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ABSTRACT

The term "online learning" refers to an Internet- or intranet-based teaching and learning system designed for World Wide Web-based delivery without face-to-face contact between teacher and learner. The Internet is the backbone of online learning. The following media are available to designers of online courses: text; graphics and images; audio and video; animation and 3D models; communication tools; electronic mail; mailing lists; discussion boards; and chat. Designing online learning requires grounding in pedagogy, understanding of the subject to be taught, and understanding of the workings of the Web. The following items are critical to building an online environment: (1) a needs analysis to identify the demand for online courses and course credits and equivalence; (2) a learner profile focusing on hardware/software, Internet access/bandwidth, and costs; (3) an organizational profile identifying expertise and infrastructure and the level of faculty development; (4) a blueprint containing pedagogical features, the media mix, provisions for interaction, assessment procedures, learner responsibilities, and the course's development strategy; (5) institutional preparation; (6) learning materials development; (7) evaluation; (8) promotion of the course; and (9) maintenance and updating. Developing effective online learning requires an understanding of the features of the Web and a carefully planned blueprint for implementation. (Contains 30 references and Web resources.) (MN)



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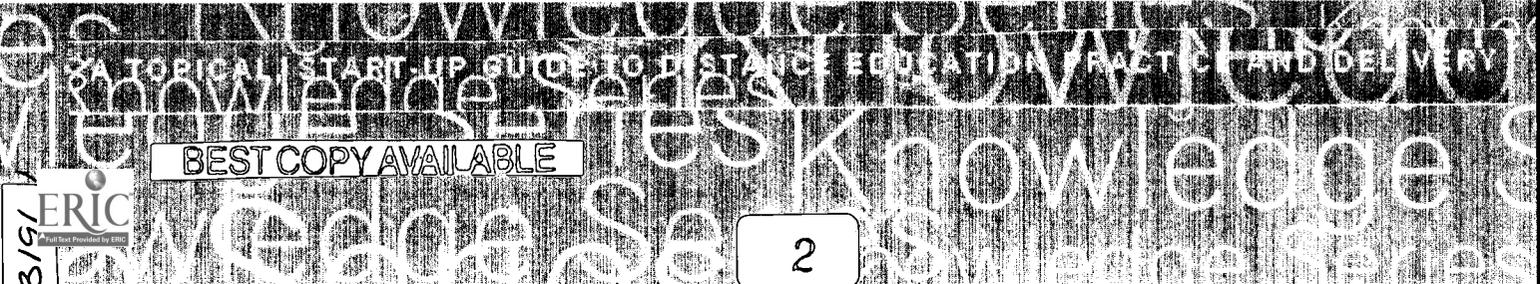
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Designing Online Learning

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Online learning is the new generation in the evolutionary growth of open, flexible and distance learning

Designing online learning requires grounding in pedagogy, an understanding of the subject to be taught and of how the WWW works.



INTRODUCTION

The Internet has simultaneously captured the imagination and interest of the world's educators. What drives this interest? Increasing demands for education, training and skills upgrading, a shift from a labour-intensive to a knowledge-intensive global economy, and the need for workers to earn while they learn. Online learning is the new generation in the evolutionary growth of open, flexible and distance learning.

Still, in November 2000 Internet users represented barely seven per cent of the global population. To ensure widespread access to online learning programmes in many parts of the world, it is often necessary and cost-effective to build digital "bridges" into their design:

- The United Nations Development Programme helped create Technology Access Community Centres in Egypt, bringing Internet and fax services to the poor and to rural areas
- Multi-purpose telelearning centers are being established in Bangladesh, India and Zambia through an initiative of The Commonwealth of Learning
- The federal government of Brazil plans to sell the Volkscomputer, developed by the Federal University of Minas Gerais, in installments as low as US\$15 per month. There is also a plan to provide Internet access to seven million students using the Volkscomputer.

This paper defines online learning as an Internet or Intranet-based teaching and learning system designed for web-based delivery, without face-to-face contact between teacher and learner. This definition covers other descriptions, such as e-learning, virtual learning or web-based learning.

ONLINE LEARNING TECHNOLOGIES

The Internet, the backbone of online learning, is an interlinked network of networks that allows computers worldwide to connect to it, and to communicate or exchange data with each other. The Internet is based on Transmission Control Protocol – Internet Protocol (TCP/IP); information is routed in "packets" according to TCP/IP specifications. The WWW works on the Internet through its own HyperText Transfer Protocol (HTTP), an interactive platform that uses the following media:

- Text, plain or formatted
- Hybrid text/graphics documents, such as Adobe Acrobat
- Colour images, still and animated or videos

- Sound
- 3-D models
- Interaction or simulation using JavaScript, VB Script, ActiveX (Ryan et al, 2000).

The WWW also supports real time, text-based chat and audio/video communication. The basic unit of the WWW is a web page, consisting of one or more of the media types above. A set of connected pages constitutes a website. Clicking on links in each page accesses other pages on a site.

Websites are *hosted* in a computer called a *server*. Individual *client* computers interface with the server computer through a web browser (such as Microsoft Internet Explorer or Netscape Communicator); when a specific address is typed into the address bar of the browser, the server supplies the requested web page.

ONLINE MEDIA CREATION TOOLS

TEXT

Preparing text-based learning material is relatively easy and can be done with only computer keyboarding skills. Text-based materials are also easily accessed and understood by learners. A typical web page is prepared using HyperText Markup Language (HTML) instructions; HTML files can be created using common word processing software, such as Microsoft Word. The WWW also supports other text formats, such as Rich Text Format (.RTF) or Adobe Acrobat's Portable Document Format (.PDF), which can be embedded within HTML-coded pages.

GRAPHICS AND IMAGES

Useful to clarify or illustrate concepts in an online learning programme. Graphics and images can be created, or digitised using a scanner and imported into a computer using specific image manipulation software, such as Adobe PhotoShop or Adobe Illustrator. Images are then imported into an HTML web page.

Common image formats include the Graphic Interchange Format (.GIF) and Joint Experts Photography Group (.JPEG), which use compression technology to make image file sizes smaller for quicker web display or download. Though graphics and images are useful learning tools, their preparation requires some skill and experience in using graphic design software. Graphics or images generally have a bigger file size than plain text, and take longer to download or to display on screen.

AUDIO AND VIDEO

Useful to show practical and real life activities. Hazardous and costly experiments can be captured using video for presentation on the WWW, for repeated use. With new digital audio and video *progressive download* and *streaming* capabilities, audio and video can be transmitted directly over the Internet although transmission quality still depends on the learner's network connection and available bandwidth.

Popular audio and video file formats and software include Apple Quick Time, Windows Media Technologies and RealNetwork's Real Systems. Another emerging format is the Motion Pictures Experts Group (.MPEG), although the disadvantage of MPEG is that the whole file must be downloaded before it starts to play. If high bandwidth is available, all these technologies can deliver high quality video and sound.

ANIMATION AND 3D-MODELS

Can be very powerful in teaching and learning spatial applications, but need high bandwidth to display well. The WWW animation standard is animated GIF files, although Java, Shockwave and Macromedia Flash are also used. The standard for 3-D modelling is Virtual Reality Modelling Language (VRML). A web browser needs a VRML plug-in to display 3-D models properly. Designing quality animation and 3-D models also requires a high degree of skills and experience in the appropriate software.

COMMUNICATION TOOLS

Internet communication is either asynchronous (email, mailing lists, bulletin boards) or synchronous (text-based chat, audio chat, videoconferencing). Web-based communication for teaching and learning has been popularised by the constructivist-learning paradigm (Oliver, 2000; Hung and Nichani, 2001), which is based on collaborative learning principles.

ELECTRONIC MAIL

Users send and receive email text messages asynchronously through a programme (like Microsoft Outlook or Qualcomm's Eudora Pro) installed on the user's computer, which sends and receives information through an email server provided by the user's Internet Service Provider (ISP) or office network. However, web-based email (like Hotmail or Yahoo Mail) allows users to access their account from any computer with an Internet connection. A user can send emails to multiple recipients simultaneously, and can attach files (word-processed documents, spreadsheets, images) to each message. This facilitates collaborative group learning at a distance, but puts the onus on the learner to initiate or maintain contact.

MAILING LISTS

Mailing lists are many-to-many communication channels on the Internet, managed using specialised software such as Listserv, Majordomo, and Listproc. People email instructions to join or leave a list to the computer running the service. Lists can be moderated or unmoderated, and can be used to collaboratively discuss and debate education or training issues within learning communities. However, too large a group can hinder rather than help the learning process.

DISCUSSION BOARDS

Internet discussion board systems such as WebBoard, Yahoogroups or Smartgroups are similar to mailing lists, with the additional feature of

everyone's messages being available on the WWW as a series of discussions. Messages are displayed online as they are received or as appended replies to the original message, allowing simultaneous coverage of many topics.

CHAT

Internet Relay Chat (IRC) is the standard for synchronous, multi-person, text-based chat. Most IRC applications (such as MSN Messenger, ICQ or Yahoo Messenger) are independent of the WWW, but can also be launched from a web page. The software keeps track from a central server of when you, and a list of people you specify, are online. You can text-chat or voice chat one-to-one, or in a conference. Some systems have an electronic whiteboard on which a teacher may "write" information viewable by all online chat participants, simulating a classroom situation. However, synchronous text or voice chat can create organisational problems – especially in globally offered web courses, where there are time zone issues.

BUILDING ONLINE LEARNING ENVIRONMENTS

Designing online learning requires grounding in pedagogy, an understanding of the subject to be taught and of how the WWW works. Collis and Moonen (2001) identify *institution*, *implementation*, *pedagogy* and *technology* as the key components; Jolliffe, Ritter and Stevens (2001) describe an 18-step process for developing online learning. However, they emphasise "there is no magic in the actual number of steps." The following is a possible plan of approach.

1. NEEDS ANALYSIS

Market research on the demand and need for an online course should be the starting point. The resulting report should contextualise the project, outlining its benefits or disadvantages and potential obstacles.

- *Demand for online courses*: does real demand exist? Will online delivery be cost-effective? Is it the best option currently available?
- *Course credit and equivalence*: how will course credits be transferred for certification? What about the equivalence of the course with face-to-face programmes? Is it necessary to get certification from an accreditation body?

2. LEARNER PROFILE

This will help you understand who your potential learners are, and how you can best fulfil their learning needs.

- *Hardware/software*: do learners need to purchase special hardware or software to access the course? Most computers now ship with a web browser. If learners have to download a special plug-in from the Internet to view a particular course component, it is better to provide them with a CD-ROM of that component to save costly Internet access time.
- *Internet access/bandwidth*: how accessible is the Internet for the learners, and what bandwidth or connectivity (e.g. dial-up modem, DSL, cable) is available? Low bandwidth availability has significant design and pedagogic implications. You can't prepare learning materials based on graphics, animation, sound or video

TABLE 1: LEARNING EVENTS BASED ON INTERACTION

INTERACTION METHOD	LEARNER-CONTENT	LEARNER-TEACHER	LEARNER-LEARNER
ONE-ALONE (WWW paradigm)	WEB PAGES WITH GRAPHICS ANIMATION, AUDIO, VIDEO, QUIZZES INTERACTIVE CHECKS ON PROGRESS		
ONE-TO-ONE (email paradigm)		EMAIL CHAT, ONLINE DIARY, TUTOR-MARKED ASSIGNMENTS	EMAIL CHAT (SOCIAL AND/OR ACADEMIC)
ONE-TO-MANY (bulletin board paradigm)		EMAIL MAILING LIST, GROUP CHAT, DISCUSSION BOARD	EMAIL MAILING LIST, GROUP CHAT, DISCUSSION BOARD
MANY-TO-MANY (conferencing paradigm)		GROUP CHAT, DISCUSSION BOARD	GROUP CHAT, DISCUSSION BOARD, GROUP PROJECTS, PEER-BASED EVALUATION

because of the time and costs involved for learners to adequately view or download the materials.

- **Costs:** who will bear the cost of needed computers and Internet access? Although normally this falls to the student, the costs may be prohibitive. Is it possible for your organisation to arrange for subsidised learning, in partnership with industry or government? Can you facilitate educational loans? Is it possible for you to create learning resource centres, with computers and Internet facilities, for group learning and access?

3. ORGANISATIONAL PROFILE

Your organisation must be prepared to undertake an online learning project.

- **Expertise and infrastructure:** do you have the in-house expertise to design, develop and deliver an online programme? Do you have the infrastructure to support online courses, or will upgrading be needed? Can you affordably outsource expertise (content and technology) and infrastructure from elsewhere?
- **Faculty development:** How prepared is your faculty to handle additional online courses? Will faculty be compensated for any extra effort, and in what way? What training facilities are available for teachers to upgrade their teaching skills for the online learning environment?

4. BLUEPRINT

In addition to the needs analysis, learner and organisational profiles, the blueprint for the course should contain:

- **Pedagogical features:** Online teaching and learning must meet the requirements of the subject and the needs of the target learner group. Online learning can be a supplement to face-to-face instruction, equally mixed with face-to-face instruction, or the main delivery method, instead of face-to-face instruction. The last category is the most challenging for educators and instructional designers. When designing online learning, it is best to consider the best practices of all learning theories (behaviourism, cognitivism, constructivism). The WWW provides opportunities to use all these.
- **Media mix:** An appropriate media mix for the course, taking into account the suitability of a given media to a particular subject (such as using 3-D models for an architectural drawing), will increase the effectiveness of student learning and contribute to the successful achievement of course objectives. Media delivery options must be decided during course content planning, so that the appropriate media creation tools can be used for content development.
- **Interaction:** Interaction is a major contributing factor to successful learning experiences. Table 1 lists different possible learning technology combinations, based on three basic interaction modes (Moore, 1989) and on four methods of computer-mediated communication (Paulsen, 1997).
- **Assessment:** Assessment and evaluation of learner

performance is crucial. Although online examination brings a number of authenticity, security and certification issues, evaluation models should take the WWW's constructivist (student-centred) approach into account. The WWW can facilitate many evaluation systems – from computer-based (web-based) objective testing to tutor-evaluated, long answer tests or assignments – but is capable of supporting much more than the traditional, three-hour paper and pencil test. Online course developers now use alternative assessment tools such as evidence-based tests (where learners submit projects online), learning diary submission, participation in discussion forums or peer-based evaluation.

- **Learner responsibilities:** The nature of online learning requires learners to be very self-motivated. The role of the instructor is to challenge learner curiosity and help learners achieve personal learning goals. Online learning should therefore be designed according to adult learning principles, in which learners have as much responsibility as their teachers, if not more. Learners need to be informed of their role and responsibility prior to starting the course. A period of orientation may be needed, as most online learners are initially novices of the medium.
- **Development strategy:** At this point in the design and development of online learning, most institutions and instructors have to decide if the course will be developed using a suite of individually available web tools, or an integrated course delivery software package.

In general, web-based applications such as email, discussion groups and chat software are not designed for educational purposes. Using them in isolation or developing an integrated educational system around them may not be effective in terms of cost, time or learning outcomes. *Integrated systems for online learning* are needed because the generic web environment does not provide:

- a standard way to organise course materials
- prior evidence of the environment's instructional effectiveness
- tools to support basic instructional activities such as course design, organisation of groups spaces and personal spaces, grading, and easy integration of multiple media files
- models to support learning strategies that involve collaborative learning, knowledge building and multiple representations of ideas and knowledge structures (Harasim, 1999).

Commercially available, integrated application software packages include facilities for every aspect of designing an online learning programme.

Learner tools are available to learners when they log on to the system:

- Course tools:* for content presentation, displaying

industry-standard, interactive web pages to learners. The pages have links for navigation, and contain all course texts, graphics and multimedia learning materials

- ii) *Collaboration tools*: for synchronous and asynchronous activities like email for one-to-one communication, discussion boards for conferencing, chat for real time clarification of doubts, whiteboards for lecture presentation and group work, or a virtual "drop box" for sharing programmes and applications
- iii) *Support tools*: include personal learner profiles, a facility to upload files to the system (e.g. for submitting assignments), personal library, search facilities, study skills guidance, bookmark facilities (to remember where you stopped in the last session) and calendars.

Developer tools for the website administrator and the instructor. These seem initially more complex, but are easy to use after a short training or demonstration period:

- i) *Administrator tools*: allow course software to be installed on a server, provides resource monitoring and website management facilities. Assigns user identification, passwords and usage rights to learners. Some systems also handle online registration and fee payment
- ii) *Designer tools*: online teaching tools for the instructor. Includes facilities to prepare course plans, upload files (course content) and announcements, design assessment tools (such as quizzes) and a calendar of activities. The instructor can also design the appearance of individual web pages through choice of background colour, text font and type of images or graphics.

Learning management tools are features to track student progress and log-ins to the website. Instructors can monitor the progress of individual learners and provide personalised feedback. Complete statistics on website use can be generated for reviewing or evaluating policies and practices. Interactive user guides and "Help" facilities for troubleshooting and systems operation are also common in almost all software packages, for both learner and developer tools.

5. INSTITUTIONAL PREPARATION

Any project-related hardware or software should be installed and tested. All involved faculty and staff should be trained in the systems and equipment, and should be familiarised with the pedagogical techniques.

6. LEARNING MATERIALS DEVELOPMENT

Implementing course development and design standards maintain consistency, especially if many people or partner organisations are involved. Since course development is time consuming, it is worth securing permission to use or adapt existing material where appropriate to launch the course more quickly.

7. EVALUATION

Once course materials are uploaded to the online learning environment, there should be a field trial of the learning materials and usability testing of the website, possibly through an initial pilot project. No online course should be launched without thorough evaluation. Consider:

- *Learning effectiveness*: how does the online course compare with face-to-face or other distance delivery methods?
- *Cost-effectiveness*: take into account the high initial set-up cost, and any ongoing costs such as upgrading of equipment or software.
- *Learning environment*: how do learners negotiate the online environment?
- *Accreditation*: the issues/problems in accreditation of online learning.
- *Evaluation*: how do you improve the evaluation process?

8. PROMOTION

The course must be promoted both online and offline to its target learners, with plenty of lead-time for course registration. Ongoing promotion will encourage the level of enrolment needed to make the programme financially viable.

9. MAINTENANCE AND UPDATING

Online programmes require constant updating and maintenance to be effective. Learners need prompt feedback to address concerns and technical problems. Course instructors or specialised personnel should be trained to constantly monitor and maintain the website.

CONCLUSION

Designing effective online learning requires an understanding of the features of the WWW and a carefully planned blueprint for implementation. The emergence of integrated systems for online learning has somewhat simplified the design process, but the instructor or manager of an online learning programme still has to have clear objectives to work from. In the initial planning stage, identifying the design requirements that are compatible with your needs and objectives will help you choose the right integrated system. Evaluation is also essential to improve on existing instructional design.



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