Distance Education in the Remote Islands of Maldives

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ABSTRACT

Maldives is a country in the Indian Ocean consisting of 200 inhabited islands. Due to the small population sizes in the rural islands infrastructure development had been a major hurdle in Maldives. This has led to the lack of secondary schools in most of the islands in the country. This research aimed at creating a distance education model that can provide access to secondary education to the students in these islands. The research looked at the existing infrastructure of Maldives and the different media used in other countries in the world to provide distance education. Based on these two sets of information a criteria was made to develop a distance education model suitable in Maldivian context. A theoretical model was then developed to suit these requirements in Maldives. The accessibility of this model was then evaluated through a field study in Maldives to find out whether the model was able to reach the students in the outer islands. A learning system was designed based on this theoretical model and implemented in different parts of the country. A questionnaire survey was then carried out to find whether the students accepted the learning system as a mode of study. The study showed that the theoretical model was able to provide access to the students in the outer islands of Maldives. Three aspects of accessibility in the outer islands were investigated, namely physical access, student learning, and student acceptance. Since the evaluation included a successful implementation of the proposed model in some of remotest inhabited islands in Maldives, physical accessibility was achieved. The study showed that the students using the proposed model were able to achieve grades similar or higher to those they obtain in normal schooling. This showed the students' ability to learn using the proposed model. Finally, the study showed that most students liked using the proposed model and were willing to use it for other courses.

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LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
AIOU	-	Allama Iqbal Open University
BOU	-	Bangladesh Open University
CAI	-	Computer Assisted Instruction
CASCADE	-	Computer Assisted Curriculum Analysis, Design and Evaluation
CDB	-	Canadian Development Bank
CMC	-	Computer Mediated Communication
CMI	-	Computer Managed Instruction
COL	-	Commonwealth of Learning
ICCE	-	International Council of Correspondence Education
ICDE	-	International Council for Open and Distance Education
IGNOU	-	Indira Gandhi National Open University
INSAT	-	Indian Satellite
IRI	-	Interactive Radio Instruction
ITESM	-	Technological Institute of Monterry
ITFS	-	Instructional Television Fixed Service
NCC	-	Non-Campus Countries
OUSL	-	Open University Sri Lanka
RME	-	Realistic Mathematics Education
SCS	-	Space Collaboration System

SITE	-	Satellite Instructional Television Equipment
TAM	-	Technology Acceptance Model
TLC	-	Telelearning Centre
TVM	-	Television Maldives
UGC	-	University Grants Commission
USP	-	University of South Pacific
UWI	-	University of West Indies
UWIDITE	-	University of West Indies Distance Teaching Experiment
VCI	-	Virtual Campus Initiative
WorLD	-	World Links for Development

1. INTRODUCTION

Distance Education is the delivery of learning or training to those who are separated mostly by time and space from those who are teaching or training (The Commonwealth of Learning, n.d.). Since the introduction of distance education in 1830s or 1840s a number of studies have been undertaken to outline the different perspectives of distance education. Several considerations have to be made in order to provide an efficient and effective distance-learning package. Some of the main areas focused on are the media choice, needs of the market, characteristics of the consumers, size and technology, and the institutional framework. This research aims to find a viable way to provide distance education in Maldives. The research will look into the possibilities of using distance education in Maldives to move towards the goal of Education for ALL.

1.1 A Brief on Maldives

Maldives is an island nation with a chain of 1190 islands scattered across the Indian Ocean. The nation is 80 – 120 km wide and stretches to 860km long. Of the 1190 islands, only 200 islands are inhabited by local people while a few others are developed exclusively as tourist resorts. The capital of Maldives is Male and one third of the country's population (about 80 thousand) live in the capital.

1.2 Education in Maldives

Primary education is universal in Maldives, but access to secondary education is limited, especially in the outer islands of Maldives. Maldives accommodates most of the students who need the secondary education in the capital. Furthermore, even fewer students have access to higher secondary education and only a handful is able to complete the tertiary education. Tertiary education is only available in the capital Malé. This limitation has been identified and Maldives is working towards providing tertiary and further education for a larger part of the population. For this purpose the country has established a college, which provides further studies in specialised areas. Some of these areas include Health, Nursing, Management, Computing, Accounting, and Teaching, to name a few. All of these are provided in the capital and students have to locate themselves in the capital for further studies. In addition, the college has initiated distance education programmes for the islands. However, due to the lack expertise, these programmes have not been very successful (personal communication).

With an increase in the number of students, the country needs to find new training avenues. At present more than 80 percent of students enter the working population without any specialised skills creating a largely unskilled labour force. Although the training needs of the country have been identified, the training cannot be provided, as the islands are thinly spread across a vast area. The best method of reaching these islands is through distance education.

1.3 A Bird's Eye View of Chapters

As previously mentioned, distance education has been introduced in the country. However, these programmes use print materials developed at host institutions outside Maldives and have not been able to reach all the islands in Maldives. The distance education programme is only a year old and it has not been very successful as these programmes are packaged programmes designed for other countries. Maldives needs to research how distance education could reach the students who no access to the formal education system. The research involves developing a suitable distance education model for Maldives. The model will encompass attributes like universal access, expandability, and use of technology. The development will focus on the existing infrastructure of Maldives, developments of distance education in Maldives, developments of distance education in other developing countries, and media usage in distance education.

Chapter 2 discusses the concept of distance education and identifies media that has traditionally been used. Current use of such media used is analysed for the purpose of identifying its suitability for use in the Maldives. These include print, audio, video, broadcasting, computer, and Internet. These are analysed in the context of distance education and their strengths and weaknesses are described. Broadcasting is separated from audio and video as it is used in different contexts in distance education. This enables us to see the strengths and weaknesses of broadcasting as well as when audio and video are used as separate media components. Similarly Web-based Instruction is separated from computer as the Internet is widely used in distance education and the issues involved using the Internet are more specific and cannot be discussed under a general heading of computer media. This is followed by a brief look at how media is

used in distance education in developing countries. The discussion on educational technology is separated into global programs and regional as well as country wise implementations. Global programs provide an insight into what educational technology is available and how much it is used in developing countries. The discussion then flows into the technology usage in developing countries by looking at the different regions in general and some specific countries.

Examples of models of distance education in countries with similar economic, social and cultural structures as the Maldives are also examined. These include programmes at Bangladesh Open University in Bangladesh, Indira Gandhi National Open University in India, University of South Pacific in the South Pacific, and University of West Indies in West Indies. The review focuses on delivery, support systems, target population, and communication technologies.

Chapter 3 presents the background of the Maldives. A case study approach is used in the design and development of the proposed distance education model for Maldives. This approach was used as this research fits most closely within the boundaries of a case study. This study focuses on developing a distance education model specific to Maldivian context rather than a generalised model, hence it is considered a descriptive or intrinsic case study. This chapter describes the demography of Maldives, current physical infrastructure and planned developments, the population distribution and some aspects of social infrastructure. Analysis of the current infrastructure looks at the communication infrastructure, both transport as well as telecommunications. Transport infrastructure is important for distance education, as it will influence the amount of face-to-face contact included in a program especially when there is

travelling involved. The communications infrastructure discussion focuses more on the telecommunications facilities available throughout the country, which in turn will help identify the media choice for the model. The educational infrastructure is discussed in relation to access to education, enrolment and the drop out rates by level as well as regions. The chapter concludes with a set of criteria for developing a distance education model for Maldives.

Chapter 4 uses the criteria developed from chapter 3 to design and develop a suitable distance education model for Maldives. The model developed is a hybrid model which uses CDROM and Internet. In addition, the model is a three-tier model where the students are not required to have Internet access. The students work offline and can send queries to the teacher at the headquarters through an intermediary level which has Internet connection. The headquarters and the intermediary interface (regional module) are connected through infrequent Internet connections mainly at night during off peak times. In addition to the design of the model, Chapter 4 also outlines the stages of developing a learning system based on the proposed model. The learning system was developed for the purposes of evaluating the proposed theoretical model in Maldivian environment.

Chapter 5 outlines the methodology used in evaluating the learning system. The first stage of evaluation was feedback from colleagues and students at Massey University. Based on the feedback received a learning system was developed and evaluated in Maldives. The evaluation was carried out in two remote islands and the capital. The evaluation was carried out in November 2004 to January 2005 and April to July 2005. The break in the evaluation was due to Boxing Day Tsunami in 2004. The purpose of

the evaluation was to identify if the proposed model was suitable in Maldivian environment. Three main aspects of the evaluation were to find if the model could be physically accessible to the students, would the students learn using the model, and would the students accept the model as a basis for a form of teaching.

Chapter 6 and 7 describes the results of the evaluation. Chapter 6 gives a detailed account of the statistical analysis carried out with the data collected in the evaluation. The discussion and future research areas are identified in chapter 7 of this thesis.

2. DISTANCE EDUCATION WITHIN THE RESEARCH CONTEXT

"In its pure form, distance education is a method of education in which the learner is physically separated from the teacher" (Rumble, 1992). This is just one definition of distance education amongst a wide variety of definitions by different authors. It is important to understand the meaning of distance education within the context of this research prior to identifying the most suitable model of distance education. This chapter looks at the different definitions of distance education and identifies the definition which most closely relates to the context of this research. Furthermore this chapter looks into the different ways in which distance education is delivered to the students across the world. Major focus is given to the media used in delivering distance education and how these media relate to the research context. Different media in distance education are highlighted with an analysis of advantages and disadvantages of each of them. Following the media analysis, a compilation of the media usage in distance education programmes in developing countries is made. Finally this chapter looks at specific distance education programs at both global and national level. Although some global programs are identified in this chapter, the main focus remains on the national level programs and institutional level programs within the developing world. The focus on developing world is deliberate because Maldives is a developing nation and has significant social, economic and cultural similarities with other developing nations discussed in this chapter.

2.1 Growth and Development of Distance Education

Distance Education has been defined from a number of various different perspectives with multiple meanings. First of all, different definitions of distance education adopt different meanings for the word "distance" itself. Distance can mean geographical distance, time distance and possibly even intellectual distance (Simonson, Smaldino, Albright, and Zvacek, 2003). Some authors use a framework with distance and time variables to define the type of education (Aggarwal and Bento, 2000; Simonson et. al. 2003). Using these two variables, four separate types of education can be defined.

These are:

- same time - same place
- same time - different place
- different time - same place
- different time - different place

Same time - same place can be categorised as the traditional face to face classrooms and different time - same place can be categorised as individual learning where the students can learn any time by going to a designated geographical location (such as a study centre). This type of teaching provides the students with equipment and resources in a designated location where the students can attend any time and learn. Same time – different place education occurs when students receive the education at the same time while in different places. Radio and television broadcasts done on predefined times can be categorised as same time – different place education. The final category is different time – different place where the students can access the

education from different locations and on different times. Online learning using Internet is categorised within this category.

Distance education emerged as an innovative system of education, out of some social compulsions, e.g., it began to grow in developed countries after World War II. The devastation caused by the war left these countries ravaged and they searched for an effective alternative educational system to rebuild the nation. It is not clear when organised distance education first occurred. Some historians consider the cave paintings, St. Paul's letters to Corinthians, or tribal talking drums as forms of distance education (Mood, 1995). One account traces correspondence education back to an advertisement in Boston Gazzette on 20th March 1728, in which Caleb Phillips offered to send weekly shorthand lessons to prospective students (Batternberg, 1971; Mood, 1995). Other accounts in literature trace correspondence study back to 1833 in Sweden, 1840 in England, and 1873 in United States, where the teachers sent the materials to students and vice versa via post (Holmberg, 1974; Simonson et al., 2003). According to most authors, conclusive evidence of early distance education dates back to 1833 in Sweden (Holmberg, 1986; Schlosser and Simonson, 2002; Simonson et al. 2003). In 1833, an advertisement in English in Lunds Weckoblad, No.30 (a weekly published in the old Swedish university city of Lund) offered an opportunity to study composition through the medium of post (Holmberg, 1986, 1989). In 1843 the Phonographic Correspondence Society was formed to take over these corrections of shorthand exercise. It was the beginning of what was later to become Sir Isaac Pitman Correspondence Colleges (Dinsdale, 1953).

Since its inception in 1833 up until today, the target groups of distance education have been predominantly adults with occupational, social, and family commitments (Holmberg, 1986). Although this pattern has been changing, the target group still remains as individuals unable to attend the traditional classroom education. Hence distance education stresses individualised learning and flexibility with regards to place and time.

Nineteenth century saw the widespread growth of correspondence education and correspondence education was accepted to a greater or lesser degree as a valid means of study. Several publicly funded institutions along with private colleges offering correspondence education had come into existence in many European countries and the USA. Some of the prominent correspondence colleges include:

- Skerrys College, Edinburgh (1878)
- Foulks Lynch correspondence Tution Service, London (1884)
- University Correspondence College Cambrigde (1887)
- Diploma Correspondence College (presently known as Wolsey Hall), Oxford (1894)
- Hermods School, Sweden (1868) (now Hermods-NKI, in Skolan)
- Illionoise Wesleyan College (1874) (correspondence University Ithaca, N.Y., (1883)
- University Extension Department of Chicago University (1890) in USA

(Dinsdale, 1953; Gadden,1973; and Mathieson, 1971, adopted from Manjulika and Venugopal (1996))

Since the beginning of the twentieth century more and more countries have made developments in distance education. This century saw increased interest in distance education as a means of equalizing educational opportunities, providing education to a scattered population over vast distances, and offering education to deprived and disadvantaged sections of society. The first half of the twentieth century saw significant developments in distance education in Australia and France.

Australia is seen as the first country to have shown in a systematic way, and on a large scale, that it was possible to provide a complete primary and secondary education by correspondence, for children who had never been to school. Victoria and New South Wales were the first states to establish state-wide correspondence study and later helped other states to initiate similar schemes. Australian supervised correspondence education began as a result of an individual initiative (Rayner, 1949). The correspondence movement has since spread to other provinces of Australia, to New Zealand, to West Africa, to Canada, and to USA. Today, these countries educate thousands of children by this method (Holmberg, 1989).

After the outbreak of World War II, the French Government setup the Government Correspondence College, now the Centre national De Tele-Enseignement, with the objective of providing education to school children (Simonson et. al. 2003). After 1945 the centre continued as a regular part of the state educational system.

Distance education expanded within several countries in the 1930s. The founding of the International Council of Correspondence Education (ICCE) in 1938 showed the enthusiasm of educational professionals in the development of distance education.

The ICCE, now known as International Council for Open and Distance Education (ICDE) is the "only forum in the world where distance education institutions and professionals could meet in order to discuss important issues, learn from each other and enter into partnerships and business ventures with each other" (International Council of Open and Distance Education, n.d.).

The founding of the British Open University in 1969 (The Open University, n.d.) marked the beginning of a new era, in which degree giving distance teaching universities with full-fledged degree programmes, sophisticated courses, new media and systematic systems evaluation cropped up in various parts of the world. Until the 1960s the large scale distance teaching organisations had, with a few exceptions, been private correspondence schools. The new era publicly supported and established universities and schools becoming more and more important. An outstanding pioneer in this respect is the University of South Africa, founded in 1873 as the University of the Cape of Good Hope, that spent most of its early history as an examining agency for Oxford and Cambridge universities. In 1946 it assumed a new role as a distance education university and today it offers certificate, diploma and degree courses up to doctoral level (Wikipedia, n.d.). The University of South Africa was definitely established as a distance teaching university through governmental decree of 1962 (Boucher, 1973).

With the rapid growth of new technologies and the evolution of systems for delivering information, distance education with its ideals of providing equality of access to education, became a reality. The period from 1969 onwards has been the most progressive period for the development and credibility of distance education in the

world. Today there are number of institutions and universities in private and public sectors that offer distance education courses to school districts, universities, and the military and large corporations. The establishment of some of the open universities in various countries is given in Table 2.1.

Table 2.1: Major distance Teaching Universities/Open Universities

Name	**Country**	**Year of Establishment**
University of South Africa	USA	1946
Open University	UK	1969
Universidad Nacional De Education a distancia	Spain	1972
Open University	Israel	1974
Fern Universitant	Germany	1974
Allama Iqbal University	Pakistan	1975
Atabasca University	Canada	1975
Universidad Nacional Abierta	Venezuela	1977
Universidad Estatal a Distancia	Costa Rica	1977
Sukhothai Thammathirat Open University	Thailand	1978
Central Radi and Television University	China	1979
Sri Lanka Open University	Sri Lanka	1980
Korea Air and Correspondence	South Korea	1981

University		
Open Universiteit	Netherlands	1981
Korea National University	Korea	1982
Anadolu University	Turkey	1982
Dr. B.R. Ambedkar Open University	India	1982
University of air	Japan	1983
Universitas Terbuka	Indonesia	1984
A1-Quds Open University	Jordan	1986
National Open University	Taiwan	1986
Payame Noor University	Iran	1987
Kota Open University	India	1987
Nalanda Open University	India	1987
Universidade Aberta	Portugal	1988
Y.C. Maharashtra Open University	India	1989
The Open University of Hochiminh	Vietnam	1990
Open University	Tanzania	1992
M.P. Bhoj Open University	India	1992
Dr. Baba Saheb Ambedhkar Open University	India	1994
Bangladesh Open University	Bangladesh	1995
Indira Gandhi National Open University	India	1995
Karnataka State Open University	India	1996
Open University	Hong Kong	1997

Netaji Subhas Open University	India	1997
U.P. Rajarshi Tandon Open University	India	1999
Zimbabwe Open University	Zimbabwe	1999

Source: i. Manjulika and Venugopal (1996); ii. Satyanarayana, and Sesharatnam (2000).

2.1.1 Defining Distance Education

Several authors have defined distance education and a number of different definitions exist in the literature. Although the term 'Distance Education', `Distance study' and `Distance teaching' did not originate in German usage, there are indications that at the early stages these terms were used as a translation of German words like `Fernstudium' and `Fernunterricht', traditional designation for correspondence education in Germany (Holmberg, 1985).

Some authors believe that distance education is an organised form of instruction provided through an educational institution. In this regard Dohmen (1967) described distance education (Fernstudium) as a systematically organized form of self study, where student counselling, the presentation of learning material and the securing and supervising of students' success carried out by a team of teachers, each of whom has responsibilities (cited in Tang, n.d.). Afterwards Peters (1973), defined distance education as "a method of imparting knowledge, skills, and attitudes which is rationalized by the application of division of labour and organizational principles specially for the purpose of reproducing high quality teaching material. Peters argued that this will make it possible to teach a great number of students at the same time, which Peters called an industrialized form of teaching and learning (Peters, 1983).

Peters' theory of distance education seems to have great pedagogic importance because he emphasised a specific ethos which relates distance education to the nature of an industrial society. It is also possible to view distance education as a system arising from new specific needs of an industrializing society in which almost all activities, including education, have to fit into time schedules that are geared to more rigid working and learning conditions. However, Sewart (1983) believed that the heart of distance teaching is a "continuity of concern" for students learning at a distance. This expression proposes a human element to the industrialised form of education suggested by Peters.

Another aspect widely used in many distance education definitions is the physical separation of the teacher and the student. According to Holmberg (1986) separation of the student and teacher is fundamental to all forms of distance education. Equally important is the educational organisation which structures the learning materials in a way that creates effective learning. Basic to Holmberg's definition are two elements both of which can be considered essential

- The separation of teacher and learner
- The planning of an educational organization.

Moore (1983) very fruitfully proposed the use of the term `distance' in the expression `transactional distance', which defines the nature and degree of separation of teacher and learner in the educational process. According to him, independent study is a generic term which encircles all the educational transactions in terms of variables of

`distance' or `apartness' and `autonomy'. He mentioned that 'the actual distance between the learner and the teacher is measured not in terms of the spatial distance between the two, but in terms of the degree of dialogue and individualization which an academic programme offer'.

Rumble (1989) defined distance education as a process containing a set of different components. He stated that the process must have a teacher, a student, a curriculum or course, and a contract between the student and the teacher or institution, which describes the respective roles of teacher and students. In his definition Rumble stressed the physical separation of the teacher and the students exists in distance education. Delling (cited in Keegan, 1986) defined distance education as a process which bridges the physical distance between the teacher and the students by means of a technical medium. The use of technology to bridge the physical distance between teacher and students is also emphasised by the U.S. Department of Education's Office of Educational Research and Improvement (Simonson et al., 2003). Perraton (1988) saw distance education as a process in which a significant part of the teaching is done by a teacher who is physically apart in space and/or time from the learner. In essence, Perraton's definition states that the distance education occurs where there is a lack of face to face instruction.

The French government, on 12 July 1971, passed a law regulating distance education in French territories and defined distance education (Keegan, 1983, 1986). Their definition also included the separation of the student and the teacher, and included the possibility of occasional face-to-face contact. Moore (2005) adds two-way communication and use of technical media to his definition of distance education. He

also stated that distance education should be intentional and not accidental. Hence most of the definitions describe distance education as a form of teaching where the teacher and the students are physically separated.

Keegan synthesised some of the above definitions to form a list of five key elements for distance education (Schlosser and Simonson, 2002);

(1) the separation of teacher and student

(2) the influence of an educational organisation in the provision of the instruction

(3) the use of technical media

(4) the provision of two-way communication

(5) the absence of a learning group throughout the learning process

All of these elements define the traditional view of distance education. However, the current trends in communications, and advances in technology have introduced a number of various terms into the literature which are synonymously used with distance education. For example distance learning, open learning, flexible learning. An attempt to define these terms is outside of the scope of this research. However, it is important to note that although distance learning and distance education have been used synonymously, they are two separate entities. Distance learning focuses on the student while distance education focus on activities of both the student and the teacher. Hence distance education, as defined above, is the relevant term for this research.

2.1.2 Conclusions

The common element in all the definitions discussed above is the physical separation of the teacher and the student. Therefore physical separation will be a key factor in the definition of distance education used in the context of this research. The definition that will be used in this research is in line with the definition used in Simonson et al. (2003). They define distance education using four components. The first component is the concept that the distance education is institutionally based. This research is looking at ways in which students can gain access to formal secondary education. Hence the distance education will be based on school curriculum and planning and control will be done through an educational institution. The second component is the physical separation of teacher and students which again is a major factor underlying this research. The third component is the use of interactive telecommunication for synchronous or asynchronous communication between teacher and students. In other words this would be the medium by which teacher and students communicate and possibly the medium of delivery of content. The fourth component is the concept of connecting learners, resources, and instructors. The research focuses on finding ways in which secondary education can be provided to the students in various islands of Maldives. Distance education was identified as the only feasible way as analysed in detail in the following chapter. Once the term "distance education" is defined within this context the second step is to find out what are the different ways in which distance education can be used to deliver content to the students. The following section outlines different media that can be used in distance education and their positive and negative aspects.

2.2 Media in Distance Education

Media is one of the three approaches that identify the form of distance education (Keegan, 1983). The medium of delivery has been a distinctive feature in the history of distance education (Ely, 2003). Four different categories of media can be identified in distance education, namely print, audio, video, and computer-based. All of these four different categorises of media are investigated in this chapter. In addition, broadcasting is investigated separately because broadcasting has also been used extensively in distance education. Media in distance education is reviewed in order to make an informed decision on media choice for the distance education model for Maldives. All of these media choices are examined and weighed prior to the development of a distance education model for Maldives.

The term distance education has become blurred with the advances of telecommunication technologies. The telecommunication technologies enable learners at different locations to interact in real-time diminishing the barriers of distance. Different media used in distance education provide a different set of capabilities for the distance education developers. Each of the following media sections identify the capabilities of the media they provide in distance education, and their availability and their usage in the developing world. The media sections are divided in print, audio, video, broadcasting, and computer.

2.2.1 Print

Print is the most common medium used in distance education, and is used in some form in almost all the distance education courses regardless of any other media employed (Habash, 1998). Print was used in the first distance courses offered through

correspondence study and it is the foundation of distance education (Holmberg, 1974; Keegan, 1983; Simonson et al., 2003). All the other different delivery systems have evolved from the basis of print media (Willis, 1995). Even with the technological developments and introduction of new technologies in distance education print continues to play a vital role in delivering distance education (Misanchuk, 1994).

> *"Print is a one-way communication channel that can be used very effectively to present text and illustrations and other visual information to large numbers of students who have the study skills needed to study independently" (Print, n.d.)*

2.2.1.1 Formats of Print

Originally print was used as the only medium of instruction in distance education, namely correspondence study, home study, or independent study (Moore and Kearsley, 2005; Pittman, 1990, cited in Moore and Kearsley, 1996). In correspondence study the learners are sent the information and content in print form. The communication between the teacher and the learner also occurs via print. Nowadays the interaction between the teacher and the learner takes different forms depending on the available technology and the speed of the communication. However, print is still used in some form in almost all distance education courses (Moore and Kearsley, 2005).

Print takes different forms such as study guides, textbooks, books of readings or reprints, manuals, course notes, course syllabi, workbooks, and case studies (Misanchuk, 1994; Moore and Kearsley, 1996). One of the strongest communication

and most important methods in print are study guides (Moore and Kearsley, 2005). Unlike textbooks, which follow a logical order and structure, the study guides construct devices and techniques to assist the learner to master the content. Careful design has to go into print materials to make them instructionally effective. The two critical factors in designing print materials are the reading level and simplicity of writing style (Moore and Kearsley, 1996).

2.2.1.2 Advantages of Print

Numerous advantages are linked with print in distance education. Learners are already familiar and readily accept prints materials as a medium of delivery (Barron, 1999; Misanchuk, 1994). In terms of technology, the learners, instructional designers, and subject matter experts are all competent and understand the technology (Thomas, 2001). Furthermore, print materials can be delivered to the learners without distractions from technological faults and the learners do not require any special facilities to access them. Hence, the learners are able to use print materials any time and at any place (Misanchuk, 1994; Willis, 1995). Print materials do not require the learner to learn the navigation patterns as with some other media. Finally, print media is less expensive and efficient in delivering large quantities of content (Barron, 1999; Misanshuk, 1994; Thomas, 2001).

Print materials can be used flexibly, where the students have a high degree of control over the way they use it (Barron, 1999; Thomas, 2001; Willis, 1995). In addition, the primary focus for the developer, when developing print materials can be on the content as opposed to the technical requirements of the delivery system (Willis, 1995). The introduction of electronic desktop publishing has brought more efficiency

and quality in producing print materials (Moore and Kearsley, 2005). It also allows easy revision of print materials and cost-effective to produce in small amounts.

2.2.1.3 Limitations of Print

One of the weakest aspects of print materials is the difficulty of interacting with the learners. Unlike some other media, interaction is difficult to accomplish with print (Barron, 1999; Misanchuk, 1994). Another limitation, which is mostly common to the younger generations, is their ability to optimise the print materials. As the younger generations are more confident and comfortable with other forms of media like television they find it hard to utilise the print materials to their optimal (Barron, 1999; Willis, 1995). Print media lacks the ability to recreate motion or sound (Barron, 1999; Thomas, 2001; Willis, 1995).

2.2.2 Audio

Audio is used in distance education for the purposes of voice communications. With the advances in communication technologies alternative delivery options to print have come into force (Moore and Thompson, 1990, cited in Wolcott, 1994: 135). Audio usage can be mainly categorised into radio, pre-recorded media, and telephone (Barron, 1999). Radio is discussed in more detail in the broadcasting section.

2.2.2.1 Pre-recorded Media

Pre-recorded media takes the form of audiotapes, phonograph, and audiocassettes. Audiocassettes have become an important media for distance education in the past two decades (Moore and Kearsley, 1996). British Open University used

audiocassettes as an integral part of their courses (Wolcott, 1994) and it is said to be the most important technological innovation in its 20-year history in terms of its impact on learning and the number of students and courses affected (Moore and Kearsley, 2005).

Audiocassettes are inexpensive, easily duplicated, and very versatile, which makes audiocassettes an ideal delivery media for distance learning course (Barron, 1999). In addition, audiocassettes are portable, easy to use, and provide greater flexibility and access over "real time" technologies (Macmullen, 2001).

2.2.2.2 Telephone

Telephone technology has been one of the paramount innovations in distance education. Since the 1970s the telephone has been extensively used as an audio delivery mode in distance education. The United States extensively uses its public telephone network in audio instruction (Wolcott, 1994). Today telephone technology can provide common conference calls as well as visual and data transmission with voice messages.

2.2.2.3 Audio-based Teleconferencing

Teleconferencing links students and instructors at two or more locations using a telecommunications technology. The conversation takes place in synchronous mode hence students and instructors interact in real time. Two forms of audio-based teleconferencing can occur: audio conferencing and audio graphics.

Audio conferencing is an audio only system, which is the most common and least expensive method of teleconferencing. Audio conferencing can occur in three modes: simplex, half-duplex, and duplex. Simplex systems allow communication in one direction at a time while half-duplex with faster switching allows the parties to interrupt and change direction of the flow of communication (Wolcott, 1994). Duplex allows communications in both directions at the same time as in a telephone conversation (Wolcott, 1994).

Audio graphics systems allow visual and data transmission in addition to voice communications. The data and visual images supplement the voice communication and are transmitted through the telephone lines (Moore and Kearsley, 1996; Wolcott, 1994). Audio graphics systems are suitable for courses that require a lot of illustrations hence they are very popular in science and engineering classes. However, they are hardware intensive which limits their use. Also an effective audio graphics session needs a considerable effort in terms of planning and preparation.

In addition to the telephones audio graphic peripherals are used in communicating the data and images to the different locations. These peripherals include facsimile machines, electronic blackboards, video images, and computers.

Facsimile Machines - While the audio conferencing is going on, facsimile machines are used to send images between the locations. Facsimile machines are widely used for these purposes for their availability, low cost, and speed compared to mail (Wolcott, 1994). However facsimile machines can cause delay in transmission and also the quality varies between machines (Wolcott, 1994).

Electronic Blackboards - Electronic blackboards transmit anything written or drawn at one site to television screens at other sites (Moore and Kearsley, 1996). Interaction can occur with students responding using electronic blackboards. Although real time interaction can occur with electronic blackboards, illegibility is of great concern when using these devices (Wolcott, 1994).

Video Images - Video Image Systems capture snapshots of video using a video camera at one location and transmitting the image to video screens at other locations through a separate telephone line (Wolcott, 1994). The images can be transmitted in black and white as well as in colour. Some of the advantages of this system include convenience, ease of use, affordability, and portability. The disadvantages include delay in transmission and lack of motion in images (Wolcott, 1994).

Computers - Computer-based systems transmit any images, data or even programs from one site to another. They use a graphics tablet to draw the images on computer screen and they appear on the screens at other locations (Moore and Kearsley, 1996). In some cases these systems include a digitising camera that produces an image of anything that is placed in front of the camera on the screens at other locations (Moore and Kearsley, 1996).

2.2.2.4 Advantages of Audio Technology

Advantages of audio can be threefold; inexpensive, easily accessible, and easy to use. All of the audio technologies are relatively inexpensive in terms of the costs of production, distribution, and use (Barron, 1999; Thomas, 2001). Both the students and

teachers are familiar and comfortable in using audio technologies and audio technologies are easily accessible to most students (Barron, 1999; Thomas, 2001).

2.2.2.5 Limitations of Audio Technology

Some limitations of audio technology include the lack of visual information, except in the case of audio graphics. The lack of visual information makes it hard for the students to focus and learn strictly through audio input (Barron, 1999). Furthermore, the lack of eye-contact and body language make the students' uneasy to communicate (Barron, 1999). Audio conferencing will also require scheduling a convenient time for both the student and the teacher thereby making it less flexible.

2.2.3 Video

> *"From ancient cave paintings to contemporary video technology, visual symbols and codes provide the connection between thought and experience"*
>
> *(Oliver, 1994: 165)*

Video can be used to capture attention and convey a lot of information quickly (Moore and Kearsley, 1996). Since video shows interaction between people it is very useful in teaching interpersonal skills as well as showing procedure and sequences (Barron, 1999; Moore and Kearsley, 1996). According to Oliver (1994), video in distance education can be categorised into four general categories: pre-produced video, televised instruction, interactive video, and videoconferencing. Each of these media can be described using the direction of audio and video signals used, namely

one-way video, two-way video, one-way audio, and two-way audio. Pre-produced videos are telecourses designed and produced for specific instructional objectives and can be distributed as videocassettes or other video-based technologies (Oliver, 1994). Pre-produced videos use one-way audio and one-way video. In televised instruction a normal classroom lecture is transmitted to other location. In some cases, interaction with off-campus students can be achieved through telephone. In these circumstances these televised instructions use one-way video and two-way audio. Interactive video is an integration of instructional television with computer-mediated instruction to interact with the subject matter through computer-controlled instructions (Oliver, 1994). Videoconferencing is when people at two different locations interact with each other through televised images in real time. Both interactive video and videoconferencing uses two-way audio and two-way video.

Normally both broadcast as well as non-broadcast video is used for passive viewing. This could be reduced through exercises during the video and completing activities at different points in the video. Interaction through other media like telephone and even face-to-face tutoring could counter for the passive viewing (Oliver, 1994).

2.2.3.1 Video-based Technologies

As mentioned above, video-based technologies fall into the two broad categories of one-way asynchronous communication and two-way synchronous communication. One-way asynchronous communication allows only receiving the transmission without having the ability to send any messages while two-way allows both receiving and sending messages. One-way asynchronous technologies include broadcast television, videocassettes, videodisc, interactive video, and multimedia (Oliver, 1994).

Synchronous two-way technologies include cable television, instructional television, satellite point-to-multipoint delivery, compressed video, and videoconferencing (Oliver, 1994). Broadcast television will be discussed in detail in the next section.

Videocassettes

The use of videocassettes depends on the availability of Video Cassette Players or Video Cassette Recorders. Videocassettes enhance learning when used with other media. They also provide more flexibility than broadcast television because the learners can pace the instruction according to their needs as well as choose the time for instruction (Brown, 1984 cited in Oliver, 1994). Videotapes are easy-to-use, common, and inexpensive in delivering distance learning to students (Barron, 1999).

Videodiscs (Video CD and DVD)

Videodiscs serve a similar function to that of videocassettes but videodiscs are laser encoded into plastic discs. This makes the videodisc more durable and enables instantaneous random access to information located anywhere on the disc, which videocassettes are not able to provide. Original videodiscs could store up to 54,000 still images and 30 minutes of full motion video on each side (Oliver, 1994). Video CD (VCD) today can store a full motion picture of 70 to 80 minutes and DVDs can store more than 2 hours of very good quality video (VideoHelp, n.d.).

Interactive Video

Interactive video is a hybrid technology that integrates videodiscs with the computer. This technology offers learners a self-paced system that is computer-controlled, making it more interactive (Kemp & Smellie, 1989 cited in Oliver, 1994).

Videoconferencing

Videoconferencing allows people at two or more sites to see and talk to each other simultaneously using communication technology (Knowledge Network Explorer, n.d.). Videoconferencing can also allow sharing of computer applications. Normally videoconferencing requires broadband satellite connections, which can be very expensive. Using "slow scan" or compressed video reduces the cost by using standard telephone lines to transmit the video. "Slow scan" transmits the picture in 20 to 30 seconds chunks making it as cost-effective as audio conferencing (Moore and Kearsley, 1996). Compressed video sends messages through the normal telephone lines by compressing the analogue signals into digital signals (Telg, 1999) reducing the cost considerably. As a result of this compression the picture quality of the video images is not as good as the normal television transmission (Oliver, 1994). During 1990s this technology, coupled with ISDN, became more widely available and produced better quality picture using a 128 kbps of data transmission. This technology, also known as videotelephony, costs the same as standard telephone calls and with the use of fibre-optic cable makes the video transfer at a higher rate (Moore and Kearsley, 2005). Videotelephony allows individuals and groups of learners to have conversations using their own personal computers (Moore and Kearsley, 1996).

2.2.3.2 Advantages of Video Technology

Video technology can provide the learners with both audio and video images depicting a real face-to-face environment. It will also enable the students and teachers to see the facial expressions as well as the body language adding a more personal touch to the communication (Barron, 1999).

2.2.3.3 Limitations of Video Technology

Video technology is more expensive than audio technology, both in terms of production equipment as well as delivery media. Video technology also requires more expertise, planning, and preparation in order to produce quality video (Barron, 1999). Finally, most videoconferences need to be planned and are not spontaneous; hence a lot of resources and time need to be allocated for effective communication.

2.2.4 Broadcasting: Radio and Television

Broadcasting in education can be traced to early 1900. Broadcasting has been a major evolutionary development in distance education with the use of both radio and television (Moore and Kearsley, 1996). Broadcasting has been at the heart of projects designed around communications media to address the educational needs (Perraton, 2000). It is a strong medium to attract wider audiences quickly regardless of the distance.

2.2.4.1 Radio

Radio has been one of the earliest means of delivering education apart from the traditional face-to-face classroom settings (Wolcott, 1994). Radio has been and is used in delivering both formal and non-formal programmes. Although radio has failed in some of the industrialised countries like USA, it has been a major success in developing countries (Tilson, 1994 cited in Moore and Kearsley 1996; Wolcott, 1994). Radio has been extensively used as an educational medium in Thailand, India,

Swaziland, Mali, Columbia, Mexico, Nigeria, Kenya, Nicaragua, The Phillipines, Guatemala, Sri Lanka, Trinidad and Tobago, South Korea, Botswana, The Dominican Republic, and Paraguay (Sharma, 2002). The main reason for the failure of radio in the USA was its lack of interactivity and the introduction of video technologies. However, interactive radio (two-way) has been used both in Australia as well as in Alaska (Wolcott, 1994). A very successful Interactive Radio Counselling experiment has been conducted at Indira Gandhi National Open University in India. The details of this experiment are given in section 2.3.2.1.

2.2.4.2 Television

Television, like radio, has been another broadcast media used in education for decades. The British Open University was one of the first institutions to use television extensively to deliver its distance education programs (Moore and Kearsley, 1996). Some of the forms of television transmission used for educational purposes include cable television, instructional television fixed service (ITFS), and satellite delivery.

Cable Television distributes video signal to its viewers through coaxial or fibre optic cables directly connected to their television sets. This medium is widely used in USA to deliver education to homes. Individual institutions can install coaxial cable networks inside the institution to provide educational programmes through a closed circuit transmission (Moore and Kearsley, 1996). Interaction is not possible when mass distribution of instructional video is carried out via cable television. However, other media, such as the telephone, can be used for questioning and comments while the program is being broadcasted (Moore and Kearsley, 1996, Oliver, 1994). Cable

networks do have the capability of two-way communication between the subscribers allowing interactivity (Wolcott, 1994).

Instructional Television Fixed Service (ITFS) technology uses microwave transmission and special antennae to receive the signals (Moore and Kearsley, 2005). Normally these transmission towers are located on high grounds as the signal can only be transmitted in direct line-of-sight (Oliver, 1994). ITFS originated in 1961 and is a low-cost, low-power, over-the-air distribution system in which transmits instructional video over small areas (Barron, 1999; Moore and Kearsley, 2005).

Satellite Point-to-Multipoint Delivery: Unlike ITFS satellite technology is not limited to small geographical area. Satellite technology allows video and audio signals from an uplink located on earth to be bounced to any number of downlink earth stations (Willis, 1995). The transmission costs do not increase with the increase in the number of downlinks (Oliver, 1994). Mid 1970s saw the first use of satellite technology in education. Satellites like INTELSAT, PEACESAT, and ATS have been widely used for educational purposes (Moore and Kearsley, 1996).

Space Collaboration System (SCS) is a satellite communication network developed to facilitate the video conferencing in Japan (Tsao, n.d.). It is a two-way video communication system where students receive lectures via video in a classroom type environment. In addition, the lecturers are able to observe the students. A unique feature of this system is data caching in which students in distant locations may request that CAI (computer-aided instruction) materials be delivered via satellite direct to PCs and workstations. The SCS system has been used to implement a

cooperative distance education project between Japan, China, and Thailand (Tanigawa, Ileura, Anzai, and Kaneko, 2002).

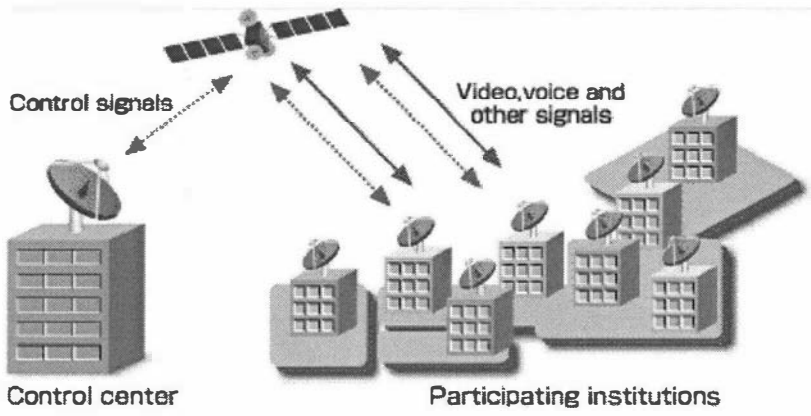

Figure 2.1: SCS system (Source: The Space Collaboration System, n.d. http://www.jsat.net/en/service/network02.html)

EDUSAT of India and USPNet of Fiji are significant programs that utilises satellite technology in the developing world. These programs are further explained in sections 2.3.2.1 and 2.4.3.3 respectively.

Direct Broadcast Satellite (DBS) technology is widely used in United States for television reception (Moore and Kearsley, 2005). DBS systems use a small, inexpensive satellite dish that makes it easy for the learners to receive the programs at their homes or offices. DBS is seen as a technology that could replace other methods of video broadcast and narrowcasting (Moore and Kearsley, 2005).

2.2.4.3 Strengths and Weaknesses of Broadcasting

One of the major strengths of broadcasting is its immediacy. Broadcasting can provide up-to-date reports to the learners on the subject. Also if broadcast media is used in conjunction with print (for example: study guides) it can keep the learners on track by providing routine and timely tasks. Broadcasting has a way of making the learners feel part of the community and it, being a public media, can attract potential learners. It can be used effectively to attract the attention of potential learners, general public, as well as decision-makers (Perraton, 2000). In particular radio has the advantage of being a flexible medium with a low production cost (Moore and Kearsley, 1996). Finally, radio is seen as one of the most easy and familiar technology to most people (Bates, 2005).

One of the major weaknesses of broadcasting is its inability to create interaction. It is difficult to have a two-way communication between the teacher and the learners with broadcasting technology. Although Interactive Radio Services with the use of phone-in service provides some form of interactivity, the level of interactivity and participation are often low (Bates, 2005). In addition, the ephemeral nature of the broadcasting technology poses a great disadvantage to the learners (Bates, 1984, 2005). Another drawback, in particular to television, is the high development cost. The better the television production is, the more expensive it becomes (Moore and Kearsley, 1996).

2.2.5 Computers

Today computers have become important tools in distance education especially in eliminating the barriers in long-distance communication. Computers are used in several different ways to derive educational goals and objectives. Computer-based instruction offers the students with high quality opportunity to interact with the subject matter with his/her complete control (Moore & Kearsley, 2005). Computer applications in distance education has been categorised in many different ways. The most common set of categories include computer assisted instruction (CAI), computer managed instruction (CMI), computer mediated communication (CMC), and computer-based multimedia (Willis, 1995). Computer assisted instruction is an early attempt to provide adaptive instruction but falls short of analysing students needs (Computer-Assisted Instruction, n.d.; Willis, 1995). Computer managed instruction incorporates broader objectives through the utilisation of computer's capabilities to manage learner's progress, learning process, individualised tutorials, evaluations, and guidance (Markwood, 1994; Willis, 1995). Computer managed instruction is also known as learner management system (Computer-Managed Instruction, n.d.). Computer mediated communication is the use of networked telecommunications systems that facilitate encoding, transmitting, and decoding messages between participants (Romiszowski and Mason, 2004). Computer-based multimedia comprises of a common delivery system which incorporates several different media including text, audio and video (Willis, 1995).

2.2.5.1 CD-ROMs

Computer-based instructional materials have been used widely in education since the advent of personal computers however it has not been very popular in distance

education until recently (Moore and Kearsley, 1996). Despite the late popularity computer-based materials provide a major strength in creating an interactive environment for the learner. Especially with the introduction of CD-ROM based materials the developers can incorporate audio, video, text and graphics into one CD-ROM creating a very effective interactive environment. Even before the use of CD-ROMs in distance education The British Open University demonstrated the extent of computer usage as standalone devices in distance education through its Home Computing Program (Markwood, 1994).

2.2.5.2 Computer Networks

Networks make the delivery of computerised distance education easier and effective. Two types of computer networks exist, they are local area networks (LANs) and wide area networks (WANs). LANs are computers connected through wire or radio circuit while WANs rely on telephone circuits for their connections. Several advantages can be gained from having a network such as resource sharing, reliability through redundancy, decentralisation, and providing powerful communication tools (Markwood, 1994). Communication tools are the one aspect that draws most attention from a distance education perspective. Some of tools that the distance education developers use include Email, Bulletin Boards, Computer Conferencing, Internet and the World Wide Web (WWW).

Email is a computer messaging system where a person could send a mail to another. This is an asynchronous mode of communication where messages are left in one person's mailbox without any real-time dialogue (Williams, Paprock, and Covington,

1999). Email is used widely in distance education for tutoring purposes making the contact time that much faster.

Bulletin boards are based on email where the learners can post anything on it. Bulletin boards can be referred as an email conference (Markwood, 1994). Anyone who has access to the bulletin board can post anything on the board and the messages has no order unless someone takes times to organise the material posted on the board. Moderated bulletin boards will have editors who determine the content that will be posted on them and can make the communication useful, interesting, long-distance, and on going (Markwood, 1994).

2.2.5.3 Computer Conferencing

Computer conferencing allows the students and teachers to communicate both asynchronously or in real time using computers to deliver a variety of different media (Markwood, 1994; Moore & Kearsley, 2005). Computer conferencing offers the following features

- Electronic mail between the participants in the system
- Conferences where the participants can read and write messages
- Sub conferences
- User information of all the participants
- Level of privileges of the participants
- Synchronous communication by means of chat facilities

(Mason, 1998)

Some computer conference systems also allow anonymous contributions, make connections to other email and conferencing systems, and support online examinations and assignments (Mason, 1994).

2.2.6 Web Based Instruction

World Wide Web (WWW) is increasing its role in delivering distance education. Web combines text, audio, video and graphics and also allows interactive audio and video (Mason, 1999). More and more institutions are engaging themselves in developing and delivering online courses. Several universities in USA are already providing online education where the processes from registration to graduation are all available online. Institutions in the developing world are following suit, for example Indira Gandhi National Open University in India recently launched its virtual campus initiative (Sharma, 2001) and the World Bank has begun to use computer technology to establish an African Virtual University (Perraton, 2000).

2.2.7 Media Usage in the Developing World

Different media dominate our world at different times. Radio, television, satellite and computer have all had turns at this domination. Distance education has used these media to some extent. The distance education continuum of the developed world is in shown in Figure 2.2.

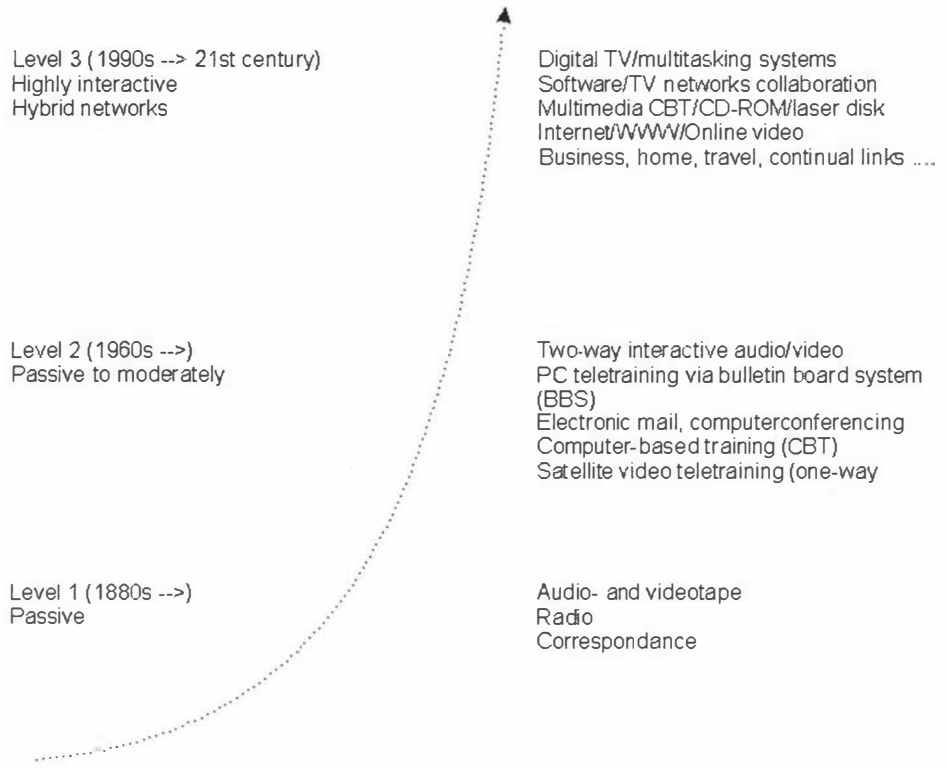

Figure 2.2: Distance Education Continuum (adopted from Williams, et. al. 1999)

Although the developed world moved towards the hybrid networks and virtual classrooms the developing countries still use print as a dominant media. As seen in Table 2.2 90% of the institutions still use print as one of the mediums of delivery with 70% of the courses having a face-to-face component. Audiocassettes, videocassettes, and radio have 30%, 25% and 20% usage respectively; the rest of the media have been used rarely.

Table 2.2: Media used in Distance Education in developing countries (data taken in 2001)

Regions	Print	Audiocassettes	Videocassettes	Videoconferencing	Radio	TV	Satellite (Video)	CBI	Internet	Email Support	Face-to-Face Sessions	Telephone Support	Teleconferencing
Africa (139)	121	27	19	0	28	6	0	4	4	1	86	13	1
Asia (92)	85	31	25	1	25	13	3	6	4	1	69	2	2
Caribbean (4)	3	2	1	0	1	0	0	0	0	0	2	0	0
Latin America (48)	46	26	27	0	4	6	1	4	2	1	41	20	4
South Pacific (5)	4	1	1	0	1	0	1	0	0	0	4	1	1

(Adapted from International Centre for Distance Learning website, http://www-icdl.open.ac.uk)

However, there are some good examples where media other than print is used primarily in delivery distance education. The radio schools in Latin America use radio as primary tools to disseminate the instruction. Since the radio stations are privately owned the choice of radio as a medium for delivery was not a political decision but it was based on the need to reach isolated peasant learners (Perraton, 2000).

The use of a dedicated radio and television broadcasting system in Central Radio and Television University in China is another example where broadcasting media is used effectively to reach scattered distribution of learners. Telesecundaria in Mexico is another education project where television is primarily used to reach a large number of secondary level students. Even in this case the television option is feasible because

the audience is scattered and large (Perraton, 2000). Although broadcasting can be used to reach large and scattered audiences it is not always practical. For example in China additional media like text-books and face-to-face tutoring were required to supplement the instruction that could not be broadcast due to time constraints (Perraton, 2000). Satellite communication and teleconferencing has been widely used in University of South Pacific (University of South Pacific, n.d.) and University of West Indies (UWI) to reach students in the small island states (Perraton, 2000). USP offers distance education to its 12 member countries through its own satellite communications network (University of South Pacific, n.d.). The cost of establishing the telecommunications networks for both these countries were borne by external aid. In case of UWI the Caribbean Development Bank (Brandon, 1999) financed the network while New Zealand and Australia financed the USP network (Matthewson and Va'a, 1999).

Computers in distance education brought a new dimension to its delivery. Computers provided the options of tutoring, distributing, and teaching distance education programs. Emails, bulletin boards and mailing lists provided the tutoring while computer links meant that the materials could be delivered electronically. Electronic distribution of materials increases the speed of delivery and reduces distribution costs while overcoming the problem of postal delays. However, this poses more disadvantages, one being that this shifted the cost from the producer to the user (Perraton, 2000). Computers could also be used for teaching; for example a whole course could be developed and put on the Internet. Hence computer technology can enhance the open and distance learning. Yet it cannot be capitalised on in most parts

of the developing world as there is a lack of access to computers and because of the high cost of telecommunications.

The use of media and technology in distance education is based upon the environment in which it operates. Mostly the media choice is dictated by the availability and the effectiveness of media in a given environment. With the advances in the technology distance education has expanded from national to global programmes and it is important to look at some of the technology implementation within the developing world.

2.3 Educational Technology Implementation

Educational technology implementation in developing countries is reviewed to understand how technology is used in these countries and how these experiences can be used in the Maldivian context. The media discussion builds the platform for discussing the use of different media in separate regions of the world. These discussions are focused in developing regions as these regions have to some extent similar infrastructures and conditions as Maldives. The discussion will lead to a better understanding on how media and technology has been successfully implemented in developing countries across the world.

Educational technology has leaped ahead during the last decade. However, the leap occurred only in the developed countries while developing countries were still struggling to get enough textbooks to their schools. The developed nations have the infrastructure and economic capabilities to reach rural areas whilst the developing

countries are desperately searching for effective ways to reach rural populations. Internet is the main tool used in the developed world with more than 50% of their population having access to telephones, but most of the developing nations do not even reach 1% (Eastmond, 2000). The lack of infrastructure severely restricts the use of advanced technology in developing nations. It is important to evaluate what educational technology is used and to what extent it is used in the developing world.

The development of educational technology differs in different countries as well as different regions. For a comprehensive review of the educational technology implementation a number of different regions are to be looked at. However, some educational programs exist that use the same technology across the globe. This section will first review these programs and then focus on the implementation issues in the different regions.

2.3.1 Global Programs

2.3.1.1 World Links for Development (WorLD)

WorLD provides Internet connectivity to the developing countries bringing the students into the global community through online (The World Bank Group, n.d.). The WorLD program provides Internet connectivity in secondary schools, training and educational content, regional and global partnerships with the private and public sector, policy advice in the use of telecommunications in education, monitoring and evaluation. A more detailed description of WorLD projects is given in the regional sections later in this document.

2.3.1.2 Schools Online

Schools Online is a public benefit organisation formed to help ensure schools across the globe have effective access to communication and information resources of the Internet (Schools Online, n.d.). Schools Online is the educational division of the Relief International[1], whose mission is to help students get access to communication and information resources for learning. Schools online provide equipment and Internet access to schools in developing countries. "Since 1996, over 5,700 under-served schools in the US and over 400 schools in 35 other countries have received equipment and support necessary to get online" (Schools Online, n.d.).

2.3.1.3 iEARN

iEARN is a non-profit organisation made up of 4000 schools in 90 countries allowing the teachers and students to work together online through a global telecommunications network (iEARN, n.d.). iEARN allows students at the different corners of the world to participate in a project and collaboratively work towards a common goal. iEARN projects are proposed by teachers to meet the specific needs of their curriculum.

All these three programs were initiated to provide access to communication and information resources to students who do not have that access. The main target audience of these programs were similar to Maldivian environment. Hence, the researcher contacted these programs to find out how they can help reach the students

[1] Relief International, (RI) is a humanitarian non-profit agency that provides emergency relief, rehabilitation, development assistance, and program services to vulnerable communities worldwide. RI is solely dedicated to reducing human suffering and is non-political and non-sectarian in its mission.

in Maldives. Unfortunately, these programs had limited budget consequently limiting the program to certain countries. Hence, Maldives was not included in the set of countries where these programs were available.

2.3.2 Regions

For the purposes of this research the developing countries are divided into three regions: Asia, Africa, and South America. Differences exist between countries even in each of these regions and these differences as well as similarities are discussed. Eastern Europe is another developing region to be considered. However, Eastern Europe as a near neighbour of the west has easy access to the western technologies. Hence Eastern Europe is not discussed within the scope of this research.

2.3.2.1 Asia

India

The educational technology usage in India ranges from the basic to the most advanced. The technologies range from the postal service to state-of-the-art virtual classroom environments. Being the second populous country in the world India has to cater for huge numbers of children in the rural areas with very limited information infrastructure. One of the programs carried out in India during 1975 to 1976 included the Satellite Instructional Television Experiment (SITE). The major aim of SITE was to provide mass communications using Satellite technology. SITE produced and transmitted 150 different science programs of 10-12 minutes long to a total of 2330 villages in six geographical clusters (Shrestha, 1997).

The SITE program demonstrated that satellite communication was feasible for disseminating information for education (Govindaraju and Banerjee, 1999). To cater for the ever-growing student population the University Grants Commission (UGC) took an initiative to utilise Indian Satellite (INSAT) to deliver high quality educational materials to the students, teachers and other viewers (CEC, 1993 cited in Govindaraju and Banerjee, 1999). The educational materials were telecasted through Indian Television Channel Doordarshan during specified times. The primary target audiences for these programs were the college students studying in small towns and rural areas. However, only 31% of the rural population were television viewers and students had no direct access to television viewing. To overcome this problem UGC provided rural colleges with television sets for the community (Govindaraju and Banerjee, 1999). The national television Doordarshan was used because poor countries like India with limited resources and infrastructure are restricted to use them (Eastmond, 2000).

India has launched an educational satellite designed and developed exclusively for serving the education sector. The satellite known as EduSat is intended to provide an interactive satellite based education at national level. Two hundred and sixty locations in three different institutions across the country use the EduSat National Beam. Several proposals have been sent to the managing organisation for setting up EduSat networks for elementary education in different states of the country (EduSat, n.d.).

Interactive Radio Counselling was launched in early 1999 in Jaipur through ALL India Radio. The project was aimed at bridging the gap between the institutions and the learners, and was initiated by Indira Gandhi National Open University (Sharma,

2002; Vyas, 2002). The programme allowed the learners to dial in and interact with the counsellors when the programmer was on air. Phone-in facilities at a specific location were used by the learners while the counsellors were in the studio. An evaluation of this programme showed that care was needed in structuring the activity to make it successful. Furthermore, some training was required for those who were involved in the programme (Sharma, 2002).

The technology implementation is based on the availability of resources and existence of infrastructure. The universities and the schools in India use a combination of various media including printed correspondence texts, audiocassettes, videocassettes, radio broadcasts, residential schools, face-to-face tutoring, and face-to-face counselling (International Centre for Distance Learning, n.d.). In addition institutions like Indira Gandhi National Open University (IGNOU) use radio via satellite and video via satellite for selected programmes (International Centre for Distance Learning, n.d.). Virtual institutions do exist in India to some extent although they do not reach the whole population. A complete virtual university, which provides the complete cycle of instruction from registration to certification online, is Netvarsity (Mitra, 1999). Netvarsity is developed and administered by the National Institute of Information Technology which is the largest private education provider in the region. IGNOU also provides some of its services virtually, for example students are able to register online and also participate in online discussions (Mitra, 1999). In 1999 IGNOU initiated a Virtual Campus Initiative (VCI) to provide three of its courses online. These programs were delivered using (a) live satellite-based teleconferencing lectures, (b) recorded video lectures, (c) practical laboratories, (d) computer-based training tutorials, (e) learning resources accessible through Internet browsing, and (f)

online interactive chat with peer group, faculty, and external experts (Sharma, 2001). Telecentres were established to deliver the programs online to the students.

Although computers and multimedia have been developed on a large scale in India, their use in education lags behind this development. Apart from NIIT no other group is making major use of multimedia technology (Krishnayya, 1998). However, the Department of Electronics has floated a scheme to establish countrywide multimedia centres. These centres will operate similar to telephone booths. The Centre for Development of Advanced Computing is responsible in developing the curriculum and software package materials for these centres (Krishnayya, 1998).

Other Asian Countries

In most of the developing countries in Asia the main form of instruction is face-to-face using the black board and chalk. The instructional technology does vary depending on the areas as well as the situation. Mainly the educational technology is based upon the availability and accessibility of resources. Most of the distance education programs in these countries use print media as the main medium of instruction with a large number of countries using regional centre model (International Centre for Distance Learning, n.d.). The print media is often supported by face-to-face sessions, audiocassettes and videocassettes (International Centre for Distance Learning, n.d.).

Interactive Radio Instruction (IRI) has been successful in delivering primary education to some of these developing countries. One of the examples is the use of IRI in teaching Mathematics in Thailand (Searle, 1985 cited in Eastmond, 2000).

"Multi-channel learning involves audio-video and computer based media in cooperation with a variety of instructional techniques: workshops, symposia, panel discussions, role-playing, simulations, and games" (Eastmond, 2000).

Multichannel learning is an approach that addresses different learning styles. The Instruction Managed by Parents, Community, and Teachers (IMPACT) project is one, which uses this approach in the Philippines, Indonesia, Thailand, Malaysia, and Bangladesh (Visser, 1995, cited in Shrestha, 1997).

As mentioned earlier in the global programs World Links, Schools Online, and iEARN are all existing in many of the developing countries in Asia. However, due to the lack of access to Internet the use of these programs is limited. Another such program used in Asia is CASCADE-MUCH, which stands for Computer Assisted Curriculum Analysis, Design and Evaluation - MUltimedia curriculum design in China. CASCADE-MUCH is a software that supports the teacher-designers in the production of good quality scenarios for multimedia curricula (Smarter Network, online). CASCADE-MUCH helps 'teacher-designers' produce scenarios that enhance cooperative learning. It also ensures that the scenarios produced should be feasible (practical) to implement. Another Cascade project, which is underway in Asia, is CASCADE-IMEI (Innovative Mathematics Education in Indonesia). CASCADE-IMEI helps support material designers developing realistic mathematics education (RME), which focuses on the use of mathematics in everyday problems.

2.3.2.2 Africa

Educational technology plays a vital role in the African countries to meet the challenges and improve curriculum to better prepare students for labour market demands (Ba, 2000). Several countries in Africa are expanding access to advanced technologies in public schools. Tanzania is increasing access to computers to 400 schools while Kenya planned to extend it to 600 by 2001 (Ba, 2000). These projects include developing courses in computer literacy and Internet technology to teachers, students and other resource staff (Ba, 2000).

Some of the programs that address the problems of curriculum design and lesson planning include the CASCADE-SEA program and the SHOMA program. CASCADE-SEA program is a computer-based tool that supports the curriculum designers in developing curriculum using exemplary science curriculum materials (Smarter Network, n.d.). SHOMA is another program, which helps the teachers develop lesson plans using satellite TV, Internet technology, and collaborative discussion forums (SAIDE, 1998). African students are also taking part in online international programs like WorldLinks, iEARN and GLOBE which allows the students to carry out collaborative projects using the Internet (Ba, 2000). The World Link group provides its services to seven African countries (The World Bank Group, n.d.).

In-service training to unqualified teachers using distance mode allows the teachers to become trained while fulfilling their responsibilities. These are achieved in Africa through correspondence courses, radio broadcasts and IRI. Among these, Tanzania's teacher training program combines on-the-job-training with correspondence and radio

broadcasts to produce four times as many graduates as those trained conventionally with no difference in quality of training in the distance program compared with conventional schooling. Mozambique administers a similarly effective program for upgrading primary school teachers. In addition to its focus on primary-level students, IRI is being used to upgrade teachers in South Africa (L. Visser, 1999 cited in Eastmond, 2000). Another option is to have community telecentres as support sites for providing distance courses with virtual library, online courses, which provide their services more to the local communities, nongovernmental organizations, and schools (Ba, 2000). Some countries, like Burkina Faso and Senegal, have experimented with these models (Ba, 2000).

"Sesame Street" was one of the most famous educational television programs in the world. This show uses furry Muppet puppets to teach children to read, write and be nice to each other. It has been viewed in many countries and the show has been adapted to fit dozens of different cultures (The Economist, 2000).

Many families were deprived of this show, as they were too poor to own a television set, hence these programs were broadcasted over the radio for these families (The Economist, 2000). Since the radio broadcast does not allow the children to see things like television this program developed books to go with the radio broadcasts. The characters in the Sesame Street read the books aloud with sounds for turning pages. Also songs and sounds are used for counting practice (The Economist, 2000).

Commonwealth of Open Learning (COL) provides portable radio stations to countries to deliver training to the local people. Some of the African countries like Uganda,

Zambia, Namibia and South Africa have these portable radio stations functioning. The radio stations can be packed in a suitcase and consist of earphones, a microphone, a mixer, two tape players and recorders, two CD players and a transmitter, as well as a hook-up to commercial FM networks and to satellite feeds for off-air programming (Chin, 2000). The radio station can broadcast to a radius of 50 km, runs on a car battery and can be adapted to use solar energy (Chin, 2000).

2.3.2.3 Latin America

Mexico

The last 40 years has seen tremendous efforts in education to reach more people in Mexico. One of the systems used in Mexico is the Education Network which is a fully computerised system for teachers and students providing pedagogical and informational resources for improving teaching and learning processes (Ortiz, 1999). Another system designed, developed and implemented by the Ministry of Education in Mexico (SEP) is Edusat. Edusat is a closed circuit system consisting of 6 television and 24 radio channels broadcasting throughout Mexico, southern USA and some countries in the Latin America. Since its establishment in 1994 Edusat has reached over 9,000 schools throughout the country providing basic education to the remote and outlying areas (Ortiz, 1999).

Another technological development in Mexico's educational system is the ITESM (Technological Institute of Monterry's) virtual university. With advanced telecommunication technologies and electronic networks ITESM provides education to different sites in Mexico, the Latin America, USA and Canada (Ortiz, 1999). The

virtual university offers 12 masters degrees and doctorate degrees in the fields of education, administration, and engineering and technology (Ortiz, 1999).

One of the research projects carried out in Mexico and US conducted school activities using videoconferencing between two classes in Mexico City and two classes in College Station, Texas (Cifuentes and Murphy, 1999). The aim of the project was to introduce the students to different cultures as well as teach the students to work in collaborative environments. The students were asked to describe how they envisaged the culture and environment of the other group. For example, the Mexican students were asked to describe themselves as a Texan student and vice versa. This exercise was carried out before the students met through video conferencing. The results of this exercise showed that Mexican students had a more accurate picture of a Texan student than a Texan students of Mexican students. The main reason being that majority of the Mexcian students had visited United States and knew the culture while only a few Texan students had visited Mexico. The results after the video conferencing show that both the set of students had cleared up their misconceptions about the other culture. The results of the project show that at the end of the videoconferencing sessions both sets of students appreciate the other cultures and had a better worldview on the events discussed.

Argentina

Argentina is one of the Latin American countries most interested in using distance education to deliver the educational programs to the growing demands of the population (Ortiz, 1999). The ESA Open Secondary School delivers the secondary education programs and uses a multimedia educational approach including printed

materials, audiocassettes and video. Radio and television is used to complement the multimedia approach, as it is costly to use the usual infrastructure (Ortiz, 1999). Since July 1996 a one hour telecourse entitled "Teleducación:una mirada abierta" is transmitted every evening on weekdays. The materials presented in these programs complement the printed subject matter in each area. The educational television service under this program meets the needs of 350 related institutions in Argentina.

> *In addition, "Schools Online has set up seven Internet Learning Centers (ILCs) in different provinces in the interior of Argentina. These centers were installed in April 2001 in the provinces of Chaco, Cordova, Jujuy, Mendoza, Neuquen, Salta and Santa Cruz" (Schools Online, online)*

In other countries like Peru schools have installed computers and hired technicians to maintain the machines. However, efficient use of these machines is not made as in most cases these computers are used to teach commercialised software packages rather than using them as an educational tool (Ortiz, 1999).

A wide range of educational technology is being implemented in the developing countries. Each implementation is based upon a variety of factors and limitations. The main aim of using educational technology in these countries is to reach more people. Hence, cheap and accessible technology is often preferred although advanced technology is available. For example, in rural areas radio is preferred over television, because more people would have a radio set than a television set. This aspect of availability has to be considered in designing the model for Maldives so that more people have access to education.

The educational technology discussion has provided insights into media usage and implementation across different regions of the world. Further investigation into specific distance education institutions will provide a better understanding of these at an institutional level. Although the model sought after in this research is a countrywide model, institutional models will help in designing the model. The following section looks into few distance education institutions and investigates their delivery, support systems, programme development, target audiences and so on.

2.4 Distance Education Models in Developing Countries

Distance Education models used in different institutions differ considerably according to the needs of the institutions as well as the resources available. In order to develop a model best suited for Maldives it is important to look at some of the distance education models used in the developing world. This section looks into a few of these models which may relate to Maldivian context. The models analysed in this paper include Bangladesh Open University (BOU), Indira Gandhi National Open University (IGNOU), University of South Pacific (USP), and University of West Indies (UWI). BOU and IGNOU are used in this research as both Bangladesh and India are South Asian countries with similar economic and social infrastructures to Maldives. However, the size of these countries both in their physical size as well as population differs considerably to Maldives. USP and UWI are considered as both these institutions cater for small islands similar in size to Maldives.

A brief background and procedures followed by these institutions is included in order to have a better understanding of these models. These backgrounds will help to place the models into perspective and understand them from a Maldivian context. Some of these institutions have similarities in terms of constraints and needs as Maldives while others have similar resources and geography.

2.4.1 The Bangladesh Open University (BOU)

BOU was established by an act of Parliament in October 1992 (Bangladesh Open University, n.d.). Asian Development Bank (ADB) carried out an appraisal showing high absolute levels of poverty, low per capita GNP, high population growth, low adult literacy rate and the inability of the conventional educational system to meet the country's requirements (Rumble, 1999). This led to the establishment of BOU with the already existing distance education institution, Bangladesh Institute of Distance Education forming a part of the university.

> *"Prime objective of Bangladesh Open University is to transform the country's vast human resources into an educated and trained work force by extending to them a wide range of academic programmes both formal and non-formal. BOU's programmes are aimed at every one, particularly working people and women and those socially disadvantaged groups who cannot enrol in traditional universities" (Bangladesh Open University, n.d.).*

2.4.1.1 Programme Development

The different schools were given the responsibility of creating the distance mode courses. Academic staff were recruited to develop the materials. In 1994 and 1995

several materials were developed to support the Secondary School Certificate, Certificate of English Language Proficiency, Certificate of Management, Diploma in Management together with non-formal programmes. These materials consisted of 27 course books, 116 radio programmes of 30 minutes each, 57 television programmes of 25 minutes each, 5 one-hour audiocassettes (Rumble, 1999). All the texts were put on tender to be printed commercially while the audio and television materials were produced locally.

> *"Every student of a BOU formal programme is provided with a set of audio cassettes containing course materials together with a set of textbooks" (Bangladesh Open University, n.d.).*

The audiocassettes are produced at Media Division in the university. In addition programmes for radio and television broadcast are also produced in-house at Media Division. The educational broadcast team consists of teachers, scriptwriters, producers, cameramen, sound technicians, and presenters (Bangladesh Open University, n.d.). Currently the Media Division is a small centre with limited facilities but a new Media Centre is under construction equipped with the latest technology including a network of Internet system connecting all its regional resource centres with the main campus (Bangladesh Open University, n.d.).

2.4.1.2 Target Population

Although the target population consisted mostly of males in the Secondary School Certificate program the female numbers were higher. Seventy-seven percent of Bachelor Education students were males, 70% of Certificate in English Language

Proficiency was males, but more than 50% of the Secondary School Certificate was females (Rumble, 1999). Most of the students enrolled in the Certificate of English Language Proficiency have a degree (67%) and are job seekers (51%). Likewise the majority of the Bachelor of Education students are (75% to 78%) and Diploma in Management students are already working (74%). However these programmes do not reached the deprived, rural areas with 74% of the target population of the Diploma in Management living in the Dhaka region (Rumble, 1999). These figures are not surprising as the rural population have a high level of illiteracy hence tertiary education is of no great interest to them. However, enrolments of the rural population, in Secondary School Certificate, are considerably high with the female participation rate very encouraging (more than 50%). Hence BOU is reaching the rural masses initially through the Secondary School Certificate and later on these students may progress to tertiary education improving the enrolments rates of the rural population in tertiary qualifications.

2.4.1.3 Delivery

A combination of different educational media is used to disseminate the courses to the target audiences. Text in the form of print is the core medium used in BOU (Rumble, 1999). With the high illiteracy rate in Bangladesh, comprehensibility of texts produced is a major issue. While a little percentage of English Language Proficiency program find the first three books difficult more students (between 7.9 and 11.9 percent) find the next three books difficult or very difficult (Rumble, 1999).

Other media used in delivering distance programs include audio in the form of radio and audiocassettes, television in the form of broadcasting, and direct human contact

through lectures and interactive questioning. The norm used at BOU is to include 75 minutes of broadcast television and 120 minutes of broadcast radio for every 45 hours worth of printed course materials (Rumble 1999).

As mentioned earlier, all formal programs use audiocassettes in addition to the printed textbooks. However, there is an acknowledged production problem of these tapes with up to 8% of them being faulty (Rumble, 1999). Radio broadcasts reach all parts of the country except Chittagong area where a local radio station is based. Likewise the television broadcasts reach 85% of the total population through terrestrial transmission networks (Rumble, 1999). Although the transmission reaches most areas of the country television ownership in the country severely reduces the numbers reached. In total only 8% of the population own a television set with a wide disparity between the rural and urban. Only 3% of the rural population owns a television while 40% of urban population owns one (Rumble, 1999). The relative reach and access figures are very high compared to the actual ownership figures as the owners let other watch it.

Face-to-face contact sessions are mandatory for all of the programmes at BOU. Fortnightly tutorials are arranged for students of every programme at the tutorial centres (Bangladesh, Open University, n.d.). The tutorial centres are scattered across the country. School of Education has 16 centres while School of Business has 20 centres (Rumble, 1999). Tutorials for the Secondary School Certificate students are arranged at the Thanas (administrative units of the country). The total number of tutorial centres opened in the country now amounts to 600 (Bangladesh Open University, n.d.).

2.4.1.4 Support Services

In order to provide support to students BOU established centres at three levels. They are the regional resource centres, local centres, and the tutorial centres. The regional resource centres provide the students with a library and a study room with audio, video, radio, and television facilities. Other support service functions carried at the regional resource centres include distribution of materials among the students, arranging tutorial centres, appointing coordinators and tutors, holding examinations, announcing results and distributing certificates. The local centres are established to assist the regional resource centres. There are 12 regional resource centres and 80 local centres across the country. The tutorial centres, as mentioned earlier, provide tutorial support to students (Bangladesh Open University, n.d.).

2.4.1.5 Achievements

Some of the objectives for establishing BOU

- *Meeting a wide range of identified educational needs, both formal and non-formal*
- *Assisting national development and meeting the needs of the national economy*
- *Reaching large numbers*
- *Helping democratise education*
- *Reaching the masses through the use of technology*
- *Being cost-effective and more cost-efficient than traditional educational systems*

- *Helping avoid opportunity costs of taking people out of their normal employment for training*
- *Raising educational standards through the use of high quality materials*

(Rumble, 1999: pp172-74)

In terms of reaching a wide range of educational needs BOU introduced formal education at higher education level as well as secondary level. Higher education programmes include certificates, diplomas, bachelors and masters; and the Secondary School Certificates programme is run at the secondary level. In addition the university also runs non-formal programmes for the general population.

BOU also aims at developing professional and vocational skills in areas of management education, nursing, computing, agriculture, and rural development. The university has developed specific programmes for untrained teachers and other programmes for the working population to attain the required skills. These programmes have been successful and well received by the target audiences.

One of the most successful programmes run at BOU is the Secondary School Certificate. This program reaches the rural areas as well as the urban. Unlike the tertiary level courses Secondary School Certificate has more female enrolments from both rural and urban areas (Rumble, 1999). In addition the non-formal programmes have significant numbers of viewers despite the low ownership of television and radio in rural areas. However, the total enrolment figures need to be assessed more closely to get an accurate picture, as these figures do not reflect the dropouts (Rumble, 1999).

Unlike the Western distance education providers, BOU does not use state-of-the-art technologies in delivering their programmes, as the truly underprivileged will not be able to access these technologies. As discussed earlier even with radio and television broadcasts the reach is not optimal. The use of lower-resource-intensive technologies by BOU is emerging as an attractive and sustainable model for developing countries where the resources are scarce (Rumble, 1999).

Initially the concept of a new university was regarded with some scepticism but with the quality products it has produced it has been rapidly accepted. BOU course materials are now widely used in the traditional system; namely universities of Dhaka and Chittagong use the texts produced for School of Business and Teachers' Training Colleges use the texts produced by the School of Education (Rumble, 1999).

The cost-effectiveness and cost-efficiency of BOU is yet to be established as the dropout rates are unclear. However some points to note are that only about 15 to 20 percent of operating costs are covered through the fees in the traditional universities in Bangladesh. The current projections suggest that BOU will recruit sufficient students so that it can recover most of its operating costs and make a contribution to overheads as well.

2.4.2 Indira Gandhi National Open University (IGNOU)

Although India is a neighbour to Bangladesh the requirements of education are quite different to that of Bangladesh. The elementary education up to grade 8 (age of 14) is free and universalised by the government of India. Hence the emphasis of distance

mode learning is to provide higher secondary and tertiary education as opposed to secondary education . IGNOU, which was established in 1985, provides courses in all disciplines ranging from certificates to postgraduate level (National Library of Australia, n.d.). IGNOU services its 750,000 students through 46 regional centres and over 1000 study centres spread across the country (Indira Gandhi National Open University, n.d.).

2.4.2.1 Student Support Services

Student support services at IGNOU were provided through three levels; regional centres, study centres, and distance learning facilitators. The following services are available at regional and study centres

- *Subject-specific academic-counselling by part-time academic counsellors*
- *Audio and Video viewing facilities*
- *Library facilities*
- *Participation in Teleconferencing*
- *Information services related to rules, regulations, procedures, schedules, etc. of the University*
- *Submission of assignment-responses for tutor-comments and grading / marking and*
- *Term-end examination*

(Indira Gandhi National Open University, n.d.)

Distance Education Facilitators are used where support facilities of IGNOU are not available. These facilitators are postgraduate degree holders who are permanent residents of that particular area (Sharma, 2001).

2.4.2.2 Communication Technologies

IGNOU uses a multimedia approach to instruction and on average 20 percent of a course is delivered through multimedia (Sharma, 2001). These multimedia packages incorporate print, audio, video, interactive radio counselling, one-way video with two-way audio teleconferencing, television lessons, CD-ROMs, and web-based content delivery (Indira Gandhi National Open University, Online). The radio programmes are broadcasted in the form of Interactive Radio Communication through All India Radio. All India Radio serves 98 percent of the people in India through a network 207 broadcasting centres (All India Radio, n.d.). Video teleconferencing is offered through the study centres using Indian Space Research Organisation's (ISRO) Training and Development Communication Channel (Sharma, 2001).

IGNOU has established very well in the higher education providers' market increasing from 2 programmes and 4528 students in 1987 to 60 programmes, 600 courses, and 600,000 students in 2000 (Sharma, 1999). The success with print-based programmes led the university authorities to decide on providing online delivery. The online delivery project was named Virtual Campus Initiative (VCI).

2.4.2.3 Virtual Campus Initiative (VCI)

Since the government of India were establishing computer networks at district level and the university already has email and Internet links between all its regional centres

it was decided IGNOU was adequately equipped for online delivery mode. In addition the cost of production and distribution of course materials in print-form was expensive and online delivery was seen as a reduction in cost for distribution as well as complaints from students of late receipts. Another factor considered in pursuing the VCI was the competition from new entrants into the market. The university decided that it was important to go for online delivery mode to keep up with the technology and changing educational scenario (Sharma, 2001).

Delivery Format

The three programmes that adopted the VCI initially were Bachelor of Information Technology (BIT), Advanced Diploma in Information Technology (ADIT), and Management Education through Interactive Delivery System (MEIDS) project. These programmes followed an Internet-centric approach since their inception (Sharma, 2001). School of Computing and Information Sciences has been looking for possibilities of delivering their programmes through electronic and network-based infrastructure that would enable interactive learning for its 70,000 students (Mahabharat, 1999).

With the adoption of VCI these programmes incorporated several delivery formats that include

- Live satellite-based teleconferencing lectures
- Recorded video lectures
- Practical laboratories
- Computer-based learning tutorials
- Learning resources accessible through Internet

- Online interactive chat with peer group, faculty, and external experts.

In addition the courseware for the registered Computing students will be delivered on a CD-ROM, which will also include software for the Internet access (Mahabharat, 1999). School of Computing and Information Sciences distributed 4000 CDs to its widely distributed students during the first semester of 1999 on an experimental basis (Mahabharat, 1999)

IGNOU used privately owned Telelearning Centres (TLCs) to provide these facilities. The TLCs comprise of 50 Pentium computers, printers, scanners, digital cameras, colour televisions, data projectors, and microphones. These TLCs provided the students with library facilities with reference books, recorded video lectures, computer-based training, CD-ROM courseware, and access to Internet (Sharma, 2001). Since these TLCs were privately owned IGNOU had little control over them hence difficulties were faced in terms of scheduling. This was partially overcome with the introduction of Regional Computer Laboratories in 8 regional centres fully controlled by IGNOU.

Consequences

The aim of the VCI was to achieve democratisation of educational opportunities nation-wide which had unintended consequences. Since online education services and Internet are not yet available in small cities the gap between the learners in big and small cities increased as a result of VCI. Another intended aim, which was achieved through VCI, was a move towards a paperless style of work environment. This was achieved through increased use of Internet, Online registration, database driven

content delivery, online tutorials, online library, and online assignment submission and evaluation.

Some of the shifts from traditional system include

- Course materials changing from print-form to online HTML or MsWord format
- Students can work from home or office rather than being attached to a study centre
- Counselling can be done via chat or email and no face-to-face contact is required
- Students can submit assignments electronically as attachments in email and can download corrected assignments from the IGNOU website
- The lead-time for the programmes decreased from 6 months to 4 weeks while the number of sessions increased from 2 to 4.

Implications

Some of the implications of VCI identified are

- Learners have the choice of approaching any TLCs of their choice
- Proper web administration is crucial for success
- The need for highly qualified academics who readily accept the responsibility of online course development will be acceptable

2.4.3 University of South Pacific (USP)

USP was established in 1968 and is recognised worldwide. The university serves 12 member countries in the South Pacific (University of South Pacific, n.d.). USP offers distance education to its 12 member countries through its own satellite communications network (USPNet).

2.4.3.1 University Extension

Extension Services (renamed University Extension in 1992) is a centralised department that administer, develop and support distance mode programmes (Matthewson and Va'a, 1999). In addition to the central hub at Fiji University Extension also comprises of staff, resources and activities of the university's representative national centres and the USPNet. University Extension is also responsible for coordinating and managing the continuing education functions of the region. By mid 1990s University Extension had 160 staff most of whom work at the network of centres and outer island sub-centres (Matthewson and Va'a, 1999).

2.4.3.2 Teaching and Support Services

Distance programmes are taught using locally developed, print-based materials supported by a range of other media and resources. Tutorial support is provided for these programmes both in face-to-face contact as well as via technology. Frequently audiotapes are used to complement the programmes as well as videotapes on occasional instances. All the programmes get support from the human network of full- or part-time staff widely dispersed in the local centres. All these services are centrally coordinated at University Extension (Matthewson and Va'a, 1999).

USP has 3 campuses located in Fiji, Vanuatu and Samoa and national facilities in 12 other countries (University of South Pacific, n.d.). The facilities at national centres include management and academic staff, library, computer room, science laboratory, USPNet, and email access. (Matthewson and Va'a, 1999) Some centres also have residential facilities available. Majority of these centres operate sub-centre outposts either in other establishments or agents (Matthewson and Va'a, 1999). All the materials for the students including the assignment are transported through weekly mailbags and examinations are held simultaneously across the time zones (Matthewson and Va'a, 1999). Most of the university's courses do not include mandatory face-to-face components except for the science course, for which tutorial support and face-to-face sessions are held by the local centres or visiting tutors.

2.4.3.3 USPNet

USPNet was established in 1974 to provide a communication network for the distance education programmes run between the main campus in Fiji and other campuses and local centres in the participating countries. The USPNet connected three campuses and 11 centres in the participating countries in the South Pacific (Figure 2.3). This communication network started with radio communications and evolved through PeaceSat satellite and into 64Kbps leased lines together with HF radio communications system (University of South Pacific, n.d.). However as the system became more unreliable the university upgraded the system to USPNet-2000 which comprised of

- *"provision for permanently assigned 64kbps two-way data circuits between the Hub earth station and all Mini-Hub/Remote earth stations for data and audio services,* ***as well as***
- *provision for a maximum of three simultaneous 128kbps video transmissions for lectures from the Hub earth station and single lectures from Mini-Hub earth stations,*
- ***or*** *a maximum of two simultaneous video conferences between the Hub earth station and Mini-Hub/Remote stations"*

(University of South Pacific, n.d.)

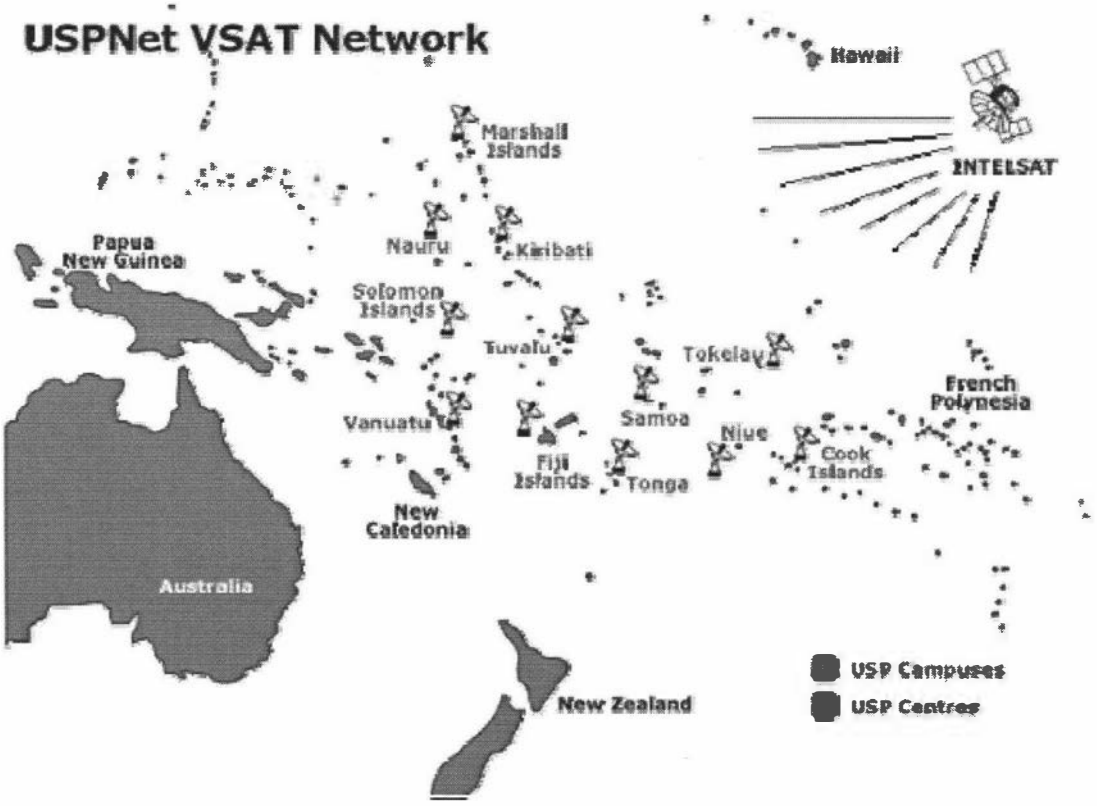

Figure 2.3: USPNet VSAT Network (source: University of South Pacific, http://www.usp.ac.fj)

USP owns and operates this private network and it is used purely for university's purposes. The network offers audio tutorials, email facilities, Internet access, live video broadcasts of lectures, and video conferencing. The live audio and video broadcasts are done from the three campuses and received by any of the centres. In addition university administration also uses the network making it more efficient.

2.4.3.4 USPNet Services

USPNet consists of three different areas: the data services, audio and video. The data services use 64kbps circuits connected to multiplexers at each location. The data services using the multiplexers manage the network's data as well as audio capacity for computer data, email, and web service. The Information Technology Services located at Laucala campus in Fiji manages and controls the data network hence providing the email, web service and help desk facilities for staff and students (University of South Pacific, n.d.).

USPNet enables audio conferencing between and among any of the campuses with the call being generated at the Laucala campus. Laucala campus satellite studio was upgraded to offer this service. In addition, two modes of video capability are offered through the USPNet. Video broadcast transmits live or pre-recorded course materials from any of the three campuses and can be received at any of the local centres (Figure 2.4). Lectures can be broadcasted in real time with audio feedback from students. The second mode of video capability is video conferencing. USPNet offers this service through small conference rooms, which are equipped for group of participants to see

and talk to each other. The video quality of these services cannot be compared to televsion as USPNet uses 128kbps for satellite transmission and the images are digitally compressed before being transmitted.

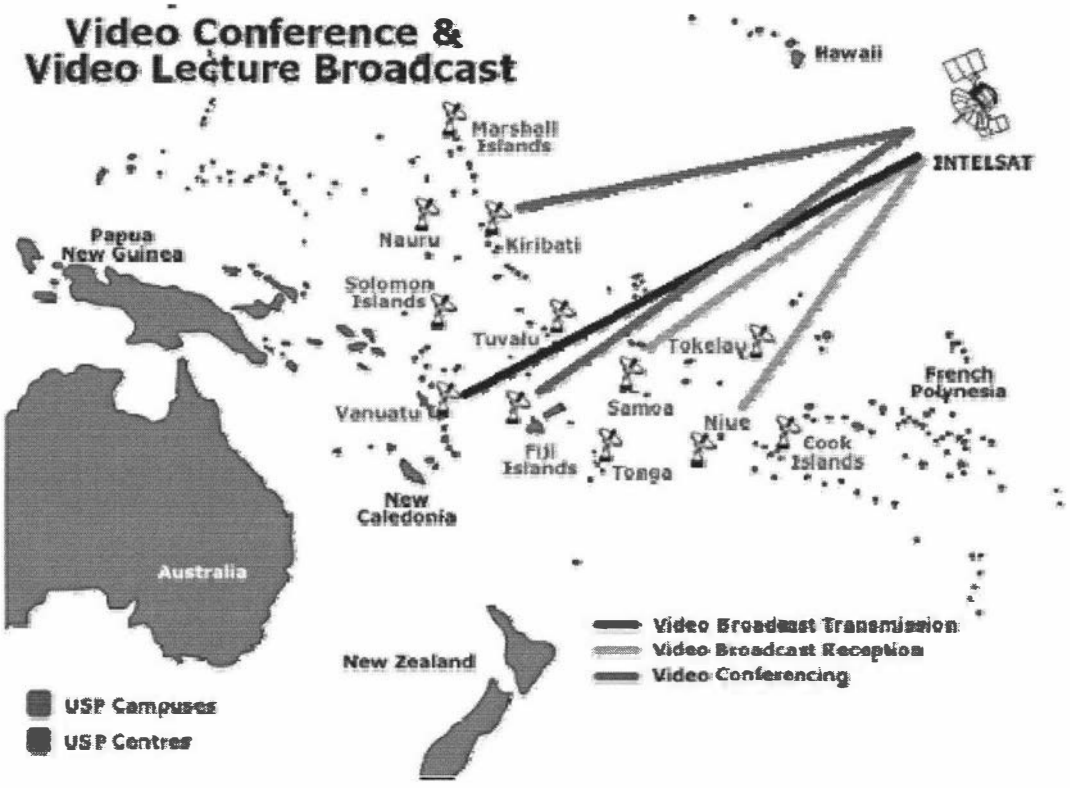

Figure 2.4: Videoconference and Lecture broadcast using USPNet (source: University of South Pacific, http://www.usp.ac.fj)

2.4.4 University of West Indies (UWI)

University of West Indies (UWI) was established in 1948 to cater for the English-speaking population in the Caribbean. It was formed as a college in collaboration with University of London at Mona, Jamaica (Brandon, 1999). The university consists of

three campuses in Mona (Jamaica), St. Augustine (Trinidad and Tobago), and Cave Hill (Barbados). In addition twelve non-campus countries contribute to the university for whom the university runs distance courses.

While enrolment figures increased from 1268 in 1948 to 18058 in 1996-7 the non-campus countries were not proportionately represented in terms of enrolment rates (Office of the Board for NCCs and DE, n.d.). One reason is the high cost of studying at UWI as opposed to the low fees at local institutions. Also UWI operated on a no open access policy where the normal entry requirements are two passes in A Level plus three passes in O Level or CXC (Caribbean Examinations Council). These requirements are not high but the lack of resources and weak secondary schooling makes it difficult for the students from non-campus countries to attain these grades (Brandon, 1999; Office of the Board for NCCs and DE, n.d.).

2.4.4.1 Distance Education

The distance education program at UWI began in 1983-4 under the name University of West Indies Distance Teaching Experiment (UWIDITE). UWIDITE centres included a telephone-based system with telewriters and slow-scan television with audiotapes, VCRs, and monitors for off-line use (Brown, 1995). These systems provided the means to deliver the distance education programmes using print and teleconference and very rarely audiotapes and videotapes. In addition local tutorial support and practical supervision was provided. The three campuses and two other non-campus countries were initially involved in these programs but the other eleven non-campus countries joined by 1993. Other sites in non-campus countries have also

linked to the network to get the benefits of the distance education programmes (Marrett, 1989).

With the increase in budget for distance education and loan project from Caribbean Development Bank (CDB) saw a need to move from teletutoring style delivery to more self-instructional print based materials with occasional local tutorial support (Brandon, 1999). CDB Appraisal Report (Office of the Board for NCCs and DE, n.d.) suggested that the use of teleconferencing causes under representation of rural students hence self-instructional print materials should be given predominance.

2.4.4.2 Management and Structure

UWIDITE originated from Mona and with funding from USAID later became the University Centre. At this point the university centre was directly responsible to the Vice Chancellor for Science and Technology (Brandon, 1999). The success of UWIDITE depended a lot on faculty assistance but the required consideration was not received from respective faculties as most viewed distance programs as external components to their faculties. Even the CDB loan project leading to formal adoption of dual-mode did not change the views and perceptions of the faculties. Furthermore the administration showed lack of interest in processing the distance education applicants (Office of the Board for NCCs and DE, n.d.). Hence UWI was restructured in 1996 that gave academic control partly to the three campuses and partly to three boards. The Board for Non-Campus Countries and Distance Education was one of these boards and it directs the works of Distance Education Centre, School of Continuing Studies, and Tertiary Level Institutions Unit. The board provides a forum for coordination of the programmes run by the faculties as well as gives a prominent

place to the agencies outside UWI (Brandon, 1999). To overcome the reluctance of both academic and administrative staff to support distance education programmes some transitional arrangements were made (Office of the Board for NCCs and DE, n.d.). In these arrangements the departments were compensated for the use of their staff or individuals were brought on contract terms to produce the distance education materials on a consultancy basis. It was also agreed that work carried out by staff in distance education would be counted in the regular assessment and promotion. In addition contracts for new staff make explicit mention of the types of duties relating to distance education.

2.4.4.3 Development and Delivery

Teams of members from different campuses working collaboratively are supposed to produce the distance education materials. Also individuals are identified to develop some materials, which will then be peer-reviewed by others from the university or outside. The Distance Education Centre co-ordinates the development of materials and provides specialist assistance as well as ensures cross-campuses discussions.

A course co-ordinator from the specific departments is identified for each of the distance education programmes. The co-ordinators brief the local tutors and determine how teleconferencing for that particular course will be employed. The co-ordinator is also responsible for producing the assessments and making arrangements to mark them.

The distance education programmes are mainly delivered through self-instructional print materials but in some cases computer-based web pages are utilised. In addition

teleconferencing is widely used for interaction between the students, tutors, and the co-ordinators. Some programmes include audio and videotapes as well. Local tutors supplement the self-instructional materials wherever possible.

2.4.5 Other Significant Distance Education Institutions in Developing Countries

Two of the distance education institutions in the South Asia region need to be mentioned here as these institutions have some commonalities with Maldives. These are Open University Sri Lanka (OUSL) and Allama Iqbal Open University (AIOU) of Pakistan. There is limited literature on both these universities in the library databases; hence an extensive overview was not done. However, certain aspects of these two institutions are worth mentioning within the context of this research.

The Open University Sri Lanka (OUSL) was one of the earliest open universities established in the South Asian region. It was set up in 1978 to provide higher education facilities to learners above the age of 18 years with relevant basic qualifications (Open University Sri Lanka, n.d.). The latest statistics available for the university show that approximately 25,000 students are enrolled in different courses within the institution. OUSL has a similar target audience to that of Bangladesh Open University (BOU) and uses both face to face sessions and educational technology to deliver the content.

Allama Iqbal Open University (AIOU) is the major distance education provider in Pakistan, which was established in 1974 (Allama Iqbal Open University, n.d.). The courses at the university are delivered using mostly print materials, with radio and

television broadcasts used in some cases. The university consists of regional study centres where the students are provided tutorial support. The target audience for AIOU are the marginalised children and adolescents, out-of-school children, teacher trainees, and basic education for adults (Reed & Perraton, 2001). The out-of-school and the marginalised population are a similar audience to that of Maldives.

2.5 Conclusions

The above overview of the different countries and institutions show that most of the institutions in the developing world provide distance education as a means of reaching the marginalised children in the rural areas. The main focus of this research is to provide access to formal education in rural islands of Maldives, hence the target audience is similar to most of the institutions describe above. It is also clear that a number of different technologies are used across the different institutions described above. The successful technologies in these institutions are described above and these will be viewed in Maldivian context in chapter 3 of this thesis.

2.6 Factors for Distance Education Model in Maldives

The following chapter discusses the different issues relating to distance education model in Maldives. Finally the chapter draws up criteria for the distance education model for Maldives. This chapter forms the basis of literature research on Maldives. It can be seen from the literature that the delivery medium has been the distinctive feature in the history of distance education. The medium of delivery in distance education is the major factor that determines how distance education can be implemented in a given situation. Hence, the major focus of literature review on

Maldives has been to analyse the different distance education delivery medium within Maldivian context. The following chapter looks at the Maldivian infrastructure and identifies how feasible it is to implement each of these different delivery medium across Maldives. A major part of the following chapter is identifying what medium of delivery can work in Maldivian environment. In addition, the chapter also looks at how other distance education models described above fit into Maldivian situation. Maldives 'being a developing country' falls into the same category as these countries. However, a lot of similarities and differences exist between Maldives and these countries. Bangladesh and India being South Asian countries share a similar culture with the Maldives but have a huge difference in terms of population and physical size. Maldives is one of the smallest countries in terms of population while India is the second most populous country in the world. Amongst these similarities and differences lies the relevance of these distance education models to the Maldivian context. The chapter looks at how these similarities and differences are influential in determining the criteria for distance education model in Maldives.

Once the criteria for the distance education model are determined in the next chapter the following chapter describes the distance education model for Maldives. Once again a closer analysis of what delivery medium can work in Maldives is looked at before outlining the proposed distance education model. The proposed distance education model takes into account all the different factors identified in the literature on Maldives.

3. RESEARCH CONTEXT

The previous chapter looked at distance education in general and this chapter focuses on developing a set of criteria that should be present in a distance education model for Maldives. A case study approach is used in the design and development of the proposed distance education model for Maldives. The case study approach was used as this research fits most closely within the boundaries of a case study. However, before going into the factors on Maldives, the case study approach itself is outlined to show how the Maldivian case fits into the scope of this approach. This is followed by the case description of Maldives and finally the criteria for the distance education model in Maldives.

3.1 Case Study Approach

The case study approach involves the use of several data gatherings techniques to systematically gather information about a particular phenomenon (Berg, 2004). According to Yin (2003a), case studies are preferred when the focus of research is on a contemporary phenomenon within a real life context. Furthermore Yin (2003b) stated that the case study method is chosen when the phenomenon under study cannot be easily distinguished from its context. Gall, Gall, and Borg (2003) describes case study research as having four different characteristics. Case study research is the study of phenomena by focussing on specific instances, an in-depth study in each case, the study in its natural context, and the study of the emic[2] perspective of case

[2] a perspective in ethnography that uses native explanations and concepts

participants. Case study research is conducted in order to describe, explain, or evaluate particular phenomena (Gall, Gall, and Borg, 2005).

According to Yin (2003b), there are three appropriate designs for case study research, namely exploratory, explanatory, and descriptive case studies. An exploratory case study defines the questions and hypothesis of a subsequent study or determines the feasibility of the desired research procedures. An explanatory case study looks at cause-effect relationship explaining how events happened within the case in question. A descriptive case study gives the complete description of a phenomenon with its context. Similarly, Gall et al. (2003) categorised case studies into three different types, stating that each case study is done for one of these purposes. According to them, case studies are done to produce a detailed description of a phenomenon, or to develop possible explanations of it, or to evaluate the phenomenon. These three purposes very closely match with the case study design used by Yin (2003b).

Stake (2002) viewed case study as a choice of what is to be studied rather than a methodological choice. He states that a case study approach is chosen based upon the context of the study rather than choosing a case study method and then determining the context. Stake (1995) also identified three types of cases. However, his classification has some differences to the others. He classifies case studies as intrinsic, instrumental, or collective. An intrinsic case study is the study of a case because we want to learn about that particular case, and not because we will be able to generalise a concept by studying that case. On the other hand, an instrumental case study is where a particular case is studied to understand and generalise a concept through the study of that particular case. Stake (1995) classified the study of a number of cases as

a collective case study where a coordination of individual studies will produce the end result. The intrinsic case study is similar to a descriptive case study while an instrumental case study is similar to an exploratory case study.

The scope of this thesis is limited to the development of a distance education model suitable for Maldives rather than a generalised model that would necessarily be suitable for other countries. Hence, this study is considered a descriptive or intrinsic case study. The following sections describe the case of the Maldives, concluding with a list of criteria for the distance education model.

3.2 Maldives – the Case

Maldives is a group of islands in the Indian Ocean, geographically located on the equator. Maldives consists of geographically dispersed small islands which cause barriers to infrastructure development. The chapter divides background information on Maldives into three parts, namely educational infrastructure, demography, and communications. The section on education describes the current educational infrastructure across the country and the accessibility to formal education within Maldives. It has been noted previously that the rationale behind this research is the lack of access to secondary education in the remote islands of Maldives. The educational infrastructure section looks into the educational statistics in terms of enrolments and numbers of schools in different parts of the country. Most of these statistical figures are taken from official reports documented at Ministry of Education, Maldives. The section on demography looks at the population distribution within the country and population densities in the islands. In small island nations like Maldives a

lot of barriers exist due to the small population densities in these islands. Finally, the section of communications looks at both transport and communications. In order to provide distance education it is critical to understand what communication methods and technologies are available within the country and how they can be utilised. In addition to identifying the technologies, this section will also address the issue of difficulties faced in transportation within the country.

3.3 Education

Maldives has universalised primary education across the whole country. Every inhabited island in the country has a primary school. However, once the students complete their primary education, access to secondary education is limited. The main reason for this limited access is the lack of infrastructure in the remote islands of the country, in other words, the lack of secondary schools. Maldivian society puts a lot of importance on education and universalised primary education has resulted in almost 100 percent children attending primary schools. Although this results in the country's literacy rate being above 90 percent, the situation is rather very different when it comes to secondary schooling.

Table 3.1 shows the enrolments figures in the islands and the capital for each grade. It shows huge decreases in enrolments from year 7 (last year of primary schooling) to year 8 (secondary school) and a further drastic reduction from year 10 (last year of secondary school) to year 11 (high school). These figures clearly illustrate that there is a drastic reduction (49%) of school enrolments between year 7 and year 8 in the

atolls[3]. This reduction is mainly due to the lack of secondary schools in the islands. The 2003 statistics show that there are only 89 secondary schools in the atolls outside the capital (Ministry of Planning and National Development, 2004). It is also important to note the increase in the school enrolment in the capital for the same age groups. Although this increase is not formally commented on any reports, the main reason for this increase is the migration of students from atolls to the capital for secondary education. The enrolment trend within the lower secondary schools (year 8 – 10) dropped 4% between 2003 and 2004 (Ministry of Education, 2004). Hence this accounts for part of the decrease in enrolments between year 8 and year 9 in Table 3.1. There would also be a drop in percentage due to school dropouts. However, the 98% decrease in the school enrolment between year 10 and year 11 (first year of high school) is almost totally due to the fact that there are only 3 high schools in the atolls (Ministry of Planning and National Development, 2004). That is, the 199 islands, excluding the capital, have only 3 high schools catering for approximately 65% of the population. Furthermore the decrease in the school enrolment in the same age group in the capital is also due to lack of schools. In the capital, there is only one high school with the capacity of around 800 students to cater for over 7,000 students who complete the lower secondary schooling. However, it should also be noted here that there are other training avenues available in the capital for the school leavers. These include vocational training as well as bridging courses leading to further education.

[3] Atoll is a group of islands surrounding a lagoon.

Table 3.1: Enrolment figures for 2004

Year	Islands	% change	Capital	% change	Total	% change
Yr 7 (Age 13)	11514		2857		14371	
Yr 8 (Age 14)	5919	-49%	3890	36%	9809	-32%
Yr 9 (Age 15)	5428	-8%	3632	-7%	9060	-8%
Yr 10 (Age 16)	4980	-8%	2292	-37%	7272	-20%
Yr 11 (Age 17)	123	-98%	736	-68%	859	-88%
Yr 12 (Age 18)	138	12%	625	-15%	763	-11%

(Source: Ministry of Education Website, Maldives,

http://www.moe.gov.mv/eng/EduStats/StatBook2004.pdf)

Finally, one aspect that is not obvious in the statistics is the content that is taught at the atolls and the capital. Maldivian secondary school curriculum is based on London General Certificate of Education (GCE) Ordinary Level examinations. Maldives curriculum has three streams of subjects chosen from the London GCE examination; these are science stream, arts stream, and commerce stream. Each of these three streams has three core subjects; for science stream they are physics, chemistry and biology; for arts stream they are economics, history and geography; and for commerce stream they are economics, commerce and accounting. In addition, all students are required to take English language and mathematics as compulsory subjects and one elective subject from computing, fisheries science, graphical communication, travel and tourism. The full curriculum is available in secondary schools in the capital but only a handful of schools in the atolls offer all these subjects. Most of the schools in the atolls offer only commerce stream subjects, forcing students to study only those subjects. A science laboratory is required in order to offer science stream subjects and more than 95% of the schools do not have science laboratories (personal

communication with Ministry of Education officials, 2000). Arts stream subjects are not offered because arts stream is not popular amongst the students and very few students enrol for these subjects. Hence, even if the statistics show that 51% of the students completing primary education in the atolls have access to secondary education, they do not have equal access to the secondary education.

3.3.1 Distance Education Developments in Maldives

Distance education has been used in Maldives to provide non-formal education since 1987 (International Centre for Distance Learning, n.d.). One of the programmes that has been successfully conducted and ongoing is teaching English language for adults, which is named Distance Education English Course (International Centre for Distance Learning, n.d.). The programme was initially targeted to upgrade the English of the atoll teachers. It is conducted through Atoll Education Centres in the atolls with the head teacher of each atoll supervising the programme at atoll level. The course is developed by the Non-formal Education Centre at the capital that is also responsible for record-keeping, setting examinations, marking, and distributing materials to the regional centres. Teleconferencing between the head teacher in the atoll and the headquarters occurs every week to clarify queries of the students. The head teacher acts as a mediator between the headquarters and the students rather than as a face-to-face tutor.

A second distance education programme that was developed and carried out in Maldives between 1989 and 1993 was Condensed Education Programme (Worldview International Foundation, 1993). It was informally named "second chance". As the

name suggests, this programme was designed to give a second chance education for out-of-school children and youth. The programme was condensed to fit the 5-year normal curriculum into two years. The objective of the programme was to facilitate participants' entrance to employment related training as well as entrance to post-primary education. The programme was conducted under the auspices of the non-formal education department in Maldives and was targeted to adults who missed the chance for primary education (personal communication, n.d.). Other non-assessed personal development programmes are continuously conducted through various government departments as informative distance education programmes (Sodiq, 2001). These programmes are targeted to general public via radio and television. All these programmes are either informative programmes or non-formal education programmes targeted for adult learners.

The need for secondary and tertiary education in atolls and islands was recognised by the government and a separate open learning department, named Centre for Open Learning, was created in 1999 under Maldives College of Higher Education. This centre has the mandate to run all the distance education courses conducted through various faculties of the college (Sodiq, 2001). The centre runs two programmes: International General Certificate in Secondary education (IGCSE) from Cambridge University and a degree course from The New Zealand Open Polytechnic. The materials from the host institutions are used in these programmes with hired tutors running face-to-face tutorials every fortnight. In addition, the centre was looking at the possibilities of running programmes from Indira Gandhi National Open University (personal communication, 2000). Since its inception, the centre has been able to

develop one course in Advanced Certificate in Primary Teaching, which is delivered in distance mode using print (Maldives College of Higher Education, n.d.).

3.4 Demography

Maldives is a group of 1190 islands scattered in 26 atolls. The islands stretch 823 km North to South and 130 km across covering a total area of 90,000 sq kms. The total land area of the 1190 islands is 300 sq km. The average size of the islands is less than half a square kilometre. Although there are 26 natural atoll formations, Maldives is administratively divided into 20 atolls. Two hundred and seventy thousand people are thinly distributed in 200 inhabited islands along the length of the country. Malé, the capital, houses nearly 75,000 people. Malé is the only island in the country housing more than 10,000 people. As seen in Table 3.2, more than 70% of the islands house less than 1000 people and more than 90% of the islands house less than 1500 people.

Table 3.2: Number of islands by size of population

Population Size	No. of Islands
Less than 500	95
500 – 999	142
1000 – 1499	184
1500 – 4999	196
5000 – 9999	199
10000 and over	1

(source: Census Data 2000 – Ministry of Planning and National Development, http://www.planning.gov.mv/census2k/).

The population size of the islands limits Maldives' ability to invest considerable amount of money in building infrastructure. In most cases, the infrastructure building will lead to diseconomies of scale in smaller islands in Maldives. This is also the case in education where building a school to cater for a small number of students will not be cost effective. On the other hand, the capital cannot accommodate the island population because it is already overcrowded with more than 70,000 people living in one and half square kilometres of land area. Of the 95 islands that have less 500 people, there are some islands where only 30 to 50 people live. Infrastructure development in terms of schools and hospitals for such a small population would be economically impossible especially for a country like Maldives. Hence, providing education to the island population through distance mode becomes an appealing alternative.

3.5 Transport and Communications

3.5.1 Physical Transport

Maldives lacks regular ferry service between islands as well as atolls with the only exception being a ferry service between Villingilli (an island close to the capital, which was developed to house people from the capital to overcome crowding) and Malé (United Nations Development Programme, 1998). Few people in the islands own boats and when they travel on business, medical or any other purposes between islands and atolls, others travel with them. Hiring boats for travel is costly and locals do not normally hire boats for their travel. Maldives Poverty and Vulnerability Assessment survey (United Nations Development Programme, 1998) shows that

transport to the atoll capital is also limited for the locals. The survey shows that as low as three trips per month are made between some islands and their atoll capital.

One of the prime examples of the transport difficulties was experienced by the researcher during the evaluation phase. The evaluation was done at two atolls geographically adjacent to each other. However, the researcher found that it was virtually impossible to travel from one atoll to the next directly due to lack of transport between the two atolls. Hence, every time the researcher wanted to travel from one evaluation centre in one atoll to the next atoll he had to return to the capital and then to the next atoll.

3.5.2 Communications

As expected, communications infrastructure has contrasting levels of development between Malé and other islands. In Malé, the communications infrastructure is highly developed with public having universal access to telephones, radio, television, and Internet. The situation is very different in the islands.

3.5.2.1 Radio

Radio is the most important medium of information, news and entertainment for the island population. Voice of Maldives (state owned radio station) covers the whole of Maldives and is the only media universally accessible to the whole population. Most of the island population listens to radio and hence radio is associated more with people who live in the islands. However, only 55% of island population have a radio at home with few variations between islands and atolls (United Nations Development Programme, 1998).

Programmes are broadcast through two channels (bands), both of them through Voice of Maldives. Several non-formal, personal development programmes are broadcasted through radio, which are mainly conducted through various government departments. No formal education programmes are conducted through this medium.

3.5.2.2 Television

Television Maldives (TVM) is the only television station in the country. TVM is state-owned and only the capital and few nearby islands receive its broadcasts. Recently TVM has introduced satellite television using encoders, which reaches all parts of Maldives. However, the island population are unable to capitalise on this technology, as they need to purchase decoders to view the broadcasts. The rental for the decoders is too high for an average income owning person. All the atoll offices have satellite receivers and decoders and public have access to their premises to view television programmes on restricted times. Statistics also show that only 15% of the island population have a television at home (United Nations Development Programme, 1998).

3.5.2.3 Telephone

Maldives has achieved universal access to telephone service on all the inhabited islands in May 1999 (Asian Development Bank, 2001). However, all the islands do not have access to public telephone nor have telephone network for the households. In these cases, the public can use telephones in island offices. Telephones are available at all the government offices and schools in the islands.

Even where telecommunications infrastructure allows household connections, the cost limits access. Dhiraagu (the telecommunication provider in Maldives) controls the prices of telecommunications as it has exclusive rights to basic voice services in Maldives. The pricing scheme for inhabited islands is one of the lowest in the world (Asian Development Bank, 2001). However, Dhiraagu categorises only 11 out of the 200 islands where people live as being inhabited islands. For the uninhabited islands categorised by Dhiraagu the monthly rentals are more than 110 percent of that of inhabited islands. The majority of the population cannot afford these high rates. Maldives is developing a project with funding from Asian Development Bank (ADB) to reform the telecommunication sector which involves reducing telecommunications prices to affordable levels. This project commenced during 2002 and is scheduled to be completed in 2006 (Ministry of Communications, Science and Technology, n.d. (b)). The major phase of the project which includes Installation and Commissioning of the government network and selected applications has been contracted to an international company and will be completed in 2006 (Ministry of Communications, Science and Technology, n.d. (b)).

3.5.2.4 Internet

Internet was introduced in Maldives in 1996 and has since been expanding at a rapid pace. The expansion in terms of usage can generally be seen only in the capital although the service has been extended to provide universal access in Maldives. In addition to the capital, cyber cafes for the public also exist in the southern most and northern most atolls. The number of cyber cafes is on the increase throughout the country as more and more people are using the Internet. In February 2002, a further cyber café has been established in Noonu atoll (an atoll between the capital and the

northern tip) as part of government's plan to introduce Internet into the islands (personal communication, 2002). Although access is available, high costs of installation and usage limits the number of users. Internet is charged by the minute and the charges are much higher than those in many developing countries (Asian Development Bank, 2001).

3.5.2.5 Planned Developments

Maldivian government has identified the potential of telecommunications and emphasis is put on rapid expansion of the telecommunications infrastructure. One of the major developments includes the National Telecommunications Master Plan which was formulated in the year 2000 (Ministry of Communications, Science and Technology, n.d. (c)). The Master Plan outlines how telecommunications and information technology will be used in improving economic as well as social infrastructure.

Another project, which was planned for 2002 is the Information Technology Development Project funded by ADB (Asian Development Bank, 2001). "The project includes (i) networking of government agencies and applications for delivery of public services, (ii) establishment of National Computer Centre (NCC), (iii) building of Internet kiosks in remote atolls, and (iv) provision of consulting services for implementation of telecommunications sector reforms" (Asian Development Bank, 2001). The government network involves establishing a computer network connecting all the government ministries and parastatal organisations in Malé via a fibre optic cable. In addition, the twenty outer atolls will also be networked relying on the carrier service offerings. The network will have the capacity to expand into individual islands

when necessary. The network will be primarily designed for data communications but will have the sophistication of accommodating future applications such as videoconferencing.

The project also involves establishment of National Computer Centre (NCC), which was planned to be responsible for coordinating all ICT policies, standards, and practices for government work (Asian Development Bank, 2001). In addition, the mandate for NCC includes:

- "Develop and monitor the implementation of framework policies;
- support government in their development of ICT strategies;
- develop shared infrastructure and applications;
- promote common policies on the management of information including privacy;
- develop crosscutting services on the government network;
- develop extranet links with wider public sector; and
- coordinate action on skills for e-government" (*Asian Development Bank*, 2001: 10).

The National Computer Centre has been inaugurated under this project, and its main mission is to cooperate and coordinate with government agencies and private sector in formulating the information and communication policies of Maldives (Ministry of Communications, Science and Technology, n.d. (a)). Furthermore, a contract has been signed between CET Technologies Pte Ltd (CET) of Singapore and the centre to implement the government network of Maldives (Ministry of Communications, Science and Technology, n.d. (a)). The network implementation will be completed by

the end of 2006, and will provide remote access to schools, hospitals, government offices across the country.

Internet kiosks are also planned for atoll offices under the ADB project (Asian Development Bank, 2001) but this phase of the project has not yet commenced. These kiosks will be connected to the government computer network allowing public to access the network. The project will provide facilities such as computers, modems, and appropriate accommodations to house the kiosks. In addition, the project includes a training component for the assistants who will staff each of the kiosks.

The project also includes a telecom sector reform component, which mainly focuses on restructuring the existing regulatory body. The existing regulatory body is one of the main obstacles for tariff restructuring for telecommunication services. The same component also involves tariff restructuring of Internet services so that the prices are affordable.

The project implementation commenced on 2002 and will be completed by the end of 2005. The first year mainly involves bidding and consulting services for the telecom sector reform and establishment of NCC and the government network. Starting from second year, the establishment of Internet kiosks was planned to commence which will be an ongoing process until the end of the project.

3.5.2.6 Computers in Educational Institutions

Ministry of Education started a Basic Computer Literacy Project aiming at providing computer literacy for all the students who complete primary education during year

2000 (Ministry of Education, 2001). This ongoing project aims at making all the primary school leavers competent in using basic computer facilities and programs. In order to achieve this goal, the Ministry of Education installed computer laboratories with multimedia computers in each of the primary schools in the country. In essence, this means that every island in the country would have a computer laboratory. The aim of the ministry was to have at least one computer for every sixty students enrolled in the school. However, this ratio was smaller overall as there were a number of schools with a very low number of enrolments. Table 3.3 shows the number of computers available in the schools when the project began. Official statistics of the current situation has not been released as yet.

Table 3.3: Student enrolments in atoll schools and number of computers used for teaching in 2003

School	Atoll	Enrolments in	No. of
Ha. Atoll School	Ha. Hoarafushi	974	10
HDh. AEC	HDh. Kulhudhuffushi	1989	16
JalaaludhinSchool	HDh. Kulhudhuffushi	865	18
Sh. Atoll School	Sh. Kanditheem	508	10
Sh. Atoll Education Centre	Sh. Komandoo	879	13
Maakandoodhoo School	Sh. Maakandoodhoo	479	10
N. Atoll Education Centre	N. Velidhoo	781	16
Baa. Atoll Education Centre	Baa. Edhafushi	1194	16
Lh. Atoll Education Centre	Lh. Hinnavaru	1226	10
Mad. Ifthithah	Lh. Naifaru	1326	14
ADh. AEC	ADh. Mahibadhoo	771	16
Gdh. Atoll Education Centre	Gdh. Thinadhoo	2278	13
Gn. Atoll Education Centre	Gn. Fuvahmulaku	1738	11
Muhibbudin School	S. Hithadhoo	1124	16
Seen. Atoll School	S. Hulhudhoo Meedhoo	597	17

(Source: Basic Computer Literacy Project – Ministry of Education, Maldives)

3.6 Why Distance Education in Maldives

Maldives is a prime example of a small island nation facing a number of barriers due to its size and economic status. Since it is not economically feasible to build a secondary school and a high school in each of the islands, one of the ways to achieve economies of scale is to have regional centres where the students travel on a daily basis to get their education. However, the absence of regular ferries between the islands in Maldives makes it impossible for students to travel to the regional centre on a daily basis if the centre is not situated in their own island. For this alternative to

work, Maldives needs to invest heavily in establishing regular ferry services between the islands in addition to the human resources development and other infrastructure development costs. Alternatively boarding houses can be established in the islands where the regional schools are located and students can reside in these houses during the school term which again requires huge financial investments. This leaves the alternative of reaching the students, wherever they are, through distance mode. Hence, distance education is seen as the best alternative to provide access to secondary education in the Maldives.

3.6.1 Audience

Although Maldives does not have a university of its own, some comparisons can be made with Bangladesh due to inherent similarities in the student population. The main target audience of Bangladesh Open University, Open University Sri Lanka, and Allama Iqbal Open University is the students from the rural areas who need secondary schooling (Bangladesh Open University, n.d.). This is similar in Maldives where only 60% of the students who complete the primary and middle school (at age 12) progress to secondary school (Table 3.1). Although this figure is not very low there is a wide disparity between the rural areas and the capital. While the total access to lower secondary schooling is 60%, only 38% of the students who complete middle school progress into secondary schooling in rural areas. As the students progress from lower secondary schooling to higher secondary schooling, the numbers drop drastically due to the lack of institutions offering this level of education. Only 13% of the students who complete lower secondary schooling have access to higher secondary schooling and it is only available in the capital. Hence, the target audiences catered at BOU is relevant to Maldives, as Maldives has to cater for similar audience. BOU's success

rates in attracting huge numbers to Secondary School Certificate could be viewed as a positive aspect for implementing secondary school programmes via distance mode in Maldives. However, with the lack of human resources and poor postal services to the islands, the medium of instruction used at BOU is not best suited to Maldivian conditions. However BOU's study centres infrastructure could be implemented in Maldives. BOU uses Thanas (the administrative units of the country) in delivering the contact sessions to the students. Maldives could use a similar approach with several options. At the atoll level, either the Atoll Education Centres (AEC) or the Atoll Offices could be used, and at the island level, the Community Schools or Government Schools or even the Island Offices could be used to deliver the contact sessions.

3.6.2 Use of Computers as a Medium of Delivery

Use of computers in both the capital and the islands are on the increase in Maldives. As mentioned earlier, the information technology project also aims at installing some Internet kiosks within the islands of Maldives. Hence, this section looks at the availability and use of computers in distance education in Maldives.

Indira Gandhi National Open University (IGNOU)'s model of virtual campus (Sharma, 2001) is too advanced for Maldives with its current infrastructure. The government is in the process of implementing a national information infrastructure, which involves the interconnection of all inhabited islands of the Maldives with a modern information infrastructure (Ministry of Communications, Science and Technology, n.d. (b)). Once this is established, Maldives could look into the possibility of virtual campuses in some island centres. However, huge amount of foreign aid needs to be secured before this project can be implemented. In the

meantime alternatives need to be found using the current infrastructure. The Ministry of Education launched a project to provide computers to those schools that are without a single computer (Ministry of Education, 2001). This project is currently ongoing. However, distance education programs completely depending on these computers will not be a viable option as the Ministry is planning to have only one computer per sixty students. This will not give an adequate student computer ratio for students to be able to use these computers long enough for effective instruction delivery.

Other facilities under consideration in this research are computer networks and Internet kiosks in the islands. Currently computer networks exist in a few islands and Internet kiosks and cyber cafes are on the increase. In addition, the Villa Foundation of Maldives has promised that it will equip every school in the country with a computer lab including the furniture (Villa Foundation, 2005). This was promised by the chairman of the foundation who is the richest man in the country. These computer labs will further expand the accessibility for the students who will use the proposed model. With the introduction of these computer labs each island will have a computer lab in their primary school and further computer centres and cyber cafes. Hence the students in the islands will have access to computers although personal computer ownership is not high in the islands. All of these options and the low computer ownership make the study centre approach the most feasible in Maldives. The technology is quickly moving to the atolls and islands of Maldives but the geography of the country makes this quite challenging. However, telephone connections are available in all inhabited islands making Internet possible in all the islands, even if at a rather high cost.

3.6.3 Regional Cooperation

Another option Maldives could pursue is using a regional cooperation model similar to that of University of South Pacific (USP) or University of West Indies (UWI). These two institutions use a regional model where the institution caters for a group of countries within the region rather than one individual country. However, the regional models used by both USP and UWI are only applicable to small island nations where neighbouring nations are also small island nations. Even with these collaborations the host countries dominate and the countries with fewer resources suffer as a consequence. This disparity will be higher when small island nations are situated alongside huge countries where total control will be taken by the larger power players making this sort of collaboration impossible. Maldives is a prime example of a small island nation with less than three hundred thousand people, surrounded with countries having millions and billions of people. Hence, Maldives has to seek an alternative model of distance education.

In addition to focussing on the strengths and weaknesses of different technologies, Maldives has to capitalise on the available technologies at different levels. For example computer-based instruction on the Internet could be used in parts, while computer based instruction using computer networks at schools and other planned kiosks could compensate in other areas. Consequently Maldives requires a distance education model where the medium of communication is selected according to the availability and which allows easy transfer from one medium to another if and when more advanced telecommunications capabilities are introduced.

3.7 Case Study Design Considerations and Results

This chapter has discussed the factors that need to be taken into consideration in developing the distance education model for Maldives. The case study design should look into five different factors, namely study question, study propositions, study's unit(s) of analysis, the logic linking the data to the propositions, and the criteria for interpreting the findings (Yin, 2003a). The study question has been covered in section 3.1 where the type of case study was identified. The study question encompasses understanding of the nature of the case study. This research is looking into ways of developing a suitable distance education model for Maldives. In other words the question "how" to develop a suitable distance education model for Maldives is asked.

The second component of the design is looking at the study propositions within the scope of the case study. The study propositions of a case are required in order to identify the relevant information to cover within the scope of the case, since it is impossible to cover "everything" about the case (Yin, 2003a). The scope of the case study of Maldives is limited to finding ways to reach the students in the outer islands of Maldives. In other words, the case study and its propositions are limited to providing access to distance education. The third component is identifying the unit(s) of analysis where the investigator lists the specific units or items to measure within the case study. This research is focussed on access to secondary education through distance education, hence the units of analysis are measures of how to provide this access. However, initially the case study focused on the limitations of access to secondary education and then focused on the opportunities. Hence, transport and communications have been the major focus in the unit(s) analysis component of this case study. The fourth and fifth components of the case study design are the least

developed areas in case study (Yin, 2003a). Hence these components have not been extensively used in this research. However, this research has identified the unit(s) of analysis and these are being used to derive a list of criteria in developing a suitable distance education model for Maldives. This stage of criteria development can be seen as the fourth and fifth components of this case study design. Finally these criteria are used to develop the distance education model for Maldives.

3.8 Criteria for Developing Distance Education Model in Maldives

The descriptive case study approach led to a deep understanding of the barriers and constraints for delivering distance education in Maldives. In addition, the case study approach also identified the opportunities available in Maldives. As mentioned earlier, this research is focussed on providing access to distance education to students in the outer islands. Hence, the research looked at the best delivery mechanism for reaching the outer islands in Maldives.

As discussed in chapter two, several delivery media exist in the field of distance education. The most widely used medium is print, where a correspondence model is used. Print medium cannot be used in Maldives as the postal system in Maldives is not reliable and there are no regular transport services between the capital and the outer islands. The case study has shown that radio and television are also not viable means for delivering distance education in Maldives. Distance education based only upon online delivery will not work in Maldives because the Internet is too expensive to use in the outer islands. Hence, students cannot afford to use the Internet for their studies.

Some of criteria for developing a distance education model in Maldives include;

- Access
- Cost
- Interactivity

Since there are no existing venues of access within the existing infrastructure in Maldives access was the main focus of this research. Hence, the distance education model designed and developed will provide access to secondary education for the students in the outer islands. The model should also focus on limiting the expenditure in terms of infrastructure development. Finally, the distance education model should provide adequate interactivity for the students to interact with both the content as well as the teachers.

The case study has shown that there is an increase in the number of computer centres in the outer islands. Several projects, some already completed and some ongoing, involving the developments of computer centres are being carried out in the islands. The case study has also shown that these computer centres can be used to deliver distance education to the students. Furthermore, the Internet can be used to provide the interactivity between the students and human teachers in the capital. In conclusion, the distance education model for Maldives should be able to use the computer centres in the islands with limited Internet connectivity for communication between students and teachers. Internet will serve as a bridge between the teacher and the students but the students will not be required to have access to the Internet. Any distance education model for Maldives has to take into account these criteria. The

following chapter proposes a theoretical model that takes into consideration these criteria.

4. MODEL DESIGN AND SOFTWARE DEVELOPMENT

This chapter looks at the process and stages of design and development of the proposed distance education model for Maldives. As previously stated, the model was designed to suit the remote islands in Maldives. Hence emphasis was given to what was effective and would work within all the limitations of the Maldives. The chapter is divided into two main sections. The first section gives an account of the design of the proposed model. The second section focuses on the development of the software according to the proposed model. The software was developed for the purposes of evaluating the proposed model in Maldives.

4.1 Model Design

The model was designed by taking into account the limitations in Maldives as described in Chapter Three. In addition to the limitations, chapter three also outlined what technologies were available in Maldives. The proposed distance education model focuses only at content delivery and two-way interaction between students and instructors. It does not attempt to covers aspects of assessment. The main reason for this is that students in secondary and higher secondary school in Maldives prepare for external examinations from overseas and it would be impossible to incorporate that into this model. However, student progress is continuously monitored in the proposed model. While considering appropriate delivery mechanisms for distance education, the first and foremost decision to make is what technology or communication mechanism can be employed. Hence the choice of technology for delivery mechanisms is addressed.

4.1.1 Choice of Technology and Delivery Systems

The advent of advanced learning technologies has seen distance education moving from the individualised correspondence model to a more interactive mode. Use of different technologies and modes of instruction can be described using the dimensions described by Aggarwal and Bento (2000) to classify teaching environments. They use time and place to classify four major types of teaching environments. These four types can be used in categorising technology used in delivery systems for distance education. The four types of instruction are: same time / same place, any time / same place, same time / any place, and any time / any place. A similar approach has been used in this research to identify the best media technology suited to deliver instruction in Maldives.

The first category "same time / same place" represents traditional face-to-face classrooms where students attend classes at the same time for instruction (Aggarwal and Bento, 2000). The fact that this category of instruction delivery is not feasible in Maldives is the major rationale behind this research. Maldives is unable to build schools in each of the islands to deliver secondary education using traditional face-to-face classrooms.

"Any time / same place" occurs when students attend study centres and labs to interact with teachers and other students. Major distance education providers like British Open University use local study centres to support students by means of tutor support, library facilities, and other interactions (McIsaac and Gunawardena, 1996). Bangladesh Open University (BOU) uses tutorial centres to deliver tutorials to the students on a fortnightly basis (Rumble, 1999 and Bangladesh Open University, n.d.).

As mentioned earlier, this alternative is not feasible because there are no regular ferry services between the islands, hence students will not be able to travel to regional centres for regular tutorials or classes. However, people travel between islands within an atoll almost everyday and students will be able to travel to a regional centre at least once a week. In most of the distance education institutions study centres have been used to provide students with access to media equipment, library facilities, computer access, and so on, rather than tutor-student interaction (McIsaac and Gunawardena, 1996). Alternatively Maldives can use local island government offices, computer centres, and schools with computer facilities as local study centres where student can have access to computers.

"Same Time / Any Place" is where instruction is delivered simultaneously to students widely dispersed geographically via one-way broadcast or using interactive communication media where students interact with teacher and other students while staying at their own locations. Broadcast media, such as radio and television, is an ideal technology for this type of instruction. Radio is widely used in developing countries because it is a much cheaper option compared to other more sophisticated technologies (Tripp and Roby, 1996). Radio is universal in Maldives and almost everyone listens to it. Radio is mainly used for informal informative programmes without any interaction on the part of the listener. Television has been used for similar programmes, which were mainly public awareness programmes. Work is being carried out to universalise television as well (Sodiq, 2001). Broadcast media is excellent in reaching the public with these kinds of programmes due to its immediacy. However, with formal education, interactivity is an important component which broadcast media lacks.

Teleconferencing is another technology that can be categorised under this type of instruction. Teleconferencing has been used in Maldives to support distance education programmes. In these programmes teleconferencing was used between the centre in the capital and the coordinators in different islands on a weekly basis (Sodiq, 2001). Teleconferencing as a means of communication between students and tutors is not feasible in Maldives because most students do not have telephones in their homes and separate facilities need to be established for this purpose.

Two types of technologies can be categorised in "any time / any place" instruction. They are technologies that deliver one-way information such as print, audio and videocassettes and those that provide interaction (McIsaac and Gunawardena, 1996). Print, audio and videocassettes will work in those parts of the world where postal service is reliable. Maldives postal service to the islands is highly unreliable hence this medium of instruction is impractical in Maldives. The second set of technologies (interactive) is further divided into instructor-learner interactive technologies and learner-machine interactive technologies. Again, instructor-learner interactive technologies need to be minimised in this research because instructors are not available in majority of islands in Maldives. Hence, more focus is given on how to maximise on learner-machine interaction and identify a suitable model for Maldives.

The communications infrastructure has contrasting levels of development between the main island and other islands in Maldives. In the main island, communication infrastructure is generally highly developed with the public having universal access to telephones, radio, television, and Internet. In contrast, as mentioned earlier, only 55

percent of the island population have radios at home and only 15 percent of the island population have televisions at home (United Nations Development Programme, 1998). Therefore deciding to use radio and television as the main medium of delivery in distance education is not an alternative. In addition, radio and television only allow one-way delivery, restricting the pathways to learning. Internet availability and usage also paint a similar picture in Maldives between the main island and the other islands as radio and television do. Although Maldives provides universal Internet access to all the islands, the high costs of installation and usage limit the number of users (Asian Development Bank, 2001). The Internet is charged on a per minute basis and the charges are much higher than those of the developed countries and many developing countries (Asian Development Bank, 2001). Therefore individuals in the islands cannot afford to use the Internet on a regular basis. Hence Internet cannot be used as the only medium of delivery because learners cannot afford frequent online connections. However, the Internet can be used for infrequent exchange of information where another medium is used for instruction and delivery.

Although Indira Gandhi National Open University (IGNOU)'s model of virtual campus (Sharma, 2001) is too advanced for Maldives, the Maldivian government is in the process of implementing a national information infrastructure, which involves the interconnection of all inhabited islands of Maldives with a modern information infrastructure (Ministry of Communications, Science and Technology, n.d. (b)). Upon completion this infrastructure may be able to cater for virtual campuses in some island centres. In the meantime, the existing infrastructure needs to be utilised. These include the computer centres established in schools through the Ministry of Education project, Internet kiosks and cyber cafes in the islands. In addition, the project

promised by Villa Foundation (Villa Foundation, 2005) will provide adequate number of computers.

In addition to focussing on the strengths and weaknesses of different technologies, Maldives has to capitalise on the available technology at different levels. For example, computer-based instruction with Internet could be used in parts where possible, while computer based instruction using computer networks at schools and other planned kiosks could compensate in other areas. Consequently, Maldives requires a distance education model where medium of communication is selected according to availability and which allows easy transfer from one medium to another if and when more advanced telecommunications capability is introduced. The proposed model therefore uses the existing computer networks to deliver the instruction, with Internet for teacher-student interaction. A three-tier architecture of communication is used to provide effective interaction between the teachers and students. In essence, the current infrastructure allows us to use computers as a medium of delivery without any access to Internet for individual students. However, at a regional level, Internet access is available and can be used for a limited amount of time without having to incur huge costs.

4.2 The Proposed Model

The proposed three-tier model is based on the assumption that the students will not have personal Internet connections and are not required to go online at any time on their own computers during their study. However, they need to communicate with the teacher who would be based in a different location (most probably in the main island),

therefore a link needs to be made between the students and the teacher. The three-tier architecture portrays these three entities: the student, the teacher, and the link between the two. The three-tiers comprise the student module, regional module, and the headquarters module. The student module is the component that the student uses to learn and interact with the content. The headquarters module is the component with which the teachers interact to monitor students' progress and provide feedback. The regional module is the link between these modules and provides a bridge between offline and online modes. The student module is sent to each student, the regional module is set up in each of the regional centres, and the headquarters module resides at the central location where teachers are available. Figure 4.1 shows the communications structure of the model. All the communications between the student module and the regional module are offline; hence the students are not required to have Internet connectivity. All the communications between the regional module and the headquarters module are online, but the communication takes place in batches, hence not requiring continuous online connection.

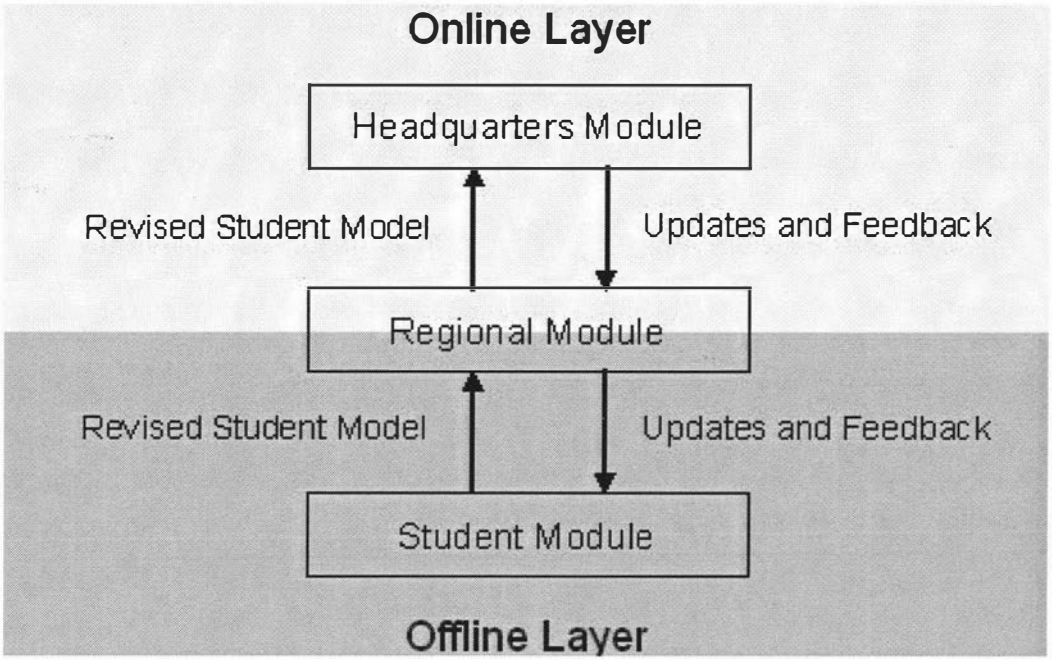

Figure 4.1: Structure of the Model

4.2.1 Student Module

The student module consists of three separate and distinctive components: the student model, the content, and the system setup files. All these components are sent to the student at the beginning of a course. The system setup files include all the files required to install the student module as well as setup information and guides. The setup files will only be used during the installation and initial setup of the learning system. Once this is completed the other two components will be used intensively by the student throughout the course. The student will interact with the content all the time the student is learning through the proposed model. The student model is a profile of the student stored in the model. This profile will keep a record of the student's progress with regard to the content he/she is studying. The student model is sent to the student on a floppy disk and the rest of the student module is sent on a CD-

ROM. The initial student model is also uploaded into a regional repository located in the regional centre to which the student belongs. The students can install the student module into their own computers or if they do not own a computer, they can install it at their local study centre.

Once the installation is completed the students can start working with the content. The student module acts as a computer based learning package. The content is divided into several topics or concepts. These concepts are further divided into learning units and each learning unit has a set of questions attached to it. The students can go through the content in any order; however some concepts require completion of a prerequisite concept which has to be completed before starting that particular concept. As the students progress through the content, their progress is recorded into the student model/profile. The process of updating the student profile is described later in the "updating student model" section of this chapter. Since the updates are recorded on the computer the student is working on, the students need to upload these updates to the regional module which in turn updates the headquarters module. Students have the flexibility of recording their profile on to the floppy disk any time and take it to the regional centre for uploading. When the students upload their updated student model into the regional module they also receive back from the regional module into their floppy disk any feedback available from last time's student model update. This can then be transferred back to their computers through the floppy disk. The main advantage of this system is that students without online connections are provided with adequate individualised instruction. This is provided through a well designed student model that characterises each student, and content is delivered accordingly. The following sections outline how the students are provided with adaptive content and

feedback without asking for online connections.

The student model for this system is based on the overlay model, as this model is widely used and tested in the domain of student modelling literature (Paiva, 1995). As mentioned in the chapter two, a student model contains the system's profile about the learner's knowledge, interests and goals. The student model will be constantly updated in accordance with the dynamic features of the student knowledge acquisition process (Brusilovsky, 1994). A comprehensive student model should contain information about the student's domain knowledge prior to the use of the educational system, the learner's progress, preferences, interests, goals, and any other information related to the learner (Self, 1994). The proposed model only concentrates on collecting and updating domain specific information of the student model using the overlay model. The overlay model represents the student's knowledge as a subset of the entire domain hence as the student acquires more knowledge the subset gets bigger and bigger. In the proposed model, the domain consists of the content that will be taught using the model. The domain is divided into a set of concepts namely topics. Each of these topics is then further divided into learning units which are considered as the smallest units of measurement in terms of learning. Each of the learning units has a set of questions attached to them which test the students' competency for that particular learning unit. The student model records the competencies of the students at each of these levels, that is concept competencies, learning unit competencies, and question competencies. For each concept the teacher defines the level of competence required from the set of learning units within that particular concept. For example, if concept A has 5 different learning units, then a teacher can state that a student can only become competent in concept A when the student achieves competencies in all 5

learning units. Or, the teacher can state that the competency of concept A is based upon the student attaining competency in any 4 of the 5 learning units. In addition, the teacher can also state the level of competency that will be accepted for each of the learning units. The concepts, learning units, and questions each have levels of defined competencies attached to them and the teachers can define what the acceptable levels for their modules are.

As previously mentioned each question belongs to one particular learning unit. Each of these questions have four levels of competencies, namely "not attempted", "failed", "solved with help", and "solved without help". Initially students will have "not attempted" as the competency for all the questions. When they attempt a question the competency is changed according to their response to the question. If the student does not manage to get the answer correctly the competency is changed to "failed". If the student does manage to answer correctly, one of the two remaining competencies is recorded for that particular question. While attempting each question the student has the ability to ask for a hint which would help him/her to answer the question. When the student chooses to use this feature and gets the answer correct the competency would be recorded as "solved with help". However, when the student does not use the hint facility and gets the answer correct the recorded competency is "solved". The competency for each of the respective learning units depends on the number of questions correctly answered by the student. Learning units consist of five levels of competencies. These are "prerequisite not complete", "ready", "visited", "completed", and "mastered".

All of the learning units that have prerequisites have "prerequisite not complete" as

the initial competency. The learning units that do not have a prerequisite have "ready" as the initial recorded competency. Any learning unit with a prerequisite cannot be started until the recorded competency for that learning unit changes to "ready" status. This can be achieved by completing the prerequisite learning unit for that particular learning unit. As soon as a student opens the first page of the learning unit with the competency as "ready" the recorded competency changes to "visited". This shows that the student is currently studying that learning unit or has started learning unit. Once the student completes the learning unit, he/she is asked to answer the questions. Depending on the competencies achieved for the questions, the competency level for the learning unit is changed to either "completed" or "mastered".

While authoring the content, the teacher will determine how many questions need to be solved without help or with help to achieve "completed" level or "mastered" level. The number of "completed" or "mastered" learning units within a concept determines the level of competency attained for the overall concept. The concepts have four levels of competencies namely "not attempted", "in progress", "completed", and "mastered". Initially all of the students will have "not attempted" for all the concepts as this indicates that the students have not yet started with that particular topic or concept. As soon as the student opens the first page of the concept the competency is changed to "in progress". As the student progresses through the different learning units of the concept, the competency for that concept is changed to "completed" status and possibly "mastered" status. The level of competency achieved will depend on the teacher's definition of the achievement level and student's level of competencies in the learning units. The different competencies within the student model are illustrated in Figure 4.2.

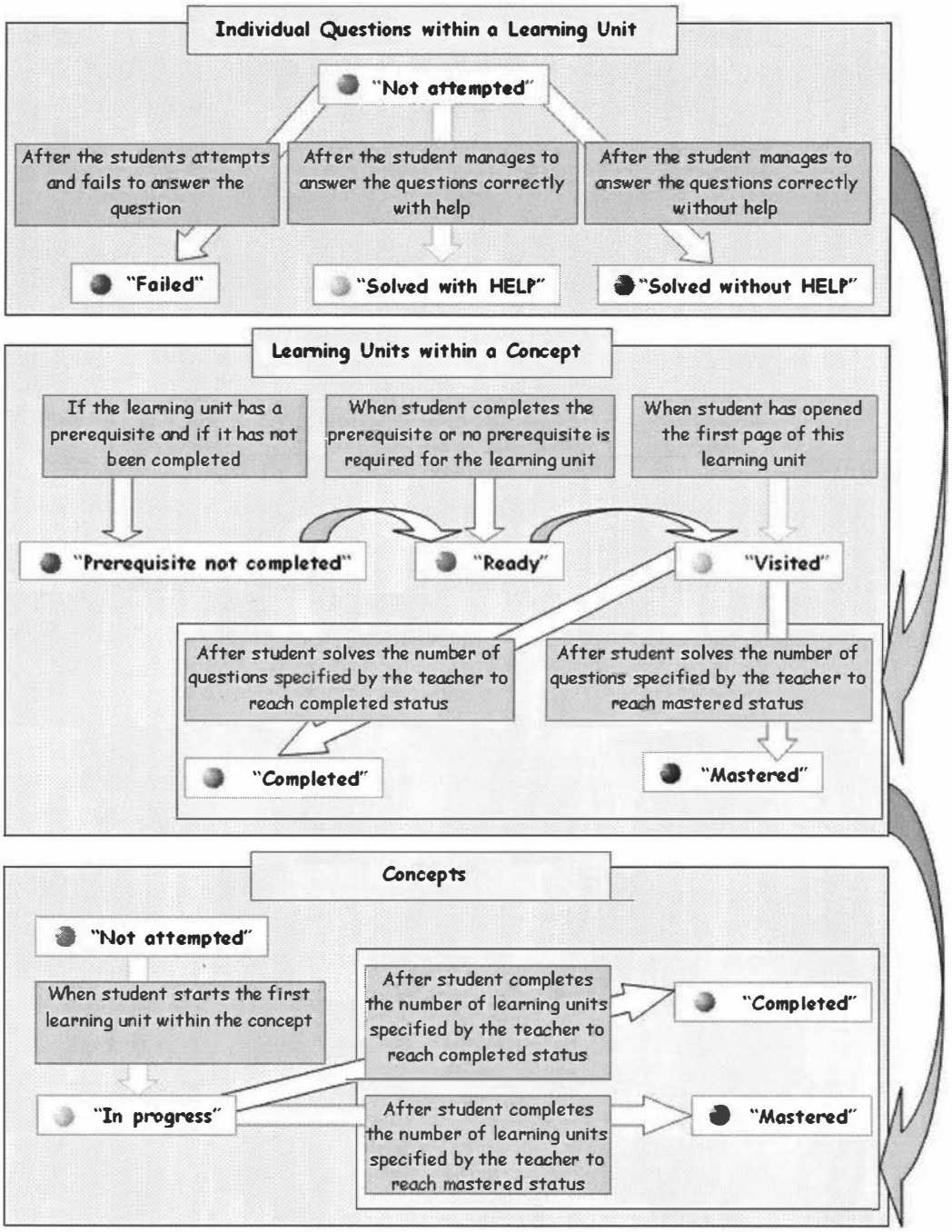

Figure 4.2: Student Model Competencies

4.2.2 Initialising Student Model

The student model has to be initialised before it is sent to the students. This section discusses the process through which the student model gets initialised in the proposed distance education model for the Maldives. When the students wish to enrol for a course they send their applications to the headquarters. These applications are assessed and approved prior to enrolling the students into the system. Students who meet the entry criteria are added to the system. This is the first part of student model initialisation. Since this model is designed for secondary education, the applications include information about the results of previous years in addition to the factual data about the students. This gives an indication of students' prior knowledge of the domain. Explicit questioning is asking direct questions to the students to find out their prior knowledge of the domain (Paiva, 1995). The data gathered through application forms, especially on the applicant's results, can be treated as data gathered from explicit questioning. If the students have prior knowledge of some of the content included in the module then these are added as competencies for that student. However, normally it is assumed that the students have no prior knowledge of the domain. Hence in general, the student model created for any student contains "not attempted" for all the questions, "prerequisite not completed" or "ready" for all learning units, and "not attempted" for all of the concepts. If a student has a very strong case with regard to their domain knowledge, these initial competencies can be changed.

Once the initial competencies are finalised for a student, his/her student model is created. Likewise, all student models for all approved applicants are created at the headquarters. These student models are then recorded on floppies and sent to the

students with the system setup CDROM. The system setup CDROM contains setup files and content files. The individual student models are stored in floppy disks for two reasons. The first reason is that each student has a unique initial student model hence the mass produced CDROMs cannot include student models within them. Secondly, the students need to use the floppy disk to upload and download their student model from time to time to and from the regional module. In addition to sending the student models to individual students, the student model is also uploaded to the respective regional module via the Internet. Each student has their student model uploaded into the regional module in the region they reside. Figure 4.3 shows the process of initialising student model in both student module and regional module.

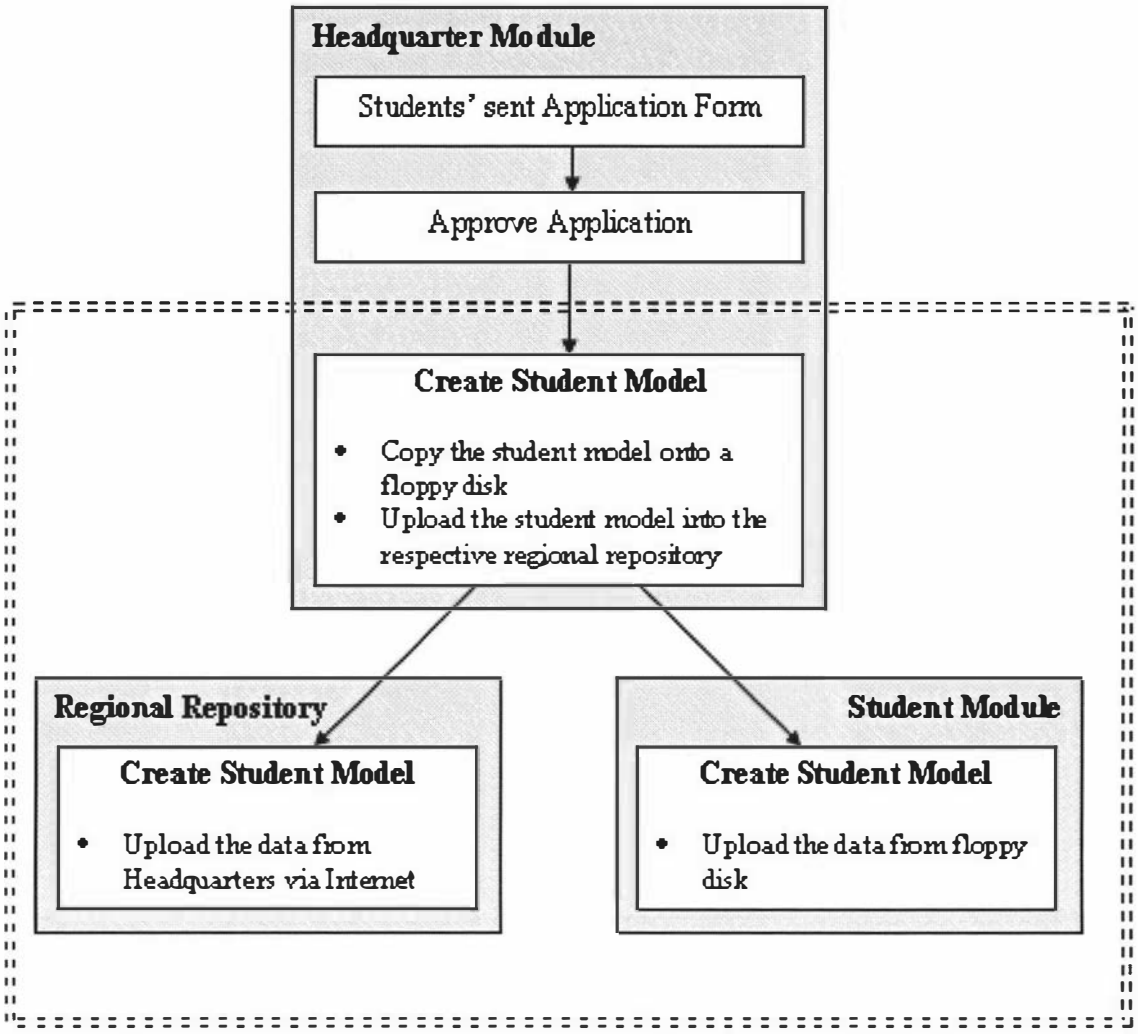

Figure 4.3: Initialising Student Model

4.2.3 Updating Student Model

Once the system is setup on the student's computer and the student model has been recorded on it, the student can start using the system. As the student progresses through the content, different levels of updates are made to the student model. There are three different levels of updates for student model (Figure 4.4).

As with any other computer-based learning system, the student model gets updated according to the student's progress with the content. This is the first level of update to the student model. This includes updating the competencies for the questions, learning units, and concepts as the student achieves competencies in each of these components. This update happens at the student module, specifically in a database that is stored in the computer the student is working on. The second level of update involves the synchronisation of the student model between student module (the computer on which it is stored) and regional module. The final update is between regional module and headquarters module. The synchronisation of the student model between the student module and regional module is a function of regional module. Hence this function will be described later in the regional module section. Likewise, the student model update between the regional module and the headquarters module takes place in the headquarters module and will be explained later in the headquarters module section. Current section will concentrate on how the student model gets updated within the student module.

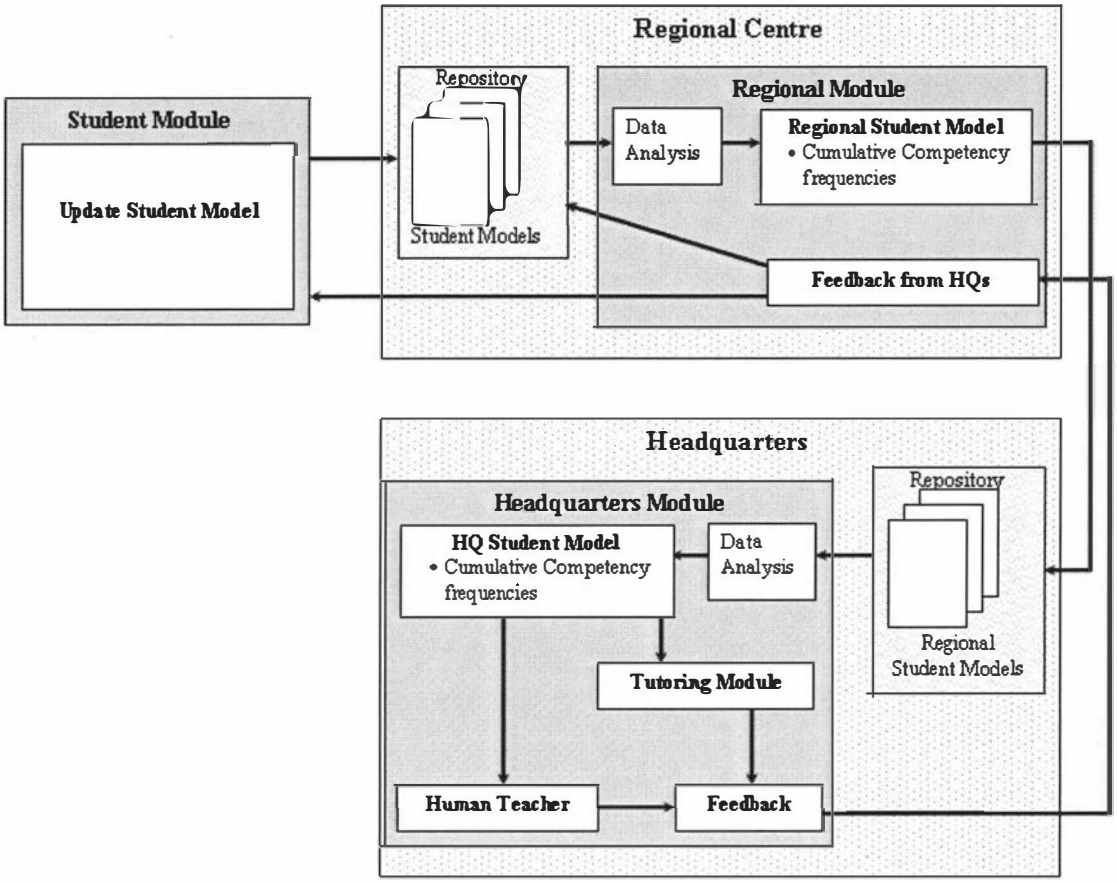

Figure 4.4: Updating Student Model

As explained earlier, the different competencies of the students get updated as the student completes different topics. Within the student module, the student model gets updated at three levels: questions level, learning unit level, and concept level. When a student completes a question, the competency for that particular question is changed depending on the student's response. Similarly, when the student completes all the questions prescribed for a given learning unit, the competency for that learning unit is changed on the basis of how the student faired in all those questions. Consequently, the competency for the concept is changed when the student completes all the learning units within that concept and the competency value depends on the overall value for all those learning units.

Since the student module is installed on standalone machines, these updates are not reflected automatically to the teacher. Hence a mechanism is needed to synchronise these changes between the students and the teacher. The first step for this synchronisation is to upload these updates into a floppy disk. The floppy disk that was initially provided to each student is used for this purpose (or any other floppy disk can be used). The students have the option of uploading their most updated student model into a floppy disk. The students are asked to insert the floppy disk prior to the process being started. The upload process automatically detects which updates have been made since latest upload and uploads only the new additions to the database onto the floppy disk. Once this process is completed the student is asked to take the floppy to the regional centre and upload the student model into the regional module. The process of uploading the student model into the regional module is explained in the next section.

During the same process of uploading the student model the students are able to send queries and receive feedback from the teachers. At every level of the content the students have the opportunity of asking a query. That is, the students can ask questions about concepts, learning units, or questions. The implementation of this feature is explained in the software development section of this chapter. Initially the ability for the students to ask queries was not designed into the model. The main reason for this was that the teacher(s) at the headquarters would not be able to attend to each student on an individual basis but rather the students are monitored on a group basis. However, it was decided that allowing the students to add queries and having the ability to compile these queries into a list will provide the students with adequate

individualised feedback. Hence this feature was added to the design. As mentioned earlier, the student can ask queries at all different levels of the student module, namely at questions level, learning units level, and concepts level. Therefore, a student can ask a question about each individual question, or a particular learning unit, or a concept. All the queries of the students are recorded and uploaded to the floppy disk and then in turn uploaded to the regional module. Any queries already uploaded to the regional module will not be uploaded a second time into the regional module. In addition, every time students upload their student models, the system will also check to see whether any feedback for previous queries has been received at the regional module. These will then be downloaded into the floppy disk and the students can then in turn download these into their computers. As soon as the feedback is downloaded into the student module in the student computer, the students will see them on the screen. For any part of the content the students will see all the queries they have raised and the feedback received from the teachers. All the queries are stored in the database and displayed with the respective content.

In addition to the feedback for the queries, updates are also uploaded from the regional module onto the floppy disk. These updates can be updates to the program or updates to the content. The program updates are rare as these are done only when there are bugs to fix or enhancements to be made. Also only updates that are small in file size are done using this method. Any substantial updates are done using CD media. The content update can be a change in one of the pages or an addition to the frequently asked questions. The content update is done based on the competencies of the students and the number of similar queries asked regarding a content. If the teachers at the headquarters feel that a page needs to be modified then the modified

content is sent to the regional module which then is transferred into the student module using the floppy disk. The content update process at the headquarters is explained later in the headquarters module section.

Frequently asked questions enable those students, who have any queries, to see if their queries have already been answered. Students are encouraged to check the frequently asked questions prior to sending the queries to the teachers. The teachers can send additions to frequently asked questions and these come through the regional module and to the student module through the floppy disk.

4.2.4 Regional Module

The regional module acts as an intermediary between the student module and the headquarters module. The main function of the regional model is to bridge the offline and online modes of the proposed model. The student modules work offline and students upload their updates to the regional module using a floppy disk. The headquarters module works online and the updates from the student module need to get updated to the headquarters module via the regional module. The regional module takes the updates and connects to the headquarters module online and transfers the updates to and from the headquarters module. The process of sending and receiving the updates are explained in this section.

In addition to acting as an intermediary the regional module also acts as a repository for the students within that region. Hence the regional module consists of two parts:

the repository and the regional model. As soon as the student model is initialised and uploaded into the regional module, each student model for individual students within that region is stored in the regional repository. In other words, this is a back up of the student model for the students within this particular region. Once students upload their updated model into the regional module using the floppy disk, the student models in the repository get updated. All the updates to the student models within the repository are made as soon as the upload takes place. However, updates to the regional model within the regional module only takes place at specified times in batch mode. The regional model is a profile of all the students within that particular region. The regional model stores the cumulative frequencies of competencies for all the students within that region. Table 4.1 shows the regional student model and the frequencies stored in this model. For example, question 1 has frequencies for the number of students who have not attempted, number of students who have failed, number of students who have solved with help, and the number of students who have solved without help. Likewise for all the questions, learning units, and concepts a cumulative frequency is stored. Initially for all the questions, the frequencies for not attempted, failed, solved with help, and solved without help are set to zero. The same applies to the frequencies for the learning units and concepts.

Table 4.1: Regional Student Model (Competencies)

Regional Concept	**Regional Learning Unit**
Concept	Learning Unit
No. of students "Not yet attempted"	No. of students "Prerequisite Incomplete"
No. of students "In progress"	No. of students "Ready"
No. of students "Completed"	No. of students "Visited"
No. of students "Mastered"	No. of students "Completed"
	No. of students "Mastered"
Regional Question	
Question	
No. of students "Notattempted"	
No. of students "Failed"	
No. of students "Solved with help"	
No. of students "Solved without help"	

At regular intervals, the regional module checks whether updates have been made to regional repository. If any updates have been received, these updates are used to update and compile the regional model. Depending on the update received, the frequencies of the regional model are changed. For example, if the new update includes two students who have solved question 27 then 2 is added to the number of students who have completed question 27. Likewise the frequencies are changed for updates for all the questions, learning units, and concepts. The main reasons for

creating and maintaining a regional model are to provide a mechanism for communication between students and teachers and to understand the regional competencies for each and every measurable competency. These measurements can be used by teachers to understand whether a certain region does better or fairs lower in a given content. If the teacher finds that attention is needed for any given content across a whole region, then updates to the content can be brought about for the whole region. The regional model allows the teachers to find the trends within each region.

In addition to the competencies, students' queries are also uploaded into the repository. During the batch processing operation in the regional module, these queries are also compiled into a list (text file). All the queries received are sorted in alphabetic order within the group they represent. For example, all the queries belonging to a particular learning unit are grouped together, while all the queries belonging to a particular concept are grouped together. The compiled list of queries and the updated regional model are uploaded into the headquarters module at designated times. This process occurs online during off-peak times. Before the regional model is uploaded it is also changed into a text file and only the updated content is added to this text file to minimise the amount of data transfer. The main reason being that the Internet connection between the regional centres and the headquarters are at best 56kbps dial-up connections. Mostly the bandwidth in the regional centres is 28.8 kbps.

The regional module also receives feedback for queries from the headquarters. Again these are received through the online connection and are stored in the regional module. These feedbacks need to be delivered to the respective students. When the

students try to upload their updated student models into the regional repository the regional module detects any feedbacks that are addressed to that particular student and downloads these into the student's floppy disk. The student is then notified about it. The students then take their floppy disks and upload the feedback into their computers. In addition to queries addressed to individual students, queries addressed to all the students are also downloaded into the students' floppy disks.

4.2.5 Headquarters Module

The regional module and the headquarters module exchange data and information on a regular basis. Once data is uploaded and downloaded between these two modules a compilation process occurs. The compilation process at the headquarters module is similar to that of the regional module. However, further actions are carried out at the headquarters module. Similar to the regional model, a headquarters or national student model is stored at the headquarters module. The data structure of the national student model is same as the regional student model (Table 4.1). The national student model stores the frequencies of competencies for all the students in the country. Hence it depicts a picture of all the students taking a particular module across the whole country.

The updates to the regional module are uploaded into the headquarters module via the Internet at predefined intervals. During these uploads the students' queries are also uploaded. All uploads are stored in a central repository in the headquarters module. Hence a backup of all the regional models is stored in the headquarters. These uploads include the updates made to the regional student models and these in turn are used to

update the national student model. This process helps to identify common mistakes made at regional as well as national level and depicts a common pattern of student behaviour at these levels. This helps in identifying which content areas require more attention and which areas are reasonably catered for. The compilation process also flags any content areas that needed attention from the teachers. This in turn sends an automatic message to the teacher stating that a content area needs attention. The teacher can then look at the national student model and if required, the respective regional student models. The teacher can also make amendments to the content in the headquarters module.

In addition to notifying the teachers about required content updates teachers also receive the list of queries raised by the students. Teachers get the set of queries ordered in groups and then in alphabetical order. Teachers are provided with an interface to reply to the queries received. Since the same query may be repeated using different words the teachers have the ability to answer one query and indicate that the same reply is to be used for a different query. The implementation of this feature is explained in the next section. The teachers are also given the option of indicating whether any particular query should be included in the frequently asked questions. This is at the discretion of the teacher and how this option is implemented is shown in the following section. The teachers also have the ability to change the wording of any query to be added as a frequently asked question so that it makes more sense to all the students.

All these responses and amendments are added to the headquarters module. Once all the changes are added, they are ready to be uploaded into the regional module via the

Internet. Again, these uploads are done regularly on predefined times. Once these uploads are stored into the regional module the students are able to download them into their floppy disks and then onto their computers. Hence, the students receive the response to all their queries from the teachers at the headquarters. Although the response time is slower than a traditional classroom environment and an online system, this model provides two-way communication between teachers and students in an environment where students do not have personal Internet connections and where the teacher resources are scarce. This makes the model the most suitable one in Maldivian context.

4.3 Learning System Development

The previous sections outlined the design of the proposed theoretical model for distance education in Maldivian environment. A learning system based on the proposed theoretical model has been designed and developed to implement the proposed model. Before describing the development of the learning system, a set of software design decisions are outlined. In order to evaluate the effectiveness of the proposed model, a proto-type of the learning system was tested in Maldives. This section discusses the decisions made during the development and testing phase of the learning system.

Two sets of decisions were made in relation to the software development of the learning system. The first set of decisions was applicable in the development of any learning system that uses the proposed theoretical model. That is, in order for the theoretical model to work effectively and efficiently, these decisions need to be taken

into consideration in any software development projects. The second set of decisions is more specific to the testing phase of the learning system in Maldives. These decisions were taken by the researcher only to make the evaluation in Maldives to take place in the required timeframe. Although these decisions were specific to the testing of the learning system in Maldives, these can still be used by anyone in developing any learning system for the proposed model.

4.3.1 Why not a Commercial Learning Management System?

The proposed model is mainly based upon the delivery of content to the students and student-teacher interaction in a distance education model. The model focuses on creating a system similar to that of a learning management system where the student's progress is monitored and catered for. Some of the popular commercial learning management systems such as WebCT and Blackboard have these features incorporated in them raising the question "why not use one of the commercially available learning management systems rather than build a system from scratch?". Typical learning management systems allow the teachers to individually monitor students' progress and change content centrally. However, there are wide and varied differences between the proposed model and these learning management systems.

Systems like WebCT and Blackboard are web-based systems where students are required to have access to the Internet. However, in the case of Maldives, students do not have access to Internet on their own computers and even where access is available the cost prohibits them from using it. Therefore these systems are not suitable in Maldives. On the other hand, the proposed system does not allow the teachers to

monitor the progress of each individual student as WebCT and Blackboard do. The proposed model allows the teachers to see a compiled competency score of a group of students and the teachers can then decide on any changes to the content based on these compiled competences. The communication between student and teacher is done via regional module which is limited to students sending queries to teachers and teachers responding to it.

4.3.2 Web Interface

The whole system is based on a web interface for both students and teachers (even though students do not require Internet access on their own computers). All the three modules (student, regional and headquarters) have web interfaces. The main reason for using web interfaces was to make all the interfaces consistent so that the students will find it easy to move between student module and regional module. Although the student module is offline, the students need to use a web interface for the regional module, in order to upload their student models. Hence, all students are required to use a web interface which makes it more logical to have a similar web interface for both the modules. In addition, java applets are used within the student module which also require web interface. Section 5.3.4 gives a justification on why java applets were used in this learning system.

4.3.3 Interface - Student Module

The interface for the student module is divided into four separate sections or frames. The screen is divided into these four frames and each of these frames provides the

students with a different set of options. Figure 4.5 shows a screen capture of the student module. The top frame consists of a panel of buttons that gives the students the options for uploading and downloading their student models from and to the floppy disk. In addition, students are also given the options of checking frequently asked questions for the topics they have loaded on the screen. Finally this panel has the logout button. The left hand-side frame consists of the contents for the module. This frame displays all the different topics included in the selected module. The topics are further divided into sub-topics and post-test (questions) for each of them. By clicking on any topic or post-test the students are able to display the content on the right-hand frame. In addition, the students can also navigate between topics using the previous and next buttons. As mentioned earlier, the main frame on the right-hand side displays the content for the students. Finally, the bottom right-hand frame allows students to enter any queries relating to the topic displayed on the screen. The frame designated for the query is further divided into two separate sections. The first section allows students to enter any queries they might have on the topic. The second section displays any queries they have already submitted and the replies from the teachers (if already given). In addition, if teachers feel that any particular query submitted by any other student is relevant to all the students then this particular query and its reply are also displayed for all the students. All these functionalities are provided using java applets in the student module.

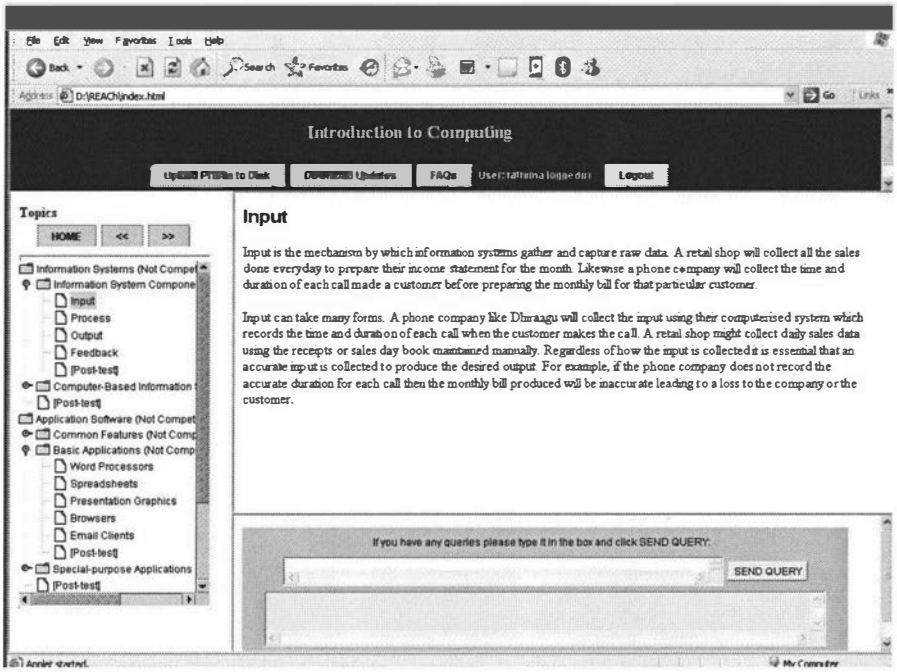

Figure 4.5: Student Module Interface

4.3.4 Why Java Applets?

As mentioned earlier, all the functionality in the student module is provided using java applets. Each of the frames on the screen uses a separate applet to display its functionality. On the top frame the applet uses five different classes to display the five different functionalities. They are upload class, download class, FAQ class, displayname class, and logout class. The applet on the left had side allows the creation of content/topics for the required course and linking each topic to the related web page to be displayed on the right-hand frame. The right-hand frame does not use any applets to display the content. It displays just the html page linked to that topic. However, when a student clicks on any of the post-test (questions), an applet is invoked which displays the questions relating to that particular topic. The applet also

monitors the student's progress throughout the test and records it in the database. The bottom frame consists of a query frame which handles the students' queries. This applet records the queries from the students as well as checks for any queries already recorded in the database and displays them on the screen.

Applets and java classes are used to provide functionalities as this would make the update process use the less Internet time due to small applet sizes. Since applets as well as classes are self-contained objects, they can be updated without changing other applets or classes. In a situation where updates need to be sent through the Internet and where Internet use needs to be minimized, any updates have to be done on the smallest unit. Hence, using classes and applets makes it more efficient to send updates. Any updates to the functionality would mean a change in the applet or the class and upload to the regional module which would then be transferred to the student module through the floppy disk. The largest class in this program is less than 10 kilobytes and on average a class is less than 5 kilobytes. Hence, any updates will take only a couple of seconds to upload to the regional module and can easily be transferred to the student module through the floppy disk.

4.3.5 Dynamic Pages

The topics for each course are displayed on the left hand frame on the screen. These topics/contents are dynamically created using a database. The left hand frame loads an applet which reads from a database. The database stores the list of all the topics, sub-topics and the linked page number for each of the page. The applet reads this database and creates the contents list every time the student logs into the system (Figure 4.6).

When the contents list is created the applet also identifies which page is linked to which topic. Hence, when the student clicks on any topic the linked page is displayed on the right frame. This mechanism allows the system to always provide up-to-date information to the students and enables the teachers to send updated content list and other information any time during the learning process.

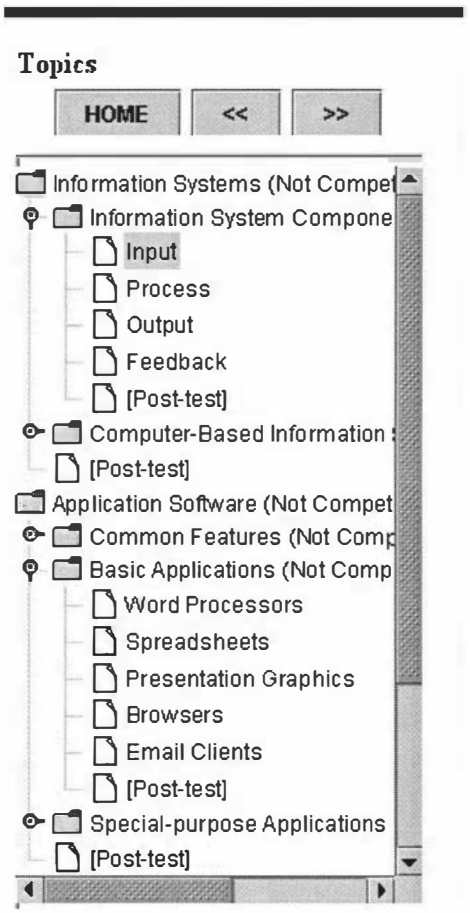

Figure 4.6: Left hand Frame of Student Module

A database is used to create the contents list to make it easier for the teachers to use the system. The teachers use an HTML form to enter the topics and sub topics for the course. This process is explained with the figures later in this chapter. Once the

teachers enter this information, it is recorded in the database and later used to create the student module.

In addition, the post-tests (questions) are also created dynamically. The questions on the post-test are stored in the database and when the student selects to do the post-test questions relating to that topic, the system randomly selects the questions from available questions for that topic and displays them on the right-hand frame (Figure 4.7). In case of multiple-choice questions, the answer options are also created using the database. Hence, the order in which the answer options appear for any particular question may differ when the student attempts the same question more than once.

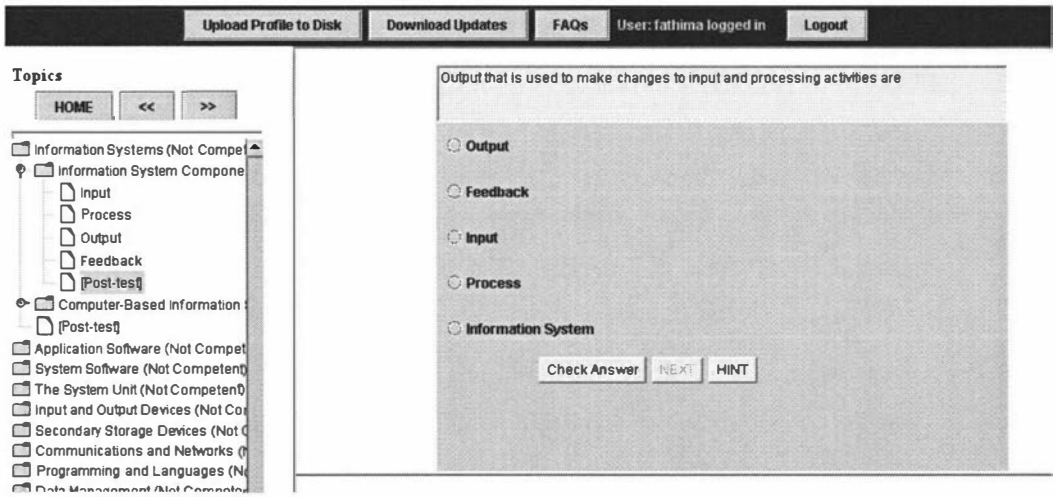

Figure 4.7: A Question Displayed on the Right-hand Side Frame

4.3.6 HTML Pages

All the study material is to be created as hypertext mark-up language (HTML) files. That is, each of the pages that are displayed on the right-hand frame are created as

HTML files. All the pages are separate and no hard-coded links are created between any of these HTML files. The dependencies between the pages are maintained at the contents list level. The main purpose of having the HTML files as independent files is to make the updates easy to implement. When a teacher decides to change the content of any particular topic or sub topic, the teacher needs to change only the respective HTML page and upload it into the regional module. This update is then downloaded by the student on to the floppy and on to the student module. The only requirement for the teacher is to create all the pages in HTML. However, this does not require teachers to know HTML as the teachers in headquarters have access to qualified computer experts who are capable of developing these HTML pages. Furthermore, teachers have possibility of using authoring tools that automatically generate HTML content.

4.3.7 Interface – Regional Module

The interface for the regional module is made as simple as possible so that the students will not have any trouble uploading and downloading the updates. The regional module has four steps for the students. The first step is to log into the system. The login process is designed exactly the same as in the student module with same username and password for both modules (Figure 4.8).

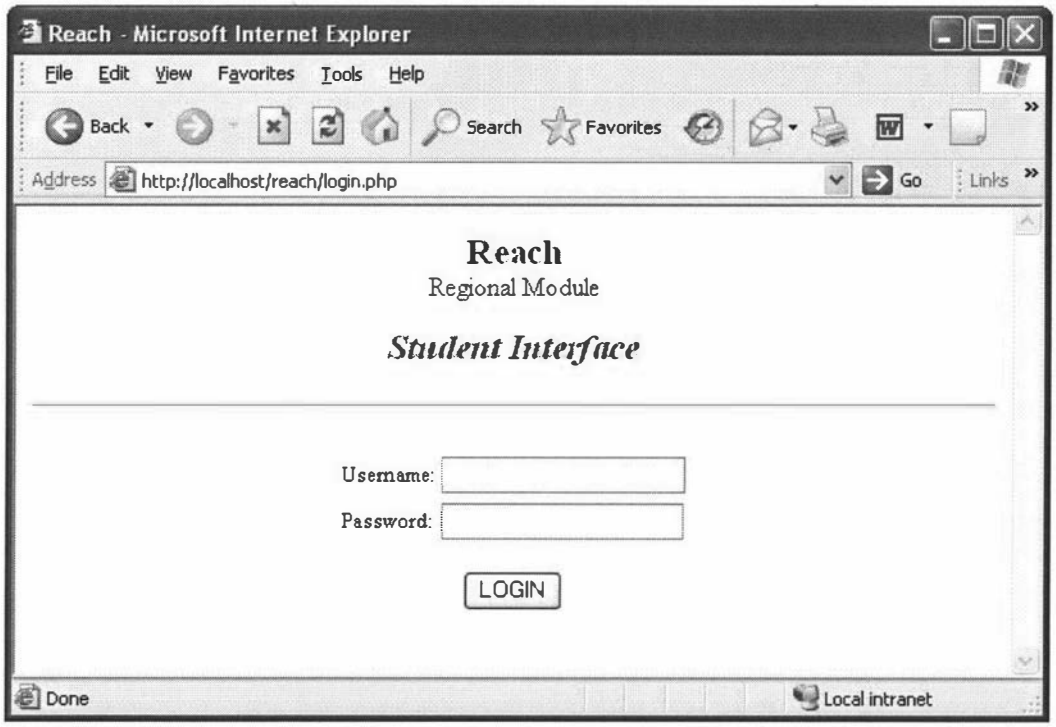

Figure 4.8: Student Login Page in the Regional Module

Once logged in, the students are given two options. The first one is to upload their student model from their floppy disk into the regional module. This is done by clicking a link on the page. Once the students click on the link, the data is transferred from the floppy disk into the database in regional module and students are given a feedback of the processing. Once this process is completed, the students can move on to the second option that is to download any updates from the regional module into their floppy disks. This process is also initiated by clicking a link available on the page. The students are given feedback of the processing during this task and once completed the students need to logout from the system (Figure 4.9).

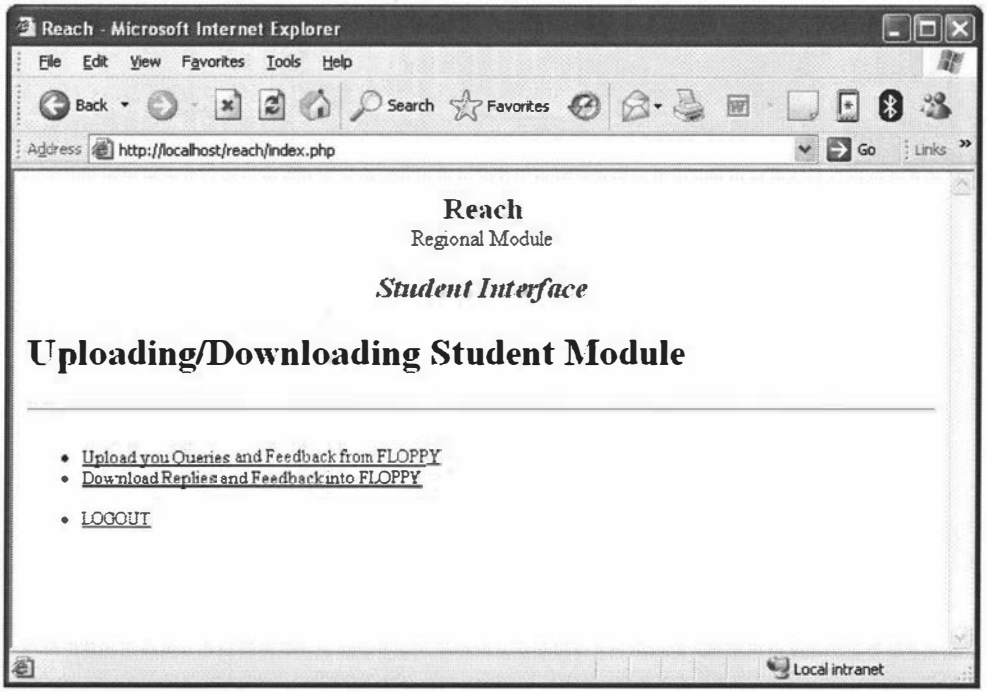

Figure 4.9: Student Interface for the Regional Module

In an ideal situation the regional module will automatically upload the student updates into the headquarters module at given intervals. However, due to unreliable Internet connections, these uploads need to be done manually at predefined times. Hence an interface for this task has been implemented in the system. In the design of this interface, consideration was given to the skills of the personnel performing this task. During the implementation of the learning system in Maldives two different personnel helped in performing this task in the islands. In the island centres where the evaluation took place administrative clerks were used to perform the system administration required at the regional centres. These clerks had some computing skills but were limited to Microsoft Word and Excel. They did not have much experience in Internet use as the Internet was not readily available in these centres. Both of these personnel had some knowledge of computing but did not have the

required skills in using web browsers. Hence, consideration was given to making the interface user-friendly and easy for these personnel.

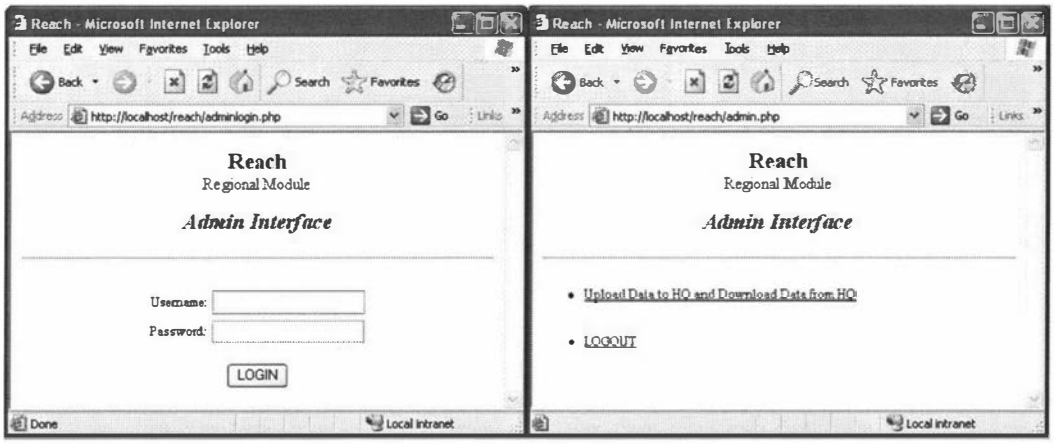

Figure 4.10: Admin Login Screen and Admin Options for Regional Module

Figure 4.10 shows the interface for the administrators at the regional module. The interface gives a login screen for the administrators and once logged in, they can click on the link to download the updates in the headquarters module and upload any updates from the headquarters module to regional module database. At the first centre where the evaluation was carried out, this process worked very well. The administrator had to just log in the system and click on a link. The rest was taken care of automatically. However, with the second and the third centres, some problems were faced with this process. The proposed model is designed in such a way that the regional model has to have Internet connection. Although the students do not need to have Internet connection they upload their data into the regional module which is then transferred to the headquarters module via the Internet. Hence, the regional module is installed on a computer that has Internet connection. In one of the centres where the evaluation was carried out, only one computer was connected to the Internet. This was

the computer of the headmaster of the school (where the centre was located). Since it was the headmaster's personal computer, students were not allowed to use the computer to upload their student models directly to this computer. Hence, an intermediary procedure was created where the students upload their student models in another offline computer at the centre and the administrator transfers these to the headmaster's computer and finally the data is uploaded to the headquarters module. The intermediary procedure had an interface for the administrator similar to that of the regional module. The only difference was that when the administrator clicks on the upload button in the intermediary process, the data from multiple students is copied to a floppy disk. The administrator then takes the floppy disk to the headmaster's computer and uses the same process to upload the data to the headquarters module. Figure 4.11 shows the interface screen for the offline computer and Figure 4.12 shows the interface screen on the headmasters computer.

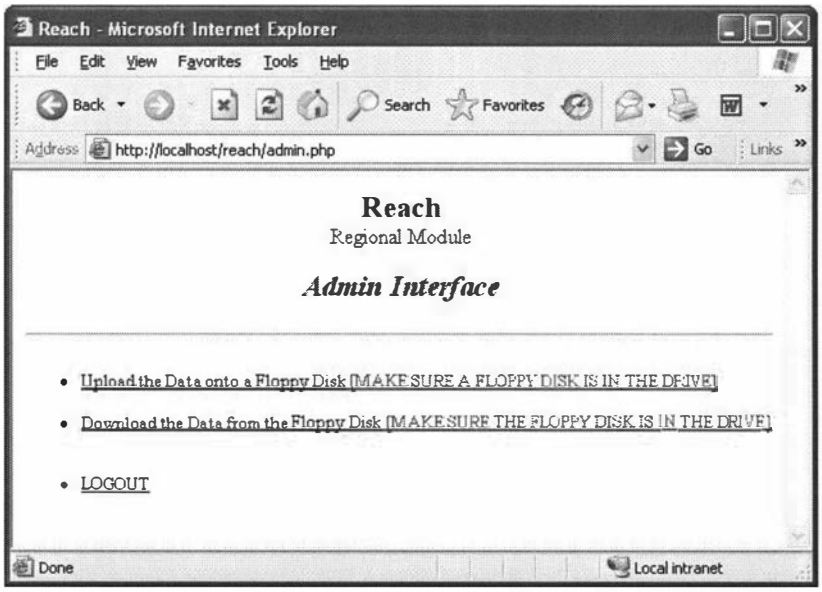

Figure 4.11: Admin Interface where a Floppy Disk was Used to Transfer Data (Offline Computer)

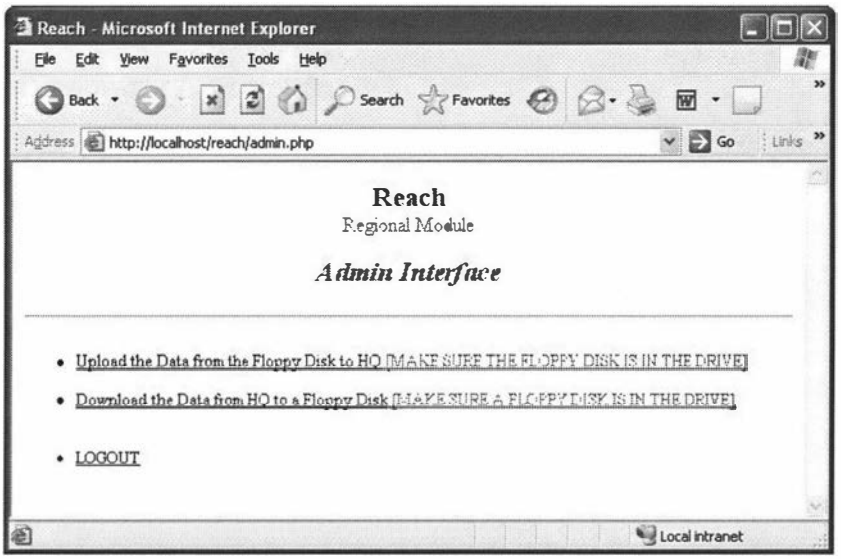

Figure 4.12: Admin Interface where a Floppy Disk was used to Transfer Data (Online Computer)

The third centre had problems with uploading the data to the headquarters module. The problem was faced due to problems with Internet connection and headquarters module being down at certain times. The main reason for these downtimes was related to the service breaks in the country's telecommunications after the Boxing Day Tsunami. In order to overcome this problem, email was used to send and receive updates between the regional module and headquarters module (Figure 4.13). Again, the interface was similar and when the administrator clicked on the upload link, an email was created with updates as attachments. The administrator then sent the email when the Internet connection was working. Normally even during the worst times the Internet was working for a couple of hours in every region. The email was then received at the headquarters and updates in the headquarters module were made using

the attachment. The same process was repeated to send updates from the headquarters to the regional module.

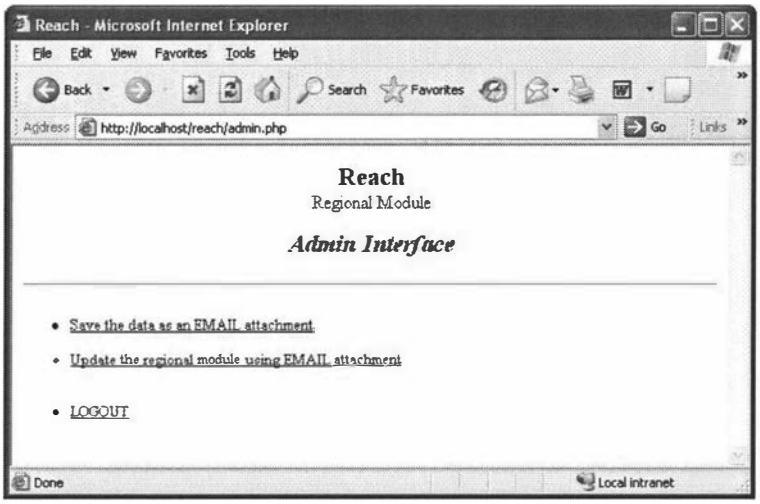

Figure 4.13: Admin Interface where Email was used to Transfer Data

4.3.8 Interface – Headquarters Module

The headquarters module is where the teachers interact with the system. There are two different interfaces for teachers in the headquarters module. The first one is where the teachers can create the course for delivery (Figure 4.14). Here, teachers can enter different concepts the course will cover, different topics within each concept, and any subtopics. In addition, the teachers can also enter the questions that will be used to test the student competencies and the answer options for each question. This is in addition to adding the HTML pages that contain all the content that will be delivered to the students. This interface is used prior to commencing the course.

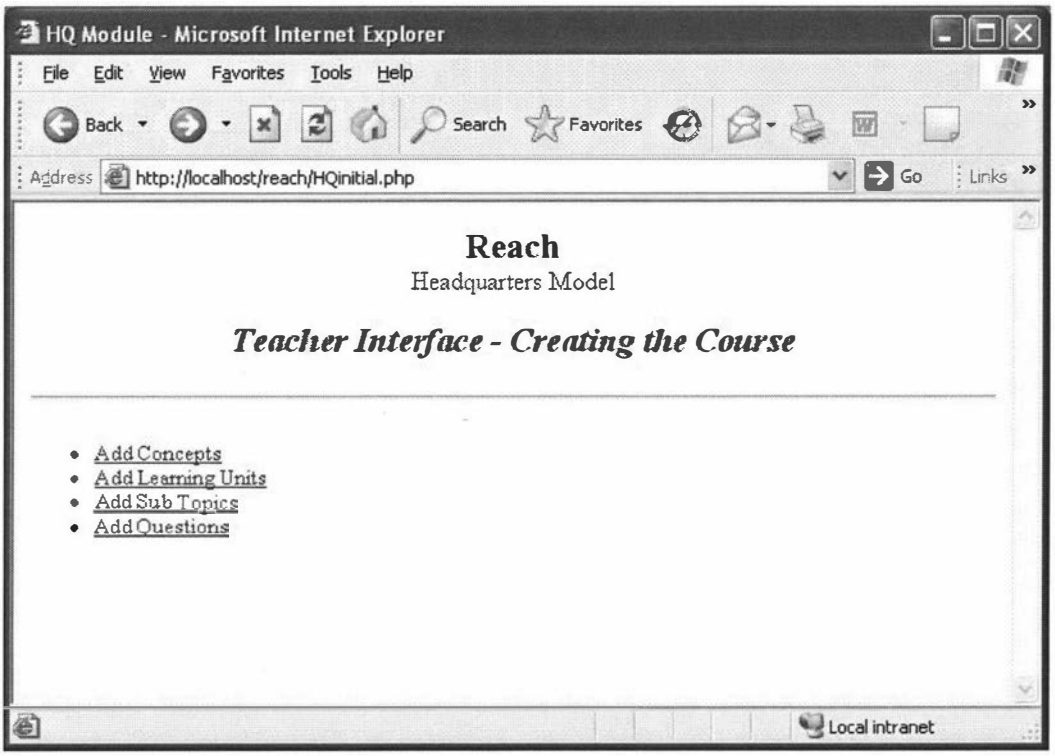

Figure 4.14: Initial Course Creation Interface for Teachers

There are four options available for the teachers in the initial interface. The first option is to enter the concepts for the course, in other words, the major topics of the course. The teachers use HTML form to enter the concepts (Figure 4.15). They enter the title for each of the concept, any prerequisites, and required level of competency for that concept, and then upload the HTML page that was created with the content for that particular concept.

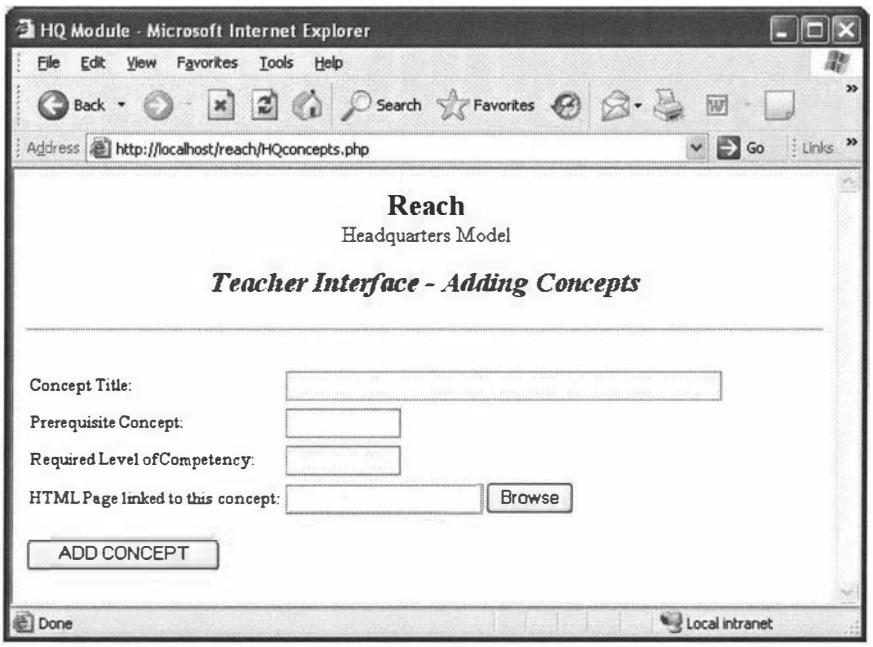

Figure 4.15: Screen to Enter the Concepts for the Course

Once all the concepts are entered, the teachers can enter the corresponding learning units for each of these concepts. Again, the teachers use an HTML form to enter the learning units for the course (Figure 4.16), and these would be the minor topics of the course. A similar process to entering concepts is used to enter the learning units.

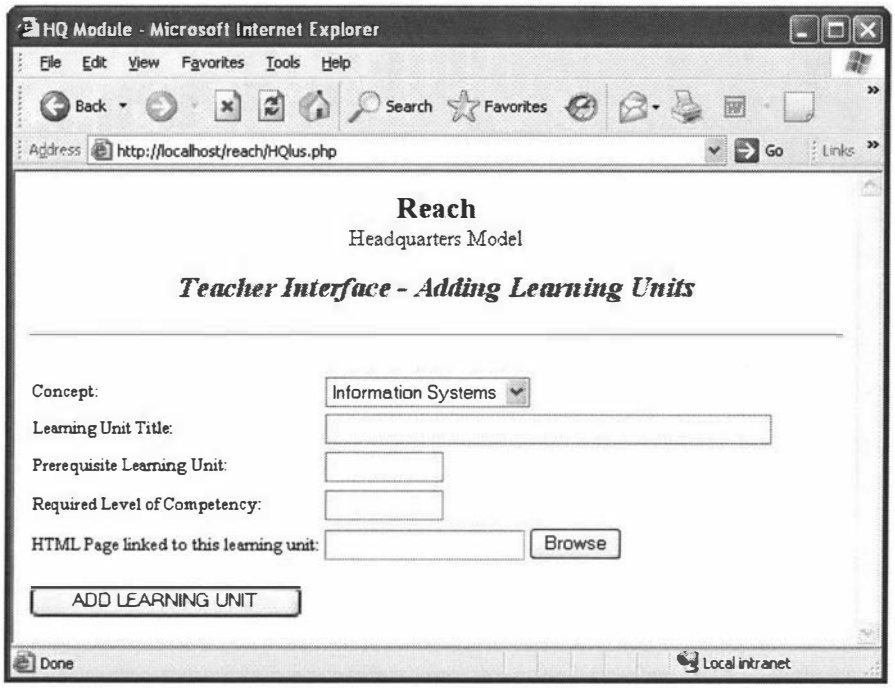

Figure 4.16: Screen to Enter the Learning Units for the Course

Most of the learning units are further divided into subtopics. These are entered into the database and links are created for the HTML pages. Figure 4.17 shows the screen used for this purpose.

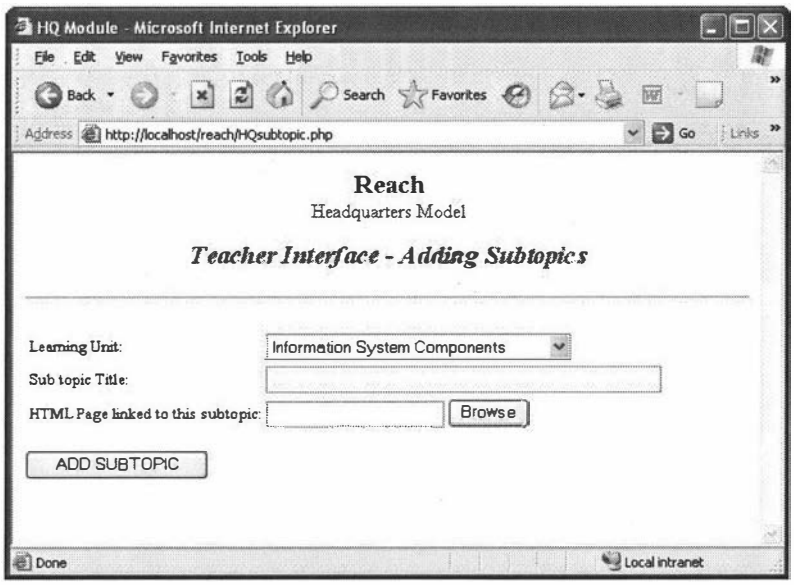

Figure 4.17: Screen to Enter Subtopics for the Course

Finally the teacher can enter the questions for the course. For each question, the teachers select which learning unit the question belongs to and enters the question, level of competency required and the answer options that will be given to the students. The teachers also identify which of the answer options is the correct one (Figure 4.18). Once all this information is entered, it is used to create the content for the student module.

Figure 4.18: Screen to Enter the Questions for the Course

Second interface is used when the course commences. It gives the teachers four different options (Figure 4.19):

- checking student performance;
- responding to student queries;
- updating concepts and learning units; and
- updating questions

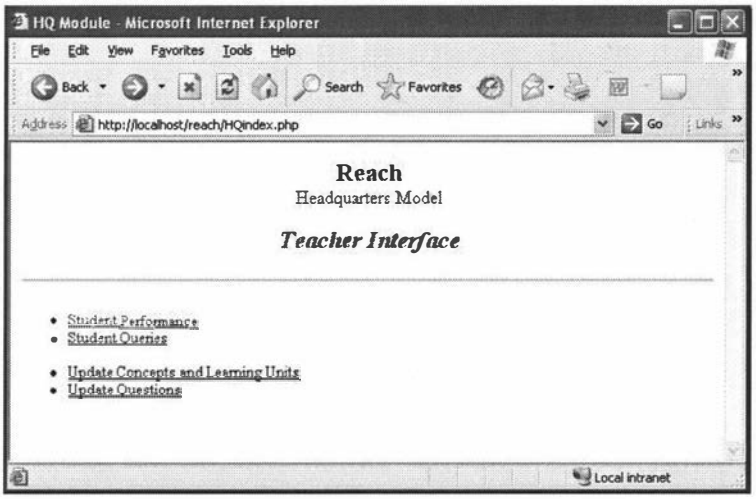

Figure 4.19: Teacher Interface During the Course

The first option is where the teachers check student performance. This gives the teachers cumulative frequencies of students' performances for different concepts, learning units and questions. Depending on the values of these competencies the teacher can decide to make changes to the content or the questions. The cumulative frequencies are given separately for each concept, learning unit, and question (Figure 4.20).

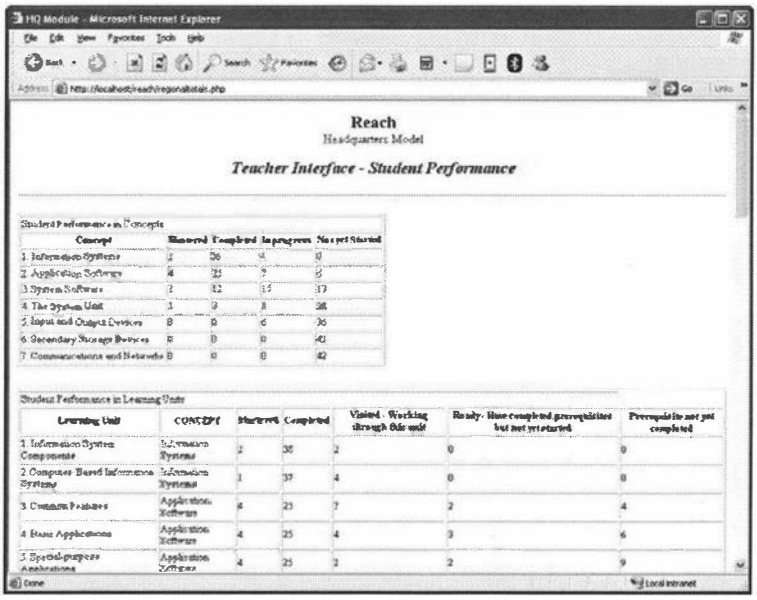

Figure 4.20: Student Performance Screen at Headquarters Module

The last two options for the teachers in headquarters module allow them to update the contents of the student module. One option is to make changes to the concepts and learning units, and the other is to make changes to questions. The teachers can make changes to topics and learning units based upon the overall competency scores of the students. If teachers feel that students are achieving lower than expected in any concept or learning unit, they can decide to change the content. There are two ways teachers can do this. One is changing the HTML page that contains the study material for that particular concept or learning unit. In this case teachers only need to upload the new HTML page and it will be updated on the student module (Figure 4.21). However, if teachers want to change how the concept is classified, for example, adding or deleting learning units, or even adding or deleting concepts, then they will use a different process. In this process they are given a list of concepts and learning units and they can decide to modify that list (Figure 4.22).

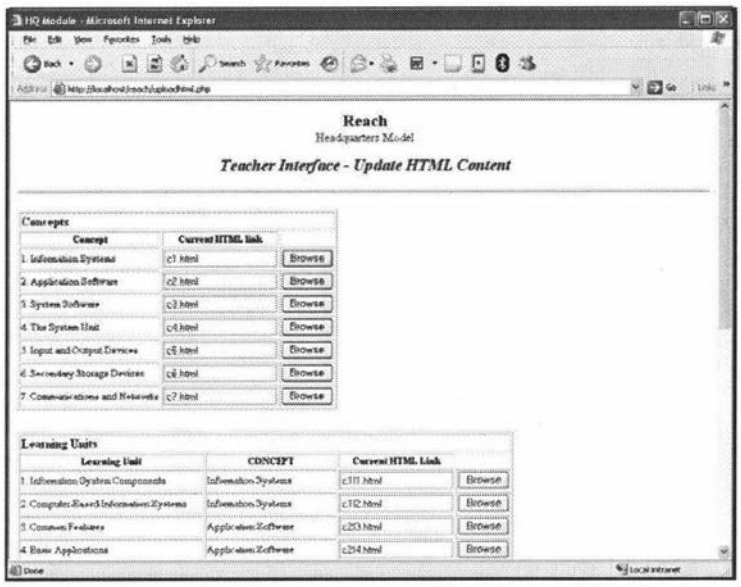

Figure 4.21: Interface to Upload Updated HTML Files

Figure 4.22: Interface for Updating Concepts/Learning Units/Subtopics

If teachers decide to make changes to questions and/or their answer options, then they use the "Updating Questions" option on the teacher interface. This option allows the teachers to view the existing questions and their answer options (Figure 4.23). From

this list of questions, they can change the wording of questions and make changes to answer options for any questions. In addition, the teachers can also create questions.

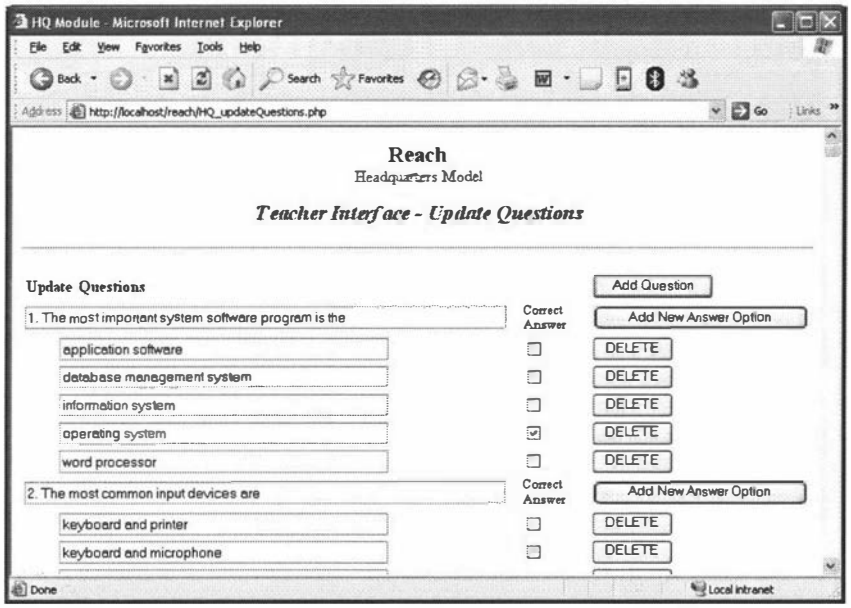

Figure 4.23: Interface for Updating Questions

The teachers also have the option here for answering students' queries. When teachers select this option, it displays all the concepts, learning units, and questions for which the students have sent queries. The queries are grouped into concepts, learning units, and questions and on the first screen only the corresponding concept, learning unit or question is shown (Figure 4.24). Each of these is linked to the list of queries corresponding to them. Once teachers click on a link it displays all the queries related to that topic giving the teachers the option of replying to them (Figure 4.25). In addition, three options are available for the teachers with respect to each query. One is to identify whether the query needs to be added as a frequently asked question. This functionality is available as a checkbox which, when checked, adds that particular query into the frequently asked questions list with the reply from the teachers. The

second option is for the teachers to identify if a particular query is the same as any other query in the list. In this case the teachers can just reply for one of the queries and write the number of that query for all the queries which they identify as the same query. When the teachers write a number, then the database records the reply for that query as the reply for all the queries with that number. Finally the teachers also have the option of deciding whether a particular query is relevant to all the students and if so they can use a checkbox to indicate that. When this checkbox is checked, then that particular query and its reply are uploaded to all students through the regional module.

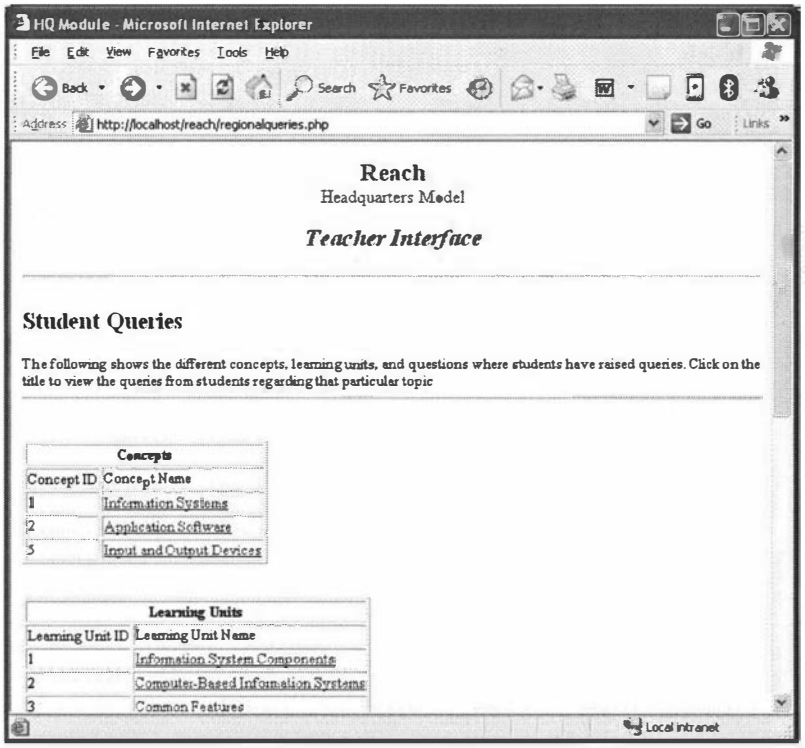

Figure 4.24: Concepts, Learning Units and Questions for which Students have Sent Queries

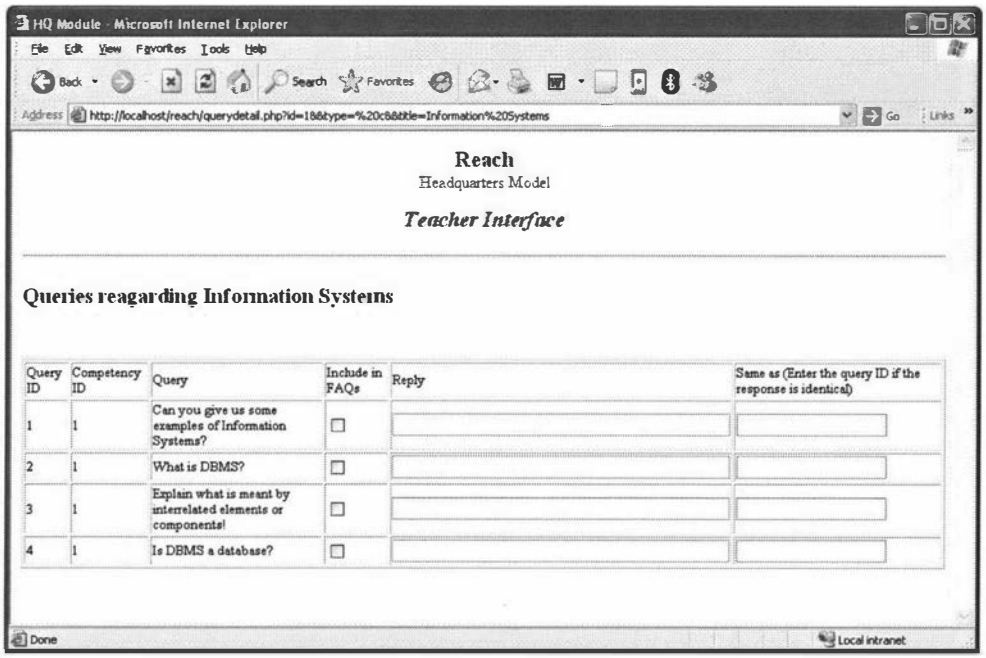

Figure 4.25: Interface to Reply to Student Queries

4.3.9 Choice of Programming Language and DBMS

The database management system (DBMS) used to create the learning system was MySQL. The main purpose of using MySQL was that it was easy to install and use. In addition, it was free and did not require any licenses for educational purposes. The use of MySQL as the DBMS proved priceless in the evaluation phase because it was possible to make a direct copy of an installed MySQL directory from one computer to another and run the database without any problems. Hence, the whole process of installation was simplified.

As mentioned earlier, all the different functionality in the student module was programmed using java applets. In addition, java applets required users only to install

Java Runtime Environment (JRE), which is freely available from the Sun website and is easy to install.

PhP was used to develop all the server-side scripting for system. This includes both the regional module and the headquarters module. PhP was easy to integrate with MySQL database and its installation as well as implementation was also easy. PhP can also be installed by copying the PhP directory from one computer to another and copying the php.ini file. Hence the installation during the evaluation phase was quite easy.

Although these programming languages were used to develop the current system, any other software or programming languages can be used to develop a learning system based on the proposed model. However PhP and Java have been proven to work in the Maldivian environment without any major problems. Furthermore, these programming languages, being freeware, make it more appealing for Maldivian situation where minimizing cost is a major factor.

The learning system was developed for the exclusive purposes of carrying out the evaluation of the proposed model in Maldives. After developing the learning system, the next stage was to evaluate the learning system in the Maldivian environment. The evaluation was carried out in Maldives during November 2004 to January 2005 and April 2005 to July 2005. The following chapter outlines the methodology used for the evaluation of the proposed model.

5. METHODOLOGY

5.1 Research Problem

Chapters 2, 3 and 4 of this research thesis outlined the issues relating to the development of a distance education model for Maldives and proposed a suitable model for this country. Chapter 3 investigated the reasons for the development of distance education model in Maldives. Chapter 4 described the proposed model that will be suitable to deliver distance education in Maldives. Throughout the literature on the Maldives justification was given as to why specific decisions were made regarding the proposed model. As mentioned in earlier chapters, the main focus of this research thesis is to provide access to secondary education for students living in the outer islands of Maldives. The key term is "access" hence the specific research questions that need to be answered are as follows:

1. Will the proposed model provide physical access to learning to the students in the islands?
2. Will the students be able to learn through the proposed model?
3. Will the students accept the proposed model as the basis for a form of teaching?

Three different aspects of students' accessibility provided by the proposed model were taken into account during the investigation. The first one was the physical accessibility where the investigation was to find out if the students in the islands could have physical access to learning facilitated by such a model. The second was a measurement of the student's ability to learn using the proposed model. Finally,

student acceptance of the proposed model as a form of teaching was measured. This was important because student acceptance is important to the success of any form of teaching. Student acceptance of the model was measured using some critical success factors, which were relevant to the form of teaching used in the proposed model. These factors are described in detail later in the chapter.

5.2 Evaluation Process

Prior to identifying the students' perceptions of the proposed model some feedback was received from colleagues and postgraduate students on the shortcomings and enhancements required for the software. This was the first stage of the evaluation of the proposed model. The proposed model was first discussed amongst the Advanced Learning Technologies[4] research group within the Massey University. The identified shortcomings and suggested enhancements were taken into account in the development of the learning system used for evaluation. Based on the feedback received from the research group as well as from various international experts from a number of conferences[5], the proposed model was used to develop the learning system for evaluation. The learning system was first evaluated by a group of 15 postgraduate students enrolled for a course called "Web-based Multi-media Systems" at the Department of Information Systems, Massey University.

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[4] Advanced Learning Technologies Research Centre is a research group within the Information Systems Department of Massey University that aims to advance research on the innovative paradigms, architectures and implementations of learning systems for individualised and adaptive learning in an increasingly global environment.

[5] International Conference on Computers in Education (ICCE 2002); International Conference on Information Technology: Research and Education (ITRE 2003); International Conference on Open and Online Learning (ICOOL 2003).

The fifteen students were used as the pilot study for the learning system. The main purpose of the pilot study was to identify errors in the learning system software as well as to identify any amendments that needed to be made to it. The postgraduate students were used in the pilot study because they had expertise in developing web-based multimedia systems. They were not a representative sample of the target audience for the proposed model. However, they were able to provide valuable feedback in the design and development of the learning system. The issues raised in this pilot study focussed mainly on layout of the screen, and some queries regarding the lack of assessment in the module. The issue on assessment was discussed in the model design chapter of this thesis.

The feedback on layout was mainly based on the navigation of the system. One of the notable suggestions were to have a forward and back button within the system, so that the students will find the navigation from page to page easier. How these are implemented in the learning system is discussed in the final section on software design and development. Once the required modifications were made in the learning system software, it was evaluated in the context for which it was designed for, the Maldives.

5.3 Overview of the Research Methodology

The first stage of the research methodology was to identify the ways to measure the three questions listed above. The best way to answer the first question was to implement the learning system in Maldives and find out whether the students had any

problems related to physical access. The second question required a measure of how much the students learnt using the learning system. Hence, pre-test and post-test were used to measure the differences in students' understanding of the content before and after using the learning system. Since the islands did not have any other form of teaching available at this level there was nothing to compare these results with to determine the effectiveness of the system. Consequently, the school records of the participants' prior learning were used as a measure of comparison. The third question required measurement of students' perception of the learning process as facilitated by the model in the learning system and how much they accept this proposed model based learning system as a form of teaching. This was measured using a questionnaire developed specifically for this purpose.

The questionnaire was divided into several parts, each part measuring a different critical factor in the students' acceptance of the distance education model. In total, the questionnaire had seven different scales each measuring a different factor. These were *students' prior computer knowledge*, *students' preference of delivery mode*, *students' perception of content knowledge*, *ease of use*, *students' perceptions of the tools available*, *presentation of the learning system*, and *the learning system as a whole.* In addition, the questionnaire also collected some background information regarding the students, including their *biographical data*, *their prior training in computers*, *their confidence in using computers*, *their enthusiasm in using computers*, and *their frequency of computer use.*

5.4 Population

The population for this study consists of all the Maldivian secondary school-aged children who do not have access to formal education. This includes most of the secondary school-aged children in the outer islands of Maldives. According to school enrolment figures of 2004, the total number of students who complete primary education and do not go into secondary education is approximately 5000 (Ministry of Education, 2004). However, this population is spread across 199 islands and only a set number of islands were able to be chosen for this study. The population sampling is based upon stratified random sampling technique which is explained in the following section.

5.5 Sample

Stratified random sampling is a procedure of selecting a sample so that certain subgroups in the population are adequately represented in the sample (Berg, 2004; Gall et al., 2003, 2005; Gorard, 2003; Mertens, 1998). A stratified random sample helps to guarantee that the chosen sample accurately represents the population on specific characteristics (Jackson, 2003; Lewis and Traill, 1999). In stratified random sampling the stratas (or subgroups) are identified and a random sample is drawn from each of the strata (Gall et al., 2005; Gorard, 2003; Jackson, 2003). In some cases, a systematic approach is used within each strata to select the sample or proportionate sample (Gall, et al., 2005; Jackson, 2003). Furthermore, Gorard (2003) argued that a stratified sampling will lead to high quality samples, reducing "freaky" results, at least in terms of strata characteristics.

This research focused on providing access to secondary education to outer islands in Maldives. Therefore, any sample taken should represent the population in the outer islands of Maldives. Hence, a stratified random sampling approach was used where subgroups were identified based on the size of population and infrastructure developments in the atolls. Although this research does not focus on the development status of the different islands, it is important to note here that there are differences in terms of infrastructure developments, especially in education, across different atolls and islands within Maldives. The educational infrastructure can be identified using the number of enrolments as well as schools within the atolls. The Statistical Yearbook of Maldives 2004 (Ministry of Planning and National Development, 2004) has published the school enrolments and number of schools across the country. The absolute enrolment figure and number of schools within each atoll does not give a true indication of the educational infrastructure status of that atoll. That is, the population of the different atolls vary immensely and school enrolments and numbers should be proportional to the population. There are no published reports on comparison between population within each atoll and its educational infrastructure. Hence, a comparison has to be made using other published statistics. Ministry of Planning and National Development (2002) has published Maldivian Census Data 2000 which shows the population distribution by age groups. Maldivian Census Data 2000 and school enrolment figures from Statistical Yearbook of Maldives 2004 can be compared to gather this information. However, an accurate estimate cannot be done as the enrolments figures are for 2003 and census data is for 2000. In order to identify the percentage of population at secondary school within the islands a comparison was made between the age group 10 to 14 from Maldivian Census Data 2000 and lower secondary school enrolments from Statistical Yearbook of Maldives 2004. Most

students start lower secondary school at the age of 13 (some at 14) and complete it at the age of 16 (or 17). Since the census data is three years older than the school enrolments, this will give an adequate comparison. **Error! Reference source not found.** shows the comparison made between school enrolments for lower secondary school on 2003 and total population between the ages of 10 to 14 on 2000.

Table 5.1: Comparison between School Enrolments and Prospective Age Group

Atolls	Total enrolment in Lower Secondary School (2003 Data)	Age Group 10 - 14 (Census Data 2000)	Percentage enrolled
Capital - Male'	9,803	9,163	107%
Shaviyani	1,241	1,927	64%
Baa	956	1,552	62%
Seenu	1,871	3,096	60%
Raa	1,447	2,415	60%
Laamu	1,107	1,942	57%
Meemu	467	824	57%
Vaavu	136	245	56%
Thaa	913	1,672	55%
Faafu	369	677	55%
Alifu Dhaalu	578	1,174	49%
Gnaviyani	703	1,430	49%
Dhaalu	402	828	49%
Gaafu Dhaalu	941	2,045	46%
Lhaviyani	664	1,485	45%
Haa Alifu	1,108	2,491	44%
Noonu	798	1,889	42%
Gaafu Alifu	513	1,332	39%
Haa Dhaalu	918	2,825	32%
Kaafu	368	1,322	28%
Alifu Alifu	183	755	24%

The second characteristic taken into account for this stratified sample was the actual population distribution within the atolls.

Table 5.2 shows the population distribution across different atolls and the percentage of the national population in each atoll. These two characteristics, which are, population distribution and education infrastructure, were taken into account in the stratified random sample for this evaluation. Using these two characteristics, six different atolls were identified for evaluation, including the capital. The capital Malé was chosen since it is the largest in terms of population and has all the facilities and infrastructure available. In addition to the capital the second and the third largest atolls in terms of population were identified. Furthermore, these are the two atolls at both ends of the country. Haa Dhaalu atoll is at the northern most tip of the country while Seenu atoll is at the southern most tip of the country. In terms of enrolments, Seenu atoll is at the top end of the table while Haa Dhaalu atoll is at the bottom end of the table.

Table 5.2: Population Distribution across the Atolls

Atolls	Population	Percentage Distribution
Capital - Male'	74,069	27%
Seenu	18,515	7%
Haa Dhaalu	16,956	6%
Raa	14,486	5%
Haa Alifu	14,161	5%
Kaafu	13,474	5%
Gaafu Dhaalu	11,886	4%
Laamu	11,588	4%
Shaviyani	11,406	4%
Noonu	10,429	4%
Baa	9,612	4%
Lhaviyani	9,385	3%
Thaa	9,305	3%
Gaafu Alifu	8,249	3%
Alifu Dhaalu	7,803	3%
Gnaviyani	7,528	3%
Alifu Alifu	5,518	2%
Meemu	5,084	2%
Dhaalu	5,067	2%
Faafu	3,827	1%
Vaavu	1,753	1%

Baa atoll is in the central region with a large population and is at the top end of the enrolment spectrum. Alifu Alifu atoll and Alifu Dhaalu atoll are both in the central region, and both these atolls have a very small population. In addition, Alifu Alifu

atoll is at the bottom in terms of school enrolment ratio with Alifu Dhaalu atoll at the middle of the table. These two centres are closer to the capital than the other centres. However, due to the small population, these two can be considered as some of the remotest islands in the country in terms of reach. Hence the use of these two centres would prove the ability to provide physical access to the remote islands in the country.

The evaluation of the study was planned and conducted from November 2004 till January 2005 (and from April till July 2005). Although six centres were selected for the study, the evaluation was conducted in only three centres due to the 2004 Boxing Day Tsunami, which hit Maldives in December 2004. The study was initiated at Alifu Dhaalu atoll, followed by the centre in the capital called Cyryx. The third centre to start the evaluation was Alifu Alifu atoll which commenced almost simultaneously with Cyryx in November 2004. The plan was to start the evaluation at the remaining three centres during late December 2004. However, before the planned date, the Boxing Day Tsunami hit the country and it was impossible to continue to collect data. Although the islands that were selected for the pilot study were not badly hit by the Tsunami, the upheaval in the country generally was such that to continue with the study at this point was impossible. Fortunately the evaluations which commenced before Tsunami were completed. Since no further studies were conducted during this time, the rest of the evaluation was postponed to a later date. Hence, the study was recommenced in April 2005 and conducted until July 2005. Unfortunately, as the Maldives were still at a stage of rebuilding after Tsunami it was impossible to conduct the evaluation in the outer islands. Hence, the study at this time was restricted to the capital. However, the Tsunami had left the country with a worse situation in terms of

human resources since some of the foreign teachers did not return for the new academic year. Hence, this study will be of immense benefit to the country, especially in the islands, where there was a real shortage of teachers after the Tsunami. The study will benefit the local population, in achieving the provision of learning without adequate human resources.

5.5.1 Selection

A stratified sampling approach was used in this research to identify six different centres within Maldives, although only four centres were able to be used. The normal process of stratified sampling would then lead to selecting random samples from each of these different centres (Berg, 2004; Gall et al., 2003,2005; Gorard, 2003; Mertens, 1998). The approach used in this research was slightly different. In the case of the two island centres, the researcher visited the islands and invited all the eligible candidates to a meeting. The candidates were then given an explanation of the research, how it was going to be carried out and they were given the opportunity of participating in the research. In essence, all the interested candidates from the islands were included in the sample which can be categorised as a volunteer sample (Gall et al., 2005) rather than a simple random sample. Nearly all educational research is conducted with volunteer samples where individual participants express their willingness to participate (Gall et al., 2005). This complication in sampling is due to researchers having a legal and ethical requirement to obtain informed consent from the participants (Gall et al., 2005). In the case of the two centres in the capital, the centres were asked to identify students from different courses. These students were then given the information about the investigation and their informed consent was sought. After that, participants were selected randomly from this group of willing students.

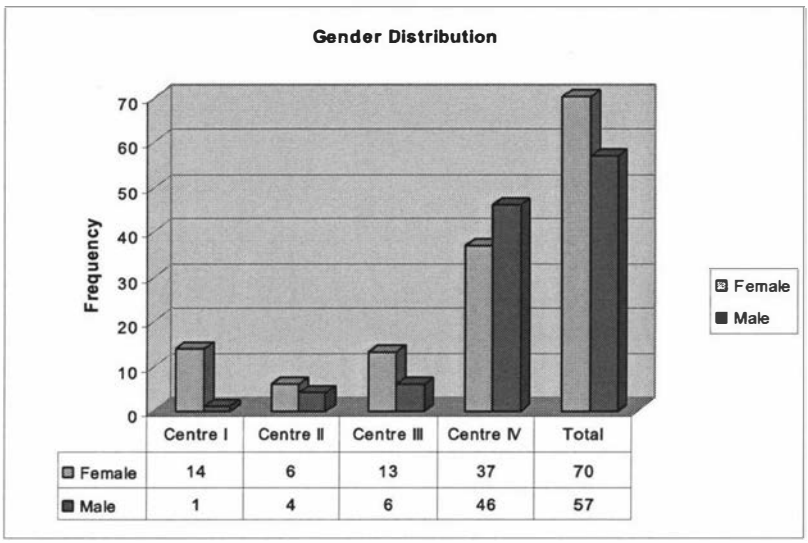
The evaluation was initially started at Alifu Dhaalu Dhagethi centre during November 2004 and this was called Centre I. Fifteen students participated in the evaluation at this centre. This was followed by the centre in the capital, and this was called Centre II for analysis purposes. A total of 10 students took part in the evaluation at this centre. The third centre to start the evaluation was Alifu Alifu Rasdhoo centre where 19 students took part in the evaluation. This centre was called Centre III for analysis purposes. Finally in April 2005 the evaluation was recommenced at Faculty of Management and Computing at Maldives College of Higher Education in the capital where 83 students participated in the evaluation. This centre was labelled Centre IV for the purposes of analysis. A total sample of 127 students participated in the evaluation. The breakdown of this sample into different centres is shown in Table 5.3.

Table 5.3: Distribution of sample across Centres

	Centre I	Centre II	Centre III	Centre IV	Total
Sample size	15	10	19	83	127

5.5.2 Characteristics of Sample

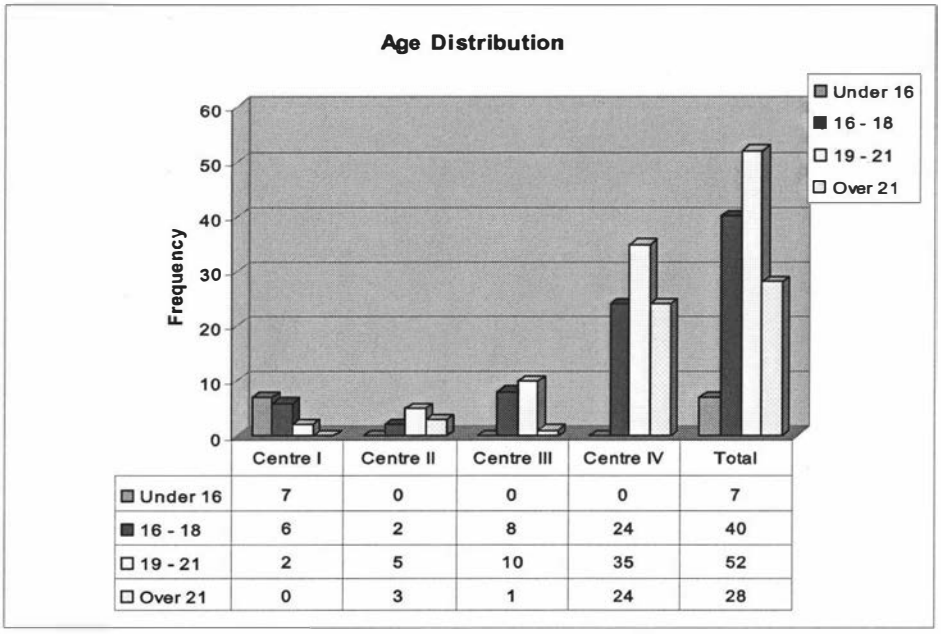
Of the 127 participants, 70 (55%) were female and 57 (45%) were male. Figure 5.1 shows the distribution of gender across the four centres. Females have dominated the islands centres and males dominated the fourth centre at the capital. Overall, the gender distribution is relatively balanced for the sample.



	Centre I	Centre II	Centre III	Centre IV	Total
Female	14	6	13	37	70
Male	1	4	6	46	57

Figure 5.1: Gender Distribution across the four centres

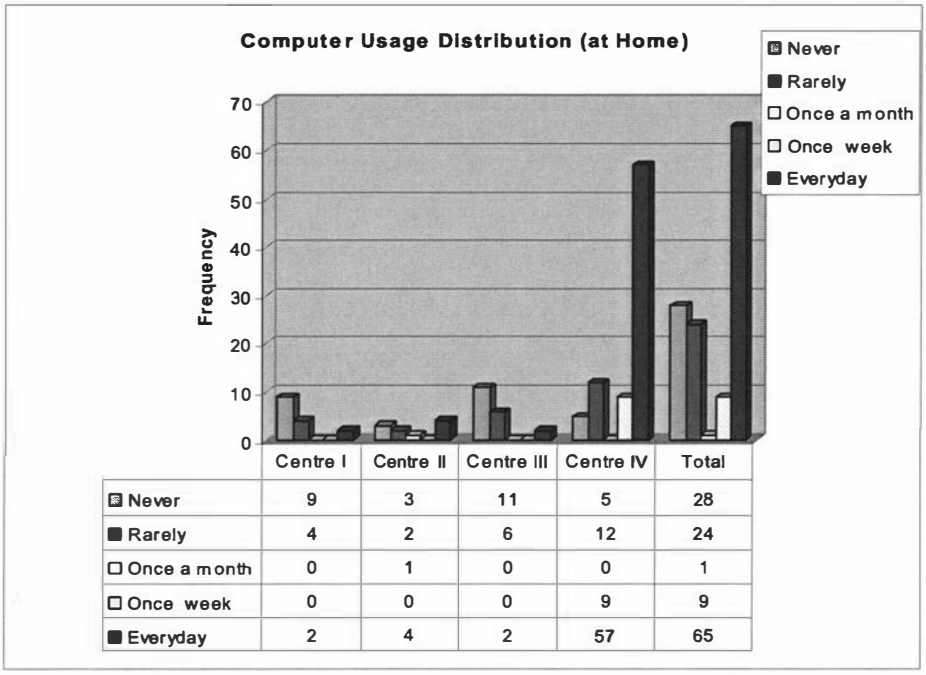
Figure 5.2 shows the age distribution across the four centres. According to this figure the participants from the islands are on average much younger than the participants from the capital. In both the centres from the capital, more than 29% of the students are over 21 years old. On the other hand, one centre in the islands did not have students over 21 and the other centre had only 5% students over 21 years of age.



	Centre I	Centre II	Centre III	Centre IV	Total
Under 16	7	0	0	0	7
16 - 18	6	2	8	24	40
19 - 21	2	5	10	35	52
Over 21	0	3	1	24	28

Figure 5.2: Age Distribution across the four centres

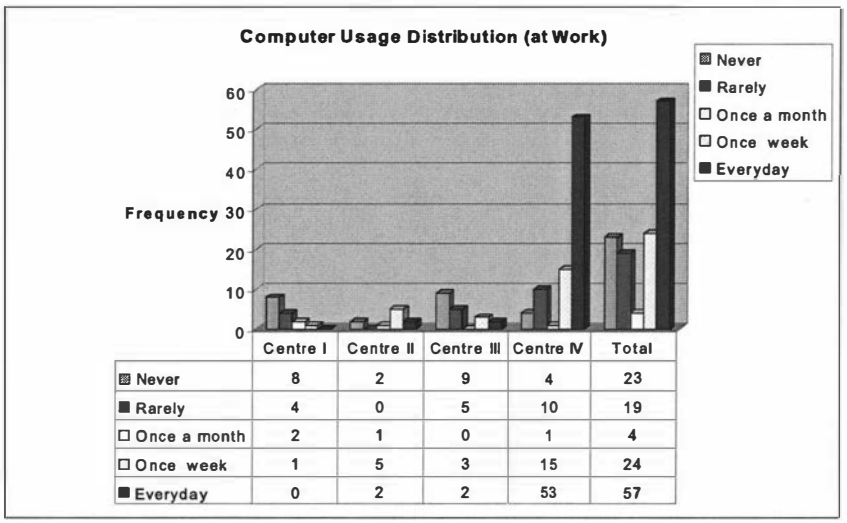
The distribution of computer usage at home shows that the students in the islands have a low usage while students from the capital have a high usage. According to Figure 5.3, approximately 60% students from the island centres never use computers at home while 40% and 69% students from Centre II and Centre IV in the capital use them daily at home respectively.



	Centre I	Centre II	Centre III	Centre IV	Total
Never	9	3	11	5	28
Rarely	4	2	6	12	24
Once a month	0	1	0	0	1
Once week	0	0	0	9	9
Everyday	2	4	2	57	65

Figure 5.3: Computer Usage (at Home) Distribution across the four centres

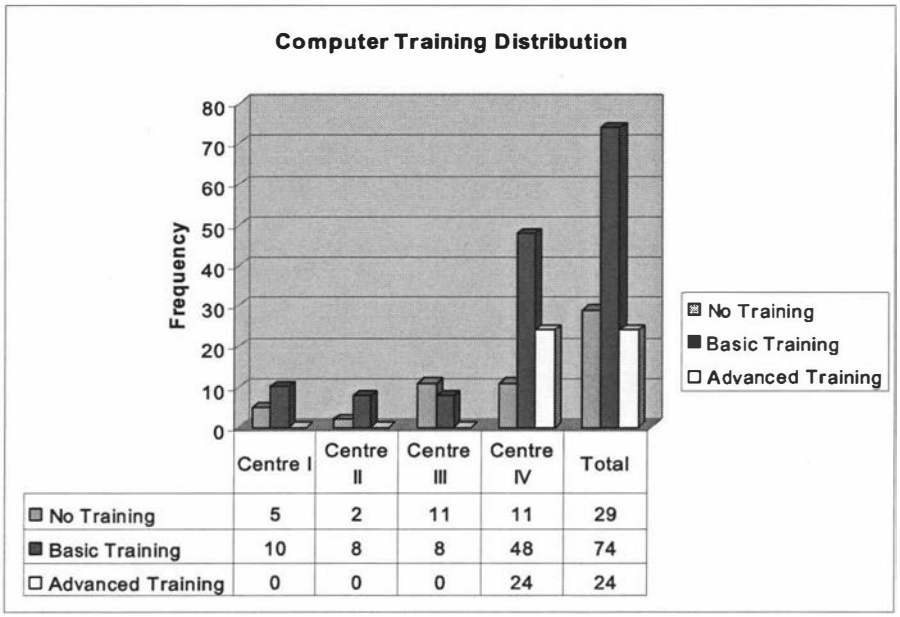
Figure 5.4 shows that the computer usage at work is low with the participants in the islands while it is high with the participants in the capital. Approximately 50% participants never use computer at work in the islands while more than 80% participants in the capital use computers at least once a week at work.



	Centre I	Centre II	Centre III	Centre IV	Total
Never	8	2	9	4	23
Rarely	4	0	5	10	19
Once a month	2	1	0	1	4
Once week	1	5	3	15	24
Everyday	0	2	2	53	57

Figure 5.4: Computer Usage Distribution (at Work) across the four centres

Most of the participants (58%) had received basic computer training across all centres. Only participants from Centre IV in the capital had received advanced training in computers. Figure 5.5 shows the distribution for computer training across the four centres.



	Centre I	Centre II	Centre III	Centre IV	Total
No Training	5	2	11	11	29
Basic Training	10	8	8	48	74
Advanced Training	0	0	0	24	24

Figure 5.5: Computer Training Distribution across the four centres

5.6 Data Collection Methods

Different data collection methods were used after implementing the learning system in Maldives. The first set of data was the pre-test conducted before starting to use the learning system and the post-test conducted after completing the module using the learning system. The pre-test was conducted on the first day of evaluation and the post-test was conducted on the last day of the evaluation. The second set of data was the administration of the questionnaire, which was given to the students after they completed the course. In most cases, the questionnaire was administered on the last day of evaluation after the students had completed their post-test. In one case, the questionnaire was administered a couple of days after the students completed the post-test. The third set of data was the students' school attainments at their last grade in school. This was done during the evaluation using the school records.

5.6.1 Learning System - Content

Once the software development of the learning system was completed, the next step was to add content into the system. The decision about which content to use was hard because it involved an ethical issue. The content that should be added has to be equivalent to secondary or higher secondary level. Since the evaluation is to be done in a part of Maldives where the students do not have access to secondary or higher education, if only one subject or part of subject was taught using this model, then the students who would participate will be left with a small body of knowledge that would be unrelated to anything they had already done, nor would it bear any relation to their further study. For example, if the students were taught Physics using this model, or even worse, a couple of topics in Physics, it will not benefit the students unless they are able to gain knowledge of other subjects if they want to go further academically. Some may argue that the students would have learnt something in Physics but it was felt that it would be ethically wrong to teach students just one secondary subject that would take them nowhere. Hence content that would stand on its own was needed for the evaluation.

For the purpose of the evaluation a module from a course called "Introduction to Information Systems" was selected. The content was based upon one of the modules taught at Maldives College of Higher Education. Maldives College of Higher Education is a tertiary training institution in Maldives, which caters for students completing secondary and higher secondary schooling. Currently the college's main intake includes students who have completed secondary school and do not proceed to higher secondary education due to various reasons. In addition, through bridging programs, the college also takes students who have not completed secondary

education. Maldives College of Higher Education consists of six faculties: Faculty of Management and Computing, Faculty of Health Sciences, Faculty of Education, Faculty of Hospitality and Tourism Studies, and Faculty of Engineering Technology. The selected module is taught at Faculty of Management and Computing. Originally, the module was developed as a vocational subject to help students gain computing skills required for secretarial and office management jobs. With the introduction of academic certificates and diplomas through the faculty, the module was adapted to suit the needs and requirements of these students. However, the vocational skill based content was kept intact and additional theoretical aspects of information systems were added to it. The module was named "Computer Applications" because the original focus was to teach specific computer applications. "Introduction to Information Systems" is used as the name of the module taught for the evaluation in this research. There are two reasons for using a different name to "Computer Applications" in this evaluation. Firstly, the content is more in line with information systems. Secondly, it was important to differentiate between the original module taught at the faculty and the evaluation module, to avoid any confusion for the students who participated in this evaluation. Although the faculty provided the content for evaluation no formal agreements were made for cross crediting of this module with the existing "Computer Applications" module. Hence, it was agreed that the use of same module name might raise a number of administrative issues. As mentioned before, this content/module was chosen because it would stand on its own and provide the students with skills that they could use even if no other modules are taught. This overcomes the ethical issue mentioned above. In addition, the skills and knowledge taught through this subject are vital in the job market in Maldives because computer use in the workplace is on the increase and computer literacy is low.

5.7 Data Collection Tools

As mentioned above, three different methods were used to collect data for evaluation. One was getting the participants' school results from their last year at school. No data collection tools were used to collect this set of data. The second set of data was students' results from pre-test and post-test. The final set of data was collected using a subjective questionnaire designed to collect the students' perception of the learning system.

5.7.1 Pre-test and Post-test

Pre-test and post-test were used to measure how much students have learnt using the learning system. A test is a structured measurement instrument that can be used to assess individual differences in various content areas (Gall et al. 2003; Jackson, 2003). In psychology and education, two types of tests are frequently used, namely personality tests and ability tests (Jackson, 2003). Ability tests are further divided into aptitude tests and achievement tests. Aptitude tests measure the potential of individuals to do something, while achievement tests measure their competence (Jackson, 2003). In this research thesis, both pre-test and post-test were used to measure the students' competence in the content area, hence these are achievement tests.

The reliability and validity of tests are two measures to judge the quality of tests (Gall et al., 2003; Jackson, 2003). Four different types of reliability testing can be done for

any measuring instrument. These are test/retest, alternate-forms, split-half, and interrater (Jackson, 2003). Test/retest measures the stability of the test over time by administering the same test to the same individuals at two different times. Alternate-forms measure the stability as well as equivalency of the tests by administering alternate but equivalent forms of the test to the same people at two different times. Split-half measures the equivalency of the test by correlating the performance of people on two equivalent halves of the test. Interrater uses two or more judges to rate the test and determine a percentage rating between the different raters.

The validity of a test measures whether that particular test is genuine in measuring the objective of the test. Several types of validity can be examined, but the most common four types are content validity, face validity, criterion validity, and construct validity (Jackson, 2003). The pre-test and post-test is only measuring the competence of students in the content area specified, so only content validity is required. Content validity is an examination of whether the test covers a representative sample of the content to be measured (Jackson, 2003). Both pre-tests and post-tests used in this research are taken from an existing course. The course has been conducted in Faculty of Management and Computing of Maldives College of Higher Education for more than five years. The pre-test and post-test were past examination papers of this particular module. The past examinations papers were compared with the course objectives and the course objectives were represented in the exam papers. Further, the test items were checked for violation of item construction rules and were found to be robust and in compliance. Hence the reliability and validity of the tests were considered satisfactory.

5.7.2 Questionnaire

A questionnaire was administered to collect the students' perception of the learning system. A total of eight different measures were administered; students' characteristics, students' perception of computing knowledge requirements to use the learning system, students' preference of teaching modes, students' perception of learning using the learning system, students' perception of ease of use of the learning system, students' perception on the tools available in the learning system, students' perception on the presentation of the learning system, and students' overall perception of the learning system.

The questionnaire was designed with four separate sections. The first and second sections were used to collect the students' characteristics. The third section measured the rest of the seven measures of the questionnaire. Finally the fourth section was used for open-ended questions in which the students were asked to give feedback on the positive and negative aspects of the learning system.

5.7.2.1 Student Characteristics

Characteristics of interest were students' age, gender, and their study centre. These measurements were used to find out if there were significant differences between students of different groups and their acceptance of the learning system. In addition, students' school grades were collected from school records to measure their school attainment levels. All the biographical data were collected in the first section of the questionnaire.

Prior experience is the relevant background knowledge the students have about a subject before they begin a course of study. In the questionnaire, prior **experience** measure was used to find out how much computing **experience** the students had coming into the course. This was measured because the learning system was designed to use computers for teaching and find out whether prior computing knowledge had any impact on students' acceptance of the system. Prior **experience** was measured in terms of students' computer usage both at home and at work, and any prior computing training they had received. For computer usage, the students had to indicate whether they use computers daily, at least once a week, at least once a month, rarely, or never. For prior training, the students had to indicate if they had basic computer training or a higher level training. In addition, the students were asked to indicate their confidence in using computers and their affluence with computers.

5.7.2.2 Students' Acceptance of the Learning System

The students' acceptance of the learning system was measured using seven different scales. These included the students' perception of prior knowledge of computing needed to use the learning system, their preference of learning modes, their perception of learning using the learning system, their perceptions of ease of use of the system, their perception of the tools present in the learning system, their perception of the presentation of the learning system, and their overall perception of the learning system.

These measurements were based upon the model for user acceptance of information technology or Technology Acceptance Model (TAM) put forward by Davis (1993). Davis (1993) proposed a model where he argued that the perceived ease of use and

perceived usefulness of a technology would formulate users' attitudes towards using a particular technology and consequently to actual use of the technology. Several significant researches have confirmed the usefulness of technology acceptance model as a tool for investigating and predicting user acceptance of information technology. These studies include Chau (1996), Doll (1998), Geffen and Straub (1997), Szajna (1996), and Taylor and Todd (1995). The seven different characteristics measured in the questionnaire were each treated as a separate scale of measurement. Each of these scales measured user acceptance based on the TAM model. Reliability testing was carried out to measure the reliability of these scales.

Reliability testing is finding out whether the instrument used is measuring the concepts in a consistent manner (Hinton, 2004). There are several ways of doing reliability tests on questionnaires. In this study, reliability testing is used to test the internal consistency of the questionnaire. The internal consistency checks whether a set of questions within a questionnaire measuring various aspects of one concept is reliable. In other words, it measures whether the responses of the participants to questions within a particular concept are consistent (Hinton, 2004). Cronbach's alpha is the most popular measure for internal consistency of questionnaires (Hinton, 2004). Cronbach's alpha examines the average inter-item correlation of the items in the questionnaire and if all the items are measuring exactly the same thing, it is referred as a true score (Hinton, 2004). A true score will give the Cronbach's alpha value as 1. The conventional view is that a scale (or a variable in the case of this study) is reliable if the Cronbach's alpha value is greater than or equal to 0.7 and in some cases a value of more than 0.5 can be considered.

The seven different scales consist of different number of questions within each scale. Students rated how closely the questions reflected their own perceptions using a five point Likert-type scale shown below.

1 - Strongly Disagree

2 - Disagree

3 - Neutral

4 - Agree

5 - Strongly Agree

Prior Knowledge of Computing required – This scale measured students' perception of whether they needed prior knowledge of computers to use the learning system. According to the TAM model, ease of use is one factor that contributes to user acceptance of technology. This scale measured how much the students felt they needed prior knowledge in order to use the learning system. In other words, the more the students' felt they needed prior knowledge of computing the more difficult they will perceive the learning system to be to use. Hence, the score in this scale can be used to measure the users' perception of this learning system as an acceptable one. The scale originally consisted of 4 separate questions. However, the Cronbach's alpha reliability test showed that only 3 of the 4 questions reflect the scale (Table 5.4). Hence one question was dropped. The Cronbach's alpha reliability score for this scale was moderate at 0.52.

Table 5.4: Questions measuring Prior Knowledge of Computing required

11. This program did not require any prior knowledge of computing
12. I spent most of the time learning how to use the program rather than learning from the module
14. The program can be used without any help

Preference of Learning Modes – This scale measured two different learning modes, electronic media and traditional face-to-face mode. Students' preference to electronic (Table 5.5) as well as traditional face-to-face mode (Table 5.6) was each measured using three questions. The reliability score for electronic mode of learning was 0.77 and face-to-face was 0.60.

Table 5.5: Questions measuring Electronic Delivery Mode Preference

18. The program helped me understand the subject well as it provided me with a one-to-one instruction
20. It is easier to learn from the program as I can learn at my own pace
21. This form of teaching was really clear

Table 5.6: Questions measuring Traditional Face-to-face Mode Preference

16. I would prefer to learn from a human teacher in a classroom environment rather than from a computer
17. A human teacher in a class room environment would have been more helpful answering my questions than a computer
19. A human teacher would be better than the program in providing explanations for the questions I have

Perception of Learning – This scale measured the students' perception of how much they learnt using the learning system. Reflecting on the TAM model, this scale measured how many the students felt the learning system was useful to them, in other words, perceived usefulness. The more the students felt that they learnt using the learning system the more the learning system is likely to be accepted by them. Seven questions were used within this scale (Table 5.7) with a reliability score of 0.75.

Table 5.7: Questions measuring Perception of Learning

22. I didn't need any previous knowledge on the subject to use the program
23. I have gained a good understanding of computers and information systems by using the program
25. It is difficult to learn the basics of computing and information systems using this program
26. I am now confident with my knowledge on computers and information systems after using the program
27. Most people would find it difficult to gain an understanding of computers and information system using this program
28. At the end I still do not fully understand the concepts of computers and information systems
29. I would like to use a program like this to learn other subjects

Ease of Use – The students' perception of ease of use of the learning system was measured using this scale. This scale directly relates to the perceived ease of use factor from the TAM model. The higher the score for this scale the easier the students feel it was to use the learning system. Consequently, the higher the score the more accepting of the system the students were. The scale consisted of 8 questions (Table 5.8) and has a Cronbach's alpha reliability of 0.82.

Table 5.8: Questions measuring Ease of Use

30. The program provides good feedback when I have entered an answer
32. The immediate feedback feature was helpful in finding out if I got the answer right or wrong
34. The HINT tool for each question was very helpful
35. I never understood what all the buttons on the screen did
36. Clear instructions on how to proceed with the program were not provided
37. The HINT tool for each of the question did not provide adequate help to solve the questions
38. The program did not allow me to keep track of things I had completed
40. The program provided me with guidance on what to do next

System tools – This scale measured students' perceptions of the different tools present in the learning system. The TAM model identifies system design features and tools as an external stimulus which leads to perceived ease of use and perceived usefulness (Davis, 1993). Hence, the measure from this scale can be used to measure the students' perceptions on how useful the system tools are, which can lead to students' belief that the learning system is useful. Five questions are included within this scale (Table 5.9) and the reliability score for these five items is 0.74.

Table 5.9: Questions measuring System Tools

41. The query tool was easy to use
42. The FAQs did not provide adequate explanations to the queries
43. The query tool was very helpful in getting the answers to questions I had
45. Some of the responses to my queries were not clear
46. The FAQs provided answers to most of my queries

Layout and Presentation – This scale measured the students' perceptions of the screen layout and presentation of the learning system. It looked at finding out how much the students felt the screen was easy to use. This scale was different from the ease of use scale as this was focused only on the screen layout whereas ease of use scale was focused on overall use of the learning system. Once again, this scale was related to the perceived ease of use factor in the TAM model. Four questions were used within this scale (Table 5.10) with a Cronbach's alpha value of 0.92.

Table 5.10: Questions measuring Layout and Presentation

47. The screen layout was easy to understand
49. The screen was attractive and clear
50. The colours on the screen were very easy to use
51. The program looked very dull and boring

Overall Perception – This is a measure of overall perception of the learning system. This scale measured whether the students liked the learning system, whether they will

use it again, and so on. This scale does not directly relate to the factors of the TAM model but it does measures, to some extent, the students' acceptance of the learning system. Six questions were used within this scale (Table 5.11) with a reliability score of 0.80.

Table 5.11: Questions measuring Overall Perception

52. On the whole I did not like the program
53. I liked the program because it was fun to use
55. The program was easy to use and did not require much practice
56. I would not use this program again for any other subjects
57. I liked the way the program helped me to learn
58. The program is good for revising subjects

The reliability scores for the different scales show that all the scales except one were moderate to highly reliable in measuring the respective factor. The students' perception of the need for prior computing knowledge gave a low reliability factor (0.52). However, since it is still greater than 0.5, this scale is also used cautiously in identifying the students' acceptance of the learning system. The results of these factors are explained in the results chapter.

The following chapter looks at the results from these evaluations and provides a detailed discussion of the findings. The analysis chapter looks into whether the learning system was able to provide access to education in the remote islands of Maldives.

6. RESULTS: IS THE PROPOSED MODEL SUITABLE FOR MALDIVES?

The earlier chapters have described how the proposed model was initiated, designed, developed, and evaluated. The main focus of this chapter is to analyse the data that were obtained during the process of evaluation. The process of evaluation was detailed in the methods chapter describing the ways in which the data was gathered. The main purpose of the evaluation was to find out whether the proposed model is suitable in the Maldivian context. In order to find this out three questions need to be answered.

- Will the proposed model provide physical access to learning to the students in the islands?
- Will the students be able to learn through the proposed model?
- Will the students accept the proposed model as the basis for a form of teaching?

6.1 Will the Proposed Model Provide Physical Access to Learning to the Students in the Islands?

Evaluation was carried out in the Maldives to investigate the suitability of the proposed model in the Maldivian environment. One of the purposes of evaluation was to find out whether the proposed model provided access to students in the outer islands of Maldives. As explained in chapter 5, evaluation was carried out in four different centres in three different islands in Maldives. Two of the islands used in the

evaluation were in the atolls with low populations and low school enrolment rates (see chapter 5). In addition, these were islands in the lower end of the development spectrum of Maldives in terms of resources.

As described in chapters 3 and 4 the proposed model was designed and developed based on the existing physical infrastructure of Maldives. Hence, theoretically the proposed model will be able to provide access to learning to students in the islands. The different options available in Maldives were outlined in chapter 3 and how these were used in designing the proposed model was described in detail in chapter 4. Although it was planned to carry out evaluation in other islands of Maldives, finally two islands and the capital was used. The two outer islands used for the evaluation are Alifu Alifu Rasdhoo and Alifu Dhaalu Dhangethi. These two centres were in the atolls adjacent to the capital atoll and due to the small population these two can be considered as some of the remotest islands in the country in terms of reach. Hence the use of these two centres would prove the ability to provide physical access to the remote islands in the country.

The completion of the evaluation at the three centres proved that physical access to students in remote islands was possible using the proposed model. One of the other aspects that was argued in the infrastructure was also proven during the evaluation phase. Although this was not at all related to the evaluation it is noteworthy of mentioning here. The two island centres where the evaluation was conducted were located in two atolls which were geographically within the same atoll and administratively adjacent to each other. However, the researcher found out that it was virtually impossible to travel from one centre to another as there was no transport

between these atolls. Hence the researcher had to travel to the capital every time before travelling to the adjacent atoll. This strengthens the claim that daily commuting to regional schools especially between atolls was impossible in Maldives.

6.2 Statistical Analysis

Physical accessibility is only one aspect of the students' accessibility provided by the proposed model. The other two aspects were how much the students learn using the learning system, and whether the students would accept the proposed model as the basis for a form of teaching. Statistical analysis was used to measure these aspects of the learning system because statistics is a useful tool for researchers to find answers to questions (Hinton, 2004). Before going into the statistical analysis of the data, the different statistical tools used for this investigation is explained in this section with a rationale for their use. T-tests and Correlation Analysis were used in this investigation.

6.2.1 T-tests

T-test is a very useful tool in educational settings as we are often comparing two methods, two programs, or two groups of students (Carroll & Carroll, 2002). T-tests are used to determine whether the observed difference in means between two groups occurred by chance or whether it reflects a true difference in the means of the population (Gall et al., 2003). In this investigation, correlated-groups t tests were used. Correlated-groups t-test compares the performance of two groups where the same people are used in each group (Jackson, 2003; Hinton, 2004). In a correlated t-test the difference in mean scores for each participant is calculated by subtracting one

score from the other. The t-test will show whether there is a statistically significant difference between the two scores of all the participants in the sample. Researchers generally agree that if a t-test yields a p-value of 0.05 or lower this can be concluded as a representation of the population (Gall et at., 1999).

T-tests are used in two different instances in this thesis. Firstly, they are used to compare students' level of attainment using the learning system and their school attainment. The t-test was used to determine if the students were able to learn using this learning system (section 6.3). Secondly single sample t-tests were used to verify results on students' perception of the learning system (section 6.4).

Correlation analysis was used to determine whether there were any relationships between the students' perceptions of the learning system and their attitudes to and experience with computers (section 6.4).

6.3 Will the Students be Able to Learn through the Proposed Model?

In an ideal situation a study will determine if the proposed model is better at delivering content to the students by comparing it to other forms of teaching. However, this research was conducted in an environment where there were no other forms of teaching available hence there was nothing to compare with. One aspect of the evaluation of this research is to identify whether the students were able to learn using the learning system. The most logical way to determine whether the students had learnt after using the learning system was to identify their knowledge prior to

using the learning system and after using the learning system and compare them to find out whether they performed better in later case. Hence pre-test and post-test were used during the evaluation and the scores from these two were compared. Since there were no control groups, a control measure was used to check the reliabilities of the test scores. That is, the average score[6] from the students' last grade[7] at school were compared with their final scores in the evaluation to see if there is any relationship. The results of these analyses are given below.

6.3.1 Did the student knowledge increase after using the learning system?

Pre-test and post-test scores were used to determine if the students were able to increase their knowledge using the learning system. A t-test was used to determine if there was any statistical difference between the pre-test and post-test scores of the students. The mean scores from pre-tests and post-tests from all the four centres were calculated and compared (Figure 6.1). The figure shows that there is a large increase in the mean from the initial scores to final scores. Table 6.1 shows the means and standard deviations for both the pre-tests and post-tests for the whole sample. It shows that on average a student scored 75 in the post-test while they only scored 31 in the pre-test. The significance of this difference was determined using a t-test.

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[6] An average score/mark is calculated for each student at the end of each year. This score takes into account all the assessments done in all the subjects throughout the year.

[7] In Maldives, each year of school is called a Grade. e.g. The last grade in secondary school is Grade 10 which is similar to Year 11 in New Zealand

Table 6.1: Descriptive Statistics showing Pre-tests and Post-tests

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	127	12.00	55.00	31.8661	11.07576
Posttest	127	40.00	100.00	75.1811	14.09966
Valid N (listwise)	127				

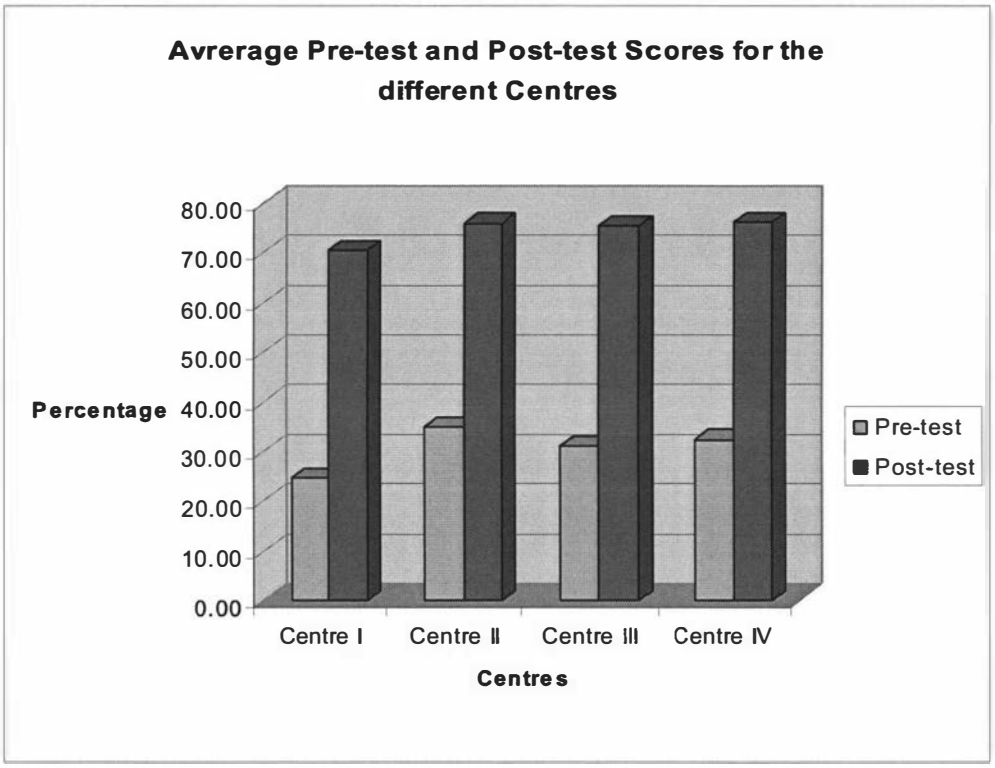

Figure 6.1: Average Pre-test and Post-test scores

The difference in means between pre-test scores and post-test scores for all the students is 43.31. This means that there is an average increase in the scores of 135% after the students have used the proposed model.

Table 6.2: T-test for Post-test and Pre-test Scores

	Paired Differences					t	df	Sig. (2-tailed)
	Difference between Means	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Posttest - Pretest	43.31496	16.67890	1.48001	40.38606	46.24386	29.267	126	.000

6.3.2 Was there a difference in students' attainment at school and their attainment using the learning system?

Although it was clear that the students' knowledge had increased after using the learning system it was not possible to measure how adequate this increase was in relation to performance using other teaching methods. This would normally be done using a control group. To overcome the problem the students' school attainment levels were compared with their attainment using the learning system to see if the level of learning on the computer system was higher than that which the students normally attained in a traditional classroom setting. If the school attainment levels were higher then it could be concluded that the students did not do as well as they would do at school using the model. However, if the school attainment level was lower, then it indicated that they did better using the learning system. Hence a t-test was performed to compare the means between the school attainment levels and attainment levels using the learning system.

The difference in post test means and school attainment levels is calculated as 5.85 (Table 6.4). This shows that on average students' scores were 8.4% higher than their school attainment level when using the learning system.

Table 6.3: Descriptive Statistics showing Post-tests and School Attainment

	N	Minimum	Maximum	Mean	Std. Deviation
Posttest	127	40.00	100.00	75.1811	14.09966
School	127	30.00	91.38	69.3354	12.36241
Valid N (listwise)	127				

Table 6.4: T-test for Post-test scores and School Attainment

	Paired Differences					t	df	Sig. (2-tailed)
	Difference between Means	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Posttest - School	5.84575	10.21665	.90658	4.05165	7.63984	6.448	126	.000

The two t-tests above establish that the students were able to learn using the learning system. The first t-test showed that the students were able to achieve a higher result when assessed on the same content, after using the learning system. The pre-test post-test method used for this t-test showed that the post-test scores were higher for the students. The second t-test was used to find out if the learning system created learning that was as good as, or better than their traditional school learning. The results of this

t-test showed that the students' grades using this learning system were at a similar level or higher with the use of the software. It has to be noted here that the standard deviation in both these tables are high. The values in these tables represent data from four different centres in three different islands. The high standard deviation is due to the heterogenic nature of the data where there is a difference in means between the different islands as large as 18.

6.4 Will the Students Accept the Proposed Model?

While it is important that any model of education is able to demonstrate that it can create effective learning, it is also important that students themselves are willing to accept the new method. Hence this section focuses on determining whether the students accepted the learning system. As mentioned in chapter 5, a technology acceptance model was used to identify how well students accepted this learning system. A questionnaire based on measuring the different aspects of technology acceptance model was administered to get feedback from the students.

6.4.1 Overall Perception of the students

Once the students completed their course using the learning system they were given a questionnaire which consisted of questions regarding their perceptions of the software. The questionnaire was divided into several scales, each scale measuring a different aspect of students' perception of the learning system. The first scale measured their overall perception of the learning system. This scale measured whether the students liked the learning system, whether they would use it again, whether the learning system was easy to use, and whether the students thought they learnt using

the system. The results from this scale are shown in Table 6.5. The mean value for this scale is 3.34 suggesting that overall that more students liked using the learning system and would be willing to use it again for other courses.

Table 6.5: Descriptive Statistics on Overall Perception Scale

	N	Minimum	Maximum	Mean	Std. Deviation
Overall Perception	127	2	5.00	3.394	.837

A single sample t-test was used to find out whether the average mean of 3.34 was significant. For the purposes of this t-test the test value was set to 3. A value of test value 3 would indicate that most students were neutral in the overall perception of the learning system. The result of the single sample t-test is shown in Table 6.6. The result show that the sample mean 3.394 is significantly higher than the test value 3, indicating that most students had a positive perception of the learning system.

Table 6.6: Single-sample t-test for Overall Perception Scale

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Overall Perception	5.300	126	.000	.394	.25	.54

6.4.1.1 Relationship between students' overall perception and students' attitudes to and experience with computers

This section looks at how the students' overall perception of the learning system relates to their attitudes and experiences of computers. Attitude was measured by their computer usage, confidence in using computers, and enjoyment of using computers. Table 6.7 shows the correlation statistics for this analysis. It can be seen from the table that there is no statistically significant relationship between overall perception and any of the students' characteristics.

Table 6.7: Correlation Statistic for Students' Overall Perception

		Overall perception	HomeUse	WorkUse	Confidence	Enjoyment
Overall perception	Pearson Correlation	1	.132	.131	.041	-.003
	Sig. (2-tailed)		.138	.142	.651	.975
	N	127	127	127	127	127
HomeUse	Pearson Correlation	.132	1	.532(**)	.597(**)	.180(*)
	Sig. (2-tailed)	.138		.000	.000	.043
	N	127	127	127	127	127
WorkUse	Pearson Correlation	.131	.532(**)	1	.564(**)	.025
	Sig. (2-tailed)	.142	.000		.000	.782
	N	127	127	127	127	127
Confidence	Pearson Correlation	.041	.597(**)	.564(**)	1	.134
	Sig. (2-tailed)	.651	.000	.000		.132
	N	127	127	127	127	127
Enjoyment	Pearson Correlation	-.003	.180(*)	.025	.134	1
	Sig. (2-tailed)	.975	.043	.782	.132	
	N	127	127	127	127	127

** $p<0.01$ * $p<0.05$

A further factor that may have influenced student perception of the learning system was their level of prior training they had had using computers. The types of training received by the students were categorised into three levels. Those are "no training", "basic computer course", and "diploma or higher". "Basic computer courses" are training programs runs across the country to teach the trainees basic skills in using computers. Most of these courses include teaching the skills to use Microsoft Windows and Microsoft Office applications. Most "diploma level" courses include theories of information systems, introduction to systems analysis concepts, introduction to programming concepts as well as skills in computer applications. Hence these two levels were used to differentiate between the different levels of computer training available in the country. A correlation analysis was conducted to find out whether the students' overall perception of the learning system depended on their level of training in computers (see Table 6.8). The table shows that there is significant relationship between the students' prior training and their overall perception of the learning system. However, the correlation coefficient of less than 0.19 is considered a very weak relationship (Jackson, 2003).

Table 6.8: Correlation between Prior Training and Students' Overall Perception

		Overall Perception	Training
Overall Perception	Pearson Correlation	1	.193(*)
	Sig. (2-tailed)		.030
	N	127	126
Training	Pearson Correlation	.193(*)	1
	Sig. (2-tailed)	.030	
	N	126	126

* $p< 0.5$

6.4.2 Prior Knowledge of Computing required

The Technology Acceptance Model suggests that ease of use of any technology is one factor that contributes to user acceptance of that technology. The questionnaire used a scale to measure whether students felt they needed prior knowledge to use the learning system. In other words, the more the students felt they needed prior knowledge of computing the more difficult they will perceive the learning system to be to use. Students' responses to this scale indicated how comfortable they were in using the learning system without any prior training. In other words, a higher score means that the students were comfortable using the learning system without any prior training in computers. Table 6.9 show the results for this scale. It shows that most students believe that they need prior knowledge of computing in order to use the learning system.

Table 6.9: Descriptive Statistics on Prior Knowledge Scale

	N	Minimum	Maximum	Mean	Std. Deviation
priorknowledge	127	1	3	1.72	.530
Valid N (listwise)	127				

In order to determine the significance of this result a single sample t-test was conducted. The results of this t-test are shown in Table 6.10, which shows that the sample mean of 1.72 is significantly lower than the test value. Furthermore, the test also showed that both the lower and upper values in the 95% confidence interval are negative. This means that all the values in this sample within the 95% confidence interval are lower than 3, which means that most students feel that they need prior knowledge. However, it has to be stated here that the reliability tests show that this scale had a low reliability in measuring the students' perception so these results are treated cautiously and other evidence is sought to support the finding.

Table 6.10: Single-sample t-test for Prior Knowledge Scale

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
priorknowledge	-27.138	126	.000	-1.276	-1.37	-1.18

6.4.3 Students' Perception of Learning using the Learning System

The third scale used in the questionnaire measured the students' perceptions of how much they learnt using the software. This scale measured the perceived usefulness of the learning system, that is the more the students felt that they learnt using the learning system the more the learning system will be accepted by the students. Table 6.11 show that the mean value for this scale is 3.28 showing that on average students responded with a value higher than 3 within the scale. This shows that more students believed that they learnt using learning system.

Table 6.11: Descriptive Statistics on Perception of Learning Scale

	N	Minimum	Maximum	Mean	Std. Deviation
contentknow	127	1	5	3.28	.835
Valid N (listwise)	127				

Although the mean value is greater than 3, a single sample t-test has to be conducted to determine if this is a significant result. The outcome of this single sample t-test is shown in Table 6.12 The results show that the result is significant and most students believed that they learnt using the learning system. Furthermore, it is worth determining whether this result (students' perception of learning) is in any way related to their attitudes to and experience with computers.

Table 6.12: Single-sample t-test for Perception of Learning Scale

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
contentknow	3.827	126	.000	.283	.14	.43

6.4.3.1 Relationship between students' perception of learning using the learning system and students' attitudes to and experience with computers

This section identifies whether the students' perception of learning using the learning system relates to their usage of computers, their confidence in using computers, and their enjoyment in using computers. A correlation statistics is used to measure this relationship.

Table 6.13 shows that there is a significant relationship between the students' perception of learning using the learning system and their computer usage both at home and work, and their confidence in using computer. There is no relationship between their enjoyment in using computers and their perception of learning using the learning system However, all the correlation coefficients are less than 0.29, and hence the correlation is considered weak.

Table 6.13: Correlation Statistic for Students' Perception of Learning Using the Learning System

		contentknow	HomeUse	WorkUse	Confidence	Enjoyment
contentknow	Pearson Correlation	1	.243(**)	.262(**)	.259(**)	.066
	Sig. (2-tailed)		.006	.003	.003	.461
	N	127	127	127	127	127
HomeUse	Pearson Correlation	.243(**)	1	.532(**)	.597(**)	.180(*)
	Sig. (2-tailed)	.006		.000	.000	.043
	N	127	127	127	127	127
WorkUse	Pearson Correlation	.262(**)	.532(**)	1	.564(**)	.025
	Sig. (2-tailed)	.003	.000		.000	.782
	N	127	127	127	127	127
Confidence	Pearson Correlation	.259(**)	.597(**)	.564(**)	1	.134
	Sig. (2-tailed)	.003	.000	.000		.132
	N	127	127	127	127	127
Enjoyment	Pearson Correlation	.066	.180(*)	.025	.134	1
	Sig. (2-tailed)	.461	.043	.782	.132	
	N	127	127	127	127	127

** $p<0.01$ * $p<0.05$

6.4.4 Students' Perception of Ease of Use of the Learning System

The fourth scale in the questionnaire measured the students' perception of how easy it was to use the software. The more the students believe that the learning system is easy to use the more the students will accept the system (according to TAM model). Hence, high scores in this scale mean that the learning system is more acceptable to the students. Table 6.14 show that the mean value for this scale is 3.28 showing that on average students responded with a value higher than 3 within the scale. This shows

that more students found the system easy to use. According to the Technology Acceptance Model this means that the likelihood of the students accepting this technology is high.

Table 6.14: Descriptive Statistics on Ease of Use Scale

	N	Minimum	Maximum	Mean	Std. Deviation
EaseofUse	127	2	5	3.28	.879
Valid N (listwise)	127				

A single sample t-test was used to determine if this sample mean (3.28) was significant to conclude that most student found the learning system easy to use (see Table 6.15). The result show that the sample mean of 3.28 was significantly greater than 3 indicating that most students found the learning system easy to use.

Table 6.15: Single-sample t-test for Ease of Use Scale

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
EaseOfUse	3.533	126	.001	.276	.12	.43

6.4.4.1 Relationship between students' perception ease of use and students' experience with computers

The students who use computers more frequently may find it easier to use the learning system. Hence this section will determine if there is any relationship between computer usage and ease of use of the learning system. In addition, the prior training in computers will also be a factor that can affect the ease of use scale. A correlation analysis was used to measure this relationship.

Table 6.16 shows that there is a significant relationship between ease of use and their computer usage both at home and work. The table also shows that the relationship between ease of use and computer usage at work is statistically significant even at 0.01. It also shows that there is no relationship between ease of use and the students' prior training in computers. Even where there is a correlation (between computer usage and ease of use) the correlation coefficients are below 0.29 suggesting that the correlation is considered weak.

Table 6.16: Correlation Statistic for Ease of Use Scale

		EaseOfUse	Training	HomeUse	WorkUse
EaseOfUse	Pearson Correlation	1	.174	.190(*)	.258(**)
	Sig. (2-tailed)		.052	.033	.003
	N	127	126	127	127
Training	Pearson Correlation	.174	1	.441(**)	.362(**)
	Sig. (2-tailed)	.052		.000	.000
	N	126	126	126	126
HomeUse	Pearson Correlation	.190(*)	.441(**)	1	.532(**)
	Sig. (2-tailed)	.033	.000		.000
	N	127	126	127	127
WorkUse	Pearson Correlation	.258(**)	.362(**)	.532(**)	1
	Sig. (2-tailed)	.003	.000	.000	
	N	127	126	127	127

** $p<0.01$ * $p<0.05$

6.4.5 Students' Perception of Presentation and Layout of the Learning System

The students' perception of the layout and the presentation of the software were recorded using a scale consisting of 5 questions. This scale measured how easy the students perceived the screen layout and navigation was. Hence, the easier the screen layout is the more acceptable the learning system is for the students.

The sample mean for this scale was greater than 3 (see Table 6.17), showing most students believed that the screen layout of the learning system was easy. A further single sample t-test was conducted to determine if this result is significant to reach this conclusion.

Table 6.17: Descriptive Statistics on Screen Layout Scale

	N	Minimum	Maximum	Mean	Std. Deviation
Screen	127	1	5	3.45	1.193
Valid N (listwise)	127				

The single sample t-test showed that the sample mean of 3.45 was significant and it can be concluded that most students found the screen layout easy to comprehend.

Table 6.18: Single-sample t-test for Screen Layout Scale

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Screen	4.239	126	.000	.449	.24	.66

6.4.6 System Tools

Technology Acceptance Model identifies system design features and tools as an external stimulus which leads to perceived ease of use and perceived usefulness (Davis, 1993). There are three built in system tools in this learning system; they are frequently asked questions (FAQ) tool, query tool, and hint tool. Each of these tools are analysed separately for their effectiveness in this investigation.

6.4.6.1 Students' Perception on the FAQ Tool

According to Table 6.19 it can be seen on average students were neutral in their perception of helpfulness of the Frequently Asked Questions tool. The sample mean of 3.13 is slightly greater than 3 and a single sample t-test will show the significant of this mean.

Table 6.19: Descriptive Statistics on FAQ Tool

	N	Minimum	Maximum	Mean	Std. Deviation
FAQTL	127	1	5	3.13	.971
Valid N (listwise)	127				

The single sample t-test show that sample mean of 3.13 is not significantly different from 3. Hence, it can be concluded that most results within this scale was neutral. This shows that the perceptions of students on the FAQ tool were neutral.

Table 6.20: Single-sample t-test for FAQ Tool

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
FAQTL	1.554	126	.123	.134	-.04	.30

6.4.6.2 Students' Perception on the Query Tool

The sample mean on this scale is 3.01 showing that the on the average score within this scale is neutral. This analysis was done without including the response time of the queries. The response time of the queries was excluded as it was already anticipated in the proposed model that the response time will be slow. The response time of any query is anticipated to be at least 24 hours. The results can be further analysed using a single sample t-test, which can determine if this is a significant result.

Table 6.21: Descriptive Statistics on Query Tool

	N	Minimum	Maximum	Mean	Std. Deviation
QUERYTL	127	1	5	3.01	.859
Valid N (listwise)	127				

The single sample t-test show that sample mean of 3.01 is not significantly different from 3. This shows that most students are relatively neutral about the ease of use of the query tool

Table 6.22: Single-sample t-test for Query Tool

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
QUERYTL	.103	126	.918	.008	-.14	.16

6.4.6.3 Students' Perception on the HINT Tool

The HINT was used to provide the students with a hint when they cannot answer the post-test questions. The hint tool provides them with the information or content that would enable the students to answer the respective questions. The results show that the sample mean score as 3.56, which indicates that on average students find the hint tool to be helpful.

Table 6.23: Descriptive Statistics on HINT Tool

	N	Minimum	Maximum	Mean	Std. Deviation
HINTTL	127	1	5	3.56	1.219
Valid N (listwise)	127				

A single sample t-test was conducted to determine the significance of this result. The results shown below (Table 6.24) determine that the result is significant. It shows that the sample mean of 3.56 is significantly greater than the test value of 3 for the sample, indicating that most students find the hint tool to be helpful.

Table 6.24: Single-sample t-test for HINT Tool

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
HINTTL	5.167	126	.000	.559	.34	.77

The analysis and results presented above are done on the data collected from the study conducted from November 2004 to January 2005 and April 2005 to July 2005 in the Maldives. The results given above provide some statistical analysis on the data collected and its statistical significance. The following chapter will discuss some of these findings and identify future research areas.

7. CONCLUSIONS AND RECOMMENDATIONS

This chapter provides an overview of the research problems addressed in this thesis. The research objectives are reviewed, and the research process and methodology used to achieve these objectives are briefly outlined. The conclusions are then drawn from this process and its impact on distance education in Maldives is discussed.

7.1 Objectives of the research

The main objective of this research was to identify a process that would allow for the provision of access to secondary education in the remote islands of Maldives where it is not available. The research has shown that there is a lack of secondary and high schools in the islands. Hence the lack of access to secondary education for children within the islands can be mainly attributed to the lack of schools within the islands. A distance education model was developed for Maldives. Distance education in preference to a face to face mode of teaching which would not be economically feasible because of the requirement to build schools on the islands to cater for those children (Shareef and Kinshuk, 2004).

As a result, a hybrid learning model was developed to deliver distance education in the islands. The model uses CD-ROM and the Internet to deliver the content and monitor the students' progress. Students receive individualised feedback to the queries they pose for the teachers while content updates are made based upon compiled student competencies. The model takes into account the existing infrastructure of the country and requires no additional infrastructure investment.

Three different aspects of access have been taken into consideration in this research: physical access to the education, students' learning using the proposed model and students' acceptance of the proposed model. The physical access was measured in terms of whether the proposed model can be used across the country to deliver secondary education to the students. Student learning using the proposed model was measured using a set of pre-tests and post-tests. Finally, student acceptance was measured using a questionnaire which looked at the attributes of the technology acceptance model.

The study has also examined the effectiveness of the proposed model through a series of evaluations in Maldives. A learning system was developed based on the proposed model and has been evaluated in different parts of the country to find out its suitability in Maldivian environment.

7.2 The Proposed Model

The proposed model was a three-tier system with a student module, a regional module, and a headquarters module. The student module was an offline model which was sent to the students on a CD ROM with the content and a floppy disk containing their initial student profile. The students' progress was recorded offline and uploaded manually to the regional module at the end of each day. The regional module then compiled all the students' progress, and sent a compiled assessment to the headquarters via the Internet. The teachers at the headquarters then assess the progress and send their responses to the regional module. These can then be manually

downloaded on a floppy disk and subsequently into the student module. The teachers respond to individual queries of the students as well as to overall progress of students within a region. Chapter 4 has described the model in detail.

A learning system was developed based on the proposed model for the purposes of evaluating the model. The learning system was designed to teach an introductory information systems module for the students. Although this is not part of the curriculum for secondary schools it was selected as this will give the students computing skills required for secretarial and office management jobs. Furthermore, the level of this module was equivalent to a secondary subject in the school curriculum.

7.3 Evaluation and Analysis of the Learning System

A set of 15 postgraduate students at Massey University, New Zealand evaluated the learning system. A discussion session with these 15 students was held to identify flaws in the usability of the learning system. Some minor modifications were made to the learning system based on the outcomes of this discussion.

The evaluation in the Maldives was carried out during November 2004 to January 2005 and then again in April to July 2005. Two of the centres were in the remote islands and two centres were in the capital. The two centres in the islands were some of the remote islands in the country. A total of 127 students participated from the 4 centres. The evaluation measured the accessibility of the learning system and in turn the proposed theoretical model. Furthermore, the investigation looked at whether the

students learnt using the learning system. Finally, a questionnaire was used to find out whether the students accepted the learning system.

Statistical analyses were used to determine the validity of the results. Mainly two sets of statistical tests were used; namely t-tests, and correlation analysis. The knowledge gained was measured in terms on percentage gains between pre and post test. These were analysed using t-tests to see if the gains were significant. Correlation statistics were used to find out if the students' attitudes to and experience with computers had any impact on their acceptance of the system as a learning tool.

7.4 Conclusions

The key issue of this research is to find out if the proposed theoretical model is suitable to provide secondary education to the remote islands in Maldives. In order to find out whether the proposed theoretical model was suitable in Maldives, three aspects were investigated. They are

- Physical accessibility
- Students' Learning
- Students' Acceptance

7.4.1 Physical Accessibility to the model

One of the rationales behind this thesis is the lack of access to secondary education in the remote islands in Maldives. Hence, this research aimed at developing a model that will provide access in the remote islands of Maldives. The learning system developed based on the proposed theoretical model was implemented in two of the remote

islands in the country. As explained earlier, these two islands are considered as some of the remotest islands in the country in terms of reach. The learning system was successfully implemented and a module was taught in these islands, demonstrating that the proposed model met the criteria of accessibility in the remote islands of Maldives.

7.4.2 Students' Learning using the model

The results determined that the students were able to learn using the learning system. Furthermore, it showed that the students increased their knowledge by 135% after using the learning system. When compared with their average school scores the results determine that the students scored 8% higher when using the learning system. Since the learning system was developed based on the proposed theoretical model it can be concluded that the proposed theoretical model will enable students to increase their content knowledge.

7.4.3 Students' Acceptance of the model

The research also looked at the students' perceptions of the learning system. One of the aspects the study focussed on was the students' overall perception of the learning system. Most students liked using the learning system and were ready to use the learning system again for other subjects. Sixty four percent of the students stated that they like using the software with only 20% expressing some dislike. When asked whether they would use the learning system for any other subject 52% indicated that they will use the system for other subjects. These results were then compared with factors including relating to the students' attitudes to and experience with computers.

The study examined whether there was any relationship between the students' computer usage and how much they liked using the learning system. The computer usage was measured in terms of how frequently they used computers at home as well as their workplace. Each of these two factors was treated separately as there were significant differences between students' computer usage at home and at work. The study showed there was no statistically significant relationship between how much the students liked using the learning system and their computer usage. This shows that the students liked using the system whether they had used computers regularly or not at all. The study also showed that there was no relationship between how much the students enjoyed using computers and how much they liked using the learning system. This was an important observation as it showed that even when the students did not enjoy the medium of instruction they enjoyed using it as a learning tool. The third observation was that the students' prior training in computers did not have any significant effect on how much they liked using the learning system.

Further analyses were done on the student acceptance of the proposed model. Student acceptance was measured using the attributes of the technology acceptance model. These include:

- Ease of use
- Perceived Usefulness
- System Design Features and Tools

7.4.3.1 Ease of Use

In measuring the ease of use, three different aspects were measured. They were the student perception of prior knowledge requirement to use the learning system, the ease of use of the learning system, and the ease of use of the layout of the learning system.

The first measurement was to find out whether the students were confident in using the learning system without prior knowledge of computing. The results show that the students were not confident in using the learning system and they believed that they needed prior knowledge of computers to use the learning system. However, this result was not further investigated as the reliability testing for this scale showed that the scale itself had low reliability.

The second measurement was to find out whether the students found the learning system to be easy to use. The study determined that most students found the learning system easy to use. This result was further analysed with the students experience with computers. The main purpose of this analysis was to find out whether there was any relationship between the students computer usage and their perception of ease of use. The results show that there is weak correlation between students' computer usage and their perception of ease of use, suggesting there is little relationship between ease of use and experience with computers.

The third measurement was to find out how adequate the screen layout was for the students. This factor looked at the presentation and layout of the learning system. The results of this analysis do not directly support the proposed theoretical model but

provide helpful information on screen design for a future system. The findings showed that 46% of the students believe that the screen layout was easy to use while only 29% did not believe so. Furthermore, a t-test was used which determined that this was a valid conclusion. However, further analysis is required to fully understand the interface issues relating to the learning system. Since this analysis is beyond the scope of this research it was not carried out.

7.4.3.2 Perceived Usefulness

The perceived usefulness of the proposed model was measured using the students' perception of learning. Since the learning system is used for learning and if the students believe that they learnt using the system it can be concluded that the students believe that the system is useful to them. The results determined that most of the students believe that they learnt using the learning system. Further analyses were carried out to determine if the students' beliefs were related to their attitudes to and experience with computers. The results show that there was a weak or no relationship between students' attitudes to and experience with computers, and their perception of learning using the system. Hence, it can be concluded that computer usage or experience has little effect on the students belief that they learnt using the learning system. Consequently, it can be concluded that the students are likely to accept the proposed model as a reliable form of teaching.

7.4.3.3 System Design Features and Tools

System tools and design features are other aspects used in measuring user acceptance in the technology acceptance model. The easier the tools are to use the more

likelihood of the students accepting the new technology. Three different tools were incorporated in the learning system. They were:

- Frequently Asked Questions (FAQ) Tool
- Query Tool
- Hint Tool

The frequently asked questions tool allows the students to view all the frequently asked questions for each topic before they pose a question for the teacher. Most students in the study were not sure about the helpfulness of the frequently asked questions. Although the total number of students who believed that this tool was useful was greater than the total number of students who believed otherwise, the evidence was not conclusive. The results suggested that most students believed that the frequently asked questions were neither useful nor useless. The reason for the lack of enthusiasm for this tool may be a time issue. There were few FAQs at the start of the course. These were progressively built up in response to student queries. Therefore students may not have had enough time or opportunity to determine their value.

The query tool allows the students to pose a question to the teacher and receive a response. Overall, students were unsure of the effectiveness of the query tool. However, the total number of students who responded positively to this scale was greater than the total number of students who responded negatively. The results showed that most students found the query tool neither easy to use nor difficult to use. It has to be noted that the response time for any single query was estimated to be at least 24 hours which might have influenced the students' responses.

The hint tool allowed the students to get hints on the answers to questions posed to students. The results showed that the students found the hint tool to be helpful and useful.

Overall the results do not provide a conclusive result to determine if the students found the tools to be useful. However, the results show that the students' perception of the system tools was neutral and further research has to be done to identify how these tools can be improved.

7.5 Recommendations

This research thesis provides an investigation into Maldivian educational infrastructure and development of a suitable distance education model to cater for the lack of secondary education in the remote islands of the country. The proposed theoretical model developed in the first of its kind in the Maldives. The proposed model and its evaluation will have several implications for Maldives. In addition, there are no models of this nature in the literature of distance education. CD-ROM and Internet hybrid models exists in the literature, however, a hybrid model with no Internet requirements for the students does not exist in the literature. Hence the proposed model may be able to be used in several other environments across the world. The findings of this research show that the theoretical model will work in environments where the students do not have Internet connectivity.

7.5.1 Notable Experiences and Proposed Amendments to the Model

The design and development of the proposed model and the design, development and evaluation of the learning system revealed a number of issues related to the development and implementation of such a model. These experiences will prove helpful in future developments as a number of lessons were learnt through the process.

Dynamic Content List - The design of the learning system included the contents or topics of the module as an html file. However, more content needed to be added as the development progressed, and the html file needed changing each time new content was added. Hence it was decided that the contents should be developed dynamically using a database back end. Hence an applet was developed to create the contents list from the list of topics added to the database. This made the whole process easier as the teacher only needs to add the topics and subtopics to the database and it automatically generates the contents list. Furthermore this also helped the update process in that whenever an update is required in the topics then only that update can be sent to the student and it gets updated in the student module's database. This process is much easier and faster than sending the html files and the related files. So it was decided that whenever dynamic page can be generated using databases it is easier to utilise them to make it easy for the teachers.

Intermediary Interface at Regional Module - The learning system was designed to run as three separate modules; student module, regional module, and headquarters module. The regional module needed to be installed on a computer with Internet access and all the centres had Internet connections. However, one of the centres used

for the pilot study had Internet connection only on the school headmaster's computer. This meant that the students were not allowed access to that computer. Hence an intermediary computer was used where the students uploaded their updates and these were subsequently transferred to the headmaster's computer by the administrator for the pilot study. The intermediary interface was developed and it worked for this particular centre. This was an important experience as a lot of the islands in the country might have the same problem and a solution was developed to overcome this problem. Furthermore it has to be realised that a number of administrative barriers will exist when implementing such a model countrywide.

Query Tool – The results show that the students were unsure of the helpfulness of this tool. One of the reasons for this could be that none of these students have studied using a distance learning course, hence they tend to expect responses almost immediately as in a classroom environment. In addition, the query tool itself needed to be improved to make it more intuitive for the students. One aspect that could be improved is to have an automatic search facility which looks for any existing responses that may be in the database. When the student enters a query the tool will search the existing query responses to see if there is a matching response and present to the student. If the student is not satisfied he/she can pose the question for the teacher. This process should be fully automated and will be different from FAQ tool where the students manually search for the existing responses.

Frequently Asked Questions Tool – Students were neutral in their responses regarding the usefulness of the frequently asked questions tool. The responses from the last batch of students were more positive indicating that as the study progressed

students found the tool to be more useful. The reason being that as the study progressed more and more frequently asked questions were added to the course. Hence, in using this model teachers will have to come up with an adequate number of envisaged frequently asked questions before implementing it in the field.

Upload and Download – The students were asked to name one feature of the learning system that they found to be most difficult. The highest number of common responses to this question was the "upload and download" process. In total 8% of the students identified this process as the most difficult process in the model. This process is an integral part of the proposed model. The process itself is not a difficult process as it involves loading the floppy disk into the computer and pressing a button on the screen. However, some of the students who participated in the study had not used a computer before, meaning that they needed time to get used to these processes. In future, it is worth recommending that an intensive initial training on how to use the model be given with a hands-on tutorial.

7.5.2 Proposed Model's Future in Maldives

The results show that the proposed model can be used in the remote islands of Maldives. Hence, it has the potential to be a major breakthrough in implementing secondary education across the whole country. The proposed model can be used to reach the 32% and 88% of the students who do not have access to secondary and higher education respectively in outer islands of Maldives. The next stage of development will be to create content on the secondary school curriculum for the proposed model. Furthermore, more personnel need to be trained, at least one per centre, to implement the model. One of barriers to providing secondary and higher

education in the smallest islands is the lack of skilled human resources. This can be overcome using the proposed model. In addition, the proposed model will have most impact where there is a lack of teachers in those islands affected by the Tsunami. It will benefit the local population in the islands, where there is a lack of education due to inadequate human resources.

The implications of this research are enormous for the education in Maldives. In addition to providing secondary education in the outer islands it can also be used to provide skill based training to the existing labour force. Currently, most of the students in the tertiary education sector are employed and attend evening classes after work (personal observation). The proposed model will allow these students a more flexible learning environment.

The researcher had informal interviews with officials from the Centre for Continuing Studies, Department of Higher Education, Maldives College of Higher Education, and Cyryx Computer Training Centre (one of the learning tertiary institutions in computer training). In addition, interviews were carried out with lecturers from Faculty of Management and Computing at Maldives College of Higher Education, Cyryx Computer Training Centre, and high school teachers. These interviews were not included in the research as they were informal and did not provide any conclusive evidence towards the research. However, all the interviewees were keen on implementing the proposed model. It has to be noted here that two of the centres that were used for evaluation in the capital were from two of these institutions, which further suggested their enthusiasm in implementing the proposed model.

7.5.3 Implementation across the world

Distance education has been used in all corners of the world. However, access has been limited in many parts of the developing world. Most of the developed countries use the Internet as a means of providing access, while Internet access is unheard of in several parts of the developing countries. There are several developing countries in the developing world with similar constraints as Maldives and the proposed model may be able to be adapted to these countries. The Solomon Islands is very similar to Maldives in terms of geography and demography and this model can be utilised to provide education in these islands. Other Pacific Islands or islands in the Indian Ocean may also be able to capitalise on this model. Further research has to be conducted to find out the applicability of this model in these contexts.

One of the most significant experiences during the initial stages of the model design was the identification of the existing infrastructure. The major lesson from this research was realising that each environment was different and had unique advantages which needed to be capitalized on. In the case of the Maldives it was found that although it was impossible to use post, radio and television to deliver instruction, computer based instruction was much easier to implement. Although the logical progress in terms of a country infrastructure development and capacity building will put post ahead of computer centres, it was different in the Maldivian environment. Hence every environment needs to be understood fully before implementing any model within that environment.

7.6 Future Research

The evaluation component in this research thesis was limited to identifying the usability and accessibility of the proposed theoretical model. Further research needs to be done on the students' perceptions of such a model using qualitative approaches. Other research needs to be carried out to find out how the proposed model will perform in delivering the secondary subjects in the school curriculum. This study focussed on the students but future research also needs to take into consideration the teachers, administrative personnel, policy makers, and other stakeholders. A few of these issues are explained below.

7.6.1 Teachers' involvement and perception

This research thesis has focused on finding whether the learning system developed was acceptable to the students. There were no studies conducted on the teachers' perception of such a system. Although a couple of interviews were carried out with lecturers, administrators and policy makers from several institutions these were not sufficient to draw any conclusions. Hence future research should focus on teachers, administrators and policy makers' views on the implementation of a countrywide distance education model using the theoretical framework.

7.6.2 Security

The thesis involved a learning system where each student logs into the system and their progress is recorded in the database. From time to time these get updated in the regional module and headquarters module. The learning unit used for the purposes of evaluation did not incorporate any security features other than providing the students

with their own password for log in. However, when developing a countrywide learning system security issues will arise and these need to be investigated.

7.6.3 School Curriculum

The evaluation used a learning system designed on a content equivalent to a secondary school subject. However, the content was not taken directly from the Maldivian secondary school curriculum. Since the proposed model is seen to be effective in delivering secondary level content the next step is to use the secondary school curriculum and develop a learning system. A study can then be conducted to find out how the students achieve in the secondary subjects using these learning systems. Further studies can then be carried out between students who use face to face instruction where available and students who use these learning systems. These studies will only be limited to the capital and few islands where secondary schools are already in place. However, these studies will give an insight into the drawbacks of these learning systems when compared with the face to face instruction. These comparative studies will be useful in making the future developments more efficient.

7.7 Summary

Several countries including the Maldives run distance education programmes designed and developed elsewhere. Most of these programmes do not achieve their purpose as the environment in which they operate is different to the environment they were designed for. For example a distance education programmes designed primarily dependent on post will not work in the Maldives as the postal services are not efficient within the country. Likewise a programme designed online will not work as

the students do not have access to the Internet in the islands. Hence the research thesis proposed a model that is suitable for the Maldivian environment where the students are not required to have Internet connectivity. However, regular feedback and updates are provided to the students using an online link between the teachers and a regional module within the region the student is studying. This proposal is the first of its kind in the Maldives and its evaluation has shown that it is effective in delivering instruction to the students.

The evaluation component of the research is a major part of the thesis which showed that the learning system developed using the proposed model can work in the Maldivian environment. Furthermore, the evaluation component has shown that the students' accept the learning system as a learning tool regardless of their preference in teaching modes, their confidence in computers, their computer usage, their enjoyment in using computers, and their perception of the ease of use of the learning system. This can be due to the importance the students give to education in the Maldives. However, these research issues need to be further investigated and conclusions drawn.

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APPENDIX

Appendix I – Questionnaire

The first TWO sections (section A and B) of this questionnaire consist of questions about yourself and your familiarity with computers. The THIRD section (section C) asks you to give your assessment of the program.

A. BIOGRAPHICAL DATA

Please respond either by circling the appropriate answer or by writing the relevant answer on the dotted lines

Please indicate

1. Your island: .....
2. Your atoll: .....
3. Your age: .....
4. Your gender: Male / Female

B. PRIOR COMPUTER KNOWLEDGE AND EXPERIENCE

Please respond by ticking the appropriate box or by writing the relevant answer on the dotted lines

5. How often do you use computer at home?

Daily	
Weekly	
Monthly	
Rarely	
Never	

6. How often do you use a computer at work or any other place?

Daily	
Weekly	
Monthly	
Rarely	
Never	

7. How confident are you that you can operate a computer without any help?

Very confident	
Confident	
Will give it a go	
Not at all confident	

8. How much do you enjoy using a computer?

Not applicable	
Not at all	
Not much	
Neither like or dislike	
Quite a lot	
Very much	

9. Which type(s) of computer related education/training have you received?

None	
Basic Computer Course (FMC)	
Other Basic Computer Course	
Diploma	
If other, please specify	

10. How important do you think the different levels of education are to your future?

	Not Important	Important	Very Important
Primary Education	☐	☐	☐
Middle School	☐	☐	☐
Secondary	☐	☐	☐
Higher Secondary (e.g. CHSE)	☐	☐	☐
Tertiary-Local (e.g. Maldives College of Higher Education	☐	☐	☐
Tertiary - University	☐	☐	☐

C. ASSESSMENT OF THE LEARNING MODULE

Given below are a number of statements about the Introduction to Computing Learning Module, please indicate your response for each statement by ticking the appropriate box on the scale provided. Please tick the response closest to your feelings about the module.

COMPUTING KNOWLEDGE

11. This program did not require any prior knowledge of computing

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

12. I spent most of the time learning how to use the program rather than learning from the module

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

13. The program gave me confidence in using computers as a learning tool

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

14. The program can be used without any help

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

COMPARISON WITH FACE-TO-FACE MEDIA

15. How much do you like learning in the following ways

	Not at all	Not much	Quite a lot	Very much
Face-to-face Classroom	☐	☐	☐	☐
Correspondence Study - POST	☐	☐	☐	☐
Computer-Based Instruction	☐	☐	☐	☐
Online Learning (Internet)	☐	☐	☐	☐
Individual study	☐	☐	☐	☐
Group study	☐	☐	☐	☐

16. I would prefer to learn from a human teacher in a classroom environment rather than from a computer

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

17. A human teacher in a class room environment would have been more helpful answering my questions than a computer

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

18. The program helped me understand the subject well as it provided me with a one-to-one instruction

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

19. A human teacher would be better than the program in providing explanations for the questions I have

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

20. It is easier to learn from the program as I can learn at my own pace

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

21. This form of teaching was really clear

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

CONTENT KNOWLEDGE/TEACHING

22. I didn't need any previous knowledge on the subject to use the program

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

23. I have gained a good understanding of computers and information systems by using the program

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

24. I think the program is only useful for people who already have some knowledge of computing and information systems and want to improve their knowledge

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

25. It is difficult to learn the basics of computing and information systems using this program

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

26. I am now confident with my knowledge on computers and information systems after using the program

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

27. Most people would find it difficult to gain an understanding of computers and information system using this program

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

28. At the end I still do not fully understand the concepts of computers and information systems

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

29. I would like to use a program like this to learn other subjects

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

EASE OF USE AND FEEDBACK

30. The program provides good feedback when I have entered an answer

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

31. The program didn't give sufficient praise for the correct answer

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

32. The immediate feedback feature was helpful in finding out if I got the answer right or wrong

☐ ☐ ☐ ☐ ☐

Strongly Agree Agree Neutral Disagree Strongly Disagree

33. The program did not provide adequate explanations on why I got a particular answer wrong

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

34. The HINT tool for each question was very helpful

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

35. I never understood what all the buttons on the screen did

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

36. Clear instructions on how to proceed with the program were not provided

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

37. The HINT tool for each of the question did not provide adequate help to solve the questions

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

38. The program did not allow me to keep track of things I had completed

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

39. The program allowed me to learn the module in any order

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

40. The program provided me with guidance on what to do next

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

QUERY and FAQ TOOL

41. The query tool was easy to use

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

42. The FAQs did not provide adequate explanations to the queries

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

43. The query tool was very helpful in getting the answers to questions I had

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

44. The response time for the queries I made was very slow

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

45. Some of the responses to my queries were not clear

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

46. The FAQs provided answers to most of my queries

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

PRESENTATION OF INFORMATION ON SCREEN

47. The screen layout was easy to understand

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

48. Some of the pages had too much information and this made them confusing

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

49. The screen was attractive and clear

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

50. The colours on the screen were very easy to use

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

51. The program looked very dull and boring

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

THE SYSTEM AS A WHOLE

52. On the whole I did not like the program

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

53. I liked the program because it was fun to use

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

54. I enjoyed learning with the program but it needs improvement before I would be tempted to use it again

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

55. The program was easy to use and did not require much practice

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

56. I would not use this program again for any other subjects

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

57. I liked the way the program helped me to learn

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

58. The program is good for revising subjects

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

59. In your opinion what was the:

(a) Major STRENGTH of the system

.....
.....
.....

(b) Major WEAKNESS of the system

.....
.....
.....

60. In your opinion, what was the most appealing feature of the system

.....
.....
.....

61. In your opinion, what was the most difficult feature of the system

.....
.....
.....

62. If you have to recommend ONE improvement to this system what would it be?

.....
.....
.....

63. Are there any other comments you would like to make about the experience of using this program?

.....
.....
.....

Appendix II – Publications of this Research

Shareef, A. F., Kinshuk. (2005). Distance education in small island nations, In C. Howard, J. V. Boettcher, L. Justice, K. Schenk, P. L. Rogers, & G. A. Berg (Eds.) Encyclopaedia of International Computer-Based Learning, Hershey, PA, USA: Idea Group Inc, 618-627 (ISBN 1-59140-555-6). [attached]

Shareef, A. F., Kinshuk. (2003). A computer-based distance education model for small island states: A case for Maldives. Malaysian Journal of Distance Education, 5(2), 1-13. [attached]

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