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E-learning in the Geoscience Domain: The Indian Perspective

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ABSTRACT

The Web 2.0 and e-learning technologies of today have enabled digital learning resources that enhance the learning experience of scientists and students from different fields. This paper explores the ways e-learning is being used in the geoscience domain and how geoscience libraries are placing their systems and services around them. After studying the worldwide scenario in this regard, the paper then reviews the Indian scenario. It proposes ways to enhance the role of the various institutions and agencies and the libraries affiliated to the Geoscience domain in India to gain from this technological development.

Keywords: E-learning, Web 2.0, e-learning 2.0, Library 2.0, geoscience library

1. INTRODUCTION

Knowledge and information are considered as the most important resources in today's world that leverage a nation's wealth and prosperity. This knowledge-based society is not only changing the global economy but also the status of education. Such knowledge-based information society demands a workforce that is literate in the use of technology that increases productivity and creativity. This has resulted in advancement and improvement in the quality of teaching and learning and also the sharing of knowledge and information. The use of information and communication technology (ICT) in education has resulted in expanding access, promoting efficiency, improving the quality of learning, enhancing the quality of teaching, and improving management systems.

The evolution of distance learning to overcome the physical barriers imposed by the brick and mortar infrastructure of education has resulted in the complete decentralisation of knowledge generation, representation, and dissemination[1]. Online learning or e-learning, in the simplest terms, is any education delivered using the Internet. Initially synonymous with distance learning via electronic media, e-learning has been around for more than 10 years. It has now been extended to incorporate traditional research blended with learning and teaching and is a combination of face-to-face and online instructions. The advantages of online learning are:

- The ability of anybody to learn anywhere and at any time.
- Increase in the scale at which learning can take place and thereby enhancement in accessibility.
- Cost reduction as it replaces the mode of content delivery.
- Personalised learning allowing individual learners greater control over their learning processes.
- Experimental new things, thereby eliminating the embarrassment of failure.
- Elimination of the rigors of classroom-based instructions that assumes the ability of learning as uniform amongst learners, thereby giving each learner his or her own pace to learn and excel.

The e-learning media of communication varies in its structure, role and use from one field to the other and this variance is most noticeable in the sciences. The Los Almos National Labs e-print server is the best known example that shows that high-energy physicists have long led the sciences in the use of electronic media for sharing working paper[2]. The world over, e-learning is being used by experts from all domains as a cost-effective solution to instructions. The geoscience domain is also not averse to such developments. Not only does the study of earth and space demand the latest technological tools, systems and techniques, but it also results in the most innovative technical developments. E-learning in such a domain, therefore, has to remain relevant to cutting- edge technologies for storage, access, and delivery of information instructions.

The Internet revolution gave the term Web 2.0 that further nurtured new ideas, identified as e-learning 2.0, for education. Though used since long as a information seeking tool, the Web today—best termed as 'Web 2.0' supports—enhanced multi-device oriented systems thereby further enhancing the concept of studying at any place at any time. Libraries as places that support learning, have struggled hard to maintain with every technological developments embracing each technical shift to fight obsolescence.

This paper reflects how the libraries and librarians are increasingly embracing the Web 2.0 technologies to enhance their services and be defined as Library 2.0. It explores the ways e-learning is being used in the geoscience domain and how libraries are placing their systems and services around them. After studying the worldwide scenario in this regard, the paper then reviews the Indian scenario. It proposes ways to enhance the role by various institutions and agencies in the geoscience domain in India to gain from this technological enhancement.

2. WEB 2.0, E-LEARNING 2.0 AND LIBRARY 2.0

The Web 2.0 is characterised by user-generated contents produced individually resulting in participation and thereby generation of networking effects, openness, harnessing of the power of the crowd collectively, and also resulting in the generation of data and information on epic scale. The Web 2.0 has generated the 2.0 lexicology, including e-learning 2.0 and Library 2.0. Web 2.0 products like wikis, blogs, RSS feeds, online office, social bookmarking, video repositories and online videos, podcass, social networks, and group workspaces are in use for sometime now. However, there are few instances to identify if e-learning 2.0, a term defined for the better usage of such Web 2.0 resources, actually employs these[3]. For some of these resources seem to have little or no impact on the overall e-learning scenario.

The Library 2.0 or L2 offers unique new ways to rethink and retool library services using tools like blogs, wikis, instant messaging, RSS, and social networking. It also offers new ways of involving patrons by letting them contribute comments, add tags, rate library items, and get involved in other interactive and collaborative activities. Thus libraries are making use of the collaborative tools and technologies to engage and share information rather than just provide it. Recognising that librarians need to know how to participate in the new media mix, for libraries to remain relevant, librarians worldwide are engaged in creating blogs and podcasts using Flickr, setting up RSS feeds, learning and using wikis, uploading videos into YouTube, playing with image generators, and exploring Technorati, tagging, and folksonomies. The 2.0 technology thus makes it possible for libraries to offer a lot more services without the licensing and maintenance requirements.

3. WEB 2.0 AND THE GEOSCIENCES

The digital resources, tools, and networks of the ICTs, influence ways in which scientists investigate the real world, the way they organise and communicate what they know, and how they think. Such resources offer effective ways of handling the geoscience information by opening up possibilities of more rigorous analysis with quantitative and statistical methods and more vivid visualisation techniques. Such tools have revolutionised the manipulation, management, and rapid dissemination of scientific data, information, and knowledge. E-science an abbreviation used for changes related with information technology in the scientific disciplines, used in conjunction with other terms like e-Research and e-Scholarship shows the transformative shifts sweeping across the scientific domains as a result of the information technology revolution in particular[4].

The Web 2.0 has facilitated the conduct of science and research into a global enterprise, which transcends geographical boundaries, disciplines, and educational levels. It facilitates the ability of scientists to work with experts from all over the world, to use resources distributed in space across international boundaries, and to share and integrate different types of data, knowledge, and technology being generated in real time from all around the world.

Information and communication technology applications have no disciplinary boundaries. As such, these applications have always been an integral part of the evolution of various branches of geoscience, which is centered on geology, but it inevitably, overlaps into various subjects like geophysics, geobiology, geochemistry, applied geophysics that includes geophysical prospecting and exploration, general geology that includes internal geodynamics, geotectonics, tectonophysics, external geodynamics, historical geography or stratigraphy, economic geology, and soil science. While atmospheric science, environmental science, surveying and geomorphology are related to the geoscience, one should not confuse these with subjects like hydrology, meteorology or oceanography, which are broadly into the domain of the Earth sciences[5]. The geosciences encompass an enormously complex human-natural system that operates over vast temporal and spatial scales. This discipline is a storehouse to massive data sets involving physical and digital information that is geo-spatially referenced. Geoscience data are highly heterogeneous and impact numerous other disciplines like ecology, medicine, biology, agriculture, etc. They are characterised by rich metadata and must be catalogued for long-term access involving decades or centuries owing to the nature of the associated research challenges.

4. E-LEARNING IN THE GEOSCIENCES: WORLDWIDE SCENARIO

The observations of the Earth's environment have been an activity since time immortal. The geoscience community is one of the largest producers of scientific data on the Earth's environment. Using the latest tools and techniques for gathering, storing, preserving, and accessing such data overtime has always been the forte of geoscientists. The Geographical Information System (GIS) is an example of the latest computer-based system for handling map information in this field. As such, educators and researchers have no difficulty adopting their teaching skills to the changing information world. Geophysics educators worldwide have been developing e-learning courseware as a useful aid for students. A number of geology, Earth science networks, organisations, institutions have developed educational and outreach materials on the web.

Probably, one of the best examples of technology being used over the web to explore the Earth's resources is Google Earth, with its huge database of images taken over a period of time. The US Holocaust Museum and Google have developed an impressive application to further enhance the web experience of the Google Earth and use it in classroom settings or otherwise[6]. This application can be used in lab or lectures; it mashes up data from the Google Earth, and uses personal testimonials and maps of settlements from the UN Office for Coordination of Humanitarian Affair. The result is an unbelievably striking display of images, thereby enhancing the understanding of a particular location, which would not have been possible otherwise.

In the US, while 70 per cent of all institutes offer distance learning, 80 per cent offer hybrid learning courses[7] where instructors post material on the web for students for further discussions. A number of e-learning modules of learning by doing for teaching students to use maps and aerial images, and to identify and analyse geologic features have been developed. For example, the Geoscience Department at the University of Massachusetts (http://www.geo.umass.edu/), has developed the dynamic digital maps (DDM) computer program, which is basically a 'presentation manager' that contains, texts, field trip narratives, and analytical data along with maps, images, and movies, which are displayed as icons when looking at a geological map. The DDM can be run on a computer projector on any lab/ lecture. It provides a rich learning environment in the context of digital images showing geologic examples and details. The Department of Geological Sciences of the University of Kentucky (http://www.uky.edu/AS/Geology/) uses the web to teach non majors about natural disasters like earthquakes. Drawing advantage of its postings of lecture notes and exercises on the web, it assesses students' learning. The Department of Geology at the University of Ball (http://www.bsu.edu/geology/) has implemented a web-based testing technique called INQSIT, which allows the teaching faculty to gain valuable class time, while increasing the flexibility in testing and reducing students' anxiety by decreasing the amount of study material covered for test.

A workshop on e-learning Environments for GIScience Education, conducted by the Centre for GeoInformatics, Salzburg University, Austria, as part of a project International Cooperation for GIScience Education co-funded by the European Commission under Asia Link Program in 2005 attempted to cover a number of e-learning issues with respect to GIS education. This resulted in the UNIGIS International (http://www.unigis.org/), a worldwide network of educational institutions, offering internationally recognised qualification via distance learning courses in the field of GIS.

Many country-specific projects, with respect to wide-scale implementation and adoption of e-learning as a new improved teaching strategy, can be found. New Zealand has undertaken a variety of projects, from course developments to even the smallest contribution to the e-learning process, being undertaken by teachers or departments or the institutions. With centralised funding from universities, these projects are implemented in the local context. One of its projects, Geology 205–New Zealand Half A Billion Years On The Edge (http://cad.auckland.ac.nz/index.php?p=eprojects) aims at developing the historic geophysical time-space relationship of New Zealand. Assessment linked to web resources would entail students building their own timeline and answering interpretative questions using a timeline map. Such a map would provide links to webpages covering stories, illustrations, just-in-time glossary, significant events, historic data, etc. Animations would be developed and photographs from the university's own collection would be used. Such materials would thus be without copyright.

Similarly, eight European Geo-Informatics Institutes have used their existing courses for course exchange through e-learning program (http://www.edugi.net/eduGI). For each course offered, a course is received in return.

For example, The Institutio Superior de Estatistica e Gestao de Informacao, Universidade Nova de Lisboa, Portugal, participates in the project by offering its e-learning course Geo-Spatial Data Mining. In turn it receives the course on project management, from the University of Munster, Germany. The UK has a national policy to encourage people to be familiar with new technologies that impart education[8]. The Geography, Earth and Environmental Sciences (GEES) practitioners in the UK are engaged in various projects in the development of e-learning materials over many years now[9].

E-learning cuts across space and time to reach countries like Serbia that are isolated geographically. The SinYU Project, the Scientific Information Network of Yugoslavia, was initiated and governed by the Max-Planck-Institute fur Physik[10]. This project currently connects the elementary and high schools with electronic libraries and local e-learning applications, with a goal of further expanding into the GEANT network, European Cyber Infrastructure Program that enables high-performance, Grid-enabled communications network for its researchers[4]. In Europe, Italy has embarked on the Educational Seismological Project (EduSeis) with the aim to develop and implement new teaching methodologies in the Earth Sciences[11]. This E-learning project has been built for high-school students, whereby students working in small groups are supervised by their teachers. Such a student-teacher interaction on the online teaching modules aids useful insights into the future contents, modules and activities of EduSeis, and offers a new approach to teaching seismology. The learning experience through such e-learning modules could easily be enhanced by further using the Web 2.0 tools and techniques described above in the geoscience domain.

5. GEOSCIENCE IN INDIA

The first systematic studies in the field of geological sciences in India began with the establishment of the Asiatic Society of Bengal in 1784. Asiatic Research was one of the society's most important journals in the field. Geological research further gained momentum with the establishment of the Geological Survey of India (GSI) in 1851[13]. GSI today is spread all over the country with its regional centres and circle offices.

Most of the universities in India, including the Institutes of national importance, are engaged in geoscientific study and research through their respective geoscience departments. These institutions offer undergraduate, postgraduate, and doctorate level courses in the area. Some important government departments that are engaged in geoscientific investigation and research include:

- Oil and Natural Gas Commission of India (ONGC)
- Indian Bureau of Mines (IBM)
- Central Ground Water Board (CGWB)
- Atomic Minerals Division (AMD)
- National Remote Sensing Agency
- Various Directorates of Geology in the different states of India

There are 16 central and state level autonomous research organisations in India. One of these being the Indian Institute of Geomagnetism. These organisations are fully or partially engaged in geological investigations and research. There are nine professional societies and associations contributing in significant ways towards the growth and development of geoscience in India by bringing out journals, organising seminars, etc. Recently, a new Earth Commission has been set up, and the Union Ministry of Ocean Development has been renamed as the Ministry of Earth Sciences (http://www.dod.nic.in/) to bring together all researchers on land, ocean, and atmospheric systems into the domain of Earth System Sciences. The aim of the ministry is to network all institutions and agencies involved in earth sciences, remote sensing, and oceanography in order to systematise work flow and remove functional flaws.

The geological prospecting and investigating departments are engaged in a highly competitive knowledge intensive work. Despite realising the potential that e-learning brings into the workplace, it is still in its infancy in the education or the industrial sector of geoscience and allied fields in the country. Apart from a few individual efforts and attempts at self-help, there is no concerted effort to leverage e-learning in the geoscience domain by private or public agencies in the country.

All the universities, research organizations, and professional societies in the field of geoscience in the country have a library associated with them. Most of the geoscience libraries in India have the requisite infrastructure and technical competence to embrace the latest in technologies and trends. The geoscience libraries have been involved with capturing, documenting, and organising traditional wisdom and knowledge generated over centuries. Some libraries, like the Indian Institute of Geomagnetism (IIG), have an invaluable collection of magnetic data. The IIG is the only contributor of magnetic data from India to a network of magnetic observatories established all over the world, under the name of World Data Center[14]. Similarly, other geoscientific institutes in the country are engaged in the production of various types of scientific data. Libraries in such institutes are involved in long term preservation, and generating subject-specific bibliographic databases. Despite experimenting with various modes of information provision, geoscience librarians have however, not yet engaged in any e-learning initiative. It would not be hard to say that since the education and industry sectors in the geoscience domain have lapsed in bringing the benefits of e-learning to their subject specialists in the first place, geoscience libraries as aids to the knowledge process have not made amends to their work process.

6. GEOSCIENCE LIBRARIANSHIP

The best example of digital library (DL) engagement in the e-learning scenario is the Digital Library for Earth System Education (DLESE)[12]. The DLESE is an online storehouse of high-quality educational materials about the Earth and its environment. Representing a beginning among the DL developers towards library-maintained repositories for data and documents, and the digital reference desk, the DLESE represents one approach to increase user involvement in growth of educational DLs. With an aim to provide a mechanism for the teachers and students to engage in online communication, the DLESE helps aggregate student reviews, generate individualised reports, and evaluate and reformat information tools and services to maximise the usefulness of the materials provided.

The geosciences libraries and librarians have a huge stake in the geoscientific information scenario in view of the enormous expenditure on geoscientific research. Worldwide the geoscience librarian community has responded positively to the constantly evolving web. Frequent courses, on the information skills required of the geoscience librarian/information specialist, are organised either by professional bodies, or the Geoscience Librarians' groups. Many of these societies have an online presence as websites, e-mail forums, or discussion lists. Courses focusing on subject specialisation, specific competencies and services with respect to the changing information scenario, users and their continuously changing information needs, management and teaching skills, seeking funding and grant writing, etc. are continuously offered. Such courses are either offered as seminars, or pre-conference tutorials, or as continuing education programs (CEP) of the department or institutes that the library or librarians is affiliated with.

More recently, the trend has been towards webcasts of seminars or conferences. Such webcasts often have their own wikispace, RSS feeds, and other widgets for further discussion and elaboration on the topics covered. Further a copy of the recorded webcast could be posted on Youtube.com or blogged. Besides the dynamic ways in which a library and information professional could engage him in the e-learning process as discussed above, an adaptation of any of the Web 2.0 tool would result in a more meaningful engagement of the geoscience information specialist with the Web 2.0 world.

7. SUGGESTIONS

The right implementation and combination of approaches with regards to ICTs can help India solve a number of problems pertaining to Indian education scenario. For example, a combination of virtual classroom, online tutors, digital libraries, and the virtual reference tools in local languages could help the rural Indian youth to compete with the outside world and move towards information literacy path irrespective of their socio-economic status. E-learning could be a powerful tool for lifelong training to workplace employees and help them remain competitive. It is thus a successful tool to re-skill large workforces that become redundant over time.

To remain relevant, libraries worldwide need to constantly adapt and re-invent themselves with any advances brought in by the ICTs. Library professionals can play a significant role in the E-learning process as such programs are tailored to update their knowledge periodically. Learning from a host of Web 2.0 implementation initiatives in libraries abroad, libraries in India in general and geoscience libraries in particular, too can undertake the following steps:

- Have features like study rooms and other spaces within the library devoted to support the users and their changing needs and habits.
- Should market and brand their services and products.
- The libraries with institutional repository or any such ICT implementation or any new user services, should brand their services as the leading unit in the institution.
- Build a web-presence, either in search engines or the wikipedia.
- Stress on providing services through the Internet or over the phone or the mobile.
- Libraries should use blogs, RSS feeds, widgets and other forums to stay informed of the latest subject enhancements and in-turn connect in better ways with the library users.
- Librarians should remain connected to their professional communities to remain update and informed of the happenings in their field.
- Library advocacy is a must and libraries must stress for the role of libraries in any decision regarding e-learning or any related policy.

The following suggestion need to be taken into consideration for E-learning initiatives in the geoscience domain:

(i) There is a need for the government and other interested agencies to consider geoscientific information as a basic ingredient for the growth and development of geoscientific research.

(ii) Professional bodies in the geosciences like GSI, can play an active role in enhancing the role of libraries and information professionals. It is proposed that such professional bodies could have a special group for information professionals like in the Geological Society of America. Such societies would be committed to furthering the role of libraries in geoscience education by promoting excellence in innovative approaches to library systems and services for furthering instruction, research, public service, and practice.

(iii) There should be a National Information Centre for geoscientific information. The centre could have local information centres for natural disaster awareness and mitigation.

(iv) To network all the geoscience libraries in the country and share their resources by bringing out a union catalogue of books, periodicals, reports, maps, reprints, microfilms, E-resources, etc. The community could have a presence on facebook with an aim at creating awareness of new and existing resources amongst the users. Besides collaborating and communicating within their group, the geoscience librarians could post online tutorials to help the library users learn the geoscience information resources.

(v) The Indian Library Association could have different caucus and sections representative of individual subject domains. The role of such subject-specific groups should be enhancement of the role of IT in library applications, the e-learning being one of its technical applications.

(vi) The Digital Library of India (DLI) initiative could have subject portals providing information space and tools to facilitate the work of students, educators, and scientists. Using open source tools, such digital portals could easily transform into a laboratory/ workspace by integrating digital repositories into the researchers' workspace, thereby enhancing the impact between research and education.

8. CONCLUSION

Education is the single most important instrument for improving the quality of life in the country. The right combination of learning tools can enable every individual to draw on his talents of memory, reasoning power, imagination, physical ability, aesthetic sense, aptitude to communicate, etc. e-learning tools have the ability to revolutionise the Indian education scenario. It can help in India's quest for information literacy amidst the huge data and information deluge. It can empower its citizens by imparting lifelong learning and training capabilities irrespective of their socio-economic status and bring India to the forefront of development.

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