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Information Technology Education For Developing Countries And Beginners Using Web-Based Distance Learning

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Abstract

One of the most crucial technological challenges facing developing countries in the new millennium is the lack of suitably qualified personnel in the area of Information and Communication Technologies. Such technologies are not only important in the performance and growth of a nation's economy, but are also the effective tools in the advancement of human development. Education of a large number of personnel in Information Technology requires an infrastructure of modern educational institutions for the younger generation to help improve the nation's economy and provide suitable employment for them. In the absence of such an infrastructure, developing countries can educate their students by making use of new methods of web-based distance learning employed by various educational institutions in USA. The purpose of this paper is to discuss the ways in which web-based distance learning can be implemented in the developing countries and educational institutions wishing to start such facilities by using some of the resources available on the world wide web.   The use of web-based and virtual labs for distance education in engineering and information technology will also be discussed.

I. Introduction

In the current information age, a nation's economy is determined by the number of suitably trained people in information technology. A relatively inexpensive, yet accessible way of educating large number of students in information technology in the developing countries is to use distance education [1]. Many universities and colleges in USA are currently using some mode of distance education to teach or supplement the courses. The 1998 Peterson's Guide to Distance Learning Programs [2] listed the courses and programs of more than 800 accredited institutions in the United States and Canada and the number of institutions entering the distance education is expanding rapidly. Traditional methods of distance learning by mailing videotapes takes longer and suffers from the problems associated with different video standards used in different countries. The use of Internet for distance learning in comparison allows for very rapid distribution of course material to remote students. Its use also makes the course material more enriched by including graphics, hyperlinks to other materials and scrolling marquis. According to a recent estimate [3], between 1995 and 1998, the number of higher education institutions

offering Net-based courses rose from 22 percent to 60 percent in USA. There are over 107 on-line courses offered by the New York Institute of Technology, over 60 courses at the University of Phoenix (http://online.phoenix.edu/), and over 57 courses at the Nova Southeastern University among the leaders in on-line education. The University of Phoenix enrolls over 1100 degree seeking students, all via virtual learning environment [4].

Developing countries have also been using distance education to educate more people. According to Feisel [5], Hong Kong, Singapore and mainland China are developing distance-learning programs to help people understand the technology in a short time. China is developing a distance learning program to educate the disabled. However, for countries with budget problems, development of distance learning facilities can be expensive, time consuming, and needs suitably trained people. The internet has opened a great resources of information for the whole world and developing countries can share these resources available on the public domain or by some arrangement with the donor organizations. The United Nations can be an important vehicle in facilitating their efforts, as in a number of projects like EDUNET [1] and others. Once these resources are accessed , it can be distributed inside the countries with the help of local telecommunication facilities. Our work reviews the efforts of educational institutions in the USA which are using internet for distance education . The work also lists resources and websites from where course material, software, web-based labs, and other relevant information for developing web-based courses   can be downloaded or shared without any cost.

II. Internet-based Distance Education

Virtual online education is defined [4] as the study of credit and non-credit courses from world-wide remote sites that are neither bound by time or physical location. A student can essentially hooks up with an Instructor and other students in both real or virtual time, sitting at his home, hotel , traveling in a plane, or whenever he/she can log into a virtual class room. The students are able to e-mail their assignments from their lap top or desk top computers.

There are two basic ways [6] of delivering distance learning in which the Internet can be used. The first   way is the synchronous communication in which all parties participate at the same time, emphasizing a simultaneous group learning experience. The second method is the asynchronous communication in which parties participate at different times, offering a choice of where and, above all, when the student will access learning.

In synchronous method, the teachers and students communicate in "real time', usually via interactive audio-or videoconferencing from a class room to one or more remote classrooms . It brings the classroom on-line by capturing the courses for remote delivery across the internet. The goal in this method is to recreate the classroom environment on the remote computer and, enrich the lecture material with additional material. The live delivery of courses requires collaboration between the local and remote sites, and a high bandwidth media to deliver it. In this method, there is no audio or video editing and the simultaneous delivery of additional multimedia material is difficult. The student in this method has to view each lecture from start to finish with

no opportunity to pause and go backwards or forward, or look into related material through hyperlinks.

Asynchronous communication for distance learning involves a group effort, in which a team of professional is assembled to produce a course. The group may consist of a number of people , including the Instructor, computer programmer and graphic artist and others. These courses might take longer, but once the course is completed, it has high quality professional looking material that may be delivered over the internet on demand or distributed through CD-ROM. These courses are assumed to be static, although supplements could be made available to keep the course material up to date. This method produces a captured version of the class , which provides the remote student with a replay of the classroom experience after some processing. This mode can be enriched with various forms of multimedia information, and may be hyperlinked to other lectures, a textbook , and other related sites on the world wide web [7].

The asynchronous method for distance learning allows a student to learn any time and any place he/she chooses. The web-based courses belong to this category. In this method the instructor usually posts the course material and assignments for the course on the internet and the student may read, view or copy the material in their own time. The developing countries should start their efforts with this method because of the cost and use of limited bandwidth.

III. Implementation of On-line courses.

The management of online courses is needed to provide structured environment for course notes, references, enhanced materials, online quizzes, assessment and grades. A system used to manage an online course is called course management system (CMS) and a number of such systems offering different features are also available. In a recent workshop on "CMS Platform Comparison", SUNY Syracuse Training Center [8] compared the capabilities of three course management systems, the Blackboard, WebCT and TopClass on the following task units.

1.   Create a syllabus. This can be accomplished by the following different ways.
    (a) Importing text & other instructional materials
    (b) Modifying the contents of the online courses
    (c) Importing graphics & multimedia
2. Creating and modifying links to extended web sites
3. Applying synchronous and asynchronous communications. This will also need the following:
    (a) Set-up threaded discussion boards
    (b) Sending & receiving E-mail
    (c) Applying chat & white board
4. Generating customized feedback by the following:
    (a) Creating &administering quizzes & tests
    (b) Attaching & opening student & faculty files easily

IV. Course Management Systems

The following platforms are available.

Angel [9] (A New Global Environment for Learning), is a novel teaching and learning computing environment developed by Cyber Lab and was designed by the creators of the Oncourse project currently used by the all eight campuses of Indiana university. It was originally designed to fully address the needs of distance learning programs, and can also offer an automated method of creating a complementary web environment for every classroom in an educational or corporate environment. It is available free to non-profit K-12 and higher education Institutions in the United States. Individual faculty members, departments, schools, or an Institution can download, install and customize the environment to serve all of their needs. It can function as a stand-alone course management system or can be integrated with one's Institutions back-end systems such as Registrar's information to provide completely automated e-learning environment.

Blackboard from Blackboard Inc.[10] provides end-to-end solution and supports chat, whiteboard, and FTP. The company's marketing strategy is to allow individual instructors to create courses on their server free, take distance learning courses and utilize 25 specific resource centers and customize them to match your own classes, and share tips and information with other teachers and students. The program was developed and spun off by folks at Cornell University.

WebCT[11] facilitates the creation of sophisticated world wide web-based educational environment and can be used to create entire on-line courses, or to simply publish materials that supplement existing courses. It is the most popular courseware product in higher education. The program is HTML-based and relatively easy to learn. Due to its flexibility, the Instructors may use the testing component of the software, or use the program's built-in directory structures or create their own course structure. It allows the Instructor to administer their courses and track the students activities. It has good testing capabilities and supports calculated answers. Purdue University fully supports it through the Multimedia Instruction Design Center, which provides good documentation of the software.

CyberProf (http://www.howhy.com/home) is an interactive web-based educational software system developed at the University of Illinois. It allows instructors to create on-line lecture notes that include equations, animations, and graphics that can be reviewed by students any time from any location. It also includes on-line interactive homework problems, Network TA that enables students to communicate with their peers, on-line teaching assistants and instructor via web as well as web-based bulletin board system and on-line grade book to record student grades. CypberProf enables students to review lecture notes all day, complete homework problems on the web and receive immediate feedback on their work, and review their grades any time by posting question to their instructor, teaching assistant, and peers using Network TA.

Other course management systems are given below:
e-college (www.ecollege.com)
e-education (http://www.e-education.com)
Prometheus new(http://www.prometheus.com)

Intralearn (http://www.intralearn.com)
Quickplace (http://www.quichplace.com)
Serfsoft (http://serfsot.com)
Toolbook II (http://home.click2learn.com)
WebCourse in a Box (http://www.madduck.com)
Virtual U (http://www.pjb.co.uk/16-17/virtualU.htm)

The course management system software like First class, Instructor and assistant, Topclass, and E-learning in engineering are also available.

V. Educational Institutions Involved in Internet-based Distance education

Many universities and colleges in USA are currently using Internet for delivering courses or programs. Some of the universities and colleges have formed their own networks and special centers to manage, distribute and share Internet based education. Given below are some of these institutions using internet based distance education which can be used to model or share in developing an effective   web-based distance education system.

State University of New York System Administration with the support of Alfred P. Sloan Foundation has developed [12] a project called SUNY learning network with the help of over 40 SUNY Institutions. SLN is an asynchronous learning network which uses a new approach to teaching and learning that is student centered, and eliminates the constraints of time and locations that the traditional education places on students. The activities of a traditional class are the same namely reading course material, writing papers, doing research and communicating with the instructor and other students. The faculty and students, however, use technology to accomplish these activities. SLN provides a complete program including training, helpdesk, a customizable course template and many other support features like training of the faculty. According to Alexandra M. Pickett [13], by 2000-2001 academic year SLN has trained over 1000 faculty, offering over 35 full online degree programs with more than 1500 courses and over 20,000 students enrolled. It is one of the three largest universities in online education.

The Multimedia Education Resource for Learning and Online Teaching [14] (MERLOT)
 hopes to establish itself as a clearing house for online courses. It started in1997 as an academic technology initiative of the California State University System. The goal of MERLOT is to organize, evaluate and create learning activities that complement the vast, though frequently chaotic, higher education resources on the internet. Its mission is to improve the effectiveness of teaching and learning by expanding the quantity and quality of peer reviewed online learning materials that can easily be incorporated into faculty designed courses [15].

The US Army is launching a major new educational initiative , called Army University Access Online, designed to offer eligible soldiers the opportunity to obtain higher education degrees by maximizing the use of technology –based education opportunities. This on line program will

start at selected Army installations and will follow soldiers as they move throughout the Army and providing opportunities also to the family members . It will be completed with the expertise and commitment of the academia, industry and the Army and is expected to reach an estimated one million users. SLN is one of the member who have committed to work with them [16].

World Lecture Hall [17] publishes links to pages created by faculty worldwide who are using the web to deliver course material in any language. It is supported by the Academic computing and Instructional Technology Services at the University of Texas at Austin. Courses are delivered over the Internet as well as designed for students in residence. All these courses on the Internet can be accessed by the faculty interested in developing the courses and the students. The World lecture Hall does not administer the courses it links to, hence the all those interested should use the contact information published at the particular course Web site.

Global Campus [18] is a collaborative multimedia database containing a variety of educational material such as images, sounds, text, and video to be used for non-profit, educational purposes. The project was started by the California State University System through a grant from DELTA and collaboration with the New Media Centers to build an electronic "Global Campus" accessible worldwide to anyone on the Internet. The goal of the project are to share resources, to provide a means for institutions to make their resources available to others worldwide while respecting intellectual property, and to provide high quality materials for instructional development.

Georgia Institute of Technology has been engaged [7] in distance education since 1991 using videotapes delivery and embarked on Internet –based education in the fall of 1997. The earlier delivery of internet courses consisted of power point slides and synchronized audio. It was later modified to accompany streaming video and audio and adding many other features to create class room environment.

National Technological University has been awarding master's degree in 18 key engineering, technical, and management disciplines using their instructional television network via satellite to organizations in many parts of the world. The virtual university which is accredited by the North Central association of Colleges and Schools has recently started offering web-based (or any combination of web and satellite) degree programs in computer science, computer engineering, software engineering and systems engineering [19].

Agilent Technologies (formerly HP) has a Website called Educators corner giving courses and useful material for courses, labs, and virtual labs in engineering and technology. It also provides free Web seminars, and free software on engineering and technology topics. New material and lab experiments are regularly added to the online collection It also includes education/training section on worldwide education containing versions in Spanish, Chinese, and Japanese [20].

The American Society of Engineering Education (ASEE) Website offers engineering resources

including material on distance education. One of its publication " Prism" includes useful Web sites recommended by educators [21].

VI. Virtual and Web-based Laboratories

With the popularity of web-based instruction for distance learning, the need for providing web-based teaching methods and virtual lab for experimental laboratory has also increased. Number of universities and colleges are developing such facilities to supplement their distance education programs. A virtual lab is a simulation of a physical laboratory experiments where the students use computer simulation to investigate simple and complex phenomena by changing parameters, boundary conditions, and other mathematical variables within the experiment. This experimental facility allows students to investigate and examine variations in problems that are difficult or sometimes impossible to duplicate in the physical labs. It is also possible to offer students these virtual labs via the world wide web or CD-ROM anytime any where in the world.

Johns Hopkins University [22] has developed such a laboratory for their beginning science and engineering students in an engineering/science laboratory course. The objective of the course and virtual lab is to introduce students to problem solving, data gathering, scientific interpretation and experimentation early in their careers. The experiments are written in Java and are fully interactive. The student needs to access them using Web browser Microsoft Internet Explorer 3.0 or later operating within a 32-bit operating system.

The cost of creating and maintaining these labs is less and students in certain cases like them more than the real labs. The virtual lab despite being a valuable learning tool has limitation in realizing a physical experiment. It is difficult to simulate features like repeatability, random error, equipment accuracy, analog to digital conversion, probe placement error and other physical phenomena which makes the experiment inherently "hands-on" [23]. Through the use of Internet, it is possible to expand the laboratory learning environment by making experimental laboratories available for on-campus students as well as off-site locations throughout the world. The students can gain access to experimental laboratories to perform hands-on experiments using some of the same methods employed for other web-based instruction, such as Internet lectures, Internet servers , chat rooms, video conferencing, and virtual laboratories.

Illinois Institute of Technology has developed a WebLab-IIT [24] which is a collection of Web-based experiments designed to control real "hands-on" devices and equipment in science and engineering with the help of Internet as the primary means. The first Weblab project was based on the conversion of several existing fluid mechanics and engineering instrumentation to provide uniform data acquisition, processing, archiving, and presentation techniques for undergraduate laboratories. These experiments were designed to either supplement or replace existing "hands-on" experiments and can be conducted anytime, anywhere in the world. These experiments use a standard Pentium PC with Windows NT operating system with National Instrument's Lab View software, data acquisition hardware, and the Web-server. Video camera, or CCD camera is used to provide the visual feedback. The standard Web-browser initiates the control of the

experiments, and data is acquired and sent to the remote user as measured in the laboratory.

Massachusetts Institute of Technology has successfully completed [25] the working of a Web-based microelectronics testing laboratory and has made it available online to students from anywhere at anytime. The laboratory is being used to teach several undergraduate courses to a large number of students. The facilities are likely to be extended to other institutions in USA and throughout the world. To achieve that a dedicated system is proposed to be permanently set up for other Institutions to log in and study it or use it on a regular basis as a part of their course offerings in the curriculum.

The University of Tennessee at Chattanooga has developed a web-based facility [26] to conduct engineering laboratory experiment from remote sites and has established a web site (http://www.engineering-labs.net) to facilitate the exchange of resources among engineering laboratories throughout the world. A total of 15 different stations are available for control systems, chemical engineering unit operations and environmental engineering experiments. The data acquisition and control software is written with LabView software from National Instruments [27] which is connected to seven stations for controls system laboratory and eight stations in the chemical and environment engineering laboratories. All of these stations have the capability to store experimental results for viewing on the web and an experiment can be specified and started by a web user.

Conclusion

The paper reviews the efforts of some of the educational institutions and   organizations dealing with internet based distance education in USA. It also discusses the course management systems available for developing online courses and the use of virtual and online labs needed to deliver science and engineering courses via distance learning.   The developing countries can use web-based distance education to educate large number of students as it is cheaper, accessible, easier to implement and does not require very high bandwidth. There are plenty free cost educational resources available on the world wide web which can be downloaded and can be customized to suit their needs. The United Nations and other International organizations can be approached to help in the development and implementation of an internet based distance education which can help their economy and educate the younger generation. The information in this paper can also be used by the educational institutions in the USA interested in starting an internet-based distance education to deliver courses or programs.

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Biography
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