitations such as:

(a) The man hours involved in developing CAI courseware.
(b) Lack of sufficient hardware to meet the needs of of students.
(c) Funds to implement the options and provide access points and community network support.
(d) The reluctance of some lecturers to leave their work-product to a programme and the unwillingness on the part of some lecturers to change teaching methods.
(e) The lack of technological infrastructure.

Degree awarding distance education institutions may consider the possibility of using computers which can be upgraded for full multimedia usage. The business sector and other organisations within South Africa or abroad could be approached in this respect. Such a venture might prove to be cost effective as opposed to buying new computers.

There is the need for research investigation into developing template-based packages for various subjects which could help teachers with little computer programming experience to convert their lecture notes into interactive courseware. Such an investigation might have to involve various institutions to facilitate the acceptability of the package across South Africa. A template-based package if well developed should reduce the many man hours involved in the development of CAI courseware, but lecturers will still require authoring skills.

Funds for setting up any of the options could be solicited from fund raising ventures. Funding should idealy not come from only one source because it might affect the proper functioning of the proposed models in future should there be a lack of support from that source.

Lecturers who cannot trust their work to a programme could be encouraged to explore the potential and the capabilities of CAI as instructional media for effective learning in distance education.

The lack of technological infrastructure in certain locations could hinder the use of CMC. Certain locations in South Africa do not have electrical power or telephone lines thus making implementation of CMC impossible. Students residing in such locations may have to continue using postal services or making trips to study centres for interaction and feedback.

6.5 Summary of Chapter

The various options discussed for improving the face of instruction and communication in South Africa can improve the quality of instructional episodes in distance education if properly planned, but the necessary infrastructure has to be in place. Large-scale

development of CAI for distance education might take time to be implemented but CMC could be made available to students sooner to reduce the gap in terms of time and distance between students and lecturers.

CHAPTER SEVEN

Conclusion

This thesis has put forward some proposals on how CAI supported by CMC could be implemented to improve instruction and communication in South African degree awarding institutions with a distance education option. This chapter draws conclusions from the various topics discussed in this thesis.

7.1 Conclusion

Distance education in degree awarding institutions in South Africa has the potential to be a good alternative to conventional education, but instruction and communication would have to improve. There is the need for a distance education model that closes the gap between the student and the lecturer in terms of time and distance. This gap results in the isolation of the student since feedback is often delayed and there are not sufficient channels for interaction. The use of technology in distance education could close this gap by facilitating the development and delivery of quality instructional episodes needed for effective knowledge building, feedback and interaction. The use of an instructional medium such as CAI in distance education would mean that students do not have to be passive recipients of knowledge but be able to participate in the teaching-learning process in the absence of the lecturer.

The use of technologies such as the World-Wide Web and Lotus Notes to deliver CAI has already proved to be a valuable educational tool in both small-scale and medium-scale programmes [SHEA95]. Students can have interactive lessons as well as retrieve learning materials during and after instructional episodes at a distance. Some of the degree awarding distance education institutions in the developing and developed countries that participated in the surveys provide examples of successful applications.

Despite the potential and the availability of some of these instructional and communication technologies in South Africa, there are barriers that might delay their implementation. These barriers are factors such as cost, the man-hours required for the development of CAI courseware, lack of technological infrastructure, apathy and lack of encouragement.

CAI would require extensive time, commitment and heavy funding for development, thus the possibility of establishing joint ventures among South African degree awarding institutions in carrying out pilot projects should be explored. New communication technologies will also require significant funding to establish, but the purchase of hardware does not necessarily guarantee that any effective use will be made of it. The lack of technological infrastructure in some locations in South Africa that do not have electrical power or basic communication lines would hinder the implementation of these educational and communication technologies.

Active participation of academics in the development of CAI would be essential if the instructional medium is to make any impact on students' performance in future. Most lecturers are already working to capacity with current work loads and without incentives and rewards, the use of a new technology may become a voluntary overload for a few dedicated academics who are constantly looking for new ways to teach. There might be CAI courseware that is idle, not because it is not effective, but simply because the use thereof does not count in the performance measures by which a lecturer is judged. Without incentives and rewards for participation, many lecturers may not use technological solutions regardless of how much they might cut institutional cost or improve the quality of instructional and learning episodes.

CAI cannot replace the lecturer and should be augmented by other instructional media or methods such as printed text, audio cassette and periodic meetings. The learning style and needs of students must be taken into consideration in the choice of instructional and

communication media for South African distance education. Some students will find CAI comfortable to use, others might not. For example in some of the degree awarding distance education institutions where the use of on-line CAI and CMC are well advanced, printed text, audio and video cassettes are still utilised. Lecturers will have to determine which subjects and sections of syllabi are best taught using CAI. Other traditional instructional media or methods such as printed text and face-to-face teaching may be more effective than CAI in some aspects. The ideal solution could be to make a wider range of instructional and communication media available to students to choose from, without necessarily imposing any one form on them, but this could be costly to implement.

The installation of the necessary technological infrastructure for CMC via E-Mail, BBS and IRC could benefit distance education students who normally depend on personal visits, postal mail and telephone for interaction and feedback. The use of E-Mail, BBS and IRC could reduce the gap in terms of time and distance between the student and tutors.

The availability of communication technologies such as E-Mail, IRC and BBS would enable distance education students to receive frequent feedback and interact effectively with tutors and peers, thus reducing their isolation. Students who have access to CMC channels would be able to collaborate in their studies through formal and informal discussions in asynchronous mode. Students and teaching staff do not have to meet at the same time because the computer stores their commmunications and CMC can be used any time of the day if facilities are available. The computer also facilitates communication structures that would be an improvement on what can be done in the face-to-face classroom situation. For example, a student can participate effectively in a group discussion via his or her computer without feeling intimidated by the presence of other students.

The aggregation of students at access points could be the cheapest alternative to students buying their own computers because many students may not be able to afford them individually. Thus degree awarding distance education institutions in South Africa may have to explore the possibility of using a number of access points for interactions and collaborative learning via CMC. Though the cost of making sufficient number of computers available for students could be very high for institutions, the long term benefits are worth the investment.

Through networking, on-line CAI and CMC could bring an entirely different dimension into traditional distance education in South African degree awarding institutions because of the academic opportunities that the technologies offer the distance education student. CAI and CMC could offer the distance education students many of the learning resources that are available in conventional education. Unless an effort is made to improve the face of instruction and communication in degree awarding distance education institutions in South Africa, distance education might not be an effective alternative to conventional education. CAI in South Africa has a long way to go in terms of development, but CMC via E-Mail, BBS and IRC could be implemented to reduce the feedback delay between the student and lecturer in distance education. Finally, the implementation of CAI and CMC could be costly, but the long term benefit outweighs the seed money if this is carefully planned and developed.

This thesis was undertaken to investigate the following objectives:

(a) To establish whether the face of instruction in South African universities with a distance education option can be improved via on-line Computer-Assisted Instruction.

The review of literature and the analysis of the data collected indicated that the use of CAI in South African degree awarding distance education institutions, whether on-line or on

stand-alone, primary or adjunct, can be effective in improving the face of instruction in some courses if carefully planned and implemented. CAI could also improve the performance of students in some subjects.

(b) To establish whether the gap between the lecturer and the student in South African distance education universities can be closed in terms of time and distance, via Computer Mediated Communication.

The use of CMC may close the gap between distance education students and lecturers if used for interaction and feedback but there has to be sufficient student access to computers. CMC channels such as E-Mail, BBS and IRC which are available in South Africa could be used for asynchronous communications. CMC may have to be used alongside other communication channels such postal mail, telephone and personal visits to meet the different communication needs of students and teaching staff.

(c) To establish whether the gap between conventional and distance education universities in South Africa can be closed in terms of learning resources.

Students in South African degree awarding institutions with a distance education option would have access to learning resources such as publications, library references, databases and other research that could be made available via on-line databases. Solutions to assignments, tests and examination questions could also be made available through these databases.

7.2 Recommendations for further research

Software developers in South Africa together with educators should investigate the development of template-based authoring packages that would reduce the programming skills required of lecturers. Lack of programming skills is one of the factors that

contributes to resistance to CAI in distance education. Academics may have to play appropriate roles such as subject matter consultants and learning theory specialists.

Research into the use of Lotus Notes bases for submission of assignments, collaborative projects and groups discussions should also be conducted.

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APPENDIX A

Table 3.1

University	Subjects
University of Western Cape	. Languages . Biochemistry
Rhodes University	. Accounting . Business Administration . Chemistry . Computer Science . Education . Law . Linguistics . Mathematics . Music . Physics . Psychology . Social Work . Zoology
University of Cape Town	. Biochemistry . Chemistry . Construction Technology . Mathematics . Medical curricula
University of Pretoria	. Biochemistry . Computer Science . Economics . Psychology . Medical Curricula
University of Natal	. Biology . Computer Science . Construction Management . Economics . Medical Curricula

Table 3.1 continued

University of the Orange Free State	. Accounting . Agriculture Economics . Chemistry . Greek . Nursing Science . Physics

APPENDIX B

QUESTIONNAIRE (1st Survey)

1. What is the name of your institution?

2. What is the student population?

3. Since when have you been using Computer-Assisted Instruction?

4. Which Authoring languages/tools do you use to design Computer-Assisted Instruction courseware?

5. Is Computer-Assisted Instruction being run on a small, medium or full-scale?

6. What are the subjects being taught using Computer-Assisted Instruction?

7. How do you deliver Computer-Assisted Instruction courseware to students?
- Post them on diskettes
- Other

8. To what extent are computers available to students in homes and institutions?

9. How do students submit assignments?
- Post back diskettes
- E-Mail
- Paper
- Other

10. How do students react to Computer-Assisted Instruction in general?

11. Do you have any statistics on the effect of Computer-Assisted Instruction on students' performance?

12. What are the constraints that you face in the implementation of Computer-Assisted Instruction?

13. What are the sources of funds for Computer-Assisted Instruction projects?

APPENDIX C

QUESTIONNAIRE (2nd Survey)

1. What is the name of your institution?

2. Is your institution mainly a distance education university or do you offer conventional education as well?

3. What is your student population?

4. What is the dropout rate in general?

5. What type of media do you use to deliver lessons to your students?

- Printed text
- Audio cassette
- Radio broadcast
- Television broadcast
- Telephone
- Interactive Video
- Teletext systems
- Computer-Assisted Instruction
- Cable
- Other

6. What percentage do these media form of the overall teaching media?

7. How do students submit assignments?

- By post on paper
- Presented personally
- E-Mail
- On computer diskettes
- Other

8. If you do not use computers as a teaching medium in your school then provide the following information. What are some of the hindering factors?

- Funds
- Hardware
- Software
- Computer Personnel
- Other

9. If you are using computers as a teaching medium, do you have Computer-Assisted Instruction courseware?

10. If YES, why did you introduce Computer-Assisted Instruction courseware?

11. What is your opinion on the effectiveness of Computer-Assisted Instruction as an instructional medium?

- Can reduce learning time in some courses
- Same as face-to-face instruction in some courses
- It improves learning in some courses
- It can change learners attitude towards computers

12. In what mode (primary or adjunct) is Computer-Assisted Instruction being used in your institution?

13. How do you deliver Computer-Assisted Instruction courseware to students?
- By post on diskettes
- World-Wide-Web
- Integrated Services Digital Network
- Lotus Notes
- Other

14. At what level (postgraduate or undergraduate) do you use Computer-Assisted Instruction via the World-Wide Web, Integrated Services Digital Network and Lotus Notes?

15. What type of communication technology do students and teachers use for interaction and feedback in your institution?
- E-Mail
- BBS
- Postal mail
- Telephone
- IRC
- MOO
- Listserv
- Other

16. Do students buy their own computers?

17. Do you have computer centres for your distance education students?

18. What percentage of your students have experience with computers?

19. Which subjects do you teach using Computer Assisted Instruction courseware?

20. Has there been any improvement in student performance since you introduced Computer-Assisted Instruction courseware?

21. What was the dropout rate in these subjects before you introduced Computer-Assisted Instruction?

22. What was the dropout rate after Computer-Assisted instruction courseware was introduced?

23. How do students react to Computer-Assisted Instruction?

APPENDIX D

QUESTIONNAIRE (3rd Survey)

Section A

1. Does your institution have a distance education programme? If no, answer the questions in **Section B**.

2. What is the mode of interaction between your students and their instructors/teachers/facilitators at a distance?

- Post
- Telephone
- Electronic Mail
- Other

3. What percentage of your students have access to Electronic Mail?

4. Does your institution use Computer-Assisted Instruction courseware to teach your students at a distance?

5. Does your institution have the resources to deliver Computer-Assisted Instruction using any of the following

- Lotus Notes
- World-Wide Web
- Integrated Services Digital Network
- Other

6. Do you intend to use the World-Wide Web, Integrated Services Digital Network or Lotus Notes at undergraduate or postgraduate level?

7. How would you provide Internet access for your students at a distance?

- Use study centres
- Rely on the assistance of local businesses that have the resources to share cost
- We have Internet access
- Other

8. What type of communication technology do you intend to use?

- Listserv
- MOOs
- IRC
- E-Mail
- BBS
- Postal Mail
- Other

9. What are the likely constraints that your institution might face?

- Lack of funds
- Lack of personnel
- Lack of interest from lecturers
- Other

Section B

10. Does your institution have plans to offer distance education at tertiary level in the near future?

11. If your institution taught students through distance education, will it be in a position to deliver Computer-Assisted Instruction courseware using any of the following?

- Lotus Notes
- World-Wide Web
- Integrated Services Digital Network
- Other

12. Do you intend to use the World-Wide Web, Integrated Services Digital Network, Lotus Notes at undergraduate or postgraduate level?

13. What type of communication technology do you intend to use?

- Listserv
- MOOs
- IRC
- E-Mail
- BBS
- Postal Mail
- Other

14. How would you provide Internet access for your students at a distance?

- Use study centres
- Rely on the assistance of local businesses that have the resources to share cost
- We have Internet access
- Other

15. What are the likely constraints that your institution might face?

- Lack of funds
- Lack of personnel
- Lack of interest from lecturers
- Other

APPENDIX E

Table 5.1

Question: What is the name of your institution?

Country	**Names of Institutions** n = 16
United States of America	University of Colorado, Boulder
	Syracuse University
	Indiana University, Bloomington
	St Edwards's University in Austin
	Texas A. M. University
	The Regent University in Virginia
	The North Western University of Lousiana
	The State University of New York
	Edmonds Community College, Lynwood
	University of South California
Canada	Assiboine Community College
	University of Manitoba, Winnipeg
	Memorial University of New Founland
Netherlands	University of Armsterdam
Australia	Central Queensland University
Puerto Rico	University of the Virgins Islands

Table 5.2

Question: What is the student population?

Response	Number of Institutions n = 16	Percentage of Respondents
1 400	1	6.3%
2 000	1	6.3%
2 100	1	6.3%
3 200	1	6.3%
8 500	1	6.3%
9 000	1	6.3%
10 000	1	6.3%
17 000	1	6.3%
20 000	1	6.3%
25 000	2	12.5%
35 000	1	6.3%
36 000	1	6.3%
44 000	1	6.3%
No response	2	12.5%

Table 5.3

Question: Since when have you been using Computer-Assisted Instruction?

Response	Number of Institutions n = 16	Percentage of Respondents
1984	1	6.3%
1985	2	12.5%
1987	2	12.5%
1988	1	6.3%
1990	1	6.3%
1991	1	6.3%
1992	2	12.5%
1993	2	12.5%
1995	2	12.5%
No response	2	12.5%

Table 5.4

Question: Which Authoring languages/tools do you use to design Computer-Assisted Instruction courseware?

Response	Number of Institutions n = 16	Percentage of Respondents
HTML	6	37.5%
Authorware Pro	3	18.8%
Lotus Notes	3	18.8%
Quest	3	18.8%
Toolbook	2	12.5%
Macromedia Director	2	12.5%
Commercially designed courseware	2	12.5%
C programming language	1	6.3%
Miss	1	6.3%
Pascal	1	6.3%
TAIGA (A Dutch authoring package)	1	6.3%

Table 5.5

Question: Is Computer-Assisted Instruction being run on a small, medium or full-scale?

Response	Number of Institutions n = 16	Percentage of Respondents
Small-scale	10	62.5%
Medium-scale	3	18.8%
Full-scale	3	18.8%

Table 5.6

Question: What are the subjects being taught using Computer-Assisted Instruction?

Response	Number of Institutions n = 16	Percentage of Respondents
Mathematics	4	25.0%
Educational Technology	3	18.8%
Computer Science	3	18.8%
Computer Aided Drafting	2	12.5%
Agriculture	2	12.5%
History	2	12.5%
English	2	12.5%
Engineering	2	12.5%
Chemistry	1	6.3%
Communications	1	6.3%
Economics	1	6.3%
Food science	1	6.3%
Music	1	6.3%
Vertinary Medicine	1	6.3%
Certified Midwifery	1	6.3%
Wildlife Science	1	6.3%

Table 5.7

Question: How do you deliver Computer-Assisted Instruction courseware to students?

Response	Number of Institutions n = 16	Percentage of Respondents
Post CAI courseware on diskettes	9	56.3%
WWW	8	50.0%
Install courseware at study centres	6	37.5%
Lotus Notes	3	18.8%
Conferencing systems	1	6.3%
ISDN	1	6.3%

Table 5.8

Question: To what extent are computers available to students in homes and institutions?

Response	Number of Institutions n = 16	Percentage of Respondents
Computer laboratories	12	75.0%
Students have computers at home	9	56.3%
Dial-up modem from community centres	3	18.8%
Public libraries	2	12.5%
Places of work	1	6.3%
No response	1	6.3%

Table 5.9

Question: How do students submit assignments?

Response	Number of Institutions n = 16	Percentage of Respondents
Paper	16	100.0%
Electronic Mail	10	62.5%
Computer diskettes	4	25.0%
Lotus Notes databases	3	18.8%
LAN-based package (FORUM)	1	6.3%
File transfers	1	6.3%

Table 5.10

Question: How do students react to computer-Assisted Instruction in general?

Response	Number of Institutions n = 16	Percentage of Respondents
Positive	16	100%
Negative	2	12.5%
Indifferent	1	6.3%

Table 5.11

Question: Do you have any statistics on the effect of Computer-Assisted Instruction on students' performance.

Response	Number of Institutions n = 16	Percentage of Respondents
No available statistics	9	56.2%
Statistics being compiled	4	25.0%
Improvement, based on observation	1	6.3%
Improvement, based on statistics	1	6.3%
No response	1	6.3%

Table 5.12

Question: What are the constraints that you face in the implementation of Computer-Assisted Instruction?

Response	Number of Institutions n = 16	Percentage of Respondents
Lack of funds	7	43.8%
Lack of sufficient hardware for students	5	31.3%
Lack of lecturers time	5	31.3%
Resistance from lecturers to change mode of teaching	3	18.8%
Lecturers cannot trust their work to software	2	12.5%
Unreasonable demand for quality	1	6.3%
Lack of input from faculties	1	6.3%
Wrong attitude from management	1	6.3%
Non-involvement of lecturers in decision-making	1	6.3%

Table 5.13

Question: What are the sources of funds for Computer-Assisted Instruction projects?

Response	Number of Institutions n = 16	Percentage of Respondents
Grants from educational organisations	5	31.3%
Existing institutional resources	4	25.0%
Government funds budgeted for CAI projects	3	18.8%
Non-governmental organsations	2	12.5%
Investment from industry	1	6.3%
Contracts for developing CAI for training	1	6.3%
Faculty	1	6.3%
Personal funds from lecturers	1	6.3%
Sloan Foundation	1	6.3%
State Public Health	1	6.3%
Returns on royalties	1	6.3%

APPENDIX F

Table 5.14

Question: What is the name of your institution?

Developed Countries	Name of Institution	Developing Countries	Name of Institution
United Kingdom	The Open University	**Malaysia**	Universiti Pertanian
Australia	University of Wollongong	**Thailand**	Sukhothai Thammathirat Open University
	Central Queens University	**India**	Indira Ghandi National Open University
	Deakin University	**Argentina**	Instituto Universitario Aeronautico
Canada	Memorial University of Newfoundland	**Israel**	The Open University of Israel
	Assinibone Community College	**Namibia**	University of Namibia
	University of Manitoba	**Pakistan**	The Allama Iqbal Open University
	Simon Fraser University		
Netherlands	The Open University		
United States of America	Indiana University, Bloomington		
	The City University		
	The Indiana University, Gilbert		
	Syracuse University		
	The Virtual College		

Table 5.14 continued

Developed Countries	Name of Institution	Developing Countries	Name of Institution
United States of America	Texas A. M. University		
	Indiana University, East		
	Anthena University		
	Antioch University		
	University of Florida		
	Oregon State University		
	Rogers State College		
	Cerritos Community College		
	Webster University		
	State University of New York		

Table 5.15

Question: Is your institution a distance education university or do you offer conventional education as well?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Distance Education	11 (45.8%)	6 (85.7%)
Conventional Education	-	-
Both	13 (54.2%)	1 (14.3%)

Table 5.16

Question: What is your student population?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
2,000	1 (4.2%)	
10,000	3 (12.5%)	
14,000	2 (8.3%)	
17,000	2 (8.3%)	
20,000	1 (4.2%)	
25,000	1 (4.2%)	
30,000	1 (4.2%)	
44,000	1 (4.2%)	
100,000		1 (14.3%)
200,000		1 (14.3%)
240,000		1 (14.3%)
No Response	12 (50%)	4 (57.1%)

Table 5.17

Question: What type of media do you use to deliver lessons to your students?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
CAI	24 (100.0%)	5 (71.5%)
Printed text	18 (75.0%)	7 (100.0%)
Radio /Audio cassette		
Audio cassette	14 (58.3%)	6 (85.7%)
Radio		3 (42.8%)
Television/Video		
Television broadcast	1 (4.2%)	4 (57.1%)
Interactive television	3 (12.5%)	
Interactive video	1 (4.2%)	1 (14.3%)
Video	8 (33.3%)	2 (28.6%)
Cable transmissions	1 (4.2%)	
Satellite transmissions		1 (14.3%)
Conferencing systems/ Telephone		
Teleconferencing	2 (8.3%)	1 (14.3%)
Computer conferencing	1 (4.2%)	
Telephone		2 (28.6%)
Face-to-face meetings		
Summer/Vacation school	1 (4.2%)	2 (28.6%)
Weekend sessions		3 (42.8%)
E-Mail	1 (4.2%)	
Fax	2 (8.3%)	

Table 5.18

Question: What percentages do these media that you ticked form of the overall teaching media you use?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
CAI		
< 5%	2 (8.3%)	2 (28.6%)
10% - 20%	14 (58.3%)	3 (42.8%)
30% - 40%	7 (29.2%)	
50% - 60%	1 (14.2%)	
Printed Text		
30% - 40%	5 (20.8%)	
50% - 60%	7 (29.2%)	
70% - 80%	6 (25.0%)	4 (57.1%)
90% - 100%		3 (42.8%)
Radio/Audio cassette		
Radio		
30% - 40%		3 (42.8%)
Audio Cassette		
< 5%	1 (4.2%)	2 (28.6%)
10% - 20%	4 (16.6%)	3 (42.8%)
30% - 40%	4 (16.6%)	1 (14.3%)
50% - 60%	5 (20.8%)	

Table 5.18 continiued

Television/Video continued		
Television Broadcast		
< 5%		1 (14.3%)
10% - 20%		1 (14.3%)
30% - 40%	1 (4.2%)	2 (28.6%)
Interactive televisison		
20% - 30%	3 (12.5%)	
Interactive Video		
10% - 20%	1 (4.2%)	1 (14.3%)
Video		
< 5%	2 (4.2%)	
10% - 20%	4 (16.6%)	2 (28.6%)
30% - 40%	2 (8.3%)	
Cable Transmissions		
30% - 40%	1 (4.2%)	
Satellite Transmission		
10% - 20%		1 (14.3%)
Conferencing systems/ Telephone		
Teleconferencing		
10% - 20%	2 (8.3%)	1 (14.3%)
Computer Conferencing		
10% - 20%	1 (4.2%)	

Table 5.18 continued

Telephone		
< 5%		1 (14.3%)
10% - 20%		1 (14.3%)
Face-to-face meetings		
Summer/Vacation school		
10% - 20%	1 (4.2%)	2 (28.6%)
Weekend sessions		
30% - 40%		3 (42.8%)
E-Mail		
70% - 80%	1 (4.2%)	
Fax		
< 5%	2 (8.3%)	

Table 5.19

Question: How do students submit assignments?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Electronic Mail	22 (91.7%)	3 (42.8%)
Postal mail	16 (66.7%)	7 (100.0%)
Computer diskettes	13 (54.2%)	1 (14.3%)
File Transfers	10 (41.7%)	
Lotus Notes databases	4 (16.6%)	
In person	3 (12.5%)	7 (100.0%)
Conferencing software	1 (4.2%)	
Fax		1 (14.3%)

Table 5.20

Question: If you do not use computers as a teaching medium in your school then provide the following information. What are some of the factors?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Lack of funds	N/A	2 (28.6%)
Lack of computer hardware	N/A	2 (28.6%)
Lack of computer software	N/A	2 (28.6%)
Computer personnel	N/A	1 (14.3%)
No response	N/A	5 (71.4%)

Table 5.21

Question: If you are using computers as a teaching medium, do you have Computer-Assisted Instruction courseware?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Yes	24 (100.0%)	5 (71.4%)
No		
No response		2 (28.6%)

Table 5.22

Question: If YES, why did you introduce Computer-Assisted Instruction courseware?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
To provide interaction with lesson material	4 (16.6%)	
To bring reality in the teaching-learning process	1 (4.2%)	
To make some aspects of instruction effective	10 (41.7%)	
To develop critical thinking in students	4 (16.6%)	
To bridge the gap between face-to-face and distance education	3 (12.5%)	
Facilitate drill and practice		2 (28.6%)
Feedback in the absence of the teacher		1 (14.3%)
To improve students performance		2 (28.6%)
No response	2 (8.3%)	2 (28.6%)

Table 5.23

Question: What is your opinion on the effectiveness of Computer-Assisted Instruction as an instructional medium?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Can reduce learning time in some courses	5 (20.8%)	3 (42.8%)
Same as face-to-face instruction in some courses	16 (66.7%)	2 (28.6%)
It improves learning in some courses	21 (87.5%)	3 (42.8%)
It can change learners attitude towards computers	12 (50%)	5 (71.4%)
No response		2 (28.6%)

Table 5.24

Question: In what mode (primary or adjunct) is Computer-Assisted Instruction being used in your institution?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Adjunct mode of instruction	15 (62.5%)	4 (57.1%)
Primary mode of instruction	21 (87.5%)	3 (42.8%)
No response		2 (28.6%)

Table 5.25

Question: How do you deliver Computer-Assisted Instruction Courseware to students?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
World-Wide Web	19 (79%)	3 (42.8%)
On stand-alone computers at study centres	7 (29.2%)	4 (57.1%)
By post on diskettes	7 (29.2%)	
Lotus Notes	6 (25.0%)	
CD-ROM servers	4 (16.6%)	
CD-ROM	3 (12.55)	
ISDN	2 (8.3%)	1 (14.3%)
No response		2 (28.6%)

Table 5.26

Question: At what level (postgraduate or undergraduate) do you use Computer-Assisted Instruction via the World-Wide-Web, Integrated Services Digital Network and Lotus Notes?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Undergraduate	24 (100.0%)	3 (42.8%)
Postgraduate	21 (87.5%)	2 (28.6%)
No response		3 (42.8%)

Table 5.27

Question: What type of communication technology do students and teachers use for interaction and feedback in your institution?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Electronic Mail	24 (100.0%)	4 (57.1%)
Postal Mail	20 (83.3%)	7 (100.0%)
Telephone	20 (83.3%)	6 (85.7%)
Bulletin Board Services	15 (62.5%)	
Listserv	14 (58.3%)	
Multi-User Domain Object Oriented	7 (29.2%)	
Computer conferencing	5 (20.8%)	
Internet Relay Chat	5 (20.8%)	
Forms on World-Wide Web	1 (14.2%)	
Personal visits		6 (85.7%)

Table 5.28

Question: Do students buy their own computers?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Yes, some students have	21 (87.5%)	5 (71.4%)
No, institution provides	3 (12.5%)	5 (71.5%)

Table 5.29

Question: Do you have computer centres for your distance education students?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Yes	24 (100.0%)	5 (71.4%)
No		1 (14.3%)
No response		1 (14.3%)

Table 5.30

Question: What percentage of your students have experience with computers?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
30% - 40%	6 (25%)	2 (28.6%)
50% - 60%	8 (33.3%)	2 (28.6%)
70% - 80%	11 (45.8%)	
No response		3 (42.8%)

Table 5.31

Question: Which subjects do you teach using Computer-Assisted Instruction courseware?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Mathematics	6 (25.0%)	1 (14.3%)
Pyschology	3 (12.5%)	
Neuroscience	2 (8.3%)	
Computer Science	8 (33.3%)	3 (42.8%)
Engineering	3 (12.5%)	
Education	3 (12.5%)	
Social Science	4 (16.6%)	
Law	2 (8.3%)	
Agriculture	4 (16.6%)	
Water Management	1 (4.2%)	
Statistics	2 (8.3%)	1 (14.3%)
Archaeology	1 (4.2%)	
Biological science	2 (8.3%)	
Business Administration	2 (8.3%)	
History	1 (4.2%)	
Anatomy	1 (4.2%)	
Midwifery	1 (4.2%)	
Filming	1 (4.2%)	
Physics	1 (4.2%)	
Chemistry	1 (4.2%)	
English	3 (12.5)%	1 (14.3%)
Human Resources		1 (14.3%)

Table 5.31 continued

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Music	1 (4.2%)	
Business Administration	1 (4.2%)	
Physical Education	1 (4.2%)	

Table 5.32

Question: Has there been any improvement in students performance since you introduced Computer-Assisted Instruction courseware?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Yes	17 (70.8%)	4 (57.1%)
No significant difference	1 (4.2%)	
No		
No response	6 (25%)	3 (42.8%)

Table 5.33

Question: What was the dropout rate in these subjects before you introduced Computer-Assited Instruction?

Response	Number of Institution (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
< 5%	4 (16.6%)	-
No Response	6 (25.0%)	3 (42.8%)
Not sure	12 (50.0%)	4 (57.1%)
Too early to tell	2 (8.3%)	-

Table 5.34

Question: What was the dropout rate after Computer-Assisted Instruction Courseware was introduced?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
< 5%	1 (4.2%)	-
No evaluation has been done yet.	13 (54.2%)	4 (57.1%)
Evaluation in Progress	10 (41.6%)	-
No response	-	3 (42.8%)

Table 5.35

Question: How do you students react to Computer-Assisted Instruction in general?

Response	Number of Institutions (Developed Countries) n = 24	Number of Institutions (Developing Countries) n = 7
Positive	22 (91.7%)	4 (57.1%)
Indifferent	2 (8.3%)	1 (14.3%)
No response	-	2 (28.6%)

APPENDIX G

Table 5.36

Qestion: What is the mode of interaction between your students and their instructors/teachers/facilitators at a distance?

Response	Number of distance education Institutions n = 3	Percentage of Respondents
Postal Mail	3	100.0%
Telephone	3	100.0%
E-Mail	2	66.6%

Table 5.37

Question: What percentage of your students have access to Electronic Mail?

Response	Number of distance education Institutions n = 3	Percentage of Respondents
10% - 20%	2	66.6%

Table 5.38

Question: Does your institution use Computer-Assisted Instruction Courseware to teach your students at a distance?

Response	Number of distance education Institutions n = 3	Percentage of Respondents
No	2	66.6%
Yes	1	33.3%

Table 5.39

Question: Does your institution have the resources to deliver Computer-Assisted Instruction using any of the following: Lotus Notes, World-Wide-Web, Integrated Services Digital Network ?

Response	Number of distance education Institutions n = 3	Number of institutions contemplating distance education n = 3
World-Wide Web	2 (66.6%)	2 (66.6%)
ISDN	1 (33.3%)	1 (33.3%)
Lotus Notes	-	-

Table 5.40

Question: Do you intend to use the World-Wide, Integrated Services Digital Network and Lotus Notes at undergraduate or postgraduate level?

Response	Number of distance education Institutions n = 3	Number of institutions contemplating distance education n = 3
Postgraduate	2 (66.6%)	2 (66.6%)
Undergraduate	1 (33.3%)	-
No response	i (33.3%)	1 (33.3%)

Table 5.41

Question: How would you provide Internet access for your students at a distance?

Response	Number of distance education Institutions n = 3	Number of institutions contemplating distance education n = 3
We have Internet access	3 (100.0%)	3 (100.0%)
Use study centres	2 (66.6%)	1 (33.3%)
Collaborate with other tertiary institutions	2 (66.6%)	1 (33.3%)
Rely on local business community	1 (33.3%)	1 (33.3%)

Table 5.42

Question: What type of communication technology do you intend to use?

Response	Number of distance education Institutions n = 3	Number of institutions contemplating distance education n = 3
Postal Mail	3 (100.0%)	3 (100.0%)
E-Mail	2 (66.6%)	3 (100.0%)
Bulletin Board Service	1 (33.3%)	2 (66.6%)

Table 5.43

Question: What are the likely constraints that your institution might face?

Response	Number of distance education Institutions n = 3	Number of institutions contemplating distance education n = 3
Lack of funds	3 (100.0%)	2 (66.6%))
Lack of personnel	1 (33.3%)	1 (33.3%)
Lecturers do not have the interest	1 (33.3%)	1 (33.3%)

APPENDIX H

AFRICA

Institution	Instructional and Communication Media
University of Botswana, Botswana	Print, periodic residential sessions, weekend sessions at study centres, postal mail, telephone
Universite Marien Ngouabi Service De Enseigneme, Congo	Print, postal mail, telephone
University of Abuja, Nigeria	Weekend sessions, print, audio cassettes, postal mail, telephone
University of Ibadan, Nigeria	Radio and television, teaching sessions during vacation, postal mail, telephone
University of Lagos, Nigeria	Print, television, residiential sessions, face-to-face tuition at study centres, postal mail, telephone
The Open University of Tanzania, Tanzania	Print, face-to-face, session at regional study centres, postal mail
Institut Superieur de Education et de la Formation Continue, Tunisia	Print and summer School, telephone, postal mail
University of Nairobi, Kenya	Print, video and audio cassettes, seminars, postal mail telephone
Institute of Extra-Mural Studies, National University of Lesotho, Lesotho	Print, radio and television broadcast, periodic residential sessions, postal mail
Institut Pedagogique National du Mali, Mali	Print, radio and television broadcast, video, audio-visual and audio cassettes, postal mail
University of Zambia, Zambia	Print, radio broadcast, periodic residential sessions, postal mail, telephone

AFRICA continued

Institution	Instructional and Communication Media
University of Zimbabwe, Zimbabwe	Print, audio cassette, telephone, residential schools, postal mail, telephone
Centre Ivoiren de Formation a Permanentea Distanc, Ivory Coast	Print, postal mail

ASIA

University	Instructional and Communication Media
University of Hong Kong	Printed text, audio cassettes, video cassettes, weekend and evening seminars and lectures, postal mail, telephone
Alagappa University	Printed text, one month contract session, postal mail
Andhra University	Printed text, weekend sessions, postal mail
Barkatullah University	Printed text, personal contact programmes during certain vacations and before examinations, postal mail
G. B. Pant University of Agriculture and Technology	Printed text, seminars and workshops, postal mail
Jawaharlal Nehm Technological University	Printed text, personal contact programmes, postal mail
Katatiya University	Printed text, audio cassettes, video cassette, weekend classes, postal mail
Kota Open University	Printed text,audio cassettes, video cassettes, postal mail

ASIA continued

University	Instructional and Communication Media
Kurukshetra University	Printed text, personal contacts, postal mail
Madurai-Kamaraj University	Printed text, radio broadcast, personal contact seminars - at the end of every year
Maharshi Dayanand University	Printed text, seminars and personal contact programmes
Meerut University	Printed text, personal contact programmes, postal mail
Mother Theresa Women's University	Printed text, personal contact programmes, postal mail
Osmania University	Printed texts, postal mail
Panjab University	Printed text, audio cassettes, personal contact programmes, radio broadcast
Putna University	Printed text, personal contact programmes and radio broadcast
Punjabi University	Printed text, radio broadcast, postal mail
Shivaji University	Two contact programmes for two weeks during the Diwali vacations, postal mail
Sri Venkateswara University	Printed text, personal contact programmes, postal mail
University of Allahabad	Printed text, audio cassettes and radio broadcasts, postal mail
Universtity of Bombay	Printed text, audio cassettes
University of Calicut	Printed text, personal contact programme the last 10 days in a year

ASIA Continued

University	Instructional Media
University of Delhi	Printed text, radio broadcasts, audio cassettes, video cassettes, personal contact programmes (20 days for undergraduates) (30 days for postgraduates)
University of Jammu	Printed text, audio cassettes, postal mail
University of Kashmir	Printed text, personal contact programme which entails two 15-day sessions at the start and end of the academic year
University of Kerala	Printed text, postal mail, telephone
University of Madras	Printed text, personal meetings of 10-12 days
University of Mysore	Printed text, personal contacts
University of Poona	Printed text, audio cassettes, personal contacts
Utkal University	Printed text
Malaysia Sains Malaysia	Printed text, video cassettes, audio cassettes, slides, postal mail
Open University of Sri Lanka	Printed text, audio and video cassettes
Bangladesh Institute of Distance Education	Printed text, audio and video cassettes, radio broadcast

LATIN AMERICA

University	Instructional Media
Circulo de Suboficiales del Ejercito	Printed text, audio cassettes, postal mail , telephone
Universidad Nacional de la Patagonia San Juan Basco	Printed text, audio and video cassettes, postal mail, telephone
Universidad Nacional de San Luis	Printed text, audio cassettes and radio broadcasts, postal mail
Universidad Major de San Adres	Printed text, postal mail
Universidade Federal do Rio Grande do Sul	Audio cassettes, video cassette, Computer Assisted Learning, postal mail, telephone
Universidad Anstral de Chile	Printed text, audio and video cassettes,

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