

Challenges, Convergence and Integration of Synchronous and Asynchronous Technologies in Online Learning

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Abstract : *Internet, the most powerful computer network on the globe, provides the users a uniform, convenient and user-friendly way of accessing the vast resources world-wide. Internet and world-wide-web applications are the latest in a string of technology innovations which have captured the imagination and interest of researchers, educators and learners everywhere. It has the potential to meet learners' changing social and educational needs and, therefore, has a crucial role to play in open and distance learning in this new Millennium. It can be very well considered as a sub-set of diversified delivery mechanism of open and distance learning. Since the communication technologies are simultaneously exploding and imploding, they exert necessary influence on the ways in which learners learn and teachers teach. The effective use of these technologies can obviously extend the reach and flexibility of distance learning system many-fold.*

The web-based delivery mechanism provides unprecedented opportunities for the teachers and learners to teach and learn in a collaborative environment. The learning, here, can take place synchronously, asynchronously or in a domain with a combination of the two. The synchronous learning, which takes place in a real-time environment, is best suited to the learners who are able to meet at the same time but not at the same place due to various other commitments. On the other hand, asynchronous learning can better serve the learners who suffer from time as well as place constraints. Thus, Internet and WWW technologies can be used to effectively reach heterogeneous learner groups transcending the barriers of time, place and distance. The present paper analyses the integration of different synchronous as well as asynchronous tools and techniques in open and distance learning following a constructivist approach.

Introduction

The new applications of information technology have a great potential to improve teaching and learning from a distance. That is why the information technology is seen as a wonderful knowledge media. The emergence of Internet has revolutionised the open and distance learning. The technology media mix in the open learning has opened new doors for the teachers and the taught and has increased the accessibility of the ODL many-fold. The extensive use of technology has enabled the teachers and learners to identify and use technologies that integrate with their teaching and learning processes.

The use of technology and more specifically the Internet is a wonderful advancement for Open and Distance Learning. Wireless communication technology is also on the fray and the portable computers can now work without any visible wire connection. They can act as cellular phones with the help of an antenna erected at the side of computer and it can literally remove the transactional distance transcending the constraints created by physical connectivity gadgets between the teacher and the learner in open and distance learning system. The Internet has the capacity to meet learner's changing social and educational needs, in particular the need to choose their own time, place and style of study (Petre *et al*, 1998).

As a tool for learning, Internet has a prominent role to play as far as distance learning is concerned. Moreover, web-based learning and other associated technologies are inevitable in knowledge-based society (Khan, 1999).

Demystifying Internet

Computer technology has ever enriched distance learning with its distinctive features. Its increased use is seen in networking. Internet has come of age as the most powerful network of computer networks connecting personal computers, sophisticated mainframes and high speed supercomputers around the globe (Kochmer, 1995). At physical level, it is a collection of communication media which enables connectivity between remote computers. This traffic on the Internet is controlled by the software using protocols which are essential to perform in a distributed environment (Greening, 1993). Internet effectively communicates a piece of information between any two points around the globe in real time (Srishaila and Aptagiri, 1993). It also offers access to online library catalogues for many virtual libraries (Minoli, 1996). The Internet may always not be a useful tool and, therefore, in order to maintain its feature of user-friendliness, different tools and techniques are used e.g. WWW. These Internet and WWW applications are the latest string of technological innovations which have captured the imagination and interest of researchers, educationists and learners everywhere (Freeman, 1997). It has the potential to meet learners changing social and educational needs and therefore, best suited for the revolutionisation of the open and distance learning. Since the communication technologies are simultaneously exploding and imploding, they exert necessary influence on the ways in which learners and teachers interact for construction of knowledge. The web-based delivery mechanism provides unprecedented opportunities for learning to take place in a collaborative environment and its effective use can obviously extend the reach and flexibility of distance learning system many-fold. Synchronous and asynchronous technologies coming together have proved to be a boon for distributed learning.

Synchronous Environment

In a synchronous teaching and learning process, the teacher and the learner are made to interact on line while being away from each other. Synchronous environment helps providing real time text based learning and problem solving using screen sharing with live audio (Mason, 1997). Since it takes place in real-time, it helps in creating a sense

of classroom setting and thus covers the transactional distance between the teacher and the learner to a great extent. Since the activities of learning are synchronous and occur simultaneously at different places, the communication is instant. This instant interaction helps the learner in getting prompt feedback which acts as a motivational factor for him/her. Variety of tools and techniques are available on the Internet to facilitate distance learning in synchronous environment.

Chat

Chat provides an online real-time interaction through exchange. Plain text is used as the medium of interaction with the help of a software designed for the purpose. Some websites provide separate chat rooms where common interest groups can join the debate. It can assume different forms ranging from simple text transaction to audio and video support. Chat allows real-time text based conversation among multiple users. An important feature of Internet Relay Chat (IRC) is the provision of channels (Kouki & Wright, 1999). These channels can be considered as separate chat rooms dedicated to a particular topic or a particular interest group. It helps in creating a virtual classroom environment. Since chat also heavily depends on text, typing speech plays an important role in maintaining track of the discussion and deciding the level of active participation in the discussion. However, it is the most effective tool in a synchronous learning environment and is frequently used by the virtual institutions. Some softwares provided by popular sites like www.excite.com, allow and provide the users with graphics for illustrating facial expressions, thoughts and feelings.

Audio/Video Conferencing

Conferencing denotes interconnection of different users interacting with each other and holding discussion on a topic of common interest. The audioconferencing has an edge over chat as it can facilitate expressive communication and can use tones, inflections and pitch. It has, however, all the characteristics of Chat. The videoconferencing can transmit non-verbal communications also which may include body language, gestures, facial expressions etc. It is an emerging Internet services that enables the learners to establish low-end two-way-video and audio connections with teacher and other learners around the globe (Minoli, 1996). The advantage of videoconferencing is that the learner can utilize their time by listening and watching the experiments on video. However, where on the one hand videoconferencing provides an environment more close to face to face, net congestion makes transfer of huge data difficult and jerks in the audio and video become irritable for the learner being totally unsynchronized coming one after the other. But the richness of videoconferencing cannot be undermined since the experiments which need live demo, can well be shown on video in real-time. Audioconferencing tools offer a great potential for programme delivery. It is suitable for structured as well as unstructured discussions. However, participants become more active in videoconferencing and can assimilate the discussion material in a better way. It enriches the tele-learning environment and provides opportunity to the learner as well as teacher to meet virtually which otherwise is very difficult to meet face to face. Videoconferencing is a combination of dedicated audio, video and communication networking technology for real-time interaction. The audio/video conference can be

easily integrated into distance learning programmes with minimal adaptation to the course content and can support audio/video communication among multiple locations (Kouki and Wright, 1999).

Whiteboard

Sometimes along with chat or conferencing, certain illustrations are essential to be communicated, such as diagram etc. Whiteboard is a useful tool for providing such type of supplementary information. It facilitates graphical presentation of a problem on the board. The sharing of this virtual board enhances interactivity and promotes interest of the learner. It creates a shared, virtual whiteboard space for learners to exchange and share documents, display slides, write queries and comments, draw some models etc. (Kouki and Wright, 1999). It permits import of slides and other material from different sources to be viewed by all the learners sharing the board. It is generally a supplementary tool to substantiate audio/video discussion. Electronic whiteboard makes a dialogue among the researchers, educators and learners more interactive and effective by enhancing the collaborative research and learning process (Minoli, 1996). However, Bernholdt *et al* (2000) observed through their experiment with 'Tango', a collaborative tool of synchronous learning, that an electronic whiteboard would be an extremely useful tool in a distance education situation, though it is too clumsy for practical use in class setting.

MUDs/MOOs

The multi-user dimension/domain (MUD) or multi user domain object oriented (MOOs) is an effective synchronous tool of online learning. It helps the user interaction to take place in a real time, and provides a separate place for the common interest groups to discuss on the topic of their choice. Keeping in view its friendliness and ability to provide virtual classroom setting, this tool is increasingly being used for learner interaction to their teacher as well as peer groups. The latest technologies in this area allow users to scan images and attach to a movable onscreen body (Porter, 1997). The multi-user domain can provide a formal collaboration and role playing between the teacher and the learner in a virtual environment. In fact beauty of MOO is seen in providing virtual environment for learning. It is, therefore, becoming more and more popular among the virtual institutions. The MOOs designed for educational and professional interaction are, therefore, common now-a-days. The typical interaction with the help of this tool may include conference, tutorials, informal meetings etc. Though it is a synchronous tool, MOO also facilitates the use of asynchronous learning tools along with it. The MOO provides active learning support to the learner in a constructivist manner. However, the richness of the environment in a MOO depends upon the imagination and creativity of the teacher and the learners. It provides ample space for creation of new things, objects, situations and scene. At the same time, it encourages cooperative learning in which all the learners contribute their bit.

Asynchronous Environment

In an asynchronous environment, communication technology is used to work with remote interactive learning resources without necessarily being online at the same time. The

different strategies are applied on the learners who are separated by time and space but share common interests and, of course, electronic communication with each other. The learner control is a different feature in this domain, which emphasises the control over path, pace and contingencies of instruction (Doherty, 1998). The asynchronous learning implies that the acts of learning and the teaching are not simultaneous. The elements of asynchronous learning function as connecting devices between the instructional support and learner. Shifting to asynchronous techniques decreases dependence of instruction on face to face interaction. A shift from institutional-centered approach to learner-centric approach is the prerequisite for online learning. The challenge and excitement in an online programme for a teacher include determining as to which combination of delivery methods and communication tools would best suit the learning objectives of the programme and learner's life and learning styles. All the self-learning approaches are asynchronous in that they do not require the learner to synchronise his or her schedule with any one else or with any other event. By this definition, attending a class either face to face or through interactive TV would not qualify as asynchronous learning (Miller, 1998)

World Wide Web

The World Wide Web (WWW) is achieving a place of prominence in educational practice (Greening, 1998). It works in an asynchronous environment and is a part of a set of cognitive tools that have been adopted by a distributed global community. The distinctive feature of WWW is its potential to create and handle multiple links between text and other media not only within a particular document but also between some other document available in a distributed environment on any computer accessible to web around the globe (Alexander, 1995). It is a popular and useful instructional medium for a number of reasons. It is easily accessible and supports flexible storage and display options.

The hypermedia format used by WWW has received wide acclaim and its potential as a learning tool is derived from the nature of learning that it supports. It facilitates learner-centered approaches creating a motivating and pro-active learning environment (Becker and Dwyer, 1994). The WWW enables the user to easily navigate and access a large database world wide over the Internet. It now constitutes the most traffic on the Internet (Minoli, 1996). In order to communicate with each other, clients and servers use Hyper Text Transmission Protocol (HTTP). The hypermedia files are formed using Hyper Text Mark-up Language (HTML). The HTML file contains different links to other information sources having a unique Uniform Resource Locator (URL) address (Kouki and Write, 1999). The WWW in conjunction with Mosaic is an extremely effective mechanism for distributing and sharing information. However, more than often the access to this information is unidirectional, and limited by a client-server model where only predefined data are provided/accessible. With the technological development, WWW is possible to be harnessed to support bi-directional communication (Fong, 1994).

It is considered as an effective and excellent tool for asynchronous learning environment. However, of late WWW has been harnessed in such a way that it can facilitate both asynchronous as well as synchronous learning experiments. It can use both structured as well as unstructured learning material. However, flow capacity of a WWW can restrict fast transmission of data. The hyper media design characteristics of the WWW emphasize

the associative thinking pattern of an active learner and support the concept of discovering learning (Leonard, 1996).

E-mail

Email is the acronym of Electronic Mail. It is supported by a wide range of delivery agents or text editors and delivery mechanism. Multipurpose Internet Mail Extensions (MIME) is an extension to basic Internet mail (Minoli, 1996). It is an excellent tool to communication which works well in an asynchronous environment. It is widely used on the Internet. Email is the first and foremost attraction for a new user. It provides a popular platform for systematic data transfer. It also enables the user to send data files in different formats like graphics, audio and video as attachment. Thus email can be used to send several types of files ranging from plain text to sophisticated pictures (Kouki and Wrightm, 1999). Email and WWW comprise the core technologies of asynchronous learning environment. Though, it is labour intensive and long email message arouse boredom and disinterest, it is a cost effective tool of communication. It is a potentially faster method of distribution limited to learners with access to Internet (Porter, 1997). It is the flexible tool of communication since it can be used in-house to connect people via intranets or can be used to send messages across the Internet. It can be effectively used in one-to-one as well as one-to-many communication.

Email provides excellent opportunities for discussion outside the traditional framework of education and facilitates learning to take place anytime and any where. It can help learner to shoot questions for the teacher to be replied at his convenient time and place. Frequent use of email develops a personal relationship with the teacher as well as other fellow learners. One exclusive advantage of email is that it gives ample scope to the responder to diligently think and brood over the subject of discussion and saves one from extemporaneous retorts. In distance learning email is a wonderful tool for overcoming transactional distance and learner's sense of isolation. Electronic mail provides an entirely new wrinkle on communications by enabling us to communicate in quick, casual and often spontaneous way (Carton and Branwyn, 1995). It waits patiently to be answered at learners leisure which provides flexibility in time. It also maintains privacy.

Mailing List

Mailing list is bulk e-mail data transfer. It is helpful in discussion on a certain topic or in other case supplementary information can be mailed through the mailing list. The mailing list also is influenced by interest groups and many a lists are available depending upon the topic. It can be a small, intimate group of people interested in a similar topic carrying on discussions (Carton and Branwyn, 1995). Many a messages are generated by the mailing lists and a person can subscribe more than one lists but since the mails keep on coming from the different users it is quite difficult to manage the emails. Moreover the mails are received in a haphazard manner and establishing a link between the previous mails becomes quite difficult.

One benefit of the list is that it is a deliberate attempt to become a member of the list, hence generally truly interested people who either are experts in their fields or are

anxious to know more, join the list. The tool can be very useful way of keeping the interest of distance learners alive towards a particular topic. Since it establishes interactive communication online, the teacher can supplement useful and interesting information through the mailing list. It is a computer mediated many-to-many asynchronous communication technology. Electronic mail is the backbone of the discussion lists. The emails can be responded at the leisure of the user. It can also be used for holding virtual conferences. Since the listserv is the embodiment of an interest group, more professional interaction is expected to take place on it. Multiple number of lists on a particular topic can be found on the Internet.

NewsGroup

The newsgroups are another form of discussion groups. They work almost in the manner in which mailing lists work. These are interest group oriented devices for dissemination of information. Generally, the messages sent by different members are grouped together topic-wise. A newsgroup is a wide-open forum for any one with access to Internet to provide news (Portern, 1997). These are greatly helpful in seeking comments and feedback on a topic. The newsgroup keeps on discussing a particular topic at length unless the discussion is over. The concept of newsgroup can be explored to make online learning more effective and fruitful. The interaction which takes place between the peers will encourage them to be active contributors on the group. The attentiveness on the part of learner is the prerequisite for all types of learning irrespective of the mode of delivery of the programme.

Streaming audio/video

Streaming audio/video is a server based application. As the name suggests the audio/video file downloads starts in the form of a stream, maintaining a continuous flow of data. The audio/video would start playing as soon as the client starts receiving data and does not wait for download of full file. There is at the same time, no need to store the whole file on the client. The client would temporarily download the file and will use it for display purposes and as soon as the application is closed the data will be removed from the memory of the client. The online lectures can be stored on the server in the form of streaming audio/video for the learners who do not meet the teacher synchronously. It will again increase flexibility of time and prevent the learner from scheduling his activities with those of teacher and other learners which may otherwise be quite difficult for him/her due to various reasons. This tool can be exploited in a better way by integrating it with the requirement of a particular programme of delivery.

Challenges

Since the involvement of Internet in the field of education is not very old, there are many experimental difficulties in harnessing and implementing instructional plans for learning purposes through the advancing technologies. Moreover since, almost every alternate institution wants to register its presence in virtual campus, the challenges become heterogeneous depending upon the profiles of the institution faculty and the learners. Some of the common challenges which a new institution, a new faculty and a new learner tend to face are discussed below.

Resources and Structures

The technologies are ever changing and new innovations take place every now and then. As online delivery system advances, more comprehensive resources and structures are needed to support high quality learning and communication process (Dringus, 1999). Therefore, it is essential for educators and trainers to constantly enhance their understanding of the issues, trend and opportunities associated with web based learning and its related technologies and their impact on learning (Aggarwal, 2000).

Support Services

Since in an online programme, computer mediated communication is the only medium of interaction, the support services become more vulnerable and the index of transactional distance becomes highly sensitive. If the medium is under breakdown, it can play havoc with the mindset of the learner. The institution providing online educational programmes must ensure that ample technical support is available to the participating learners. Though, it may be required only at the early stage (Owston, 1997). It should also provide knowledge to the learner as to how to exploit and use the Internet resources and interact with the material provided online. The web instruction is still a new experience for many a learners. The effective use of technology for learning requires that the learners possess both the required equipment and the skills and willingness to use them for learning. The system must be user-friendly which requires minimal computer knowledge and skills (Morgan, 1998). Thus, the teacher has to help them adjust to the demand of such programmes, especially those who are not adapted to the use of computer for learning purposes.

Instructional Design

Instructional design for online programmes is another major area of challenge for the teachers. Providing too much information through hyperlinks on the website may mislead the learners. Hence links provided should be purposive. The frequent congestion on the Internet irritates the learners and leaves a negative effect on their motivation and can disorient them. Therefore, the media-mix and integration of the different learning tools- synchronous and asynchronous - and formats of information should be decided keeping in view the bandwidth.

Changing Roles

The roles and responsibilities of the learners and teachers take new shapes in online learning and, therefore, they need to be defined and applied to interaction and learning models that work well in online learning environments (Harisim *et al*, 1995). They have to understand their respective roles in order to make effective contribution in teaching and learning process. The distance teacher has to assume the role of a mediator between the resource material and the learners to motivate them and explain (Marsden, 1996). Concurrently the teacher should maintain flexibility in the face of addressing learners' problems and concerns (Berge, 1996). Increased responsibility and accountability for learning are required on the part of the online learner (McGrath, 1998). He also assumes the role of an active seeker and producer of information (Hedberg

et al, 1997). The learner must become manager of his/her own learning process and realize an internally focused casualty for learning (Terrell, 1994).

Pre-planning

When an online counselling or discussion programme is held, enough preparations should be made well in advance and necessary supplementary material supposed to be distributed should be kept ready before hand. Bernholdt *et al* (2000) recommend that preparation for each online lecture should begin thirty minutes in advance as installations do change and external networking and other factors can effect course delivery.

Convergence and Integration

With the development and growth of Internet and its allied applications, the networking technology is getting more and more popular and consequently new type of institutions (virtual universities) are coming up in a big way around the globe. These institutions have challenged the dominant paradigm of higher education by providing universal access to online courses (Owston, 1997). The courses run by such institutions follow a constructivist approach. The information/knowledge is not simply transferred to the learner rather he/she is helped to construct knowledge at his/her own and the institution acts as the facilitator and provider of education-rich resources for use by the learner. When learner makes learning at his own, he/she may have tendency to lose focus on the original intent of the course objective. Hence, the teacher has the responsibility to prevent learner from being strayed (Beaudin, 1999). Networking, the convergence and maturation of computing and telecommunication, has become a guiding force for an altogether new form of learning creating a paradigm shift — a change to a new mode(I) and set of expectations and rules for how to deliver successfully within a new learning environment (Harasim, *et al*, 1995). The networked learning combines fun and education for the learners as they surf the Internet.

The new technologies of online learning have to be converged and integrated in a harmonious manner and a suitable media-mix has to be adopted in order to effectively deliver the educational programmes. This media-mix adds variety to the learning experiences and allows presentation of ideas and concepts to be made graphically or in video (Mason, 1997). Communication technologies definitely exert a great influence on the way in which learning takes place (Graziadei, 1996). Though synchronous components tend to restrict movement of people in time and space, convergence and integration of multiple technologies further strengthen on-line learning system in synchronous as well as asynchronous environment. Asynchronous learning tends to overcome scheduling constraints by allowing the learner to determine about the time and place of study. The asynchronous interactivity — which takes place at learner's own time, place and pace, and synchronous interactivity — which occurs at the same time but at a different place as decided by the learner jointly with teacher, form the virtual classroom environment.

The mix of synchronous and asynchronous tools in learning can be decided by the availability of the technological infrastructure, requirement and suitability of the content

to be delivered and then teacher and the learner. Since, in synchronous activities instruction and feedback are prompt but tend to fix the learner in time and space, and asynchronous activities provide flexibility of time and place but are not prompt and simultaneous, an ideal mix and combination of the two will take the distance learning to new heights. The sole purpose of this convergence and integration will be to disseminate knowledge and skills to a large and heterogeneous learner segment so that the information generates the desired results. The availability and integration of the interactive technologies will simulate the development of new knowledge, material and services. The convergence of technologies that connect teacher to teacher, teacher to learner, learner to learner and campus with library, other universities, home, business schools etc. in ways not previously possible, will continue to nurture existing pedagogical and learning style (Wilson, 1997). It is, however, essential to understand how to improve the online experience so that it enriches the process of teaching and learning.

Conclusion

The web-based education has transcended all the barriers and borders. More and more institutions are jumping to join the global virtual campus. Not only the open universities like UK Open University, Hong Kong Open University, Athabasca University, Indira Gandhi National Open University etc., many conventional universities are also launching online programmes. The virtual institutions are able to provide education to the prospective learners around the globe. Providing education in such a scenario is often easier said than done. There are many challenges and issues which the institution as a whole has to face. These may vary from institutional policy to web security and copyright issues. The issues discussed here are more pertinent to support services and integration of different learning tools for effective learning. However, given the challenges and opportunities for global learning, there is a tremendous scope for expansion of web-based learning which eventually is borderless and flexible.

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