Malaysian Journal of Distance Education 5 (2), 1-13 (2003)

A Computer-Based Distance Education Model for Small Island States: A Case for Maldives

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Abstract

Maldives consists of a group of 1,190 islands. With a population of only 26,000 and 200 inhabited islands, more than 90% of the islands consist of less than 1,500 people. The low population density in the islands limits the infrastructure developments mainly due to the lack of economies of scale. This has also affected the availability of secondary schooling opportunities for most islanders. This research describes the development of a distance education model to provide access to secondary education through information and communications technology. Previous studies have shown that all parts of Maldives have access to telephone network, and the Internet and computer facilities are establishing at a great speed mostly in the form of computer centres and cyber cafes. The system described in this paper allows the teachers to develop multimedia-based instructional content which is then delivered to the students via the Internet, or burnt onto CD-ROMs and mailed, or a combination of both. In comparison with the existing commercial systems, this system is particularly suited for small island states such as Maldives, and consists of a two-layered approach where the students with and without online connections are both catered with adequate adaptivity.

Abstrak

Maldives terdiri daripada 1,190 buah pulau. Dengan populasi yang cuma 26,000 dan 200 pulau yang dihuni, lebih daripada 90% daripada pulau mengandungi kurang daripada 1,500 orang. Kepadatan populasi yang rendah ini mengehadkan pembangunan infrastruktur disebabkan oleh ketiadaan skala ekonomi. Ini juga telah menjejaskan wujudnya peluang persekolahan menengah untuk penduduk pulau. Kajian ini menjelaskan pembangunan model pendidikan jarak jauh untuk menyediakan akses persekolahan menengah melalui teknologi maklumat dan komunikasi. Kajian sebelum ini menunjukkan hampir keseluruhan Maldives mempunyai akses kepada rangkaian telefon, Internet dan kemudahan komputer, kebanyakannya wujud dalam bentuk pusat komputer dan kafe siber. Sistem yang diterangkan di dalam artikel ini membolehkan guru membangunkan bahan instruksi berasaskan multimedia yang disampaikan kepada pelajar melalui Internet atau direkodkan ke dalam CD-ROM dan diposkan atau gabungan kedua-duanya sekali. Dalam perbandingan dengan sistem

komersial sedia ada, sistem ini sesuai untuk negara kepulauan kecil seperti Maldives yang mempunyai pendekatan serampang dua mata yang memanfaatkan para pelajar yang mempunyai akses talian mahupun tidak.

Introduction

Maldives is an island nation with a chain of 1,190 islands scattered across the Indian Ocean. Out of the 1,190 islands, only 200 islands are inhabited with an additional few others developed exclusively as tourist resorts. Almost 99% of the country being the ocean the main form of transport between the islands is by sea. The absence of regular ferries between islands makes the travel much more difficult. The capital of Maldives is Malé and one third of the country's population (about 80,000) lives in the capital. In addition to Malé, only three other islands have population of more than 5,000, and 95 islands have population of 500 or less. The low population density in the islands limits the infrastructure developments mainly due to the lack of the economies of scale. This is also the case in education where building a school to cater for a couple of students will not be cost effective but rather a waste of resources. On the other hand, the capital cannot accommodate the island population as it is already overcrowded with about 80,000 people living in one and a half-square kilometre of land area. Hence, providing education to the island population through distance mode becomes an appealing alternative. This paper looks at the current infrastructure of Maldives and based on these findings it describes a distance education model that is suitable for Maldives.

Existing Infrastructure

The communications infrastructure has contrasting levels of development between Malé and other islands. In Malé the communication infrastructure is highly developed with public having universal access to telephones, radio, television, and Internet. The island population has universal access to radio through a state-owned radio station. However, only 55% of island population have a radio at home with few variations between islands (UNDP, 1998). Television Maldives (TVM) is the only television station in the country. TVM is state-owned and only the capital and few nearby islands received its broadcasts using the rooftop aerials. Recently, TVM has introduced satellite television using encoders, which reaches all parts of country. However, majority of the island population are unable to access this as they need to purchase or rent decoders to view the broadcasts which is too costly. 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 (UNDP, 1998). Maldives has recently achieved the target of installing telephones on all the inhabited islands. 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 the telephone in island offices. Telephones are available in all the government offices (atoll offices and island offices) and schools in the islands. Even where telecommunications infrastructure allows household connections the cost limits access. Maldives has developed a project with funding from Asian Development Bank (ADB) to reform the telecommunication sector which involves reducing prices of telecommunications to affordable levels (ADB, 2001).

The Internet was introduced in Maldives in 1996 and has since been expanding at a rapid pace. Mainly the expansion in terms of usage can be seen in the capital although the service has been extended to provide universal access in Maldives. In addition, cyber cafes for the public exist in the southern most and northern most atolls. The number of cyber cafes is on the increase throughout the country as more people are using the Internet. Although access is available, the high costs of installation and usage limits the number of users. The Internet is charged on the minute and the charges are much higher than those in many developing countries (ADB, 2001).

Planned Infrastructure Developments

The Maldivian government has identified the potential of telecommunications and has emphasised on rapid expansion of the telecommunications infrastructure. One of the major developments was made when the National Telecommunications Master Plan was formulated in 2000 (MCST, online). The master plan outlines how telecommunications and information technology will be used in improving economic as well as social infrastructure. The Information Technology Development Project is an ADB funded project that was launched under the master plan and commenced in 2002 (ADB, 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 (ADB, 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 20 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 video conferencing. The Internet kiosks will be initially

housed in the atoll offices. 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 addresses restructuring of Internet services so that the prices are affordable.

Ministry of Education has started a Basic Computer Literacy Project aiming at providing computer literacy for all the students who complete primary education. As primary education is compulsory in Maldives this will aim at providing universal computer literacy in Maldives. This project will provide all schools with computers with at least one computer for every 60 students (Ministry of Education, 2001). These computers will have multimedia capability including CD-ROMs.

Education

Maldives has universalised primary education however once students complete primary education and middle school access is limited to secondary education. Due to limitations in infrastructure developments, secondary education is only available in few islands. Furthermore high education is only available in the capital (Ministry of Education, 2001a).

Distance education has been used in Maldives to provide non-formal education since 1987 (ICDL, 2001). One of the programmes named Distance Education English Course is a successfully conducted and ongoing programme to teach English Language for adults (ICDL, 2001). The programme was initially targeted to upgrade the English of the atoll teachers. The programme is conducted through Atoll Education Centres in the atolls with the head teacher of each atoll supervising the programme at atoll level. Teleconferencing between the head teacher in the atoll and the headquarters occur every week to clarify queries of the students. The head teacher acts as a mediator between the headquarters and the students rather than the face-to-face tutor. A second distance education programme that was carried out in Maldives between 1989 and 1993 was Condensed Education Programme. It was informally named "second chance" and 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 5-year normal curriculum into two years. The programme's objective was facilitating the participants' entrance to employment related training as well as entrance to post-primary education. Other non-assessable personal development programmes are continuously conducted through various government departments as informative distance education programmes (Sodiq, 2001). These programmes are targeted to the general public via radio and television.

The need for secondary and tertiary education in atolls and islands was recognised by the government and a separate open learning centre under Maldives College of Higher Education was created in 1999. Centre for Open Learning has the mandate to run all the distance education courses conducted through the various faculties of the college (Sodiq, 2001). The materials from the host institution are used in these programmes with hired tutors running face-to-face tutorials every fortnight. So far the centre is unable to develop its own programmes mainly due to lack of resources.

Choice of Technology and Delivery Systems

The use of technology in delivery systems for distance education has been so crucial that research has reflected on these developments rather than driven them (McIsaac & Gunawardena, 1996). The advent of synchronous technologies has seen distance education moving from the individualised correspondence model to a more interactive mode. The use of the different technologies and modes of instruction can be described using the dimensions used 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 same time/same place category represents traditional face-to-face classrooms where students attend classes at the same time for instruction (Aggarwal & Bento, 2000). Maldives is unable to build schools in each of the islands to deliver secondary education using traditional face-to-face classrooms hence this category is not an option for Maldives.

Students attending study centres and labs to interact with teachers and other students are categorised as any time/same place instruction. Major distance education providers like The Open University, United Kingdom (UK) uses local study centres to support students by means of tutor support, library facilities, and other interactions (McIsaac & Gunawardena, 1996). Bangladesh Open University (BOU) uses tutorial centres to deliver tutorials to the students on a fortnightly basis (Rumble, 1999; BOU, n.d.). One of the alternatives that was analysed in section two of this paper is establishing regional schools in Maldives. As mentioned earlier in this paper, this alternative is not feasible as there are no regular ferry services between the islands hence students will not be able to travel to regional study 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 were used to provide students with access to media equipment, library facilities, computer access, etc. rather than tutor–student interaction (McIsaac & Gunawardena, 1996). Alternatively, Maldives can use local computer centres (within the islands) as local study centres where student have access to computers and use regional centres as the regional hub between the headquarters and the local centres and students.

Same time/any place instruction is delivered simultaneously to students widely dispersed geographically via one-way or interactive media. Broadcast media (radio and television) is an ideal technology for this type of instruction. Radio is widely used in developing countries because it is much cheaper option compared to other more sophisticated technologies (Tripp & Roby, 1996). Radio is universal in Maldives and almost everyone listen to it. Radio is mainly used for informal informative programmes without any assessable components. Television has been used for similar programmes, which were mainly public awareness programmes. Television is now available to all islands through special receivers making the access limited in some of the islands. Work is being carried out 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. Also the fact that only 55% and 15% of islands population have radio and television respectively at home make this media choice incompatible.

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 at the different islands on a weekly basis (Sodiq, 2001). Teleconferencing as a means of communication between students and tutors is not feasible in Maldives as most students do not have telephones in their homes and separate facilities need to be established for this purpose.

Instruction using two types of technologies can be categorised as any time/any place. They are technologies that deliver one-way information such as print, audio and video cassettes and those that provide interaction (McIsaac & Gunawardena, 1996). Print, audio and video cassettes will work in parts of the world where the 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) categorised under this type 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 as human resources are scarce in Maldives. Hence more focus is given on how to maximise on learner-machine interaction and identify a suitable model for Maldives.

The Indhira Gandhi National Open University (IGNOU) 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 (MCST, 2001). Once this is established Maldives could look into the possibility of virtual campuses in some island centres. However, huge amounts of foreign aid need to be secured before this project can be implemented. In the meantime, alternatives need to be found using the current infrastructure. Ministry of Education launched a project to provide computers to the schools without a single computer (Ministry of Education, 2001). This project was set to complete by the end of 2002 and will result in resource rooms in each of the schools with computers. These computers will be available to deliver distance programmes to the students using a computer-based approach similar to the one used at IGNOU. However, distance programmes completely depending on these computers will not be a viable option as the ministry is planning to have only one computer per 60 students. This will not give an adequate student computer ratio for this purpose.

Other facilities under consideration are computer networks and Internet kiosks in the islands. Currently computer networks exist in few islands with Internet kiosks and cyber cafes on the increase. These can be used as study centres as the personal computer ownership is not high in the islands. The technology is quickly moving to the atolls and islands of Maldives but the geography of the country makes this quite challenging. In addition, telephone is available in all inhabited islands making Internet possible in all the islands.

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 should look into developing a system where media 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 system looks at ways of minimising human resources, however, it is unreasonable to totally eliminate it. Hence computer networks, with Internet wherever possible, and CD-ROMs will be used for delivery.

Model

The model is designed for providing secondary education to the island communities in Maldives. The model comprises of a student module, a regional module, and a headquarters module. 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.

Student Module

The initial student module is sent to the students in a floppy with the course content and system set up CD-ROM. The students can install the software into their own computer or they have access to local study centres where the student module is installed if they do not own a computer. The student has the flexibility of recording their profile on to the floppy disk and send to the regional centre for uploading. Any feedback could then be downloaded from the regional centre's network to the floppy and back to the student. Alternatively this can be done via the Internet where online connections are available. The main advantage of this system is that the students with and without online connections are all catered with adequate adaptivity. The adaptivity is provided through well designed student model that individualises each student and content delivered accordingly.

Student Modelling

A student model is the system's view of the student. The information held in a student model is generally categorised as domain-specific and domain-independent information. Domain-specific information represents the student's current state and level of knowledge relating to a particular concept (Brusilovsky, 1994). Domain-specific information is modelled using several techniques such as overlay models, differential models, perturbation models, and episodic learner model. The student model for this system is based on the overlay model, as this model is widely used and tested in the domain of this literature. Overlay model represents the learner's knowledge as a subset of domain knowledge. Domain independent information may include learning goals, cognitive aptitudes, motivational states, preferences, learning styles, and factual and historical data. The student model needs to be initialised before the student engages in the learning and kept up-to-date as the student progresses through learning stages. The following sections explain how initialisation and updating of the student model is carried out in the system.

Initialising Student Model

The student will send their application to the headquarters for enrolment. These applications will be assessed and approved before they will be enrolled in the system. Enrolment will be done at the headquarters using the headquarters module. Students are also able to apply online but will go through the same process of approval at the headquarters. The enrolment procedure is the first part of initialisation of the student model. As this system is designed for secondary education the application includes information on results of previous years in addition to the factual data on the students. This will give an indication of students' prior knowledge of the domain. This data will be treated as data gathered from explicit questioning, which is an effective way to obtain general information about the students (Paiva, 1995). The enrolment procedure creates the student model

for each student with the factual data on the student as well as prior knowledge of the student. The student model is then uploaded into a repository at the regional centre which contains all the student models of students for that region.

The students are sent the student model on floppy with the system setup CD-ROM. Once the set up is completed, the system asks for the student model floppy to be inserted. This creates the student model in the student's computer. Initial testing methods are used to understand student preferences, learning styles, etc. Figure 1 shows the process of initialising student model.

Updating Student Model

In this system there are three different levels of updates for student model (Figure 2). One will be the usual updates carried out, as any other intelligent learning environment, when student engages in learning and the second will be synchronising all the instances of the student model. These updates will be carried at the student module and the repositories. The student model updates at the regional and headquarters module in covered in latter sections. This section will cover the student model updates at the student module.

Information required for student model updates can be obtained using four different methods (Brusilovsky, 1994). They include implicit acquisition, explicit acquisition, structural acquisition, and historical acquisition. When a student respond to questions these responses are analysed by the system, also called performance measuring (Brusilovsky, 1994), and student model updated accordingly. The other methods used for updating student model include model tracing, issue tracing and date ageing. As the student progresses through the learning concepts of the system, the student model is updated. As each domain is divided into section and further into concepts, the competence at all these levels is maintained. Furthermore, the competence level for each of the assessment questions is also maintained in the system. The database structure of the student model allows monitoring these competencies and recording the levels accordingly.

Synchronising Student Model

From time to time the student will have to upload their student data into the regional module. This can take place via the Internet or by taking the floppy to the regional centre. Once the student uploads their student data into the regional module they get updated in the regional module. Every time the student uploads their data it goes into a regional repository which acts as a backup for student models in that region. When the students upload their student models it will be checked against the student model stored in the repository. If the student model in the repository is more up to date then the student's version of student model will be updated. Once the upload is completed, feedback from the regional

module will be loaded into the student floppy (or via online when uploading is done online). The students can then use the floppy to update their system.

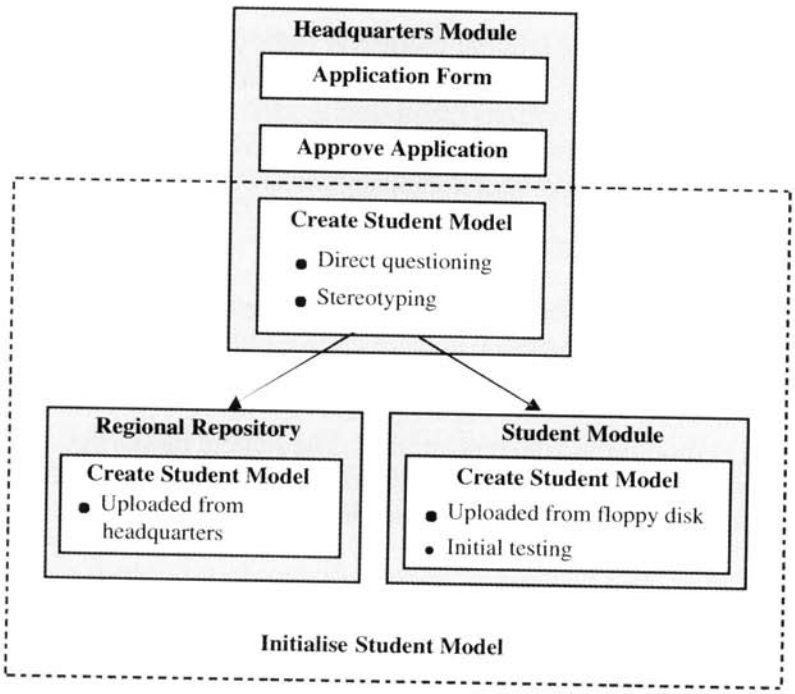

Figure 1 Initialising student model

Regional Module

The regional module creates a cumulative student model for that region (Figure 2). Initially the regional student model will have zero competencies for all the learning concepts, units and questions. These get updated as students upload there student models. The updating of the regional student model is done in batch mode at regular intervals. At a specified time data analysis is done on the repository held at the regional centre to see if there are any updates on the student models. These updates are then compiled into the regional student model. This update process will identify cumulative frequency of students doing a particular question wrong, having difficulty with any given learning unit, doing well at modules etc. At the regional module the competency levels are compiled and stored as frequencies. For example, for each of the learning units the regional module will store the number students who have not completed the prerequisites, number of student who are ready to start, number of students who have visited, number of students who have completed, and number of students who have mastered. Likewise, it stores the frequencies of competencies for learning concepts as well as questions.

The students will receive feedback from the regional module when they upload their student model. This feedback is based on previous updates for the student and general feedback for the region. The feedback will also include any updates to the system. The students can load these feedbacks onto their floppies and consequently update their system.

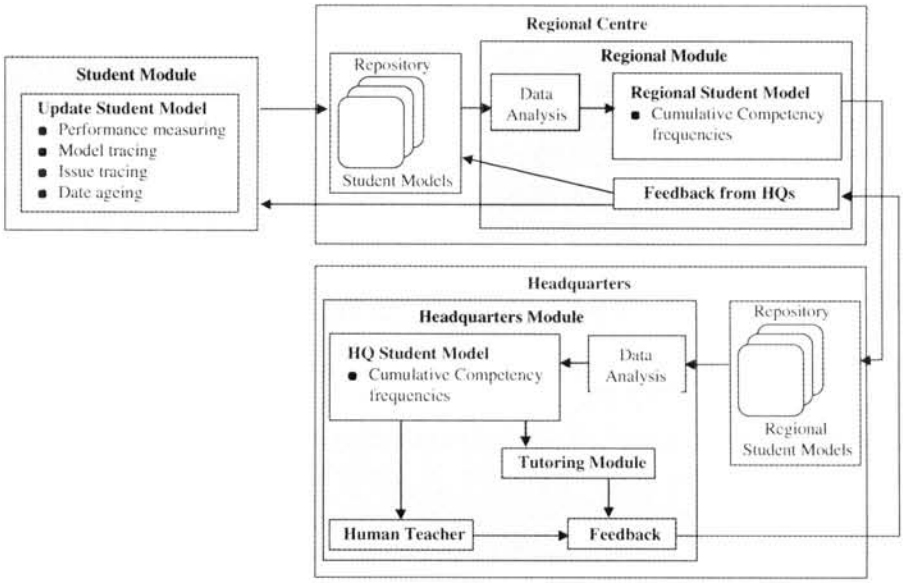

Figure 2 Updating student model

Headquarters Module

The same data structure is held at the headquarters but the data compiled are for the whole country instead of region. The process of updating the student model at the headquarters is the same as that at regional module with the only difference being that the student model created at the headquarters will reflect a nationwide student profile. Every time an update is made to the regional student model this is uploaded into a repository held at the headquarters. This process is done via the Internet and this repository will act as a backup for regional student models. Data analysis on this repository will be carried out at regular intervals and the headquarters student model will be updated. This process helps to identify common mistakes made at regional as well as national level and depict a common pattern of student behaviour at these levels. This will help identify which content areas require more attention and which areas are reasonably catered for. The feedback process starts at the headquarters module based on these updates. Using the updates the headquarters module will identify which areas require the feedback. The initial feedback comes from the tutoring module which will identify responses according to the problems. The tutoring module includes an

expert module where subject matter is stored. Human intervention is available at the headquarters when there is a lack of system based feedback. The feedback includes both content updates, frequently asked queries and responses, and common student mistakes both at a regional and national level. Once the feedback is entered into the headquarters, these are sent to the regional module via Internet. At the regional centres, these updates are passed onto the students. Another component that will be built onto the headquarters module is the authoring tool for the teachers. The authoring tool will enable the teachers to create multimedia content and deliver it to the students via Internet or CD-ROM. The authoring tool will be user friendly for the teachers so that they do not have to spend too much time learning the software. Since the headquarters module will be located in the capital instructional designers and experts are available if and when needed.

Conclusion

The system will help achieve access to secondary education throughout the country with a minimal expenditure on the infrastructure development. The system capitalises on the existing infrastructure and technology in the country reducing the costs required for implementation. In addition, the system also considers ongoing and planned infrastructure developments which will be completed by the time the system is ready for implementation. It also has the capacity to expand as and when required, e.g. when the Internet is readily available, content can be delivered online rather than CD-ROM. The system can be used as a model for other developing small island states to design distance education programmes.

One of the major differences between this system and other commercially available systems is that this system consists of a two-layered approach where the students with and without online connections are both catered with adequate adaptivity. The adaptivity will help realise individualised instruction for each and every student and help reduce the need for extensive human intervention. This will help overcome the problems faced by Maldives and many other developing small island states due to the lack of human resources.

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