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Bangladesh Virtual Classroom: Technology Enhanced Learning for all – today

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Abstract: We developed low-cost, effective ICT to improve distance education in Bangladesh, using video and SMS to implement innovative pedagogy and to create a large-scale interactive learning environment for students, hitherto not existing. We develop sustainable strategies for ICT use in education including curriculum development, teacher education for interactive learning, and a new business model. Being the first of its kind worldwide, the project will serve as a role model for how to arrange low-cost distance tuition requiring only minimal ICT infrastructure, an example providing valuable experiences transferable to other developing countries. The project addresses technical factors (development of interactive technology) as well as social ones (introducing and sustaining interactivity in education) and the business model for distance tuition (engaging local learning centres, telecommunication management).

1. Introduction

Education is a major factor for development [12, 13,14, 16], yet education in developing countries is a huge challenge [5, 6, 7, 8, 10]. As a complement to traditional education, distance tuition is established in many countries. In Bangladesh, the Bangladesh Open University (BOU) provides distance tuition to some 250 000 students all over Bangladesh since 1992. Students are distributed across vast areas with poor communication facilities. Major problems include low throughput, poor or no communication between teachers and students, traditional inefficient teaching methods, and underdeveloped use of local learning centres. Generally, technology enhanced learning has been promoted as a way to overcome physical distances, availability problems [5, 7], and teacher shortages [15], but most technology enhanced learning projects use web technology which is typically not readily available, neither now nor in the foreseeable future, more so in the rural areas of developing countries. This also deprives the education from adding features of interactivity, which has proven to be a main enabler for student retention, performance and satisfaction [9, 17, 18]. There is hence a need for solutions using existing infrastructure as much as possible.

The Bangladesh Virtual Classroom project (BVC) employs low-cost, effective ICT to improve distance education in Bangladesh, with the prospect of being able to implement both technology and methods in any developing country. Using video and SMS together with a computer server to implement innovative pedagogy we create a learning environment for students, hitherto not existing. The project is a joint effort between Örebro University, Sweden (ÖU) and BOU. We develop sustainable strategies for ICT use in education including curriculum development, teacher education for interactive learning, technical tools for large-scale interactive learning using existing mobile technology infrastructure, and a new business model. Being the first of its kind worldwide, the project will serve as a role model for how to arrange low-cost distance tuition requiring only

minimal ICT infrastructure, an example that will provide valuable experiences transferable to other developing countries. The project addresses technical factors (development of interactive technology) as well as social ones (introducing and sustaining interactivity in education) and the business model for distance tuition (engaging local learning centres, telecommunication management).

In terms of technology, the project is feasible and well timed. It is estimated by World Bank that 77 per cent of the world's population is within the reach of mobile phone network and it is estimated that the number of cell phone subscribers worldwide continues to increase at a very rapid rate, with the most significant growth being in developing countries [3]. In Bangladesh GSM technology based mobile phone was introduced in March 1996. Mobile network coverage has today reached about 97 percent of the country's population and 82 percent of the land area [4]. Competition among mobile operators has significantly reduced tariff rates in the past few years and availability of low-cost phone sets attracted subscribers of financially constrained group. Although nearly half of Bangladesh's more than 140 million people still live on less than a dollar a day it has one of Asia's fastest growing cellular markets. Already today Bangladesh has 38.93 million mobile phone subscribers by the end of March 2008 [1]. This means one out of four Bangladeshis have a mobile subscription – on average at least one in every family. The number is forecast to increase to be 44 million by 2009 [4]. Our own estimates suggest that access to mobile phone at the household level is nearing 90 % in the urban area and 70 % in the rural area. We have also done tests with delivering information through mobile phones in Bangladeshi villages that support this picture. Computer access is still miniscule, concentrated to urban areas, and not expected to increase dramatically in the foreseeable future.

Based on these preconditions, the BVC project develops interactive teaching methods and technical tools designed for the infrastructure in developing countries. Many ICT aid programs invest a lot in expensive technology, such as putting computers in schools. This sometimes succeeds, sometimes fails, and the distinguishing factor is whether or not the technology fits into the context in which it is to be utilized and maintained. The BVC project draws on an existing, and very strong, trend in technology use and extends the use of it to becoming a participatory tool in combination with computer based support for teaching and learning activities. The originality lies in non-Internet/broadband dependence, good alignment to technical trends viable also in rural areas of developing countries, and excellent compatibility with social needs by target groups. As there is also no technology investment necessary, the BVC can provide a promising business case in terms of economy as well as time to implementation.

2. Objectives

The aim of this paper is to address the question of how to use existing mobile telephony technical infrastructure to create an interactive learning environments which can reach the majority of the population, be scalable to include many thousand students, and be sustainable from a resource perspective including the business model of institutions providing education.

This question includes challenges relating to pedagogy and teaching methods, technical tools for learning and communication, and institutional arrangements. The paper addresses these challenges by the illustrative case of the BVC. We present technology developed and achievements in pedagogy and course delivery, and we discuss the challenges ahead.

3. Methodology

A research and development endeavour, the project involves both practitioners and researchers. The practitioner side was primarily Sida (Swedish International Development

Cooperation Agency) through its affiliate SPIDER (www.spider-center.org), focusing on ICT4D and acting through a network of Swedish universities. The project was conceived by researchers in Sweden and Bangladesh. Ideas and prototypes were developed and project ideas were conveyed to practitioner organizations in Bangladesh. Finally a partnership was set up with BOU and a local software company in Bangladesh in which roles were clearly distinguished. The research partner (ÖU) does all research involved (including independent software testing), the software company develops the interactive application, BOU supplies teachers, physical facilities, and administrative support. Video recording is done at BOU, by local technicians and with participation of e-learning expertise from the research partner. The research parts of the project are clearly separated from the development work and come in three stages.

1. Preparatory grounding. All prototypes draw on research in several fields; information systems development, human-computer interaction, computer-supported cooperative work, technology enhanced learning, pedagogy, and development.
2. Underway research points are identified which require scientific methods; e.g. usability testing of prototypes, sociological investigations of local communication networks, and technology use patterns.
3. Following real-world implementation are effect studies, including e.g. effects on learning, uptake, and user satisfaction.

4. Technology Description

In the Bangladesh Virtual Classroom project, SMS is used together with TV/video to make lectures interactive. To support course delivery a Mobile Course Management System has been developed.

The mobile application as well as the whole concept have been tested in laboratory-style settings in physical classrooms as well as live on TV at BOU over two years. From this work we have arrived at a technical solution and a working method that works well. During 2008 BOU is running a first large-scale pilot (“English 2”, upper secondary level), which involves some 70 000 registered students. Recordings are done in a BOU regional centre in Dhaka, including real students in the studio to give both teachers and viewers the sense of a “real” classroom.

The process change under implementation includes improving teachers’ skills on how to teach in an interactive manner and organizing teaching material for interactivity. Curriculums have to be revisited, lectures redesigned, and presentation and interaction practiced. This project develops both interactive technology and interactive teaching methods. The cartoon captures the learning situation we design for at a glance, a student sitting at home or in company with others using TV or video to watch and a mobile phone to communicate with teachers and other students.

Starting with the technology, behind the cartoon view we have built a quite comprehensive SMS-based system involving a number of tools for communication between students and teachers. There are basically three different sets of tools; for learning and communication, for administration, and for teacher support.

4.1 Learning and communication tools

The core of education, of course, has to do with learning, and the basic thrust of our system and our method is to bring the teacher and the students closer to each other, as far as this can be done given the distributed setting. The following tools have been implemented and tested to support and enhance learning.

Self Assessment Quiz: after finishing a chapter, a student can download a quiz based on the chapter. This is done by sending BOU Z <lesson number>. The students can take a quiz whenever they want, as many times as they want. The students are given random questions from a database.

Questions during class: students respond to questions by the teacher during class time by sending BOU Q <selected response>. The response is simply a, b, c or d. The students see a bar graph of the answers sent in. The teacher then discusses the answers and dials a student from among those who have answered wrongly. The conversation is heard by all the viewers.

Participatory Cards: The teacher on video asks a question like, 'In your opinion, how can language learning be made easier?' The students respond by SMS sending keywords after BOU P <opinion>. The opinions are displayed on a monitor as rectangular boxes as they come in. The students are then able to visualize the responses and group the ideas together to come up with collective strategies in response to the question. It has been found that students take ownership of the process and results. This is a workshop technique adapted to students watching a video lesson.

Homework: Not a specific technical function but a task given to students that can be reported using other functions. Homework is coupled to the learning partner idea.

Learning partner: This is also not a technical function but a pedagogical approach. It is well known from distance tuition research and practice that students who have a social network in class are less likely to drop out than those who work alone, hence it is a good idea to group them together so they can share experiences and spur each other. The students have to register as a pair in the language BVC class. They do this by sending an SMS as BOU LP <own ID> <partners ID> <partners mobile number>. When the partner confirms with a similar SMS the pair is registered. Tasks are designed to get the partners works together, e.g., partners have to send in comments on each other's work. Each comment will be recorded in a database. Each comment will be counted as one mark.

Meaning: Students can get the meaning of words given in their text as vocabulary by sending BOU D <word>. This returns the meaning and a sentence with the word. As a future development, students can also get the pronunciation of these words.

Reading: students are encouraged to read and learn by texting BOU R. This returns a short (<160 character) paragraph from a story. In return for key words that express the main idea of the paragraph students get the next paragraph. This way, students can complete stories that are stored in the server.

4.2 Administrative tools

Registration: To participate in electronic course communication students must register. This is done by SMS and checked against BOU course registration files.

Attendance: Students can register for each class. Registration gives access to all the other tools. Students can just watch the TV show, but without registration they cannot take part in activities. This function also gives the teacher a view of who is watching and who is not.

Course information & rules: Practical information about the course is disseminated over SMS, such as performance criteria, available tests, deadlines, etc (e.g. "You have to pass 8 out of 10 classes to pass the course"). These messages are not just one-way information,

they also include feedback, such as reminders like “Don’t forget to take the quiz, you haven’t done that yet”.

Results: Results of each student’s answers to SMS questions are communicated individually to each student; “Congratulations, you attempted 8 out of 10 Q’s, 7 right”.

4.3 Teacher support

Many of the above functions are automated so the teacher only does preparatory work, such as preparing or updating the course dictionary, or follow-up analysis such to see how many students took the tests, what the results were, etc. Such statistics, provided by a report generator, give BOU teachers a new view of student activities and results. Previously they had no contact with the students before the final exam after the course is completed by the end of the year.

During class the teacher is busy as the allotted time during a TV show is very limited so s/he needs to be disciplined and informed for the interactive parts. To support a ‘live’ show our system provides a “dashboard” available during class on the computer. This provides results from SMS questions asked during class and numbers to call. The teacher can see the number of correct and incorrect answers and the telephone number corresponding to who answered what – A, B, C or D. Based on this information s/he can call one of the students, by clicking on one of the telephone numbers, to discuss the answer. For example, if there are many incorrect answers the teacher may want to understand why so many people got it wrong. S/he might then choose to call someone who got it right so as to let that student provide an explanation which may help other students better understand the reasoning.

5. Developments

The mobile application as well as the concepts on how best to run the BVC have been tested in various ways in physical classrooms and live on TV at Bangladesh Open University (BOU) over two years. Starting from the basic idea of interactivity we first developed a prototype for the mobile application as of above and tested it in a setting with two ordinary classrooms. The same teacher served both classes. In one he was physically present, in the other he was visible through TV and interacted through the SMS system. Learning in both classes was compared and found to be the same [2]. This showed that the method of teacher-student interaction through SMS worked. It also showed that the usability of the system was satisfactory.

Next we developed a video designed to be a prototypical BOU TV-sent class, including interactivity between students and teacher. The purpose of this was to demonstrate our idea to BOU in a hands-on way. Traditionally, BOU teachers do not work with students. They produce lectures based on literature and deliver them as speeches on (recorded) TV. Hence, both interaction in general and the specific technical implementation of it had to be clearly demonstrated. The demonstration went well, as we learned from focus groups of teachers and students, and we were able to make an explicit contract with BOU to develop a complete course in this fashion. This course was “English 2”, which engages some 70 000 students starting in Spring 2008 and will be completed by the end of the year. 28 interactive lectures have been produced and recorded with live classes. These are shown on TV at a pace of one per week. They are also available on VHS tape/DVD to be viewed at any time at the some 1300 BOU tutorial centers, available across the country.

Technically the SMS applications as well as the TV recordings work well. Students quickly learn to use our course tools, and the mobile phone is already a familiar technology. A challenge of the large-scale test phase was to make teachers learn how to teach in an interactive manner and organize teaching material for interactivity. Curriculums have to be revisited, lectures redesigned, and presentation and interaction practiced. We have done this in the following manner. About a dozen BOU teachers were selected based on personal

interest, knowledge and availability. They were given a one-week course on interactive teaching in general and our specific method in particular in December 2007. The purpose was to prepare them for recordings by understanding how the teaching material should be organized so as to be delivered in this interactive manner. In February 2008 two intensive weeks of test recordings took place. By then, teachers had, in cooperation with the project's pedagogical expert, developed scripts for the lessons, and we recorded them with a "live" class present. We could, of course, not produce 28 lectures in two weeks with teachers inexperienced both in interactivity and live teaching, but we wanted to have an intensive session so as to find a smooth way of recording, acquaint as many teachers as possible with the method and the situation, and establish a stable design for the TV shows, meaning one that both fitted our intentions and the teachers' experience and current ambitions. Once this was done we went on with recordings engaging five teachers as the main actors.

Recordings were done with a live class of students, for several purposes. First, teachers needed to have a class present to be able to really learn interactivity. A real class gives real, and immediate, feedback. Second, it gave us a good opportunity to observe students' behavior and to inquire their views on the pedagogy, technology use, and the tools we had developed. Third, as the lectures would be recorded and used for re-plays it would be useful to have the "live feeling" to the show even when it would not be watched in real time.

Beyond this practical approach there is a wider issue about teaching methods in general which this project addresses but which can only be solved gradually and by means of sustained change processes. Interactivity in teaching has since long been found to be a success factor essential for learning. Interactive teaching has developed since the late 1960s in the industrialized world; however, in most developing countries it is a novelty. Interactive teaching puts new demands on teachers, teacher training and education organizers, and full scale implementation will require much effort. Our project has so far mainly addressed these issues by a practical approach so as to get started, but clearly this is only the beginning of a long development. We have opened the door to the benefits of interactive teaching; however addressing the demands for teacher training, change of pedagogical ideals, understanding the importance of enabling students rather than trying to fill them with information is a much more far-reaching endeavor. We are working with BOU to address also these issues; however this effort has a longer-term schedule.

6. Results

This project has, in research-practitioner partnership, developed a complete set of tools for large-scale distance tuition in developing countries including (1) interactive technology with a number of technical tools for learning and course administration, (2) a new pedagogical model designed for interactivity in a developing country context, (3) methods for focused teacher training in interactive e-learning, and (4) curriculum development. We are currently cooperating with BOU to (5) develop and implement a new business model for distance tuition in Bangladesh. We will work to make this model internationally applicable, and we are currently preparing to set up another test site in Ghana.

User acceptance and learning effects have been investigated and found positive. The level of innovation is very high concerning pedagogical methods and distance tuition business model in developing countries. The technical innovation is high concerning adaptation to needs in developing countries, i.e. usefulness, however as it uses existing technical infrastructure there is no imminent need for expansion of this.

7. Business Benefits

The BVC project has developed a model for low-cost interactive technology enhanced learning in developing countries. This is a huge benefit as both technology enhanced

learning and distance tuition in general show very poor throughput rates in developing countries and are not aligned with e-learning best practices. Drawing on existing technical infrastructure and existing skills in using technology the tools and methods developed are very feasible. The business model innovation is very high as this is a low-cost scheme with extremely high outreach already as of today. It is both affordable and useful in any developing country. As there is no technical investment necessary, the economy of the approach is promising. Yet to be done is full-scale implementation of the business model. This is beyond this actual project but as the practitioner partner, Bangladesh Open University is the major actor in the country we believe the scene is well set for this challenge.

8. Conclusions

The BVC project has developed a complete set of tools for large-scale distance tuition in developing countries including (1) interactive technology with a number of technical tools for learning and course administration, (2) a new pedagogical model designed for interactivity in a developing country context, replacing repetitious pedagogy with student centred learning, (3) methods for focused teacher training in interactive e-learning, and (4) curriculum development. We are currently cooperating with BOU to (5) develop and implement a new business model for distance tuition in Bangladesh.

There is potentially huge economic and societal significance of this effort. Economic, because it is a low-cost scheme requiring no new technical infrastructure. Societal, because it allows the rural population in developing countries to take a significant step into the "e-society". This said, there are a number of challenges which cannot be met by a single effort but need consistent and sustained change work. These include:

- Technical challenges for education providers: Making the TV shows effective in terms of production efforts and attractive to students. Less of a challenge but still a new task is hosting an SMS server and attached software.
- Organizational challenges: (1) Teacher training: making teachers learn and adopt interactive ways of teaching; (2) Redesigning the basic course model; and (3) Engaging local tutorial centers in new ways
- Cultural challenge: Making "student-centered teaching" the norm, i.e. focusing more on learning and less on teaching. This is a long-term change, which in industrial countries has taken decades. While this process may be faster as examples and methods exist one should not expect educational cultures to change quickly [19, 6, 10, 11].

While these challenges all have to be met by each project it would be beneficial if international aid providers would take care that receiving governments understand the two latter ones. "Development" programs often stop at technical development, and this is often the easiest part; certainly this has been the case in this project. Organisational changes need government support beyond what a single project can achieve alone. Cultural changes cannot be "implemented" they have to be enacted. However, they can be strongly supported by organizational changes providing incentives for innovation.

Further work for our project includes full-scale implementation of the business model, making further tests in other countries, and sustaining the technical tools. The BVC is compatible with increasing use of web technologies, so one strand of further development is to integrate it with existing learning management systems as the feasibility of this emerges.

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