E-Learning Initiatives at AIOU – A Case Study of Using ICT in Education

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Abstract
The ICT revolution has opened many ways of providing online education. Effective Internet based education models require a good information and communication (ICT) infrastructure. ICT opens up a range of exciting new ways in which instructions can be delivered and student and teacher interactions can be managed. Computer Science Department initiated working on online education options and an initial conceptual model of a Virtual University was presented in November 1999. The department extended this conceptual model into an OLIVE\(^1\) e-learning framework. The OLIVE e-learning framework has been piloted at a CS Department and results are encouraging. The outreach has increased, course operational costs have decreased and better learning has been observed during pilot testing.

Progress of online education at AIOU has been divided into three phases. In the first phase the university had experimentally started this new mode of education. In second phase, locally developed LMS software OLIVE was implemented. In third phase, an open source Learning Management System “MOODLE” has been customized according to AIOU needs and implemented to achieve the online education with low bandwidth connections typically available in Pakistan.

This paper briefly describes the e-learning progress since 1999 and describes the development and expansion process in e-learning LMSs with specific case of CS/IT education. Problems encountered and measures taken are described during each phase.

Keywords: ICT in Education, E-learning Framework, OLIVE LMS, Synchronous Teaching and Learning

1. Introduction
Distance education is a non traditional system of education in which learner and tutor are separated by distance and some times by time. A useful discussion on distance and e-learning can be found in many references [1] [2] [3]. In order to facilitate the needs of a distant learning system a communication medium is required to automate the education system [4]. In old traditional distance education system, the post office played a main role of communication medium between teacher and the learner.

The concept of distance education took a momentum with the development of electronic and communication technologies such as the Internet and ICT technologies [5]. Use of ICT technologies has progressively changed distance education into e-learning. This e-learning represents various distance education delivery processes facilitated by means of electronic communications. These may include web-based learning, computer-based learning, virtual classrooms and digital collaboration [6] [7]. With development of multimedia content, the course materials become more lively and self learning. Standardized lectures either in video, or computer based animations become available to distance learners, who can repeat or play those several times at their own time. Thus a more productive learning experience than is usually possible in traditional classroom teaching environment may also result. Recent developments in multimedia and internet technologies have therefore opened new opportunities in e-learning [8] [9]. It requires creativity and innovation in the design and development of e-learning instruction materials [10]. Efficient ICT delivery mechanisms and infrastructure

\(^1\) OLIVE is an acronym of Open Learning Institute of Virtual Education.
are also important to meet the teaching and learning requirements. This becomes specially important when local public infrastructure for communication is utilized. As many video based or high quality teaching and learning activities depend upon available computing and communication infrastructure.

Present e-learning makes extensive use of ICT technologies to provide both synchronous as well as asynchronous learning. Asynchronous processes use recorded lectures and/or instruction materials to be accessed by the learner at a distance and with open time flexibility. The level may differ from a simple electronic reading materials placed over website to fully configurable video on demand lectures placed on learning management systems (LMS). This also facilitates other academic activities and student administration. A LMS (Learning Management System) is an application that enables the management and delivery of learning content and resources to students. It is used to plan, implement, and assess a specific learning process [11]. Most LMSs are web-based and facilitate access to learning content and administration [12]. Quite a sizable LMS (learning management systems) exist to facilitate the institutions and faculty to automate student learning.

The synchronous e-learning systems facilitate prescheduled student and teacher meeting. These can be achieved through LMS or using tools such as “Net-meeting”, Messengers or videoconferencing software. The advantage of synchronous meetings is that student and teacher interact simultaneously in same time period and learning may be enhanced through a live question answer sessions. However it takes away the freedom of time and usually results into higher use of communication channels (and associated higher costs) as compared to asynchronous learning.

In Pakistan, open and distance education system has progressed since establishment of Allama Iqbal Open University (AIOU) as world’s second open university in 1974. Allama Iqbal Open University (AIOU) has emerged as one of the Mega University of the World [13]. It has large number of enrolments per year and has a national footprint. The Virtual University of Pakistan was established in 2002 as second distance education university. It uses TV channels for broadcasting prerecorded lectures where as student interaction is handled through Internet and LMS.

2. E-Learning at AIOU
E-learning work at AIOU was initiated in Nov. 1999 when a conceptual virtual education model was presented at a seminar [14]. The work was continued focusing on the issues related to maintenance of flexible and inexpensive learning process, increased outreach though public infrastructure and quality of learning and teaching. The university Academic Council approved the conceptual e-learning education delivery model with an acronym OLIVE (Open Learning Institute of Virtual Education) in 2000. With this high level support, the OLIVE delivery model was expanded and converted into OLIVE e-learning framework. It was focused on a futuristic need to integrate many online education, teaching, and research activities with operational and administrative activities which were envisaged in future when online student enrolment grows rapidly. The OLIVE e-learning framework [15] is illustrated in figure 1.
The development work on OLIVE components needed many parallel activities to be initiated. Firstly, the computing and communication infrastructure were needed for enabling the e-learning. Secondly, academic programs along with electronic content and media and LMS software were needed for initiating e-learning. Thirdly, rules and regulations changes to enable e-learning environment and interact with students were needed along with related services software. Fourthly, electronic evaluation and examinations were identified as a separate component for quality assurance of teaching and learning processes. Fifth major activity set was identified as collaborative R & D and follow up projects in e-learning and related support systems so that e-learning could be practiced with reasonable quality and confidence. In addition, these projects were envisaged to help build necessary software and infrastructure components and research data for growth of e-learning. The progress on each component is continuing at AIOU. This paper will describe the e-learning initiatives with respect to various courses and programs where e-learning had been implemented. The experiences are discussed with respect to learning support tools and technologies in different phases of e-learning.

Figure 1: Components of OLIVE E-Learning Framework [15]
implementation. It also highlights the future actions being taken and/or needed to fully implement OLIVE e-learning framework. Present e-learning progress can be divided into three phases; learning phase, practicing phase and development phase. Each one is briefly described below.

2.1 Learning Phase:
As explained earlier, learning phase started as early in 1999 where conceptual model of OLIVE was developed. This concept was discussed and approved in the AIOU Academic Council in 2000. This regulatory approval allowed department to initiate experimental e-learning. It was decided that two MCS level courses will be delivered in e-learning mode. The decision was based upon two facts; firstly these two courses (3523-Recent Advances in ITM and 3519-Recent Advances in Software Engineering) were open ended courses and secondly MCS students were comparatively considered more mature in use of Internet. As per program both of these courses were offered in spring 2002. Student enrolment in these courses for a two year period is given in figure 2.

At this time, very little computing and communication infrastructure was available to the department. Therefore common Internet facilities which were freely available to Internet were used. It was considered that some synchronous activities were essential for better teaching and learning. Therefore the teacher and students were asked to attend weekly Internet based Question and Answer meeting using MSN messenger. The course materials, assignments and other announcement messages were delivered using e-mail and web based file transfer. The e-learning class activities were conducted for a 18 week semester period. Topics for reading and discussions were identified well in advance and sufficient weekly sessions were allocated to each major topic. Students were free to read the special topic materials or related papers any time before commencement of the weekly Q & A meeting on the Internet. Students and teachers participated in these sessions from any place they had an Internet access.

The evaluation process was a little tricky one. Grading assignments was no problem but conducting midterm and final tests posed a real challenge. Individual student authenticity as well as sanctity of examination process was main university requirements. Therefore it was decided that tests will be conducted under supervision at computer laboratories at two places; Lahore and Islamabad only. The mid term and final tests were designed open book. Electronic tests with multiple papers randomly assigned to each student at the start of the test.

Since during learning phase, freely available common tools and technologies were used, therefore there was no additional cost. Students were already using such tool and they were excited and appreciated e-learning courses for the many reasons. They can attend prescheduled tutorial sessions from any location which saved traveling cost and time of the students and teacher. Student groups were from many cities including Rawalpindi, Islamabad, Multan and Mirpur AJK. However, they attended Internet based sessions at scheduled time from many places. One student even attended sessions from Switzerland where he was posted for a few days. A more qualified teacher was available to students online and during sessions they also received additional academic and professional support. The hourly online sessions were usually extended and about fifty percent more time was available to these students. Attendance was good and interaction was quite high.

However, there were problems of accessibility if students traveled to rural locations, there connections were unstable when they accessed from remote areas.
Since MSN Messenger did not allow more than five participants in a shared session, multiple sessions were managed by the teacher. Some e-mail accounts did not allow large assignment files to be transferred. This caused some deadline problem.

As per university requirement students were also called for a formal workshop at AIOU main campus. Experts from IT industry were invited as guest speakers in this workshop. This workshop was considered as an additional effective component in students learning and was highly appreciated.

2.2. Practicing Phase:
The practicing phase initial plans started early in 2001. Since initial regulatory support was already available, there was a need to build a moderate infrastructure on which e-learning capacity could be practiced and established. Referring back to OLIVE framework, it was considered that academic content, LMS, some computing and communication infrastructure form a humble requirement for starting an initial e-learning system. Therefore work started with this focus.

University had a very little capacity in electronic content. Most of the contents were printed books/guides some time supported with video or audio materials. Therefore a major project of building electronic courseware development capacity was launched. However, envisaging problems with public Internet infrastructure, video based contents were considered a costly and/or technically unfeasible content. As e-learning model was mainly based on low cost public Internet access, a commercial proprietary software such as “Black Board”\(^2\), “WebCT”\(^3\) and “IBM Learning Space”\(^4\) were experimentally tried and considered a high cost, high risk option to be used in a heterogeneous (w.r.t hardware, operating system and connectivity) public Internet access system within country. Therefore two major decisions were taken. Firstly develop a simple, need based and low cost LMS for OLIVE which could facilitate e-learning. Secondly, where ever possible, use multimedia computer animations as an alternate instruction to video based lectures. Fortunately the department was successful in getting a research grant for Multimedia Electronic Courseware Development. E-learning LMS and initial computing infrastructure was embedded in this project due to many administrative and strategic reasons.

Therefore integrated initial version of OLIVE LMS was developed in parallel with multimedia content so that e-learning can be started. The first version of OLIVE LMS was developed with facilities such as web based contents, web based assignments, web based synchronous class tutorial meetings, announcements, discussion forums, group messages and individual messages etc. etc. The teacher was given control over deadlines and discipline maintenance authority. A facility for recording and post viewing of tutorial meeting interaction was given to both the student and teachers. In this software the instructors and students were registered for each course in each semester. Examinations were conducted in online mode at university computer laboratories. Immediately both MCS courses were transferred to OLIVE LMS as complete content for a program was under development.

Assignments were posted by the instructor with a deadline. In response the students posted back the solution of those assignments to their teacher. The teacher’s comments were conveyed to students along with grades. Collective announcement of test, workshop or guest / special session were send to all students. Teacher could also send and receive messages from individual students. All records were maintained for complete semester. In order to facilitate student interaction on different topics of current interest a discussion forum facility was also provided, where students (and teachers) could share there comments in asynchorous mode.

Midterms and the final exams were conducted in the Computer Science Department Lab under supervision. Instructor uploaded the question paper exactly at test time and the students were allowed to download it. Students solved the paper in a given time and then posted the solution to the instructor site at prescribed time. Print out were also obtained for record purposes with students signatures. An opportunity was given to reappear in a new test if a test was missed. This was necessary because of some complaints on failure of the internet during the test period were reported. A MCQ type test was also conducted for quiz in some courses. However essay type descriptive question were more practiced during finals and midterm test using open book test method described earlier. A few screen shots of the initial LMS version 1 are illustrated in figure 3-6.

\(^2\) Black Board is trade mark of Blackboard Inc,
\(^3\) Web CT is trade mark of WebCT Inc,
\(^4\) IBM Learning Space is trade mark of Interantional Business Machine Corporation,
2.3. Development Phase:

As mentioned earlier, with a successful examples and acceptance of student community, it was decided that a complete program may be launched in e-learning. For initial e-learning education system development, a PGD CS one year diploma program containing 10 courses was selected for development in multimedia format. The reasons for selecting this program were that it had a sufficient number of theoretical, practical and mixed courses. The program was of a two semester duration and only 10 courses were looked for in this program to launch in e-learning mode. Another interesting fact was that this program was previously being offered in traditional face to face mode at different study centers around the country. The student intake was mature with 14 years initial education but very little computing knowledge or skills. The program was suffering from economic group size at each location (groups of 20 students were required for economic size at any single location). Even though there was a registration request at national level, at many places AIOU was unable to offer this program because of less than economic group size at some locations. This caused a considerable downfall in enrollments. With e-learning mode offering it was envisaged that national groups will be formed and all eligible enrolment requests may be accepted.

It was also envisaged that launching of complete program with 10 courses may require multiple class sessions running simultaneously. It also required more robust LMS than was practiced in MCS courses. The features like calendar, multiple sessions, white board, live lecture video etc. may be required. Since Multimedia project had a fixed period therefore it was decided that an open source LMS shall be customized as future LMS. MOODLE and many other LMS were compared and finally “MOODLE” was selected as base LMS. The customization was done to reduce the unwanted extra features which we were unable to put in practice due to use of heterogeneous connectivity available in Pakistan. Present OLIVE LMS includes the component of online publishing of multimedia course streams and reference text materials, assignment upload and download facility, course calendar, announcements and discussion forums. A sample of the module is shown at figure 7.

![Figure 7: A Sample Screen Shot of MOODLE based OLIVE LMS](image)

The live or recorded video lectures option was dropped for the same reason as it was too slow over public Internet access generally available to students. Alternatively multimedia courseware were developed for all 10 courses and used in the e-learning. These proved reasonably good, when used in streaming mode even on shared dial up lines. Whereas on single dial up connectivity these were played with out any fault or disruption.

PGD CS complete program has been operational since year 2005. So far four semesters have passed but we have experienced no major problems with respect to uploading, downloading multimedia materials. Only problem was encountered with video based lecture, so live video streams were switched off. Only text based tutorials are allowed along with presentation slides and white board is also available to teacher to give him flexibility in teaching. The students and teachers are given one day orientation training as many new teachers have been inducted.

As envisaged earlier the major outcome of this program was increased enrolment and outreach of AIOU. Presently 4-6 sessions of each course are being conducted in e-learning mode. Students are allowed to participate in morning, afternoon or evening sessions as suits to their schedule. The enrollment has increased many times as compared to enrollment when it was launched in 2005 as shown in figure 8. Now even a single student in a city can be admitted as economic group size in a local place is not a problem. Only one additional problem is experimented that in case of any trouble with public

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MOODLE is an acronym for Modular Object-Oriented Dynamic Learning Environment
internet or teacher not attending session, we have to reschedule to special session to compensate.

**Figure 8 : PGD (CS) Enrôlement comparaison**

2.3.1. Student Survey
The students are very excited about e-learning mode of education, a few sample survey responded from students surveyed during a workshop are given in figures 9-12. It can be seen from pie graphs that most of the students are satisfied with this e-learning program.

**Figure 9 : Quality of multimedia learning materials**

As, Itt can be seen from the figure 9 that majority has rated the multimedia content as quality material

**Figure 10: Faculty Quality**
The majority has rated faculty as high (figure 10) in their responses.

**Figure 11 : Interaction preferences**
The majority uses online interactions (figure 11) for learning.

**Figure 12 : E-learning preferences**
The majority has selected e-learning as their future choice (figure 12). The remaining who enrolled has generally problems due to access to the internet especially in remote areas of the country.

3. Conclusion and future work
The e-learning initiatives taken at AIOU have proved quite successful. The evolutionary approach taken has highly contributed towards the success of e-learning initiatives. The outreach has increased and program popularity shows an increasing trend. The students learning and satisfaction are also quite high.
A full four semester running of a complete program has added confidence in the e-learning even in a low access and heterogeneous Internet connectivity available to the students. A thoughtful selection of courses, teaching methodology and tools used with time has really helped in success of e-learning at AIOU. The courses materials used and associated software have proved to be very useful to students’ community.

It is now being planned that complete of OLIVE framework need to be developed and formally implemented in other departments of the University. Several components of the model are partially developed in parallel and being used by the department. Future work is needed in areas of component integration, content enhancement, new course areas and extension of access to other regions. The training of other faculty members is also required so that they can develop, offer and maintain their programs in e-learning mode of education. It is also desired that the content shall be now developed using multimedia learning objects. Fortunately, CS has been able to develop many international linkages with ICT community in Asia and around the world. A new project for e-learning infrastructure development has also been approved. We are hopeful that few years will bring quite a significant increase in ICT and e-learning development at AIOU.

Another important future development work needed is to design a robust e-assessment system for mass assessment. This is very important piece of research work which requires to carefully deal with organizational rules, technology and knowledge measurement without allowing any “unfair electronic means” This research and development work has been placed on priority with initial research support from IDRC under Pandora DLT mega project.

4. References
