

Encyclopedia of Information Science and Technology

Second Edition

Mehdi Khosrow-Pour

Information Resources Management Association, USA

Volume II
C-Der

Information Science
REFERENCE

INFORMATION SCIENCE REFERENCE

Hershey • New York

Director of Editorial Content: Kristin Klinger
Director of Production: Jennifer Neidig
Managing Editor: Jamie Snavelly
Assistant Managing Editor: Carole Coulson
Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue, Suite 200
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com/reference>

and in the United Kingdom by
Information Science Reference (an imprint of IGI Global)
3 Henrietta Street
Covent Garden
London WC2E 8LU
Tel: 44 20 7240 0856
Fax: 44 20 7379 0609
Web site: <http://www.eurospanbookstore.com>

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Library of Congress Cataloging-in-Publication Data

Encyclopedia of information science and technology / Mehdi Khosrow-Pour, editor. -- 2nd ed.
p. cm.

Includes bibliographical references and index.

Summary: "This set of books represents a detailed compendium of authoritative, research-based entries that define the contemporary state of knowledge on technology"--Provided by publisher.

ISBN 978-1-60566-026-4 (hardcover) -- ISBN 978-1-60566-027-1 (ebook)

1. Information science--Encyclopedias. 2. Information technology--Encyclopedias. I. Khosrowpour, Mehdi, 1951-
Z1006.E566 2008
004'.03--dc22

2008029068

British Cataloguing in Publication Data

A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this encyclopedia set is original material. The views expressed in this encyclopedia set are those of the authors, but not necessarily of the publisher.

Data Communications and E-Learning

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INTRODUCTION

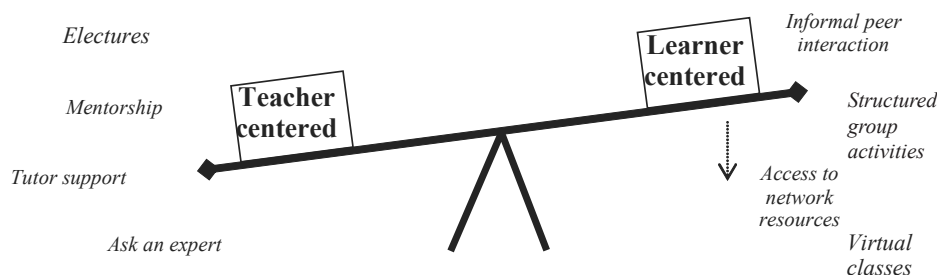
Information and communications technology (ICT) has increasingly influenced higher education. Computer-based packages and other learning objects provide a useful supplement to students studying conventionally by illustrating aspects of the curriculum. Other packages are directed at aspects of course administration such as automated assessment (for example, see Randolph et al. (2002)). Initially such software and materials played only a supplementary role in course offerings, but this has changed rapidly. For example, Coleman et al. (1998) describe a successful early attempt to replace all lecturing with computer-aided learning. Remote delivery of courses also became a viable option because of the advent of the WWW. For example, Petre and Price (1997) report on their experiences conducting electronic tutorials for computing courses. Online education of various sorts is now routinely available to vast numbers of students (Alexander, 2001; Chen & Dwyer, 2003; Peffers & Bloom, 1999). Various terms have been used to label or describe forms of education supported by information technology. These include e-learning (e.g., Alexander, 2001; Campbell, 2004), Web-based learning (e.g. Huerta, Ryan & Igbaria, 2003; Khosrow-Pour, 2002), online learning (e.g., Simon, Brooks & Wilkes, 2003), distributed learning and technology-mediated learning (e.g., Alavi & Leidner, 2001); with e-learning probably the most commonly used term used to

describe education and training that networks such as the Internet support.

E-learning has become of increasing importance for various reasons. These include the rise of the information and global economy and the emergence of a consumer culture. Students demand a flexible structure so that they can study, work and participate in family life at the same time (Campbell, 2004). This flexibility is reflected in alternative delivery methods that include online learning and Internet use. We have also become more sensitive to cultural and gender differences, and to the learning needs of the challenged. These needs may be addressed by e-learning (Campbell, 2004).

A number of studies have compared student learning and satisfaction between e-learning and traditional classroom teaching. In an early study, Hiltz and Wellman (1997) found that mastery of course material was equal or superior to that in the traditional classroom and that e-learning students were more satisfied with their learning on a number of dimensions. In particular, they found that the more students perceived that collaborative learning was taking place, the more likely they were to rate their learning outcomes as superior to those achieved in the traditional classroom. They did however identify some disadvantages to e-learning. These included ease of procrastination and information overload. More recently, Piccoli, Ahmad and Ives (2001) found that the academic performance of students in the two environments was similar, but that while e-learning students had higher levels

Figure 1. Categories of online activities



of self-efficacy, they were less satisfied with the learning process. Alexander's comment that "the use of information technology does not of itself improve learning" (Alexander, 2001, p. 241) perhaps highlights the fact that e-learning can be many things and that the intention to introduce e-learning is no guarantee of success.

The different types of teaching and learning activities that are made possible by the Internet are shown in Figure 1. Harasim and Hiltz (1995) divided these activities into two categories: learner or teacher centered. There is, however, no common agreement about which category is the best and many researchers argue for a mixture of learning activities, emphasizing group learning (Bento & Schuster, 2003; Klobas & Renzi, 2003). At the moment there still seems to be an overemphasis on teacher centered approaches, which hopefully will slowly change as a better knowledge of e-learning develops.

BACKGROUND

This article provides an illustration of blended e-learning by describing how we deliver and manage courses in a postgraduate degree in telecommunications management. We aim to foster learner centered education while providing sufficient teacher centered activities to counter some of the known concerns with entirely learner centered education. We use the Internet as the communication infrastructure to deliver teaching material globally and Lotus LearningSpace to provide the learning environment. While the primary aim of our approach is to enhance the student learning process, there are also other incentives that are consistent with this. The university is able to attract a more diverse range of students – those requiring flexibility of study and the other benefits of e-learning. Thus initiatives of this type can benefit the university while meeting the additional needs of students that are discussed in the introduction.

The use of learning and content management systems (LCMS) such as Blackboard, WebCT and Lotus LearningSpace have made e-course development less onerous for faculty. These systems provide a set of tools for publishing, communicating, and tracking student activity. Various guidelines have been suggested for evaluating and choosing software for e-learning (Klobas & Renzi, 2000). After establishing our requirements for a software tool for developing and delivering courses online, we evaluated various alternatives. The requirements that we identified included:

- Instructors should not have to program and debug HTML code;
- All courses should have the same professional look and feel without having to hire computer programmers to write special software, and students should

always be presented with the same interface for all their courses;

- The software should be fully integrated (one software package should allow the instructor to do everything required, such as course development and course management);
- Professional support.

After evaluating various alternatives we choose Lotus LearningSpace (LS). Successful use of LS by instructors proved to be significantly less dependent on the technical knowledge of the instructor than was the case with some other popular LCMS. It allows the instructor to focus on the learning of the students rather than on creating and debugging HTML.

LS provides instant feedback to the students and instructor, and enables progress and problems that students encounter as they go through the curriculum to be monitored. Students also have a discussion area where they can ask questions and communicate with the instructor as well as with other students.

LS allows us to create distributed courses that students and instructors can access whether they are online or offline. Students are able to download material for a course onto their machine so they can go through the curriculum without having to have a direct Internet connection. Using the offline access method makes it easier for students to learn wherever they are located and for instructors to develop and manage course material and reduce critical network bandwidth requirements. Features that facilitate flexible student centered learning include:

- Schedule - provides students with a structured approach to assignments, materials, and assessments. Through the schedule, students can link to everything required to complete their course.
- MediaCenter - allows immediate and searchable access to all materials for the course as the instructor makes them available.
- CourseRoom - provides a discussion group facility, which hosts collaborative interchange between student groups and/or students and instructors.
- Profiles - helps students and instructors get to know their classmates to form productive teams and to network outside the course.

Features that facilitate course management include LS Central for course management and the Assessment Manager for setting up and tracking of students' progress in their courses.

USING LOTUS LEARNINGSPLACE TO ENHANCE LEARNING OF DATA COMMUNICATIONS

Depending on course content and pedagogy the migration to e-learning can be more or less laborious. We have chosen one course in a telecommunication management degree to provide an example of how e-learning was implemented. Appropriately, this course is about networking technology.

The Data Communications Systems course provides an introduction to networking and networking devices focusing on Local Area Networks (LANs) and Wide Area Networks (WANs). Network design, Ethernet, ISDN, Frame Relay, and TCP/IP are introduced, including IP addressing and router protocols. There is a strong practical context that provides students with the opportunity to build, configure and problem solve in a multi-router network environment. This course also includes the first part of the Cisco Certified Network Associate (CCNA) curriculum. The Data Communications Systems course provides a good example of a difficult class to integrate with LS because of the external curriculum, which is contained on a separate Web server, and the external assessment requirement for students.

Students are required to log in to LS once they have selected the course. Students can access LS with a Lotus Notes Client or through a Web browser. The Lotus Notes Client allows students to work off-line by placing an image of what is on the LS server on their laptop or PC at home.

This allows students to work while they travel and can reduce the amount of time they are required to be connected to the Internet. When they connect up to the Internet they can resynchronize their copy with the master copy located on a Lotus Notes Server; this flexibility is a major goal of e-learning. The students then use LS schedule to follow the schedule for the course (see Figure 2). Through the schedule, students can access the external curriculum, which resides on a separate Web server.

The course takes a blended learning approach with both face-to-face classes and online learning. This enables us to take advantage of the benefits of technology mediated learning, but does not risk losing the strengths of face-to-face teaching. Theory is presented to students in the form of online topics (Web-based), mini lectures, and laboratories. LS is used to integrate course material from a variety of sources, for example, the Cisco material that contributes to the CCNA. This kind of external material must be integrated seamlessly with local content so that students see a totally integrated system when it comes to the delivery of each course. The online teaching material combines Web based text and graphics to explain concepts (see Figure 3 for a sample screen). Short movies are also used to illustrate concepts that are difficult to communicate with just static text and graphics. The students are given aims and objectives at the start of each topic. The teaching material covers these topics in detail and at the end of each topic students have optional self-assessment quizzes that allow them to gauge their un-

Figure 2. Sample schedule screen

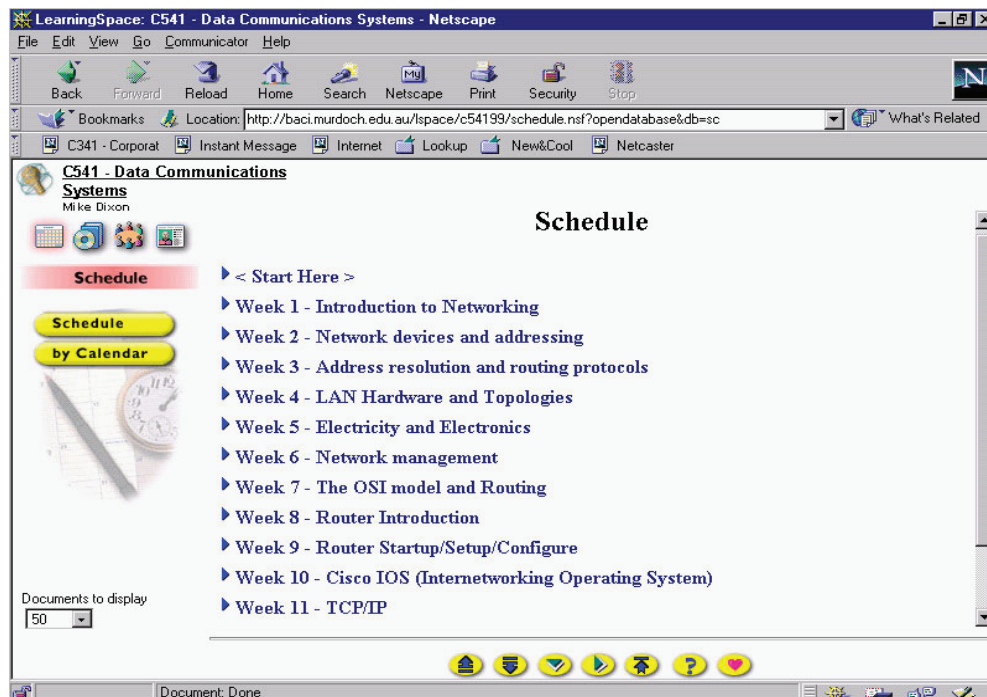
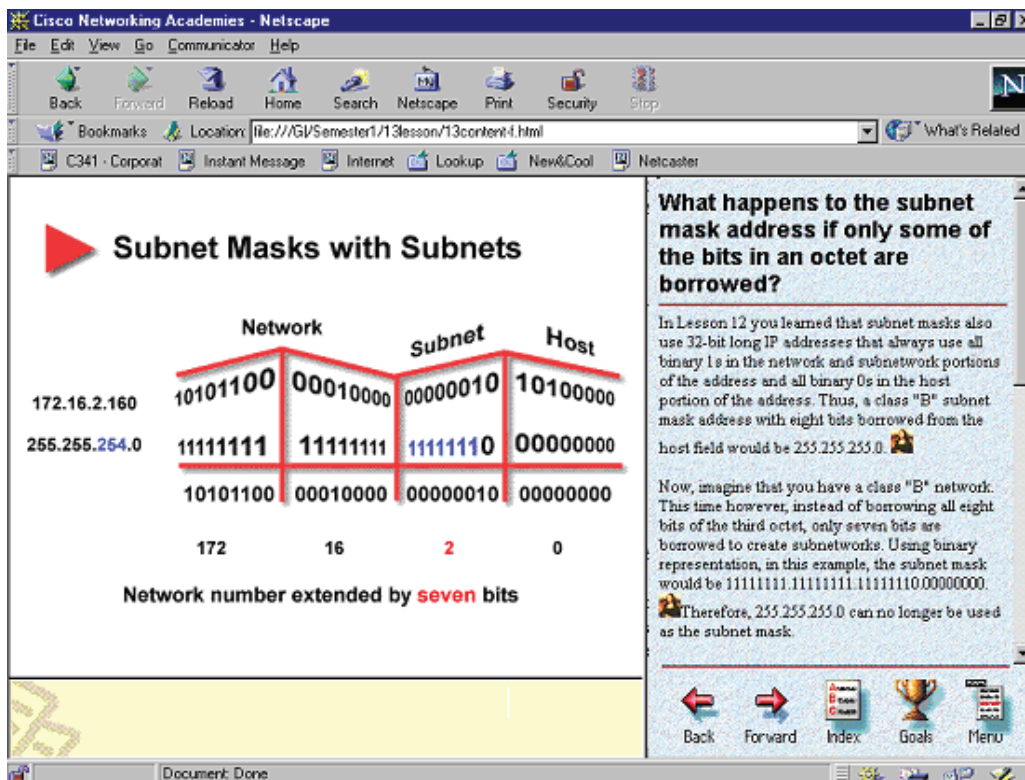


Figure 3. Sample course material screen



Understanding of the material. The multiple modes of content delivery cater to different cognitive styles of students.

Instructors also use these online quizzes to measure the understanding of the students before they attend classes. The instructor is able to identify students who are not keeping up to date with their work and also areas that students are having problems with. The mini lectures can then focus on the areas where students are having problems. The instructor can also discuss problem areas in the discussion group. Assignments are submitted online, graded locally and returned with the instructor's personal comments and grade.

There are two Cisco online exams for the course and students are required to pass these exams with a minimum score of 80%. Students are allowed to take the exam more than once. All students must also take a separate supervised written final exam to meet University requirements. The online Cisco exams are done on separate assessment servers, as they are part of the certification process. The Cisco Networking Academy results of all the students around the world are maintained in a database in Arizona so that instructors can analyze how their class has answered questions and compare the results of their students with those of students in other institutions around the world. The final exams for each course are taken locally in a more traditional way.

The course also includes on-campus practical work to prepare students to solve real-world networking problems.

Students work in groups during the practical lab sessions. Students are given timed individual and group practical exams at the end of each major component. Students are allowed to take these exams as many times as they like but are required to pass all these exams.

These factors all contribute to facilitating student learning. Faster and more frequent feedback on the material keeps students more in touch with their progress. Testing and checkpoints with built in repetition are important for long-term retention and understanding of the material. The facility to continue to work with the teaching material until an 80% pass is achieved enhances performance. Students see important material multiple times so that their learning is reinforced and students are able to study wherever they are and still be part of the student community. The use of a virtual discussion group enhances the sense of community among the students and teachers. Combining a learner centered approach with LS allows us to achieve a quality course online.

FUTURE TRENDS

E-learning will continue to play an increasing role in education and training. Greater broadband access will enable delivery of richer content and greater interactivity. Convergence of



information technologies such as notebooks, phones and television and the development of pervasive computing will provide even greater flexibility to students. Educators and students are coming to understand that learning is lifelong and that technology is a valuable tool in supporting it.

CONCLUSION

E-learning is changing the face of university education. This article discussed an approach used to adopt a learner centered environment within an Internet based degree. As the course used to illustrate the issues in the article is about telecommunications, the Internet is a very appropriate medium for instruction. Students learn about telecommunications while accessing information through the Internet. Technology can provide flexibility of learning and hence enrich the learning experience and diversify the student mix.

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KEY TERMS

Blended Learning: E-learning used in conjunction with other teaching and learning methods.

Cisco Certified Network Associate (CCNA): A data communications industry certification.

Distributed Learning: Using a wide range of information technologies to provide learning opportunities beyond the bounds of the traditional classroom.

E-Course: Another term for an online course.

Data Communications and E-Learning

E-Learning: The use of new multimedia technologies and the Internet to improve the quality of learning.

Learning and Content Management Systems (LCMS): These systems provide a set of tools for publishing, communicating, and tracking student activity.

Learning Objects: Small (relative to the size of an entire course) instructional components that can be reused in different learning contexts. Learning objects are generally considered to be digital materials deliverable over the Internet.

Online Learning: An inclusive term for any form of learning supported by computer based training.

Pervasive Computing: Technology that has moved beyond the personal computer to everyday devices with embedded technology and connectivity. The goal of pervasive computing is to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available.

Technology-Mediated Learning: Learning where the learner's interactions with learning materials, other students and/or instructors are mediated through information technologies.

Web-Based Learning (WBL): Use of Internet technologies for delivering instruction.

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