MOBILE TELEPHONE TECHNOLOGY AS A DISTANCE LEARNING TOOL

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Abstract: This paper presents the methodology, results and effectiveness in the development of Mobile telephone-based (Short Message Service-based) distance learning. The proposed novel real time interactive distance learning approach is about the application of information technology to education, was setup, delivered and evaluated using a real-life environment. Statistical analysis of the achieved results of the learners confirmed this SMS-mobile based learning being as effective as direct face-to-face learning.

1 INTRODUCTION

The term Distance Learning (DL) means different things to different people. As the meaning of the term varies so also the delivery techniques used by different users and institutions. The California Distance Learning Project defined distance learning as: "Distance Learning (DL) is an instructional delivery system which connects learners with educational resources. DL provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current students. The implementation of DL is a process which uses available resources and will evolve to incorporate emerging technologies". (Source: Distance Learning Overviews)

Distance learning is not a new phenomenon. It has a long history. In 1892, Penn State and University of Wisconsin were the first universities to develop a program of correspondence study. The correspondence model later evolved into the Independent Learning Program. During the 1960s, the British Open University in Great Britain developed off-campus teaching systems, using a combination of broadcast and correspondence study systems. Later, many US universities and universities around the world followed the Open University model to reach millions of adult educators. (Source: http://cfcc.net/dutch/DistanceEd.htm)

The recent advances in information technology have been responsible for widespread adoption with distance education. Today distance education has spread worldwide with extensive use of information technology with varying degrees of success. Some programs are very successful in delivering quality education at a distance and others are not. Quality distance education needs appropriate mix of technology, contents, processes, faculty talents while some demand motivation on the part of the learner.

Now-a-days distance education occurs in a non-classroom setting where students participate in course discussions, exercises, and receive assessment from the instructors by utilizing technology such as video conferencing, audio-graphics, CD-ROM, and Web-based media. Furthermore, distance learning programs are becoming increasingly popular at academic institutions and corporations. Most importantly these programs are offering learning opportunities for people that are normally restricted by class time and

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space.(Source: Benefits and limitations of Distance Learning)

To deliver quality education using available technology is the core of distance education definition. To ensure learning in a distance learning program several things must happen, e.g. delivery of contents, regular communication, continuous feedback, and interactions between the learners themselves, and also the instructors. Experience shows that a "*live*" interaction with the instructor is the most significant aspect of distance learning process. Presently there are several ways to achieve this goal using different available technologies, e.g., text chat, audio chat, video conferencing, and conference calls. Video conferencing and conference calls have one major limitation. They do not support "distributed" learning, it is good for only point-to-point delivery. In some situations the cost of delivery and the ease of use influence the choice of technology. In mobile technology, the use of text messaging (Short Message Service, SMS) is growing every month. Its rapid growth is generating substantial commercial applications and research interest now-a-days. This paper proposes how the mobiles' Short Messaging Service or SMS along with a live telecast can be used to create 'almost' an ideal classroom situation.

2 SCENARIO OF DISTANCE LEARNING IN BANGLADESH

The limitation of "distributed" learning is felt to a much greater degree in countries that are at the wrong end of the 'digital divide'. In such countries, the convenience and facilities afforded by the tools of information technology are not significantly felt. In Bangladesh, e.g. empirical estimates of the number of computers is around one million where the population stands at over 130 million of which 80% is rural based. Although the number of ISPs stands at more than 76, most of these are concentrated in the major cities as are the users. The estimated number of Internet users is around 13% (Source: MOSAIC groups report). Educational resources in the rural areas are meager with a severe lack of qualified teachers and educational facilities (Source: http://www.discoverybangladesh.com/meetbangladesh/people.html).

Given such tremendous odds, the Government of Bangladesh established the Bangladesh Open University (BOU) in 1992 by an Act of Parliament. Its prime objective was to transform the country's vast human resources into an educated and trained workforce. The main criterion was to provide access to educational materials. BOU airs its educational programs over the national television network. Its programs are pre-recorded and are run as regular courses. Students then go to exam centers and get certificates if they qualify. However, the envisioned success of an educated and trained workforce is far from being achieved (official literacy rate: 43%, 2003).

Compared with face-to-face learning, the limitations of such distance learning are found to be:

- Presentations are pre-recorded, i.e. they are not 'live'!
- There is no interaction between the presenter and student
- There is no feedback of learning achieved through a presentation
- There is no monitoring of student progress throughout the course
- There is no evaluation of teaching quality

To introduce interactivity in the context of Bangladesh, we have to look at solutions that would be technologically acceptable as well as affordable. In this context, it is seen that the growth of the number of mobile phones in use has been phenomenal. As per advertising claims, the total number of mobile phones in use currently exceeds 3.5 million (Grameen Phone: 2 m, Aktel: 1m, City Cell + Bangla Link > 0.5 m). The phenomenal growth of mobile phones is expected to continue with each mobile company setting their targets in terms of millions. With new companies like BTTB and Alcatel joining competition, the unit prices of calls and sending messages are also expected to drop. The companies now cover all districts of Bangladesh. If mobile phone technology could be used as a tool, it would be much more technologically suitable for Bangladesh in terms of the reach it would provide.

3 PROPOSED MODEL FOR INTRODUCING INTERACTIVITY INTO DISTANCE LEARNING BACKDROP

The ideal face-to-face classroom situation is when each student follows the thread and can answer interactive questions posed by the lecturer/trainer/teacher. In reality, however, very few students participate and answer questions posed. If participating and answering questions, in each class, could be made a pre-condition for passing the course, students would have a motive for being

attentive during a lecture. If, for instance, a rule could be made that a lecturer would ask at least 10 questions during a class session and that each student would have to attempt at least 8 questions. To get the credits for the course, each student must get at least 5 questions right in each class and have attended at least 80% of the classes. Such a rule would force attentiveness and participation. This should also help the learning process. However, such idealistic rules are meaningless for a face-to-face classroom situation as it is impossible for a lecturer to monitor, check and record the performance of all the students in a large class. In Distant Learning over national television, it would be ideal if students could participate and interact with a "live" lecture (as opposed to a recorded telecast) just as in a face-to-face classroom. Again, the vision of such idealistic participation and interaction is meaningless, as how would the presenter monitor, check and record the participation of the large number of distributed students?

3.1 Overview

In the context of Bangladesh the cost of Internet bandwidth is high and there is no countrywide internal infrastructure that would enable chat room technology or video conferencing to be established. In this backdrop, the mobile telephone industry appears to offer a feasible alternative. While using mobiles is still considered costly (e.g. compared with mobile rates in neighbouring India), the coverage of the mobile telephones is now countrywide.

3.2 Methodology

This paper proposes how the mobiles' Short Messaging Service or SMS along with a live telecast can be used to create 'almost' an ideal classroom situation. The participants would of course need individual mobile sets and access to national television. The SMS messages would directly interface with a central SMS server that would process the messages and show processed output to the presenter. The SMS server would also respond directly to the participant as and when necessary. When required the SMS server would also randomly dial individual participants so that the presenter can talk to them directly.

3.3 Operation of a Class

3.3.1 Live Presentation

It is important that the class be conducted "live", so that a presenter can ask questions and respond to clear up wrong concepts. The presenter should also be able to talk to randomly selected participants. All the participants should hear this conversation. Conducting the class on national television would allow this and a greater outreach. A course or a country wide training program can be conducted in this manner.

3.3.2 Class Timing

The class time would be fixed each week and pre-announced. This would be just like a regular time tabled class for the entire course or training program. For example, a course may consist of 10 classes for one-credit. Each class can be between 50 minutes to 75 minutes. A fixed weekly timing would allow participants to organize themselves on a weekly basis.

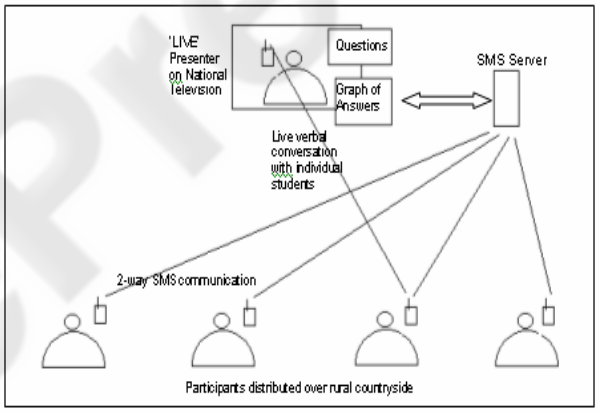

Figure 1: Mobile as an Interactive Tool in Distance Learning

3.3.3 Rules

Along with the class-timing announcement, the rules of the course would be given. A rule could be that a lecturer would ask at least 10 questions during a class and that each student must attempt at least 8 questions. To get the credits for the course, each student must get at least 5 questions right in each class in at least 80% of the classes. This would let the student/participant know what is expected of him/her. The student can also keep track of her/his own progress as would the database in the server.

3.3.4 Attendance

When the presenter comes on air for any particular class, he/she would ask the students to register attendance for the class. The attending students would register by sending an SMS to the server. The server would log the attendance of all the students who send an SMS. The SMS could contain things like "y" if already registered for the entire course. If it is a one-off session, the candidate can register with full name and other details like date of birth, if required. The server would maintain the attendance records. This would be just like a real classroom.

3.3.5 Payment

If a nominal payment is necessary, the payment may be deducted from mobile "pre-paid" cards. This would require an agreement with the mobile company providing the service. This would be a hassle free payment method.

3.3.6 Lesson

The lesson would be pre-planned and structured in such a way that questions can be asked at suitable points every 2 to 5 minutes. The questions would have multiple-choice answers that would be displayed as A, B, C and D or A, D, G and J (i.e. the first letter of the mobile keypad numbers 2, 3, 4 and 5). All the questions for the lesson would be pre-defined and entered into the computer. This would force the lesson to be planned with achievable objectives in mind.

3.3.7 Answering and Monitoring

The number of the question should also be included such as **Q1***D*, if the chosen answer for **Q**uestion **1** is ***D***. The answer would be sent by SMS. The server would register the answer against the candidates' phone number or ID and would do three things:

i) The computer would send a message to those who have not attempted the question and tell them their current status of how many questions have been attempted. The student/participant would then feel that he/she is being monitored.

ii) The computer would create a bar chart of the questions answered and mark the correct answer. The bar chart would be visible to the presenter and to the participants. To interact with the participants, the presenter would select a wrong answer on the graph and the computer would show those who have sent the particular answer. The computer would then randomly select a number that the computer would subsequently dial. Being connected, the presenter would ask the student the logic behind selecting the answer. The presenter on air can then correct wrong concepts. A few other random selections can be similarly made. This would help clear up wrong concepts immediately during the presentation.

iii) A complete record of each student's performance throughout the course would be kept. This record would be used to issue student's performance notification via SMS at the end of a session and also used to issue certificates at the end of the training or course.

3.3.8 Question and Answer Session

The last ten minutes of the lesson would be kept for questions and answers session. The questions will be typed out as an SMS message sent to the same server. If anyone asks a question, bonus marks can be given. The server would log all the questions. The computer would cluster questions with at least three or four similar words. The clusters would be visible to the presenter who would then estimate the nature of questions and show the estimated question to the audience. He would then answer the question/s live. This would allow the students to ask independent questions and satisfy their needs.

The presenter could also give a task for the next class. At the beginning of the subsequent class, a question can be asked based on the task. Quiz questions could also be set. Statistical correlations can be done over a period of time to find whether students are copying from each other.

3.3.9 Results

At the end of the lesson, each student's results could be posted via SMS saying whether the student has passed or failed the class. The student would have a record of his/her status. This would motivate the student to be more attentive in the next class or be pleased that he/she has done well.

3.4 Costs

The SMS costs per session would be between Tk.20 to 30 at current rates. To promote the sale of mobiles for this purpose, mobile companies may consider giving an educational discount of e.g. 50% on the SMS cost. The mobile companies use single packets to send each SMS. They can examine the feasibility of providing an educational SMS service and become "partners-in-education" against the cost of sales.

3.5 Benefits

The students would get a feeling of participation and be forced to follow the class. They would feel that the presenter is monitoring them individually as well as the coverage would be larger. Countrywide training of teachers in various schools or health workers can be conducted in this manner for rural Bangladesh. The current cost and time of conducting countrywide training would have to be compared with the cost of doing it over national television using SMS technology and a server. The proposed concept utilizes existing technological infrastructure to promote learning. There is no need for Internet and expensive bandwidth. The system would also lend itself to any type of distributed interactive session required.

4 TESTING OF THE PROPOSED SMS-BASED DISTANCE LEARNING

To test out the system, the following software modules were developed for the SMS Server:

- Registration of a course, dates and timing along with teacher details
- Entering questions, multiple choice answers and correct answer for each class
- Registration of a student for a course
- Class start reminder system
- Attendance at a particular class
- Presentation of questions
- Logging of answers from each student
- Plotting of graphs for each answer
- Calculating student responses and responding to students
- Final results module

A lesson was prepared on Quadratic Functions interspersed with questions. Two practice sessions were conducted – one drill sequence with the presenter and one drill session with the sequences of the SMS server. To send and receive SMSs from the server a mobile was connected via a data cable to the server. This was followed by a live session described below:

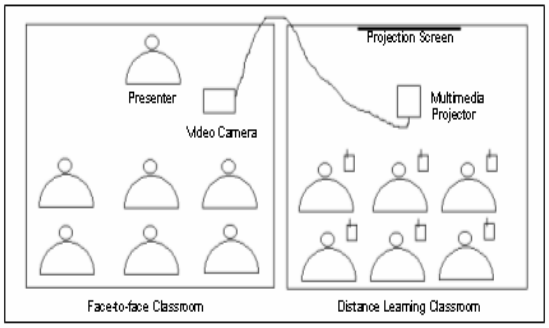

Figure 2: Live testing of the Interactive Distance Learning system with Mobiles

4.1 Live Testing

A class of 52 students was divided roughly 50-50 into those who had mobiles and those who did not. Both groups sat in two adjacent classrooms, one face-to-face (f2f) with the presenter and the group with mobile phones could see the presenter on a projection screen projected using a video camera and a multimedia projector as shown in Fig.2.

Both groups were given the same pre-test and post-test set on quadratic functions. The f2f group had a pencil and paper to answer the questions while the mobile phone group used their mobiles to answer questions via SMS to the SMS server. The mobile group was given a handout on how to register and answer questions for the session.

The marks achieved in both the pre-test and post-test for both groups were put through a t-test.

A separate video camera was used to take pictures of both the groups in action. It was found that the group with mobile phones was very excited about using their mobile phones for this purpose. Students generally love to use the SMS of mobile phones. In general it was found that the mobile phone group on average scored one to two marks higher than the f2f group. This could be due to the initial flurry of excitement over the new method used. It is expected that this excitement may wear out after the first initial classes.

4.2 T-test

We test the hypothesis that “there is no true difference between the two means” (NULL hypothesis). We used statistical t-test for this purpose.As was mentioned earlier that prior learning, the pre-test was taken for both groups in order to validate their merit-similarities. After lecturing, post-test was taken in order to compare the

results achieved in both learning methods (face-to-face and SMS-based learning).

4.2.1 Pre-test

In t-test, we got result, h = 0, which means that we cannot reject the null hypothesis. The significance was 0.1870, which means that by chance we would have observed values of t more extreme than the one in this example in 1870 of 10,000 similar experiments. The differential means of both learning was 0.2737. A 95% confidence interval on the mean was [-0.1387, 0.6861], which includes the theoretical (and hypothesized) difference of 0.1870.

4.2.2 Post-test

When degree of certainty equals 0.02 or less, the result, h = 0, means that we cannot reject the null hypothesis. The significance is 0.0274, which means that by chance we would have observed values of t more extreme than the one in this example in only 274 of 10,000 similar experiments. For degree of certainty=0.02, a 95% confidence interval on the mean is [-1.9303, 0.0553], which includes the theoretical (and hypothesized) difference of -0.9375. But when it is 0.03 or more, the result, h = 1, means that we can reject the null hypothesis. The results of the t-test showed that the post-test results of the Distance Learning class were at least as good as the f2f classroom.

5 RELATED WORKS

In (Jackson, R.H. 2001) Jackson argued that technology-enhanced e-Learning is where the learner audience has the opportunity to meet face-to-face with the instructor and is a supplement to traditional, on campus learning. In (Taylor, R. 2002) Taylor agreed with Jackson and stated that e-Learning can be used effectively in several different forms. It can be used as a stand-alone asynchronous program, or as a synchronous class where all the students are online at the same time, or as an add-on to traditional classroom presentations. In (Alexander, S. 2001) authors further argued that using technology in both classroom and distance learning would improve the quality of learning.The drawbacks of conventional distance-learning is that it requires more maturity and self-discipline from students than traditional classroom education, which may explain the higher dropout rates in distance-learning programs compared to conventional programs (Hiltz, S.R. and Wellman, B. , 1997), (Kumar, A. et al., 2001). A lot of work has been done in developing prototype-based distance learning. Some recent Intelligent E-Learning tools comprising interactive multimedia through Internet and prototype are illustrated in (Michelle, S. , 2003)(Peter B., 2004)(Zhang, D. et al., 2004). Our proposed method overcomes the above problems, which is validated through questionnaire-based observation and statistical 'T-testing'.

6 CONCLUSION AND FUTURE WORK

The Distance Learning classroom was not in a "real" rural setting where students would be separated geographically but would have access to a television network that would air the educational program. During the test, the students were sitting side by side as in a normal classroom. This however brought home another point. The SMS technology can also be used in a normal f2f classroom to log and check answers. The server would track students who are not answering questions and send them a warning SMS and remind them of their current status. In the f2f classroom, students answered questions on a piece of paper, however, the instructor was not able to monitor students who were not answering questions. The mobile as a tool and an input-output device would be useful in a normal f2f classroom situation.

However, in the last 10 minutes of a class session, students can also ask questions via SMS to the presenter. The computer would group the questions for the presenter. The cryptic language used for sending SMS adds another dimension of difficulty to grouping questions. This part was left for future work. Research has also to be done on the kind of courses that can be taught in this manner, e.g. whether English language can be taught in this manner. If it can, it would be very useful for places like Bangladesh where there is a severe shortage of English teachers.

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