Infrastructure Needed for Distance Learning in Developing Countries Through Multimedia Technology Using Mobile devices

Sagarmay Deb
Central Queensland University, Sydney, New South Wales, Australia

Abstract - Although the developments of multimedia technology and internet networks have contributed to immense improvements in the standard of learning as well as distance learning in developed world, the developing world is still not in position to take advantage of these improvements because of limited spread of these technologies, lack of proper management and infrastructure problems. Unless we succeed in solving these problems to enable people of developing countries to take advantages of these technologies for distance learning the vast majority of the world population will be lagging behind. In this paper we explore how to develop appropriate infrastructures for the use of mobile technology to provide distance learning in an efficient way using advanced multimedia tools. We recommend the use of mobile and multimedia technology to reach this vast population of under-developed countries to impart quality learning in an effective way.

Keywords: Distance learning, infrastructure, mobile technology, multimedia technology, developing countries

1 Introduction

The concepts of distance learning are prevalent in developing countries for last few decades and it is very much in vogue in developed countries [1], [4]. In developing countries it started like many other countries did with correspondence courses where printed learning materials used to be despatched to the students at regular intervals and students were expected to read the materials and answer questions. The basic philosophy was teachers would be physically away from the students and have to conduct the teaching process from distance [2].

With the development of computer industry and internet networks during the last three decades things have changed and global communication has reached an unprecedented height [1]. With these developments immense scopes have come to the surface to impart learning in a much more efficient and interactive way. Multimedia technology and internet networks have changed the whole philosophy of learning and distance learning and provided us with the opportunity for close interaction between teachers and learners with improved standard of learning materials compared to what was existing only with the printed media. It has gone to such an extent to create a virtual class room where teachers and students are scattered all over the world. Although some of these facilities are expensive still the developed world is in a position to take advantage of these facilities to impart much better distance-learning to students residing in the developed countries. But for developing countries the story is different as computerization and network connections are still very limited compared to the developed world.

In this paper we focus our attention on defining the problems infrastructures that is needed for using these technologies for much more improved and extensive distance-learning and suggest how we could possibly reach this vast majority of people from the developing countries with the improved quality of distance-learning provided by multimedia and internet networks through viable and affordable infrastructures that could be created in those setup.

Section one gives an introduction of the area. Section two presents the advancements in infrastructures developing countries are making to make use of mobile technologies. Section three presents the issue of usage of mobile technology with advanced multimedia tools in distance learning in developing countries with appropriate infrastructures. We put our concluding remarks in section four.

2 Analyses of Works Done

The open-universities which started functioning by late sixties and early seventies of last century, reaching off-campus students delivering instruction through radio, television, recorded audio-tapes and correspondence tutoring. Several universities particularly in developing countries still use educational radio as the main instructional delivery tool [1].

Print, audiocassettes, and pre-recorded instructional television (lectures) are the lowest-cost technologies for small numbers of students (fewer than 250), while radio requires 1,000 students or more to achieve comparable per-student costs. Computer conferencing is a low-cost approach to providing interactivity between teachers
and students, but live interactive broadcasts and video conferencing are still very high-cost technologies, regardless of the number of students enrolled [17].

Although distance education has been around for more than two hundred years and has been shown to be effective in a variety of settings, the introduction of technology and its application across global boundaries introduces new trends, issues, and challenges. How, for example, does one judge the quality of a degree earned over the Internet? When should technology be used? And which technology is best? Should countries use programs offered by foreign institutions rather than developing their own? These and many other questions are confronting education policymakers and practitioners around the world. Careful analysis, evaluation, and research will be needed [17].

Globalization, accreditation, and competition. Employers and universities are now drawing both staff members and students from all corners of the globe. Consequently, they face new challenges in evaluating course work done at, and degrees earned from, unknown institutions in other countries. While accreditation has typically been controlled by individual countries, the globalization of distance education has created a whole new challenge in accreditation and certification of learning. For example, the Global Alliance for Transnational Education (GATE) has been formed to carry out the formidable task of creating a global certification and review process for education delivered across borders [17].

Globalization raises other issues for countries. For example, instructional programs broadcast from abroad have heightened fears about the contamination of cultures and values. Competition between local and foreign education providers is another issue. While competition is usually good for the consumer, in that it often raises quality and reduces prices, local institutions typically resist foreign competition and, in some countries, are trying to block outsiders from operating in local markets [17].

Quality and effectiveness. Some developing countries are reluctant to adopt programs originating elsewhere, despite their reputed quality, choosing instead to develop their own; unfortunately, many lack the expertise needed to produce high-quality materials and support structures. Considerable time and expense are required to produce quality programs, and countries with limited resources may put programs together that are inadequate [17].

Technology. Making sound investment decisions about technology is a major challenge facing educational policymakers and planners. New technologies offer options to both expand educational opportunity and improve quality, but inappropriate decisions regarding whether to use technology or what type of technology to use can be costly and can impede the success of a distance education program. Unfortunately, the information needed to make such decisions is limited. Care should be taken to avoid allowing the novelty of technology to drive decisions regarding the most appropriate delivery mode for distance education programs, overshadowing the more important decisions regarding curriculum and instructional quality. If a country's conventional education or teacher training program is not effective, using a new technology to deliver that education or training will not make it any more effective [17].

Affordability. Distance education programs need sound financial planning and management to ensure sustainability. In many cases, developing countries find that funds are not available to continue a distance program after donor funds are terminated, so it is important that initial investment be accompanied by adequate funding for recurrent expenditures. A related problem arises when the per-student cost of adding distance education or other education technology is large relative to a country's average per-student financial allocation for that educational level. For instance, if a distance mathematics program using computers consumes financing equal to 50 percent of the country's per-student budgetary allocation, its financial future is likely to be bleak, despite high putative benefits. When such a situation is encountered, the country would be best advised to opt for pilot programs that test less expensive alternatives than to do away with the distance education program entirely [17].

It is useful to consider distance learning not in terms of a technical problem but as essentially similar to traditional learning. Distance learning can be seen as comprising the following functions that broadly correspond with the TrainX methodology. They are: Course design, Development of materials, Evaluation, Course delivery, Evaluation. Providing support for students can be difficult with distance learning. This can be exacerbated in developing countries where trainees may lack other kinds of support and be widely dispersed. The lack of face-to-face support and human interaction can lead to student isolation and high dropout rates. Providing support to distance learning trainees – either through online forums, telephone or mail, requires proper coordination of human resources and/or the provision of additional face-to-face training opportunities.

Ongoing support is provided by using local networks and trainers and through a 'training of trainers' programme. Distance learning activities use regularly scheduled chat sessions to provide opportunities for feedback and questions as well as regular e-mail contact or telephone support where appropriate. In order to promote a wider distribution of expertise and knowledge and so that the beneficiary countries feel some ownership over the training, regional pedagogical committees are established to oversee the training and distance learning activities [20].
In Africa there is a need for utilizing resources to effectively develop and use ICT solutions. There are a lot of previous experiences in different African countries like Sierra Leone and Nigeria, they use many methodologies of the distance learning from corresponding courses, CD-ROM, Internet, TV and World Wide Web. Sudan As in many African countries, poor network infrastructure is a main challenge, in addition to lack of awareness and commitment of teachers and institutions. The Sudan Open University is the first initiative in this area. It is prime initial phase of development, depends on printed material, lectures in CD Room, cassette, TV, Radio and new one video conference (between the main center and one state for one time).SOUI(Sudan Open University) has electronic library on line and now enrolled 93,000 students since 2003 in (Educational, Administration, Computers collages) .Their future plans include develop a video conference capabilities to enable access to their online library for their students [18].

Even though India has shown considerable progress, the full development and large scale adoption of e-Infrastructure-enabled distance learning still face several challenges, including:
- Lack of course content,
- High cost of production of high quality e-learning material,
- Lack of satisfactory quality applications in certain areas (like genomic sciences).

Tackling these challenges requires:
- More training for greater expertise in development and delivery of e-learning solutions,
- Additional investment in research and application and product development,
- More reliable communication infrastructures with higher bandwidth,
- Further development and use of standards
- Higher availability of adequate IPv6 applications [19].

3 How To Develop Proper Infrastructures For Distance Learning

With the extended application of information technologies (IT), the conventional education system has crossed physical boundaries to reach the un-reached through a virtual education system. In the distant mode of education, students get the opportunity for education through self-learning methods with the use of technology-mediated techniques. Efforts are being made to promote distance education in the remotest regions of developing countries through institutional collaborations and adaptive use of collaborative learning systems [2].

Initially, computers with multimedia facilities can be delivered to regional resource centers and media rooms can be established in those centers to be used as multimedia labs. Running those labs would necessitate involvement of two or three IT personnel in each centre. To implement and ascertain the necessity, importance, effectiveness, demand and efficiency, an initial questionnaire can be developed. Distributing periodical surveys among the learners would reflect the effectiveness of the project for necessary fine-tuning. After complete installation and operation of a few pilot tests in specific regions, the whole country can be brought under a common network through these regional centers [2].

In developed economies, newer versions of technology are often used to upgrade older versions, but in developing economies where still older versions of technology are often prevalent (if they exist at all), the opportunities for leapfrogging over the successive generations of technology to the most recent version are that much greater [3].

In the conventional view, (i.e. as seen by technology developers and donors), developing countries passively adopt technology as standard products which have been developed in industrialized countries and which can be usefully employed immediately. However, successful use of IT requires much more than mere installation and application of systematized knowledge. It also requires the application of implied knowledge regarding the organization and management of the technology and its application to the contextual environment in which it is to be used. This implied IT knowledge often represents experience with the deployment of previous technology accumulated over time, such experiences contributing towards the shaping of new technology [3].

In addition to purely technological issues, the development of appropriate human resources skills are required, i.e. extensive training of the people who are going to use (and train others how to use) the resources. Training is seen as particularly important as this is not technology just a few people to benefit from, but for many. As Pekka Tarjanne, Secretary General of the ITU, made clear at Africa Telecom 98, "communication is a basic human right" (original emphasis). Nelson Mandela, at Telecom 95 in Geneva, urged regional co-operation in Africa, emphasizing the importance of a massive investment in education and skills transfer, thereby ensuring that developing countries also have the opportunity to participate in the information revolution and the "global communications marketplace"[3].

Canada's International Development Research Centre (IDRC) runs a number of developing country projects that involve technology leapfrogging. The Pan Asian Network (PAN) was set up to fund ICT infrastructure and research projects in developing countries across Asia. Individuals, development institutions, and other organizations should all be able to use the infrastructure so as to share information [3].
PAN works with Bangladesh's world famous grassroots Grameen Bank. One service here is a "telecottage", where network services can be obtained. The technology and the material will be tailored to meet the needs of Grameen's typically poorly educated clients. One of PAN's objectives is gender equity. Women, who constitute some 95% of Grameen's borrowers, will be prominent among PAN users in Bangladesh [3].

PAN is also responsible for linking Laos to the Internet. The Science, Technology and Environment Organization (STENO) of the Laos Government invited some Laotian IT professionals living and working overseas to return home and share their experiences with their colleagues in the country. STENO collaborated with PAN in designing an 18-month long project to build the necessary infrastructure for a dial-up e-mail service. Among the pioneer users were "researchers working on agriculture and aquaculture projects; journalists managing national news agencies and newspapers; lawyers consulting on international legal issues; travel agents planning business trips; computer resellers tracking down suppliers and obtaining pricing information; and about 20 others in both the public and private sectors" [5].

Presentation of course materials through multimedia in remote locations where in villages there could be school structures where those presentations could be made is feasible. Of course learning materials must be self-explanatory and not boring. Using multimedia facilities like videos, audios, graphics and interesting textual descriptions, it is possible to reach the remote locations of the world where computer technology has not reached yet. As the areas not covered by computer and internet technology is still profoundly vast in the world this approach seems to be very constructive and should be pursued.

Wherever possible distance learning through multimedia should be imparted through internet as internet and networks are the vehicles of multimedia. But since bandwidth connection is still very limited in vast areas of Asia, Africa and Latin America it would still take long time to reach major part of the population of the above-mentioned regions with multimedia and web.

Mobile technology offers a very hopeful way to reach the vast population of the developing countries as it does not require bandwidth connections. We have to develop distance learning using multimedia through mobile technology. This seems to be the most viable way to reach billions living in the rural areas of the developing countries. Hence considerable research efforts must be dedicated to this line. Instructions could be sent through emails to mobiles of the distance learners. Also relevant website addresses could be transmitted to their emails and they could then visit those sites of distance learning though the internet of their mobiles.

In his book, Mayer (2001) declares that while learning from the text-only books results in the poorest retention and transfer performance, learning from books that include both text and illustrations and from computer-based environments that include on-screen text, illustrations, animations and narrations results in better performance [10].

Similar to e-Learning, mobile technologies can also be interfaced with many other media like audio, video, the Internet, and so forth. Mobile learning is more interactive, involves more contact, communication and collaboration with people [14].

The increasing and ubiquitous use of mobile phones provides a viable avenue for initiating contact and implementing interventions proactively. For instance, Short Message Service (SMS) is highly cost-effective and very reliable method of communication. It is less expensive to send an SMS than to mail a reminder through regular postal mail, or even follow-up via a telephone call. Further, no costly machines are required (which is clearly the case in terms of owning a personal computer). Besides SMS, distance learners can use mobile phones/MP3 players to listen to their course lectures, and for storage and data transfer. New technologies especially mobile technologies are now challenging the traditional concept of Distance Education [12]. Today the more and more rapid development of the ICT contributes to the increasing abilities of the mobile devices (cell phones, smart phones, PDAs, laptops) and wireless communications, which are the main parts of the mobile learning. On the other hand for the implementation of mobile learning it is necessary to use a corresponding system for the management of such type of education [13].

The use of mobile technologies can help today's educators to embrace a truly learner-centred approach to learning. In various parts of the world mobile learning developments are taking place at three levels:

- The use of mobile devices in educational administration
- Development of a series of 5-6 screen mobile learning academic supports for students
- Development of a number of mobile learning course modules [11].

Research into the current state of play in Europe indicates:

1. There is a wide range of roles for mobile technologies supporting the learner in many ways ranging from relatively simple use of SMS texting to the more advanced use of smartphones for content delivery, project work, searching for information and assessment. Some proponents of mobile learning believe that it will only „come of age” when whole courses can be studied, assessed and learners accredited through mobile devices.
2. Although books are now being downloaded onto mobile devices, the authors believe that to support the learning process a great deal of thought has to be given to the structure of the learning and assessment material. However, it is true that for some, mainly at higher education level, mobile phones offer the opportunity to access institutional learning management systems. This provides greater flexibility to the learner without any new pedagogical input.

3. Costs are coming down rapidly; new first generation simple mobile phones will not be available on the market from 2010. All mobile phone users in Europe will be using 3 or 4G phones within the next two years. A welcome associated step is a move towards some form of standardization by the mobile phone companies as exemplified by the shift to common charging devices over the next two years.

4. The value which is put on possession of a mobile phone, especially by young people is surprising and the data on ownership suggests that this will be a ubiquitous tool for all very shortly and that it will be well cared for: there is evidence that ownership of devices brings responsible use and care.

5. Large scale educational usage in schools currently depends on government investment but in higher and further education it is safe to assume that all learners will have their own devices. Institutions will need to advise potential students on the range of devices most suitable for the curriculum, as they do currently with regard to computers. The convergence between small lap tops and handheld devices will continue until they are regarded as different varieties of the same species of technology.

6. There is a great potential for educational providers to work with large phone companies, both to reduce costs and to co-develop appropriate software [6].

Another paper presents and discusses NKI (Norwegian Knowledge Institute) Distance Education basic philosophies of distance teaching and learning and their consequences for development of a learning environment supporting mobile distance learners.

For NKI it has been a major challenge to design solutions for users of mobile technology who wish to study also when on the move. Thus, when students are mobile and wishing to study, the equipment and technologies they use will be in addition to the equipment used at home or at work. The solutions must be designed in ways to allow both users and non-users of mobile technology to participate in the same course. This means that we have looked for solutions that are optimal for distributing content and communication in courses, independent on whether the students and tutors apply mobile technology or standard PC and Internet connection for teaching or learning. The learning environment must efficiently cater for both situations and both types of students.


Most NKI courses are not designed to function as online interactive e-learning programs, although some parts of the courses may imply such interaction with multi-media materials, tests and assignments. The courses normally involve intensive study, mainly of text based materials, solving problems, writing essays, submitting assignments and communicating with fellow students by e-mail or in the web based conferences. This means that most of the time the students will be offline when studying. From experience we also know that the students often download content for reading offline and often also print out content for reading on paper. All aspects and functions of mobile learning in the NKI large scale distance learning system is clearly an additional service to the students [8].

Mobile Assisted Language Learning (MALL) describes an approach to language learning that is assisted or enhanced through the use of a handheld mobile device. MALL is a subset of both Mobile Learning (m-learning) and Computer Assisted Language Learning (CALL). MALL has evolved to support students language learning with the increased use of mobile technologies such as mobile phones.
(cellphones), MP3 and MP4 players, PDAs and devices such as the iPhone or iPad. With MALL, students are able to access language learning materials and to communicate with their teachers and peers at any time anywhere [9].

3.1 Current Limitations of Mobile Technology

Every technology has some limitations and weaknesses, and mobile devices are no exception. They have shown some usability problems. Kukulska-Hulme summarized these problems as follows: 1) physical attributes of mobile devices, such as small screen size, heavy weight, inadequate memory, and short battery life; (2) content and software application limitations, including a lack of built-in functions, the difficulty of adding applications, challenges in learning how to work with a mobile device, and differences between applications and circumstances of use; (3) network speed and reliability; and (4) physical environment issues such as problems with using the device outdoors, excessive screen brightness, concerns about personal security, possible radiation exposure from devices using radio frequencies, the need for rain covers in rainy or humid conditions, and so on. It is important to consider these issues when using mobile devices and designing the learning environment [15]. We expect mobile producers would take care of these problems in the near future.

3.2 How To Overcome Any Limitations in the Spread of Distance Learning

As we discussed in Section 2 some countries could be concerned if they buy study materials from overseas it would have an adverse effect on their cultures. But these countries can always sit with the people preparing those courses overseas and guide them how to design the materials which would not have any adverse effect in their countries cultures or societal setup. The pedagogical considerations also could be settled this way. Even in a particular country with multi-cultural setup there could be multiple versions of the study materials available. It would be upon the governments of those developing to formulate a policy on distance education according to the requirements and existing setups and affordability. There should be schools set up on rural areas with at least couple of computers in each campus where students can watch and learn geography, mathematics and so on based on multimedia approach of text, audio, video and graphics. At the post school level there could be some small software centres where some IT trained persons could be deployed to help and guide people going for distance learning through mobile technology. This would solve the problem of learning being isolated and would lower down the number of dropouts.

Looking at how rapidly new mobile products are improving, with advanced functions and numerous applications and accessories available these days, the technical limitations of mobile devices may be a temporary concern. Also, the use of mobile technologies in education is moving from small-scale and short-term trials or pilots into sustained and blended development projects [16].

Most developing countries do not have an extensive infrastructure to support M-Learning, and this makes it more complicated to implement it in these countries. However, this developing world still maintain similar needs for M-Learning as developed countries do. Ken Masters (2004) proposes that the lack of infrastructure should be no reason for developing countries to delay implementing M-Learning. It is essential, that if the need exists, institutions within these developing countries should establish and commence mobile learning efforts as soon as possible [21].

Users in developing countries have the same need for M-Learning to be mobile, accessible and affordable, as those in developed countries do. The very significance of M-Learning is its ability to make learning mobile, away from the classroom or workplace. These Wireless and mobile technologies enable learning opportunities to learners who do not have direct access to learning in these places. Many learners in developing countries have trouble accessing the internet, or experience difficulty in affording technology that enables learning in an E-Learning environment. Mobile devices are a cheaper alternative compared to traditional E-Learning equipment such as PC’s and Laptops [22].

However, to fully utilize this potential it is imperative to explore the factors that determine mobile telecommunications development in the developing world[23]. Delivering mobile services on open hardware and open software not just practically make sense but can also lower the cost and thus increase the possibility of offering sustainable services in the future.[24] While the benefits of open-source software are proven, it is important to conduct a broader study to investigate the potential role of relatively new copyleft approach for custom hardware, as supporting mobile learners in their own socio-cultural contexts of developing countries is a significant challenge[25].

Mobile learning cannot be imparted to a learner until he or she attains certain qualifications and age. Also socio-economic situations of the society concerned would dictate the growth of mobile technology as we know in many societies young population have to enter the work force at a very early age. This shows socio-economic development is very important for providing distance learning in developing societies.

Also there could be problems of deploying qualified teachers in rural setup of developing countries. But this could be overcome if properly trained teachers are deployed to make the curriculum and to monitor and support distance learning from the resource centre setup.
in urban areas. They could even make occasional visit to rural areas for providing face to face learning support.

4 Conclusion

In this paper we studied the problems of infrastructures in imparting distance learning through multimedia in developing countries. We suggested guidelines which the developing countries can adapt to spread education through distance learning in their countries using mobile technology a viable and affordable media through which distance learning could be imparted to billions of people in an efficient way. We presented some examples of achievements in this field in this paper where we can use telephone, photography, audio, video, internet, eBook, animations and so on in mobile and deliver effective distance education in developing countries. More research needs to be carried out to improve the infrastructures required for spreading distance learning among billions in developing countries through mobile technology and gearing up multimedia technology to be easily transported to those locations.

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