

# Satellite Based Internet Education Delivery and E-Learning Objects Evaluation: SOI Asia and Codewitz Perspective

M. S. Islam, J. B. Alam and S. M. L. Kabir  
Institute of Information and Communication Technology  
Bangladesh University of Engineering and Technology  
Dhaka, Bangladesh, E-mail: mdsaiifulislam@iict.buet.ac.bd

**Abstract:** Development of Internet based distance education facilities and e-Learning objects development commensurate with the capacity building and modernization process of Bangladesh University of Engineering and Technology (BUET) and is congruent with the long term objective of the institution regarding facilitation of continuing education satisfying the temporal and spatial constraints. To fulfill the objectives, BUET has established the satellite based School On the Internet (SOI) project and has become active partner in the global e-Learning object development program through Codewitz project. In this paper we present, (i) the technology used to deliver the real time lectures through SOI, (ii) the content and quality assessment of the delivered lecture by the participants and its overall impact in the human resource development in BUET, (iii) the development of e-Learning objects for different programming languages, and (iv) the quality evaluation of the developed objects and interest from other stakeholders of the Codewitz project.

## Introduction

Today, Internet is a tool that empowers society to school the illiterate, bring job training to the unskilled, open the universe of wondrous images and knowledge of all the students and enrich the understanding of lifelong learners (Saiful 2003). Internet based education is a form of distance education in which the course contents are delivered and the interaction are provided by the technologies and methodologies of the Internet. It may occur in places where there is none, extends resources where there are few, expands the learning day and opens the learning place. It is possible to connect people, communities and resources to support learning (Aggrawal 2000).

The real revolution now taking place is not the hardware and of technology, but the intellectual technology of information, communication and augmentation of human intelligence. One of the toughest parts of Internet based education is creating effective contents/objects. Content that suits the learning style of users and relevant learning scenarios improve the success rate of an e-Learning initiative significantly. Content development plays a key role in e-Learning (Mitra 2000). Designing of contents/objects with good interactivity is essential for an effective teaching and learning system. Development of such interactive objects is not an easy task for instructors who lack technical knowledge. It requires a collaborative work among experts from various fields (Cornford, 2000).

In this paper we try to address issues mainly related to Internet based education; like, content delivery mechanism via satellite based Internet infrastructure, the quality of delivered content through School on the Internet (SOI) network and the creation of

quality e-Learning objects specially for programming languages in CodeWitz project that will ultimately enhance the learning capability of the students and teachers alike.

### **Satellite Based Internet: SOI Asia**

Satellites are playing a key role in national or global infrastructures. Satellite-based Internet systems could play an important role in distance learning (DL). A satellite earth station can be installed anywhere on the ground as long it can receive satellite signal. Thus satellite based Internet can provide Internet environment in a less expensive way for the universities located where Internet environments are insufficiently developed. The broadcast capabilities of satellite networks make them inherently multicast-enabled and as a result satellites have been, and continue to be, used for DL implementations.

SOI is the studying environment to learn about the Internet on the Internet. SOI Asia project was started in 2001 with the objective to provide higher education and opportunity for all people around the globe who have the will to study using Internet based technologies, eliminating traditional limitations. Using the multicast capability of satellites, SOI Asia project contributes to the higher education in Asian region by utilizing satellite based internet infrastructure (Mikawa 2003). SOI Asia used the Asian Internet Inter-connection Initiative (AI3) project network infrastructure using C-band satellite communication which gives a total 9 Mbps unidirectional receive only bandwidth to Asian regions. SOI Asia project utilizes satellite based Internet environments in a less expensive, easy to deploy and more feasible way for universities located in Asian regions and the development of the necessary technology for IT human resource development in Asia. It also uses the environments to try to establish a new distance educational methodology for universities in Japan as well as educational institutions abroad through field experiments.

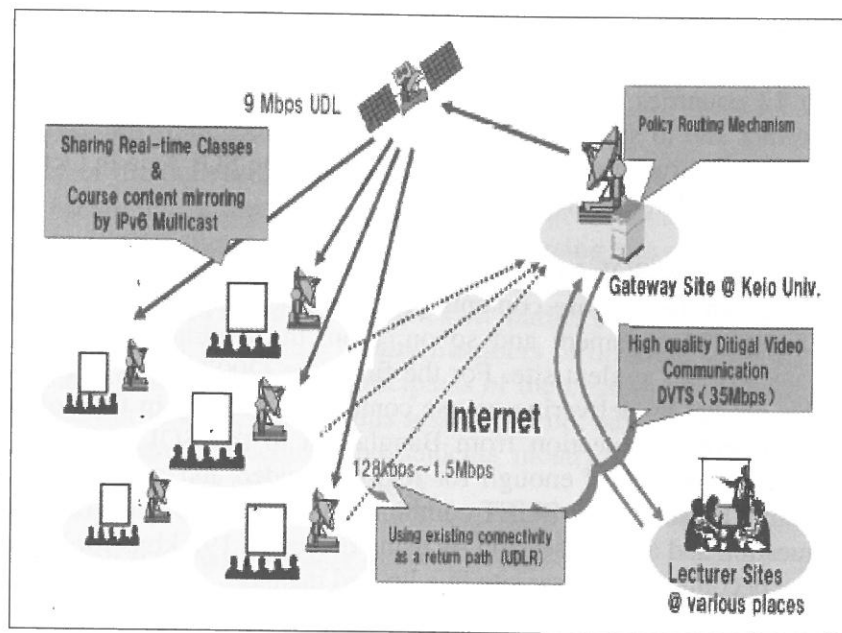
Depending on the activities SOI Asia designed the 1) lecturer site, 2) gateway site and 3) student site. The overview of SOI environment is shown in Fig.1.

eWitz project that  
ers alike.

es. Satellite-based  
) A satellite earth  
ve satellite signal.  
expensive way for  
ly developed. The  
ticast-enabled and  
entations.

Internet. SOI Asia  
ner education and  
udy using Internet  
lticast capability of  
1 Asian region by  
Asia used the Asian  
ecture using C-band  
ional receive only  
ite based Internet  
way for universities  
ology for IT human  
to establish a new  
well as educational

) gateway site and 3)



**Fig. 1 Overview of SOI Asia environment**

The lecturer site can be built anywhere as long as it has sufficient bandwidth to carry lecture video and audio in good quality to the gateway site. There are 4 types of lecturer site application configurations according to the network bandwidth: 1) site over 100 Mbps connection to the gateway site, 2) sites over 1 Mbps connection to the gateway site, 3) sites with over 128 kbps connection to the gateway site, and 4) gateway site is the lecturer site.

Mirror servers are located at the student sites for the students to the archived lectures, so that they don't have to connect to the remote/overseas original server. From the students' site, the lecturers get the feedback by video, audio, character based communication, phone or fax. Each site chooses the way in which they would send the feedback from the student's site based on the most suitable mode in light of their existing terrestrial Internet infrastructure.

At present, the gateway site is at KEIO University, Shonan Fujisawa Campus (SFC), Japan that has 1 Gbps connection to the Japanese network backbone and also has AI3 project's C-band satellite that can deliver Ethernet packets in 9 Mbps using UDLR (Uni Directional Link Routing, RFC 3077) technology. By using this environment the gateway is able to deliver good quality of video and audio to the student site.

### **SOI Asia Project: IICT, BUET Perspective**

Institute of Information and Communication Technology (IICT) of BUET aims to contribute to the Asian countries by sharing BUET professors' research results and also to enhance their own expertise by participating in other university professors' cutting edge technology lecture, through e-Learning system of SOI Asia project.

SOI Asia was launched in 2001 jointly by WIDE Project (Tomomitsu 2001) and KEIO University. As of June 2007, the project has 25 partner universities and research institutes in 12 countries in Asia, and has deployed receive-only satellite earth stations at each partner site to share the distribution of live lectures from various parts of the world as well as archived lectures. BUET has joined the SOI Asia in October 2004 and IICT is the SOI Asia BUET focal point.

Since joining SOI Asia in October 2004, BUET has participated in the live lecture and shared various lecture contents provided by SOI Asia, such as Information Technology, Disaster Management and so on. From the beginning, BUET SOI Asia environment basically is a student site. For the first time (2007) BUET professors' also contribute to this project by delivering course contents, especially in field of renewable energy. Since the Internet connection from Bangladesh to the SOI Asia gateway, KEIO University (SFC) is not broad enough for real-time video and audio transmission. Therefore, for lecture broadcasting, BUET combines 1) archived contents broadcasting, and 2) real-time question and answer session by using dedicated 192 kbps for 30 to 40 minutes per lecture and becoming a lecturer site in a limited manner.

### **Challenges in Implementation and Operation**

The primary challenge is in the implementation of the project involving equipment and technical expertise. SOI authority provides the satellite, networking and server equipments. They also arrange for extensive training programs for the system administrators and technicians. Currently BUET is smoothly offering the course by providing classroom facilities supported by facilitators. SOI is also providing online training programs for the facilitators and system administrators regularly.

### **Course Content and Student Participation**

SOI Asia project primarily focuses on contemporary issues of technical importance. It also has a long term objective of capacity building in participating institutions. With this perspective project dealt with subjects like Internet Technologies, Wireless Networking, Disaster Management, Renewable Energy, Marine Science. Courses are designed to be facilitated through interactive lectures broadcasted via SOI satellite for the students having some basic knowledge on the subject. Detail information and course contents are available at <http://www.soi.wide.ad.jp/soi-asia/>.

From students' perspective it was an experimental and innovative initiative. Initially they were a bit skeptical and took a bit of time to adjust to the e-learning culture. As BUET was introduced as a voluntary participation program only proactive learners ventured at the beginning. Later demand for participation increased significantly and now BUET has introduced a pre-registration process on a first-come-first-served basis. Researchers and academicians are also the beneficiaries of the system through facilitation of continuing education in contemporary issues of technology and innovation. Students' feedback reveals that uses of interactive animation, offline availability of course materials, timely response from facilitator are important for successful operation of the project. They requested for arrangement of some practical training whenever deemed required

u 2001) and KEIO  
l research institutes  
th stations at each  
rts of the world as  
004 and IICT is the

the live lecture and  
mation Technology,  
I Asia environment  
s' also contribute to  
wable energy. Since  
y, KEIO University  
sion. Therefore, for  
ing, and 2) real-time  
0 minutes per lecture

olving equipment and  
working and server  
ms for the system  
fering the course by  
also providing online  
larly.

chnical importance. It  
institutions. With this  
Wireless Networking,  
ses are designed to be  
ellite for the students  
nd course contents are

initiative. Initially they  
ning culture. As BUET  
ve learners ventured at  
itly and now BUET has  
basis. Researchers and  
icilitation of continuing  
on. Students' feedback  
course materials, timely  
n of the project. They  
ever deemed required

improving the quality of education. They also wished for the program to be included in regular curriculum of the institution.

### **SOI Asia Project Content Delivery and Evaluation**

To assess the quality of the delivered content and appropriateness of the courses offered (June 2006- May 2007) to the partner institutions, SOI Asia provided a 'SOI Asia Lecture monitoring Sheet'. In BUET site, we conducted a survey using this questionnaire sheet among the participants and the results are summarized in Table 1. From the table we found that except for the courses on advanced topics on marine sciences, all other offered courses evoked a high interest among the faculty members of different departments and as well as postgraduate students. Still, the participants of the courses felt inconvenienced during the question answer session, because this session did not have the facility of video, and communication between the lecturer and students mostly by audio and character based facility through Internet the relay chat (IRC).

### **E-Learning Objects and Codewitz Project**

e-Learning, which includes both purely Internet web-based training and hybrid, or blended learning that combines web-based and traditional approaches is growing faster than any other sector in post-secondary and professional education. Students like accessibility of virtual classrooms. Employers love the savings they can take to the bank. Many training companies have certain apprehension, however, worrying about potential cannibalization of existing business. This is a legitimate concern. Nevertheless experience has shown that fears of cannibalization do not materialize when e-Learning is taken as opportunities to both expand the reach and convert learning into a truly year-round experience. This makes e-Learning a valuable part of class offering to increase number of training companies and educational institutions (Kerry 2004, Pulichino 2003).



**Table 1 Course Feedback of SOI Project**

Sl no.	Course title	Target audience	No. of participant	Level of lecture	How was the main topic?	Frequency of lecture	Reason for non-participation
1	Advanced topics for marine science	Nil	-	-	-	-	No Marine Sc. Dept. in BUET
2	Tsunami phenomena and disaster	Faculty member	10	Easy	Very interested	Quite often	N/A
3	Advance topics for Marine tech. & logistics	Nil	-	-	-	-	No Marine Sc. Dept. in BUET
4	Earthquakes and their disaster reduction	Faculty member	12	Easy	Interested	Sometime	N/A
5	Advance Internet technology -III: Wireless network and mobile systems	Post graduate	25	Appropriate	Interested	Quite often	N/A
6	Object oriented software development	Post graduate	25	Easy	Very interested	Sometime	N/A
7	Metropolitan wireless mesh networks	Post graduate	18	Difficult	Interested	Not at all	N/A
8	Emergency care and long term recovery process	Faculty member	11	Easy	Interested	Quite often	N/A

One of the toughest parts of e-Learning is the development of effective contents or objects. Contents/objects that suit the learning style of users and relevant learning scenarios improve the success rate of an e-Learning initiative significantly. It is important for contents/objects to adhere to the objectives of the program and be powerful enough to engage the user. As e-Learning has become more widely used, the use of online content for learning has risen. However, much of online content typically delivers low level outcomes and thereby produces a mismatch between outcomes derived in the face to face setting to those derived online.

Development of e-Learning objects that matches intended outcomes and delivers the requisite cognitive load requires careful planning and structured development. IICT, BUET in September 2004 entered into an agreement with Asia-Link programme of European Union named Codewitz project, comprising 4 (four) universities spanning from Asia and Europe. These universities are BUET, Shahjalal University of Science and Technology (SUST) of Bangladesh, Tempere University of Technology, Finland and University of Applied Sciences, Berlin, Germany.

The main goal of Codewitz project is to plan, produce and evaluate unique illustration, animation and visualization aids for students and teachers of computer programming languages, who are involved in the field of professional and/or higher education. By reducing complexity in learning computer programming these aids, referred to as e-Learning objects help the learners to better understand and master, and the teachers to

ive	Reason for non-participation
	No Marine Sc. Dept. in BUET
ten	N/A
	No Marine Sc. Dept. in BUET
me	N/A
ften	N/A
ime	N/A
all	N/A
often	N/A

e contents or  
vant learning  
it is important  
ful enough to  
online content  
ers low level  
ie face to face

d delivers the  
opment. IICT,  
programme of  
ities spanning  
of Science and  
, Finland and

que illustration,  
r programming  
education. By  
ferred to as e-  
the teachers to

better explain and illustrate the problems connected to the use of basic and advanced structures in computer programming. The need for the development of e-Learning objects is based on the common observation that many students of computer programming encounter in their courses very serious learning-problems.

### Features of E-Learning Objects

A learning object can be almost anything. Any stand alone piece of information capable of teaching something can be a learning object. It can be a chapter in a book, a video, an image, a wiring diagram, an interactive application, a simulation and so on. As well as being of a flexible type, a learning object can be of any size. A learning object should be a self-contained, reusable, smaller unit of learning that can be aggregated with other learning objects to produce more substantial units of learning. They are generally tagged with meta-data to allow them to be easily retrieved by a search.

Each learning object should be developed such that it is self-contained so that it can be used without depending on other learning objects. These learning objects can be reused by the other courses that need to convey the same concept rather than requiring development of their own description. This can save both the time and the expense.

The availability of computational power and network infrastructure that greatly facilitate distribution and sharing of learning objects coupled with their flexibility and re-usability creates a compelling economic rationale for e-Learning objects. In order to make such a system distributed and interoperable, we need to ensure that there is a common language that different systems understand and communicate. Extensible Markup Language, or XML, developed by the World Wide Web Consortium seems like the obvious solution for its two main reasons. First, it is structured so it is capable of representing an object hierarchy. Second, it is in plain text and easily machine-readable. Thus, it provides a means of distributing content to other systems no matter where they are located and no matter what program they are running. Thus, a piece of learning material, no matter where it is located, may be seamlessly integrated into an online course, provided the XML tags are employed consistently.

### E-Learning Objects of Codewitz Project

BUET as a partner university of Codewitz project has developed more than 100 e-Learning objects in the area of C/C++, Java and embedded system programming. In addition, we also developed some learning objects on data structure, algorithm and operating system as well. We have selected the most complex and critical topics for e-Learning object development. Fig.2 shows the snapshot of a developed e-Learning object in Java programming language for method overloading.

The developed e-Learning objects are interactive and in some cases we incorporated animation for clear understanding. To ensure the quality, these objects are evaluated by a group of expert and with a brain storming environment. After accommodating the observations, the objects are uploaded to Codewitz material bank (CMB). The uploaded objects in the CMB from each partner university are evaluated by other partner universities and the system keeps the record of all comments, commendations and suggestions. In the bi-annual meeting of Codewitz project observations on different e-

Learning objects are discussed in detail and a date is fixed to address the shortcomings of the uploaded objects.

### Course Content, Participation and Evaluation

CodeWitz primarily focused on improving understanding of IT related topics to the students through improved teaching and learning tools with a global perspective. In this context project ventured into develop learning objects for C++, Java, Operating System, and Embedded System. Elements are designed to be facilitated through independent self-learning modules. Detailed information and module contents are available at <http://www.codewitz.net/>. The module development process is pretty simple and needs only basic expertise in Macromedia Director or Java Applet besides knowledge of the specific topic for which the module is being developed.

BUET has introduced Codewitz modules as complementary entities of relevant courses of the institution's curriculum. It is observed that students regularly access the modules which are available online and then start to develop learning modules themselves.

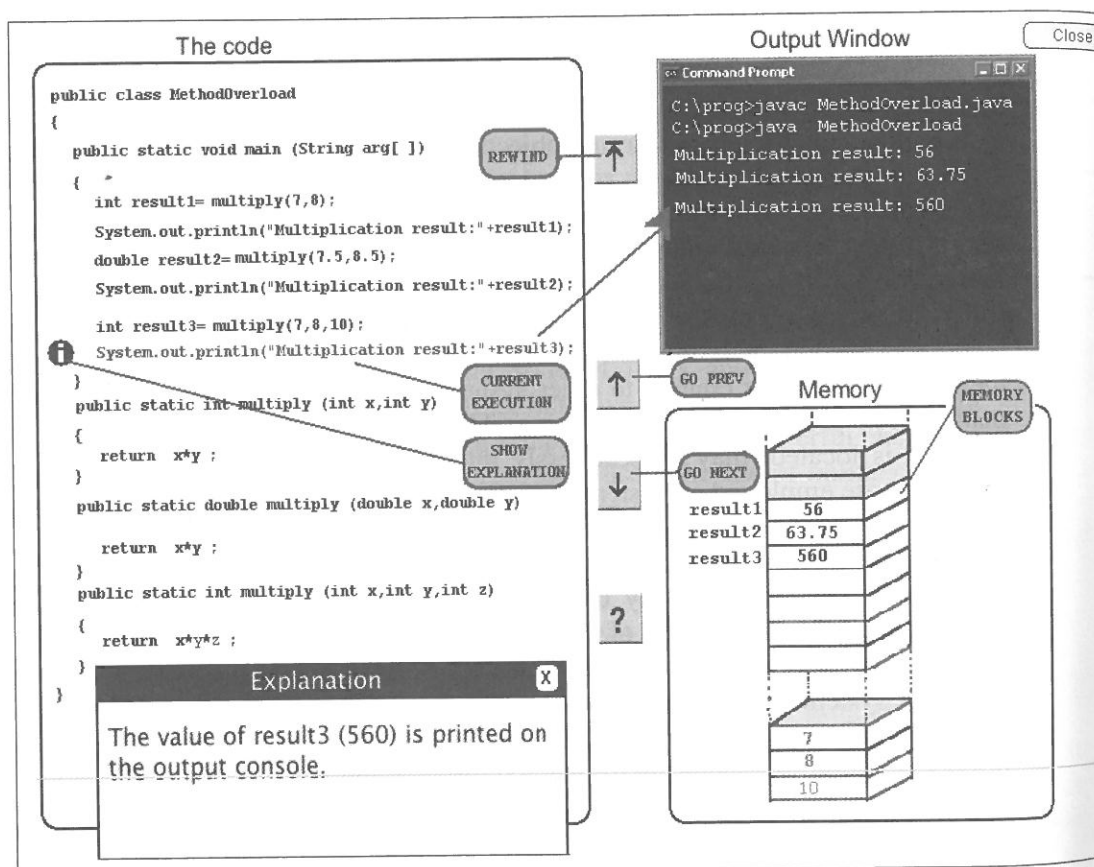


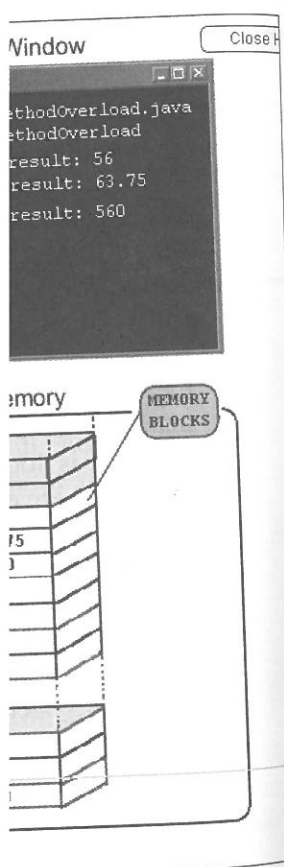
Fig.2 A Typical E-Learning Developed Object (Concept of Method Overloading in Java)



the shortcomings of

related topics to the perspective. In this Operating System, though independent self- are available at ty simple and needs es knowledge of the

s of relevant courses y access the modules s themselves.



Method Overloading in

## Distance/E-Learning Environment at BUET

Development of e-Learning/distance facilities is consistent with the capacity building and modernization process of BUET and is tuned with the long term objective of the university and also towards the fulfillment of global trend in advanced education. Considering all these factors, in October 2004, BUET established the satellite based school on Internet with the active cooperation of SOI Asia Project of Japan which is a totally advanced distance e-Learning facility. From its inception, a lot of short courses and lectures on special topics were attended by the faculty members of different departments/institutes and postgraduate students. This year (2007) BUET faculty members also participated as a resource person of SOI Asia and as a result BUET has become a member of the lecturer site. To run the daily activities of the BUET SOI site, human resource development is also important and SOI Asia imparted 3 month long operator training to one of the operators from BUET at SFC. In August 2006, 3 operators also attended the 5-day long global workshop arranged by SOI Asia project

There is no alternative of quality contents/objects to make the web-based e-Learning more interesting. Without quality contents the objectives of e-Learning will not materialize. Keeping this in mind, IICT, BUET joined the Codewitz project in September 2004 which is aided by the Asia-Link programme of EU. Through this project we have developed e-Learning objects in different courses of information and communication technology and particular emphasis was given on programming languages. By utilizing these objects the undergraduate students and teachers of BUET will highly benefit in terms of learning time and comprehension. Thus, working with these two projects BUET is establishing a pedagogical base for the effective and diverse use of Internet learning.

## Conclusions

Internet is changing the very structure of society. The question is no longer if the Internet can not be used to transform learning in new and powerful ways, nor is the question should we invest the time, the energy and the money necessary to fulfill its promise in defining and shaping new learning opportunity. Our ability to use the Internet to reshape education and learning requires actions that also interrelated and interconnected.

In this paper, we have discussed the two important avenues and their implementation i.e., satellite based Internet distance education and e-Learning object development for Internet based learning. Still, there are many other related issues to be addressed to reap the full potential of Internet and to make it available for all. Thus, through the successful implementation of the above mentioned projects IICT, BUET is gaining experience and will be able to develop a sustainable e-Learning model for Bangladesh in future.

## Acknowledgement

This research work has been carried out as part of the Asia-Link programme of EU Codewitz project. The authors also gratefully acknowledge the contribution of SOI/AI3 Asia Project of Japan in establishing the SOI at IICT, BUET.

## References

- Aggrawal, A. K, Bento R., 2000. Web-based Learning and Teaching Technologies: Opportunities and Challenges, Idea group publications, New Delhi, India
- Cornford, J, 2000. The Virtual University is... the University Made Concrete? *Information, communication and society*, vol. 3, no.4, pp. 508-525.
- Keichi, K, Keiko, O, Murai, J, 1999. Practical experiences of higher education on the Internet – cases from school on Internet, Proceedings of the ICCS, 1999, Tokyo
- Kerry, B, Mason, J, McLean, N, Wilson, S, 2004. Trends and Issues in E-learning Infrastructure Development
- Lee, J, and Dziuban, C, 2002. Using Quality Assurance Strategies for Online Programs, *Educational technology review*, vol.10, no. 2, pp. 69-78.
- Mikawa, S, Keiko, O, Murai, J, 2003. Establishment of a lecture environment using Internet technology over satellite communication in Asian countries, SAINT 2003 workshop.
- Mitra, S, 2002. Research and Development Issues in Internet Based Education, Center for Research in Cognitive Systems, Synergy building, IIT Delhi-10016
- Pulichino, J, 2003. Current Trends in e-Learning, *Research Report*
- Saiful, S. I, 2003. Prospects and challenges of Internet based education and research, *Proc. of international workshop on distributed Internet infrastructure for education and research (IWIER 2003)*, Dhaka, Bangladesh, pp.36-41.
- Tomomitsu, B, et. al.2001. AI3 satellite Internet infrastructure and the deployment in Asia, *IEICE transactions on communications*, vol. E84-B, no. 8, pp. 2048-2057