CHAPTER 5

TECHNOLOGIES OF ONLINE LEARNING (E-LEARNING)

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Introduction

This chapter includes an examination of some of the most exciting technologies and features used in online instruction today, and those we may use tomorrow. Education is one of the fastest-growing economic and social sectors in the world, and the use of new technologies is an integral and driving component of that growth.

Multimedia on the Internet

Multimedia incorporates text, graphics, and audio media (often with real video or animations) and combines them, using a computer. Almost every personal computer built today is capable of delivering multimedia presentations for entertainment, advertising, or education. *Edutainment* is a word for applications that incorporate multimedia entertainment with educational objectives.

Multimedia on the Internet is still not an everyday reality in the same sense as multimedia on CD-ROM or DVD, which may be commonplace in the home or classroom. Internet connection speeds limit the quality and quantity of what can be transmitted. Even with wired/wireless and high-speed advances, the transmission of large sound, animation, and video files can be time-consuming and frustrating.

However, with the introduction of streaming multimedia in the past five or six years, large multimedia files can now be delivered even over modem connections. Streaming multimedia is an Internet

data transfer method that facilitates the transfer of audio and video files from computer to computer in a "stream." Streamed media packets can be played as soon as the data starts arriving at the receiving computer—users do not have to wait until the full file has been downloaded. Streaming audio has been more successful than video, which has generally been limited to small picture sizes or low resolution (grainy) video projections, but as the bandwidth increases, higher quality, full-screen video becomes possible.

The key to this breakthrough is the format in which the files are distributed, or served, over the Internet. Large audio or video files are converted into a format that can be sent as a continuous stream of small pieces to a user's computer. At the user's end of the connection, special software interprets the "stream" of data and begins to play the sample. While the first part of the sample is being played, the next is being downloaded. The second begins seamlessly, the first is deleted, and the third is downloaded. Using this format, hours of audio and video content can be received over a slow modem connection.

Recommended Links

The following links provide some good examples of educational multimedia on the Web:

- Arnett, B., *Nine Planets: A multimedia tour of the solar system:* http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html

- East-West Project, Digital Numbering (flash): http://teleeducation.nb.ca/it/module3/section2/ASCII/ASCII.html

- Malloy, T., *Understanding ANOVA Visually* http://www.psych.utah.edu/stat/introstats/anovaflash.html

Streaming Audio

Audio was the first type of multimedia to be delivered over the Internet in a streaming format, and concerts and "live" radio broadcasts were among the first examples of streamed audio to

appear. A wide range of streaming audio formats is in use on the Web today, but while each is different in name, the basic technology remains the same.

When a sound file is to be prepared for streaming, it is compressed to reduce the overall size of the file. A news broadcast, for example, consisting of a single recorded voice, would normally be a smaller file than an orchestral sample. In some cases, compression also means that the quality of the file is affected.

Different programs are available for receiving streaming audio, each with its own proprietary sound or media format. Quality varies from format to format, but all are compatible with modem connections. Recently, these programs have become more generic, which is good news for the end user, who no longer faces the hassle of installing three different programs in order to listen to three different sound formats. Instead, the newer, more powerful media players can decode, decompress, and play a variety of proprietary sound samples.

Many of the Internet's most widely publicized "firsts" have happened as a result of streaming media events. The longest continuous Internet broadcast in history was in the form of a "jam session" held during the East Coast Music Awards in Moncton, NB, in 1997; and the record was bettered during the following year's ceremony. Producing a live, continuous stream of music (and in subsequent years, video) for over 80 hours was truly an impressive feat. Another, more widely known "first" was Paul McCartney's 1999 return to The Cavern, the bar in Liverpool where the Beatles first played. This live broadcast over the Internet was the most listened-to sound production in Internet history.

Educational Uses

Streaming audio is currently being used as a supplement to classroom-based and online course delivery, usually in the form of prerecorded lectures, interviews with guests, student projects, samples of student classroom interaction, or sound bytes of content relevant to the course of study. For music or English composition courses, it could be used by teachers or students to record samples of their work and to make them available to the teacher and other students. Streaming on demand is becoming a key feature in Web-

based education. For example, listen to Gustav Holst's musical interpretation of *The Planets* included in the list of recommended links given below.

Recommended Links

- Trussler, B., *Gustav Holst: The Planets Suite:* http://www .aquarianage.org/lore/holst.html

- Jupitermedia Corp., What's New: Internet News Channel: http: //www.internet.com/sections/news.html

- East Coast Music Association, *Your Music:* http://www.ecma.ca

- Jupitermedia Corp., Streaming Media World: http://www .streamingmediaworld.com

Streaming Video

First came radio, and then came television. And on the Web, first came streaming audio, and then streaming video. When a video sample is presented in electronic format, there are many more "layers" of data to be converted and compressed than is the case with audio alone. As a result, when this multimedia format is delivered over the Internet in a streaming delivery system, more technical and educational issues must be taken into consideration.

Size is the first issue. Video files are much larger than audio files, and video combined with audio is larger still. Video samples also demand more processing power on the part of the receiving computer. It is relatively simple to record sound—music, voice, or both—even on a home computer. However, recording video and saving it in an electronic format is more demanding on hardware and requires additional software. Because of this and other issues, video has taken longer to become an industry standard, and it is harder to find educational applications for streaming on the Web.

Receiving streaming video feeds on a home computer is not difficult. The newer versions of Windows, Apple OS, and Linux come with pre-installed streamers for audio and video. Generally, these streamers are sufficient for most educational applications. As is the case with streaming audio, different formats require different

applications; however, most multimedia applications now available for the home market have been designed to receive both audio and video streams. Superbowl XXXV, held in January 2001, saw the recreational and commercial use of streaming multimedia go to new heights. Long known for its glamorous halftime shows and extremely expensive commercials, this event was different from those of past years because of the means by which the commercials were broadcast. For those unable or unwilling to sit through hours of football to see a few commercials, several online video streaming sites encoded and broadcast the commercials within minutes of their "traditional" broadcast. By noon of the next day, hundreds of thousands of people had a chance to see what they had missed the night before. This application illustrates how events or sequences can be decomposed to extract only the relevant components. This technique is now driving the creation of modular, chunk-sized content objects often referred to as *learning objects,* or more precisely, *knowledge objects.*

Educational Uses

The stiff, unemotional "talking head" of a professor or tutor in a corner of an e-learning Web page is the image that most quickly comes to mind when one considers video clip use in an online educational situation. In such a presentation, a professor or tutor delivers a prepared lecture or shows an example of a hands-on activity; however, almost any video sample with educational value can be converted to a streaming format, and many will serve as excellent additional resources on an educational Web page or for classroom courses or online courses delivered synchronously. When implemented wisely, video can alleviate the "page-turning" boredom of many online courses. The LearnAlberta.ca project, included in the list of recommended links provided below, is an example of an educational video streaming project with a variety of video-based curricula for Alberta teachers and students. This project was established to define and deploy a prototype K-12 application.

Recommended Links

- Alberta Learning, LearnAlberta.ca: http://www.learnalberta.ca

- University of Washington, EDGE, Streaming Video Site: http://www.engr.washington.edu/edge/streaming.html

- CyberTech Media Group, *Streaming Video over an Intranet:* http://www.cybertechmedia.com/intranet.html

- MP3, *Top 40 Charts:* http://genres.mp3.com/download_charts

Push Technologies and Data Channels

It was inevitable that proponents, developers, and consumers of the existing forms of media (television, radio, and print) would attempt to take advantage of the Web's capacity to play "on demand," its exponential growth, and its diverse global audience. There are innumerable examples of new technologies that try to address the marriage between existing media, with their synchronous broadcasting of news, weather, and sports, and the asynchronous nature of Web publishing. Pointcast (now Infogate Inc.) was the first such service, offering up-to-the-minute customizable information to individual desktops.

Channels of "pushed content" are another source of dynamic and often media-rich content online. Channels are customized communications paths between computers, and are comparable to "Bookmarks" or "Favorites" within a browser, but with added features and interactivity. Standard Web sites require that the user browse the site to see any new developments or changes; however, Web content that is formatted for channel-based delivery is pushed directly to the end-user's desktop. Channels can be chosen, modified, or created from scratch. They are used for monitoring new content from relevant sites, as well as for navigating sites that the channel holder considers interesting. An individual user can create his or her own channel that links to a number of sites that pertain to a specific subject of interest. Customizable default channels might be "Archeology" or "Arachnids." Each channel can be subdivided into folders with further links; for example,

"Archeology" could be divided into "Roman," "Greek," "Indian," and "MesoAmerican" subchannels.

Educational Uses

Push technology applications can be used to feed inexpensive and timely news, weather, and sports or other information from relevant sites to a classroom for use in reports, essays, or current events classes. The growing number of channels available for subscription can offer supplementary information from a wide variety of sources, including sites such as NASA, the Science Channel, and the Computing Channel. As these technologies evolve, individual classes and schools will create their own dynamic channels, narrow-casting school updates to parents and other interested parties. Schools and parents should be vigilant in their school's use of these channels to ensure that they are used for educational purposes and not for advertising and other commercial concerns.

Recommended Links

- Discovery Communications, The Science Channel: http://science.discovery.com

- ZDNet, The Computing Channel: http://www1.zdnet.com/datafeed/ie4/channels/zdnet/cached/index.htm

- NeoPlanet, Neoplanet Browser: http://www.neoplanet.com/site/products/browser.html

- TEAM Software, Channels.com (the largest collection of channel links on the Internet): http://www.channels.com

Audio Chat and Voice over Internet Protocol

Text chat has long been a popular feature of the Internet. More recently, audio chat has also become popular. Point-to-point audio connections can be made between almost any two computers on the Internet, and some Internet service providers (ISPs) and online

services are now offering free Internet-based long-distance service that connects individuals calling through a personal computer to the public telephone system.

Although the quality of Internet phone calls, or voice over Internet protocol (VoIP), is currently somewhat inferior to that of dial-up long-distance telephone, consumers are becoming increasingly attracted to Internet telephony because of the lure of free or extremely cheap calls. About 25 million Americans now use Internet-based voice communication, up from five million in 1999 (Romero, 2000), and about two dozen companies have begun to offer online voice communication. Internet telephony is relatively simple, requiring an Internet hookup, headphones or speakers, and a microphone. After signing up with an Internet telephony provider, users can make local or long-distance calls to people with any type of phone. However, since voice transmissions are carried over the Internet in small packets, in the same manner as data transmissions, conversations can be subject to delays. Without a high-speed Internet connection, the quality of an Internet call can be poor, but companies are working to improve it. By 2006, International Data Corporation (IDC) estimates that 50% of the traffic minutes will be transmitted using VoIP (Glascock, 2002).

Educational Uses

Classroom-based, e-mail pen pal programs have been used for a long time as a way of making intercultural connections between schools. Internet telephony will add an opportunity for students to speak to others in their age group, almost anywhere in the world, It will, therefore, facilitate more fluid and natural communication between different cultural groups, and will be especially useful for foreign language exposure and practice.

Teacher or tutor and student communication can be greatly enhanced by the opportunity to speak to one another to discuss an assignment or a difficult concept without the expense of long-distance tolls. An *electronic blackboard* can be used along with VoIP for synchronous teaching. This practice is known as *audio-graphic teleconferencing.* Microsoft's NetMeeting is often used in this way.

Recommended Links

- FunPhone.com (Internet telephone and communicator): http://www.funphone.com

- Cybration Inc./ICUII.com. ICUII Video Chat (I See You Too, audio and video phone): http://www.icuii.com

- Selectra OOD, PC-Telephone.com: http://www.pc-telephone.com

- Microsoft Corp., NetMeeting: http://www.microsoft.com/windows/netmeeting

Web Whiteboarding

Web whiteboarding is a form of graphic conferencing used in combination with VoIP as a single tool in general Web applications that support real-time collaboration. Whiteboarding emulates writing or drawing on a blackboard. With a whiteboard, both teachers and learners can create, manipulate, review, and update graphical information online in real time while participating in a lecture or discussion. Using a mouse, an electronic stylus with a tablet, or even a large electronic classroom-sized whiteboard, users can annotate by writing; cutting and pasting; or clicking, dragging, and dropping. Contents can be saved and used in future presentations. Imported graphics can be used as underlays that the user can trace over, using an "onionskin" "placed" on top of the image; for example, routes can be drawn and redrawn on maps. The providers listed in the "Recommended Links" section below sell or rent "virtual classrooms," with size (number of simultaneous log-ons permitted) determined by the license and the bandwidth available at the central site. These products are now incorporating small video images as well as "Web safaris," in which the teacher leads the class to visit various sites, and application sharing that allows any of the distributed users to control a single application.

Educational Uses

This blackboard substitute allows for the emulation of classroom lessons. Students in different locations can participate actively and collaboratively with the teacher and with other students in the creation and adaptation of graphical information. It is particularly appropriate for brainstorming sessions.

Recommended Links

- Centra Software, Inc. Centra.com: http://www.centra.com

- Elliminate, Inc., Elluminate.com: http://www.elluminate.com

- Electronics for Imaging, Inc., eBeam: http://www.e-beam.com

- Department of Computer Science, University College, London, WBD Whiteboard: http://www-mice.cs.ucl.ac.uk/multimedia/software/wbd

Instant Messaging

ICQ (I seek you), a commercial product distributed freely over the Net, has been heralded as the "killer app" of the instant messenger genre. The easiest way to describe ICQ is to call it an Internet paging device. It has some similarities to other modes of text-based communication, such as e-mail or Internet Relay Chat (IRC). It allows short messages to be sent electronically from computer to computer. As in e-mail, the messages are stored on a central server until the recipient collects them; however, ICQ is more dynamic in that it shows all of the group members when the recipient logs on. Thus, the exchanges are often very rapid and work much like synchronous text exchanges. Attachments and Web addresses (URLs) can also be sent. Unlike e-mail, however, ICQ allows group chat sessions to be opened and voice chats to be established. In addition, and unlike most e-mail systems, ICQ is highly transportable: a user could have ICQ on a computer at work, at home, and on a laptop, and receive "pages" only on the active computer.

ICQ is only one of a growing number of *instant messenger* services that have appeared online in the last three years. Other than ICQ, users can choose from MSN Messenger (from Microsoft), AIM (AOL Instant Messenger), and a bevy of other similar applications. ICQ has been popular for some time, especially with technically proficient Internet users. More recently, because of the capacity of central servers, immediate and delayed message delivery, and increased functionality, instant messaging has become a popular choice for millions of users.

Educational Uses

Instant messaging is not yet used as an efficient content-delivery teaching tool. Its strength lies in its ability to facilitate immediate contact with other students and teachers, or with a tutor who is supervising chat sessions.

Recommended Links

- ICQ, Inc., ICQ: http://www.icq.com
- Microsoft Corp., MSN Messenger: http://messenger.microsoft.com
- AOL Canada Inc., AOL Instant Messenger: http://www.aol.ca/aim/index_eng.adp
- Jupitermedia Corp., Instant Messaging Planet: http://www.instantmessagingplanet.com
- International Engineering Consortium, *Instant messaging* (tutorial): http://www.iec.org/online/tutorials/instant_msg

Hand-held and Wireless Technologies

Imagine the power of the Internet in the palm of your hand, using a HandSpring, Palm Pilot or other personal information manager (PIM). Wireless technologies, cellular modems and hand-held devices are moving from elite gadgetry into the mainstream. How

will this cord-free revolution change how we work and learn? *Fortune* magazine claims that

> Your next computer probably won't be a computer. It'll be a phone, an organizer, or a pager. You'll use it for communications: to read e-mail on the go, to find the nearest gas station, to check your bank balance, to buy groceries. And it will connect to the Internet wirelessly. (Shaffer, 1999)

Mobile computing has arrived. Already, wireless devices are being chosen over desktop and even laptop computers, not only as the preferred Internet access tool, but also for common computing applications, such as word processing and spreadsheets. These devices are being disguised as telephones, tablets, e-books, and Web pads, and are now including a Web browser, an instant messenger, and an e-mailer, along with other features.

So your next computer probably will not be just a computer. It will also be a phone and an organizer, and will include other serious and gaming applications. You will use it to check your bank balance, buy groceries, and bet on the lottery. Cordless devices, pocket PCs, or PDAs (personal data assistants) are the wallets, checkbooks, calculators, and Rolodexes of the twenty-first century. The size of a calculator, or smaller, these devices are capable of basic computing tasks, such as handwriting-recognition text processing and contact management. More complex and higher-end hand-helds have multimedia capabilities, wired or wireless Internet access, and the ability to send and receive data and text alike. With the advent of infrared networking, these hand-held computer devices can offer students and teachers a previously unknown degree of flexibility.

Dr. Bess Sullivan Scott, a principal at Goodrich Middle School in Lincoln, Nebraska, has this to say about her handheld device:

> My Palm IIIc has improved my focus on instructional leadership by eliminating organizational time spent coordinating various paper records. Through analysis of data I have increased my time in classrooms as well as distributed my time among teachers more equitably. (Scott, 2001)

Dr. Scott understands the usefulness of wireless technology in educational management.

The basic construction set for much of the wireless traffic and applications to come stems from the Wireless Applications Protocol (WAP). Microsoft, among others, has joined a forum that will help to shape the programming languages, protocols, and processes for the next generation of the Internet, one that transcends the very infrastructure—cables, servers, and phone lines—that the Web is founded upon (see Wireless Application Protocol Forum Ltd., 2002).

Educational Benefits and Uses

According to a 2001 report produced by the research firm eTForecasts, in 2002, more than 673 million people would use the Internet, and 225 million of them (about one-third of all users) would have wireless access. By 2005, there should be a total of 1.2 billion people on the Internet, with the anticipated 730 million wireless users accounting for 62.1% of the total (Ewalt, 2001).

As affordable access to high bandwidth increases, and as the cost of wireless devices that will be able to incorporate all the features of a PC decreases, the educational possibilities become unlimited. It might mean the end of paper-based teaching and learning, lost homework, missing tests, and costly textbooks. In the Philippines, for example, people living in rural environments, even in communities without electricity, are using their cellular phones for text-based digital messaging. Newer applications, available using small devices, are opening up the possibility of using wireless to deliver graphics and video to users no matter where they are. Learning becomes universally accessible.

Recommended Links

- PDA Verticals Corp., pdaED.com: http://www.pdaed.com

- Palm Inc., Palm Products: http://www.palm.com/us/products

- Casio Computer Company, Inc., Casio.com (for handheld devices, go to "USA" and check under "Personal PCs"): http://www.casio.com/index.cfm

- Handspring, Handspring.com (handheld devices): http://www
.handspring.com

- Tucows, Mobile/PDA (PDA and handheld device software):
http://pda.tucows.com

- Lincoln Public Schools, Goodrich Middle School: http://
goodrich.lps.org

Peer-to-peer File Sharing

Perhaps the most publicized Internet event in the past couple of
years has been the controversy surrounding peer-to-peer, or file-
sharing, applications. Peer-to-peer applications allow users,
regardless of location or connection speed, to share practically any
kind of file with a limitless population of other Internet users. In
contrast to the currently predominant client-to-server model, where
users retrieve information from a centralized server, the peer-to-
peer model allows members of its "community" to transer files
directly between users, without having to access, or be constrained
by, a centralized server.

Of all the P2P (peer-to-peer) applications, Napster has become
the most well-known, because of its popularity and its ultimate
demise in the courtrooms. Napster became prominent because of
its focus on facilitating the distribution and sharing of files, and
especially copyright-protected media, mainly music files encoded in
the MP3 format. While P2P software and services have been
considered mainly as a means of downloading music files, the
technology and goals behind the peer-to-peer concept allow for
much more wide-ranging uses.

Andy Oram, editor of *Peer-to-peer: Harnessing the Power of
Disruptive Technologies*, notes that communities on the Internet
have been limited by the flat interactive qualities of e-mail and
network newsgroups, and that users have great difficulty
commenting on each other's postings, structuring information, and
so on. So he recommends the use of peer-to-peer applications with
structured metadata for enhancing the activities of almost any
group of people who share an interest (Oram, 2001).

Educational Uses

It is easy to make connections between learning objects, intelligent educational systems, and the peer-to-peer model. Research and other materials could easily be offered online and "harvested" by a well-designed P2P program, offering the student or teacher a wealth of knowledge that might not otherwise be available. Upcoming peer-to-peer educational applications include edutella and eduSplash, products that support the exchange of learning objects or units of learning.

Recommended Links

- Nejdl et al., Project edutella: http://edutella.jxta.org

- eduSplash.net, *Welcome to Splash:* http://www.edusplash.net

- Roxio, Inc., Napster (the infamous P2P application): http://www.napster.com

- Audiogalaxy, Inc., About the satellite (the next generation of P2P): http://www.audiogalaxy.com/satellite/about.php?

- Sharman Networks, Kazaa Media Desktop (P2P continues): http://www.kazaa.com/us/index.htm

Learning Objects

Knowledge objects are discrete items that can be integrated into lessons; for example, a text, graphic, audio, video, or interactive file. *Learning objects* are more highly developed, consisting of discrete lessons, learning units, or courses. A video clip from a speech would be an example of a simple knowledge object. It becomes a learning object when a lesson is added to it. Many different learning objects can be created from one such component; for example, lessons in politics, history, ethics, media studies, and many other subjects could be created from a single video clip. They could then be made available in online databases for efficient access by learners using international standards. Imagine having seamless access to a vast store of learning objects in the form of animations,

videos, simulations, educational games, and multimedia texts, in the same way that Napster users had access to music files.

Educational Uses

The principal benefit of learning objects comes from their reusability. As discrete units, they can be incorporated into a wide range of courses or learning scenarios. Their standards-based structure makes them available for use in many different learning management systems and other applications. They also appear to be pedagogically effective:

> NETg compared typical expositive courses with a blend of case-based learning and self-study learning objects. They found that the students who used the objects-based course enjoyed a 41 percent drop in the time required to complete the task that was taught. (Clark & Rossett, 2002)

Recommended Links

- MERLOT, *Welcome to MERLOT!*: http://merlot.org
- CAREO, Home: http://www.careo.org
- Longmire, W., A primer on learning objects: http://www.learningcircuits.com/mar2000/primer.html
- McGreal, R., & Roberts, T., A primer on metadata for learning objects: http://elearningmag.com/ltimagazine/article/articleDetail.jsp?id=2031

Conclusion

Does the Web offer us the potential to expand our classrooms and study halls beyond the school grounds, beyond provincial and national boundaries? Can our educational systems evolve into entirely new institutes that support learning by taking full advantage of the emerging technologies? Certainly, distance

education and traditional correspondence courses will never be the same because of the World Wide Web. All levels of education stand to benefit from what the Internet has to offer. For educators, Web participation could range from simply putting class notes and lecture materials online for absent students, to integrating dynamic online quizzing systems, to preparing classes for upcoming tests and examinations, all the way to enabling learners to participate in highly interactive, true-to-life simulations and games.

With the evolution of more user-friendly applications and interactive content encapsulated in learning objects, one need not be a coding expert to take advantage of the learning opportunities that are becoming available on the Web. Many instructors and learners are already bridging the divide by using hybrid access and delivery models, complete with an Internet component. As the cost of hardware, software, and telecommunications declines, even developing countries can look forward to a future where access to the wealth of the world's knowledge is assured. The future has arrived.

Disclaimer: The site links in this chapter were working at the time of submission in summer 2003. Some sites are those of small companies that tend to change from time to time. If you find a dead link, you should try a search using the title given.

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