E-learning Based Capacity Building in Geoinformatics

Harish Karnatak*[+], P. L. N. Raju*, Y. V. N. Krishna Murthy** and A. Senthil Kumar*
* Indian Institute of Remote Sensing, ISRO, Dehradun; ** Indian Space Research Organization
Head Quarter, Bangalore .+ Corresponding Author Email: harish@iirs.gov.in

Introduction

E-learning or electronic learning is an active learning experience for the learners which works on interactivity or "learning by doing" methodologies rather than a passive learning methods in which the learners are sitting in front of the teacher and "learning by telling". E-Learning makes learning exciting, engaging and compelling with full involvements of learner in the subject. Difficult and boring subjects can be made easier, more interesting and appealing and learner centric with e-learning. Learning is a social activity, and e-learning means that powerful and enduring learning experiences can be achieved, not just through content, but through the use of online communities and networks (Jane Knight, 2003). In this mode of learning, the learners are encouraged to communicate, collaborate and share knowledge through Internet or similar network. E-learning includes various types of media like text, audio, images, animation, and streaming video etc. to deliver the contents to the learner. In typical environment the contents are shared either through CDs, DVDs, Tape, Hard disks or by Internet media. In e-learning based learning methodologies many methods are available like synchronous learning, Asynchronous learning, linear learning, Collaborative learning etc. These methods will be discussed in coming sections of this article.

The recent Developments in web and related technologies using Web 2.0 and AJAX has opened new dimension for skill development using new learning methods. The learning methodologies are moved towards self-paced learner centric environment. During last decade the utilization of Internet technology by different user groups in the society is emerged as a technological revaluation which has directly affect the life of human being (Karnatak et al, 2012). The role of internet technology is very important for capacity building in any discipline which can satisfy the needs of maximum users in minimum time (Karnatak et al, 2014). The successful implementations of internet based e-learning methods are already demonstrated for many areas in worldwide (www.creativity-portal.com, www.wanna learn.com, www.howstuff works.com/, www.skilldom. co.in/ etc.). One of the interesting e-learning contents available in Internet for different subjects is from Khan Academy (www.khanacademy.org/) where learning is available in very interactive mode with more involvements of learners in the subject.

The capacity building for geospatial technologies and applications using e-learning based methods are getting popular among user communities. Remote Sensing and geo-information science have become key technology tools for the collection, storage and analysis of spatially referenced data for resource planning and decision making (Karnatak et

al, 2007). Today it is the backbone to many decision-making systems and location-based services emerging in the new information economy. Planners and decision makers' utilize these geo-spatial technologies for variety of applications in agriculture, forestry, mining, market research, environmental analysis as well as the social, utility services and disaster management.

In the recent years, sharing and disseminations of geospatial information via Internet and World Wide Web (WWW) became interesting and most popular among geo-spatial community and general users. The online map and satellite data services like Google Maps, Bing Maps, Openstreet Map, ISRO Bhuvan etc., are some of the success stories. By using these web mapping services the users are able to generate some of the interesting applications using mashup architecture. The internet based GIS are now becoming a platform for further capacity building for geo-spatial technologies and applications. In this article various technical issues and challenges are discussed for Internet based e-learning for Geoinformatics. The Initiatives of Indian Institute of Remote Sensing (IIRS) Dehradun for e-learning based capacity buildings are also presented in this article.

E-learning based education system

E-learning or electronics based learning is the use of electronic media with Information and communication technologies (ICT) in capacity building including training and education. E-learning includes various types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet and web-based learning (Tavangarian et al, 2004). The e-reading based systems works on downloading the reading contents and read it offline while e-learning is a systematic learning system which guides the learners online with various learning methodologies implemented in LMS. The E-learning contents can be accessed by the students during live classrooms or in out of the classroom. E-learning can be self-paced, asynchronous learning or may be instructor-led, synchronous learning. E-learning is suited to distance education, but it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used (Wikipedia, accessed 12th Nov. 2014). E-learning based learning methodologies are also known as, technology-enhanced learning (TEL), computer-based instruction (CBI), Computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), flexible learning, web-based training (WBT), online education, virtual education, virtual learning environments (VLE), digital education, tele-education etc. The learning methodologies in different modes were presented by Nick Van Dam using education model of Charles Merril, 1960 (Mayer, 1960). According to this model the learners through electronic media remembers 10% of what they read (like e-mail, e-documents etc.), 30% of what they see (like online self-study guide, video, ppt etc.), 50% of what they hear and see (like e-course with audio and video), 70% of what they say or write (like live e-class, interactive e-course). The most effective mode of learn-

ing in electronic mode is what learner do (like simulation and gaming) where the learners are actively participating in learning process.

The levels of instructional design are very high in e-learning based system rather than e-reading. The virtualization of classroom through internet media is one of the emerging domain in e-learning environment. Here the term "Virtual" is used to describe a course that not taught in a classroom face-to-face but through a substitute mode that can conceptually be associated "virtually" with classroom teaching. In virtual classroom the student participates from remote places in live classrooms. The e-learning based systems are typically depends on internet and multimedia technologies which are the basic enabler of online learning.

The extent to which e-learning assists or replaces other learning and teaching approaches is variable, ranging on a continuum from none to fully online distance learning (Bates, A. and Poole, G., 2003; OECD, 2005). Further the concept of e-learning can be sub divided into four major sub categories:

Synchronous e-learning:

Synchronous learning occurs in real-time, with all participants interacting at the same time through some media like face-to-face discussions, live chat (audio, video and text), live lecture delivery, virtual classroom etc. The virtual classroom is one of the most popular technique which is getting very popular among learners.

Asynchronous e-learning:

Asynchronous learning is self-motivated and allows learner to engage in the exchange of ideas or information without the dependency of other participants or involvement of trainer at the same time. Asynchronous learning may use technologies such as email, blogs, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents (HTML, XML etc.), audio, video lectures, and social networking using web 2.0 (Loutchkoet et al, 2002).

Asynchronous learning is very effective for the working professionals or the participants those are not able to participate in lectures or practical in pre-fix time slot. In asynchronous mode of online courses, the participant proceed at their own pace and convenience. Both

the asynchronous and synchronous methods rely heavily on self-motivation, self-discipline, and the ability to communicate in writing effectively.

Linear learning:

Linear learning or e-reading through Computer-Based Learning or Training (CBT) refers to self-paced learning activities delivered on a computer or handheld device such as a tablet or smartphone. Zahm (2000) described computer-based training (CBT) as usually delivered via CD-ROM or as a Web download and that it is usually multimedia-based training. Karon (2000) discussed the convenience factor of well-designed computer-based training by saying that any well-designed computer-based training- whether it's networked based or delivered via the Internet – is more convenient than traditional instructor-led training or seminars.

Collaborative learning:

Computer-supported collaborative learning (CSCL) uses instructional methods designed to encourage or require students to work together on learning tasks. CSCL is similar in concept to the terminology, "e-learning 2.0" and "networked collaborative learning" (NCL)

(Trentin G., 2010). The utilization of Web 2.0 technology for collaborative learning is very successful by using Blogs, wikis, discussion forum, social networking, live chat, etc.

Technological standards for E-learning

The standards for contents creation and development of Learning Management System are important to achieve interoperability among learning objects in Internet environment. A learning management system (LMS) is software used for delivering, tracking and managing training and education. The first e-learning standards were developed by Aviation Industry CBT Committee (AICC) (www.aicc.org). AICC brings together trainers, courseware developers, software vendors, simulator designers and airframe manufacturers to develop standards, technology recommendations and analysis of best practices (www.coursea venue.com). The most popular AICC standards are AICC documents AGR-006 (File-based CMI Systems) and AGR-010 (Web-based CMI Systems).

Another important e-learning object is Sharable Content Object Reference Model (SCORM) which integrates a set of related technical standards, specifications, and guidelines designed to meet requirements including accessibility, interoperability, durability, and reusability of content and systems. The e-learning contents based on SCORM standard are delivered through SCORM compliant Learning Management System (LMS) like Moodle, Blackboard, A-tutor etc. SCORM is produced by Advance Distributed Learning (ADL), a research group sponsored by the United States Department of Defence. Since its establishment in 1997, ADL has worked with military and government agencies, industry, academia, and professional organizations world-wide to accomplish its mission and realize its vision that learning experiences must be accessible to all online and on demand (www.courseavenue.com).The SCORM version 1.1, 1.2 and 2004 are available for their implementation in LMS. The SCROM 3rd (2005) and 4th edition (2009) are most popular and widely used standards implemented in majority of LMS. The Tin Can API is latest development in e-learning object standards. The first version of Tin Can API is published in April 2013 and had its name changed to "Experience API" (xAPI) and "Next Generation SCORM" (SCORM, 2014). The Tin Can API solves many of the problems inherent with older versions of SCORM (SCORM, 2014).

The Hyper Text Mark-up Language (HTML) is most common language for development of online learning system in conjunction with JavaScript, XML and other server side programming languages like Java, PHP, C#, VB.net etc. using web 2.0 and AJAX. The XML provides an easier way to read and exchange information, allowing the reusability of the information presented in the files in order to present it in different formats and to different audiences without the necessity of reprogramming (Bray et al, 2004).

E-learning for Geoinformatics

The e-learning based online education is offered by different universities and Institutions across the globe in the field of Remote Sensing and Geoinformatics. A brief summary of popular programmes are given below:

Penn State University USA under the banner of COURSERA offers UG and PG course on Remote Sensing Image Analysis and Applications. Graduate Certificate in Geospatial Intelligence, Master of Professional Studies in Homeland Security - Geospatial Intelligence Option, Certificate of Geographic Information Systems and Master of Geographic Information Systems. COURSERA has also conducted online course on Maps and the Geospatial Revolution with video lectures and demonstration (https://www.coursera.org).

UNIGIS International offers online distance learning education across the world with different course structure for various countries. In UK, with collaboration of two universities viz Manchester Metropolitan University and the University of Salford offering certificate, PG diploma and M.Sc. degree through online e-learning based education system (www.unigis.org).

ITC university of Twente, Netherland offers several distance education based certificate and diploma programmes in modular structure with limited availability of seats. The contents of their online educa-

tion programmes are e-reading based rather e-learning. The six-week Distance courses (5 credits) have a weekly study load of 20 to 24 hours (www.itc.nl).

In India, the e-learning based online education programme is in emerging stage. The Open universities like IGNOU and Sikkim Manipal University (SMU) are offering various distance education programme (very limited for Geo-spatial technologies) but the interactive contents for e-learning are very limited. Status of major programme areas under:

The National Institute of Disaster Management (NIDM) under the Ministry of Home Affairs, Government of India is offering e-Learning courses on Disaster Risk Management. The Interactive contents are developed for Comprehensive Disaster Risk Management Framework and various thematic courses. The contents for NIDM course are based recorded videos and e-reading materials available for downloads.

Sikkim Manipal University offering distance education programmewith Master's Degree in Geoinformatics. They provide access through online

Learning Management System (LMS) and e-reading contents for its regular distance education students.

All the courses mentioned above are based on recorded videos and demonstrations where the learners has to play these contents as their own convenience and pace. It looks like an extension of classroom teaching where learning is based on "learning by telling". The interactive multi-media contents where the learners are involved in learning process are still very limited. The availability of teachers for live interaction is also very limited. But these efforts encouraging and exciting for learners.

IIRS Initiatives in e-learning for Geoinformatics

The initial focus of IIRS was to use EDUSAT/INSAT 4CR satellite for distance learning but extended the scope to use broadband internet so that access to large number of institutions/universities /individuals with little cost the user (Krishna Murthy et al, 2014). IIRS distance learning program initiated in 2007 and successfully conducted 14 programs in the last eight years. The first

course was attended from twelve universities and the number of institutions / universities increased manifold. The fourteenth course is in progress with more than 222 institutions /universities / departments with more than 4000 number of participants attending the program live and interactive. IIRS program is unique and interactive and demand is increasing not only universities but among research institutions, user departments and individuals. In this mode of online education the teachers are available for live classroom during 16:00 hrs to 17:30 hrs on daily basis during the course. The practical exercises are being conducted as live demonstration with open source and COTS packages. The live classes are being conducted using A-VIEW system developed by Amrita University funded by Ministry of Human Resources Development (MHRD), Government of India.

Further to enhance the outreach of geo-spatial science and technology, IIRS has developed e-learning contents and LMS for different certificate courses in Remote Sensing and geo-spatial technology. The e-learning courses are self-paced and learner centric courses. The syllabus of the courses are as per latest developments and trends in geo-spatial science and technologies with specific focus on Indian case studies for geo-spatial applications. The learning is made available through interactive 2D and 3D animations, audio, video for practical demonstrations, software operations with free data applications. The learning methods are implemented to make it more interactive and learner centric application with practical examples of real world problems.

The e-learning contents are created as interactive multimedia application and integrated with customized LMS based on Moodle. The user registration and admission module is developed outside Moodle LMS for proper user management and linking the participants with IIRS EDUSAT programme. The adopted e-learning objet standard and other technical details are shown in Table 2.

The hardware infrastructure is setup for 1000 concurrent learners with 100 Mbps Internet connectivity from NKN which is fully scalable to satisfy more number of participants. Open source software and data sets for practical exercises are also available to the participants. In future it is planned to give access to IIRS laboratory for practical exercises through private cloud.

IIRS e-learning courses are flexible for anytime, anywhere learning keeping in mind the demands of geographically dis-
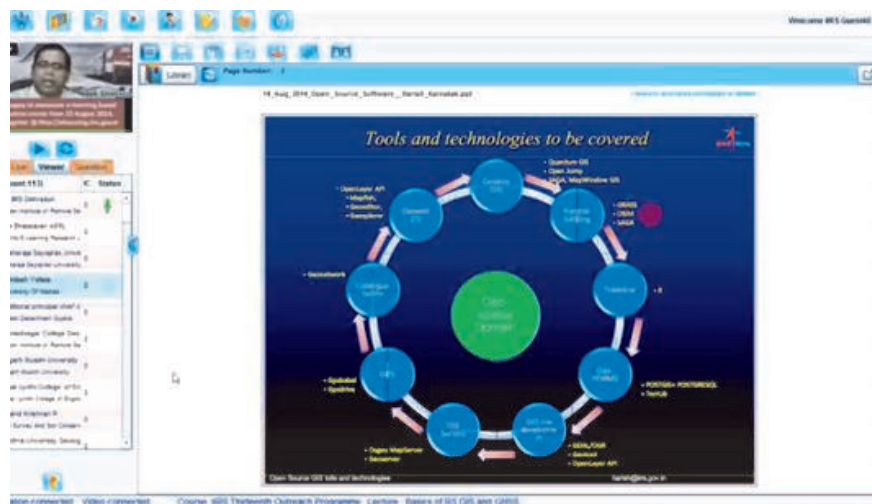

Figure 1- Online Delivery of lectures in IIRS Outreach programme

Table 1: Distribution of e-learning hours for available courses under IIRS e-learning programme

Subject	E-learning Hours	
	Theory	**Practical**
Image Statistics	3	2
Basic Remote Sensing	19	3
Photogrammetry and Cartography	12	2
Digital Image Processing	14	7
Geographical Information System	19	7
Global Navigation Satellite System	4	2
Customization of Geospatial Tools	3	5
Applications of Geospatial Technologies-Theory	4	-

persed audience and their requirements. Program is comprehensive with variety of online delivery modes with interactive, easy to learn and having a proper blend of concepts and practical to elicit students' full potential.

Following e-courses are currently available:

- Comprehensive certificate course on Remote Sensing and Geo-information Science - 4 Months duration.

- One month fundamental certificate courses on

  * Basics of Remote Sensing;

  * Photogrammetry and Cartography;

  * Geographical Information System and Global Navigation Satellite System

  * Digital Image Processing.

Conclusions

Electronic mode of learning is becoming an important tool for

Table 2: Technologies and standards

Component	Technology / Standard
Operating System	Linux
Database Server	MySQL
Application Development	PHP, Javascript and HTML, Flash
LMS	Moodle
Web Server	Apache
Object standard	SCORM 2004, 4th edition
Online classes	Apache OpenMeeting
URL	http://elearning.iirs.gov.in

capacity building in geo-spatial technologies and applications. The e-learning systems are based on self-paced, learner centric methodologies which focusses on "learning by doing" where learners are involved in learning process. The e-reading based systems works on downloading the reading contents and read it offline while e-learning is a systematic learning system which guides the learners online with various learning methodologies implemented through LearningManagement Systems (LMS). E-learning based education and training is one of emerging mode of learning by harnessing the power of ICT and educational tools in the area of Geoinformatics. The utilization of Internet and multimedia technology for capacity is very effective for remote sensing and geo-spatial technologies. Various e-learning object standards are providing an interoperable solution for online learning contents. The role of open source/freeware Learning Management System (LMS) is very important for wider uses and application of this technology. Moodle LMS is one of the ma-

Figure 3: LMS and contents delivery (Theory and Practical) in IIRS e-learning courses

ture software product which provide excellent platform to run e-learning based online courses. The e-learning concept is very new in education system where sometimes the students are confused in e-reading and e-learning. The validity of e-learning certificates and degree is still in discussion stage while for learners it is a successful platform. In geo-spatial domain e-learning based capacity building is good for theory and practical but the fields survey exercises are again depend on self-motivation of the participants. In future some virtual simulations for field exercises can be attempted for under-standing the geographical features.●

Acknowledgements

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