PRODUCTION NOTE

University of Illinois at
Urbana-Champaign Library
Computer-Based Instruction in Libraries and Library Education

T. G. McFadden

Issue Editor
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Publications Committee: Linda Smith, Marlo Welshons, Betsy Hearne, Janice Del Negro

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Computer-Based Instruction in Libraries and Library Education

T. G. McFadden

Issue Editor
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Introduction

T. G. McFadden

Computer-assisted instruction is really nothing more than the electronic application of well-understood principles of learning that gave rise to the popularity, some years ago, of "programmed instruction." But if the instructional use of computers in libraries amounted to little more than self-paced, guided-task, learning, we should not be very interested. In fact, libraries find themselves, as they often do, at a significant intersection of various technologies, services, products, and scholarship that offers unique opportunities. We are in a position to integrate, within the same technology, teaching about scholarship, production of scholarship, delivery of information and services, and effective use of these simultaneously. The computer, and electronic technology generally, has finally begun to realize some of the promise that Memex offered (Bush, 1945). The same technology that delivers information and scholarship can also be used to teach the direct, and indirect, use of that information and associated research and analytical techniques. The "how to" and the "what" can be presented in a seamless environment of tutorial or classroom learning managed and presented by electronic media and computing machines.

This issue of Library Trends includes articles that explore both the theoretical and practical aspects of the use of computers to teach, and not merely to deliver, information. Inevitably, any discussion of the use of computers in instruction, and as teachers, will evolve into a discussion about the general nature of the skills to be taught, as well as the skills required to learn from a computerized instructional program. A computer may be used to teach about a great many things, not least importantly about itself.
One of the things that one may usefully learn from a machine program is the technique of information retrieval and management. And this is what many librarians and faculty members have in mind when they speak about "information literacy." How to define this concept, and how to draw useful connections among the related ideas of "technical literacy" and "information technology literacy" is the subject of contributions here by O'Hanlon, Cox, Kaplowitz, Hansen, and Brandt.¹

It is important to note that much of the current discussion about "information literacy" is really more about "computer literacy." The ability to handle information in an intelligent and critical way is not different from the kind of thing required of any undergraduate, for example, as a normal part of general education and of meeting the requirements of the major. We might wonder if, in fact, most undergraduates do actually succeed in acquiring these skills and abilities, but that is another matter.

Many colleges and universities have established guidelines for describing this kind of competence and for evaluating undergraduate achievement, but most of these programs simply reflect traditional concern for library and research skills.² What some have called "digital literacy" is something else again, although there are overlaps.³

Genuine digital competence, in the sense intended, can be thought of as having two distinct aspects: desktop competence and electronic information retrieval competence (largely a matter of World Wide Web skill, but not entirely). These two types of competence are closely related, as Brandt argues, and we need to pay more attention to how the first level of competence contributes to the second (and to the assumptions we make about the prior levels of competence of either kind that our students and users bring to our libraries). If our readers do not possess some minimal set of desktop competencies, they will not be able to profit from instruction by computers, or even in the most basic elements of electronic information retrieval competence as taught by and through computing machines.

One of the most exciting developments in library and information retrieval instruction has been the rapid expansion of quality content—general as well as specialized intellectual resources—available through the Internet. The problem of how to retrieve and evaluate this content, and distinguish it from the vast amount of low- or no-quality information on the Internet, has become the subject of countless conference papers, journal articles, and books by librarians and faculty members alike. The authors of several articles in this issue of Library Trends (for instance, O’Hanlon, Cox, Kaplowitz, and Hansen) present the results of practical experiences in teaching these skills and general World Wide Web skills through the medium itself. Using the medium to teach about itself, doing so essentially to the autodidact, exploits two important aspects of one kind of successful learning: the instruction is self-paced and the subject matter
Combining instruction of this kind with the use of computers as instructional devices puts this strategy directly into the center of a controversial, and now somewhat neglected, historical tradition.

The idea of using a machine to teach something is not new. The theory and application of programmed instruction (however delivered) is commonly associated with the work of Harvard psychologist B. F. Skinner. But Skinner (1958) was not the first to suggest that a machine could be used to teach a skill, as he was always careful to point out (p. 969) (see also Skinner, 1954, 1961). The most obvious antecedent to Skinner’s work was that of Sidney L. Pressey (1926, 1927, 1932) at Ohio State University, who published a series of papers in *School and Society* between 1926 and 1932 on his development of a simple teaching machine to provide self-paced instruction in a variety of basic skills. But Pressey (and Skinner) had been anticipated as long ago as the beginning of the nineteenth century by various “educational appliances” designed to teach spelling, reading, and other basic skills. Whether these devices qualify as genuine teaching machines is a matter for debate (Benjamin, 1988). What these machines, and their electronic offspring, have in common as teaching devices is that they derive their justification from certain fairly well-established principles in the psychology of learning. Briefly summarized, these principles are: that programmed learning recognizes individual differences in learning behavior, that active learning is superior to passive reception, that immediate feedback of results favors learning, and that the acquisition of at least some kinds of knowledge is a stepwise affair (see, for example, Hilgard, 1961). These conclusions, taken together with the frequent observation that students (of all kinds) generally prefer self-teaching when confronted with the kind of instruction that is the subject of this issue of *Library Trends*, would strongly suggest that the use of computers as teaching devices is on firm theoretical and experimental ground.

But to teach what? And, for that matter, to learn what? Historically, the application of teaching-machine technology has been to rote learning and repetitive drill. This is why most of the early successes with programmed instruction were in the teaching of languages and arithmetic. But programmed instruction, whether in the linear mode of Skinner or the branching mode of Crowder, is independent of the particular technology used to deliver it. And the use of computers as teachers need not necessarily involve a strict application of the principles of operant conditioning. It may be true that learning, “in its most general description, is the modification of patterns of behavior, under the influence of agreeable or unpleasant stimulation” (Sayre, 1970, p. 909), but it does not follow that teaching machines, especially computers, cannot be used to provide instruction in higher order conceptual tasks. The application of hypertext technology to instructional and tutorial computer software has taken the possibilities of computer instruction to a new level. And this is precisely where one of
the most interesting recent collaborations of the Internet with teaching machines occurs—the intersection of distance education with independent learning.8

Distance education is, of course, quite different from online instruction, but increasingly the two modes have merged in practice. What they have in common is that distance education and online instruction are both intimately connected to the idea of independent learning.9 Hence, it can be said that independent learning and teaching is what occurs outside the school environment (Moore, 1973, p. 662). And what this means, most importantly, is that a key marker of the independent learning situation is increased learner responsibility. We already know much about the intellectual and psychological characteristics of independent (autonomous) learners: they can organize their time effectively; they are motivated to read and study without direction; they have generally good study habits; they enjoy the process of learning; and they can work cooperatively when they need to. Most of all, perhaps, they prefer to learn on their own. Herbert Thelen (1960) characterizes this personality type as having “captaincy of self” (pp. 14, 51, 75). The goal of education, one might even say, is precisely to turn every student into this kind of learner (Bruner, 1966, p. 53). The marriage of the Internet with computer instruction, in the form of both directed and self-paced tutorial modes, is a match nearly made in heaven. In one way or another, most of the contributors to this issue of Library Trends are concerned with this dynamic, but most especially O’Hanlon, Kaplowitz, and Hansen.

But one learns nothing unless one is ready to learn. In the world of information technology and the Internet, this truism comes down to the question of whether students (and other learners) come prepared to understand fairly high-level concepts in the realm of telecommunications, electronic information retrieval, and the digital organization of information in a network environment. And if they do not, as often seems the case, what preconditions must we try to meet to bring novice network users up to this level?

Both Brandt and McFadden explore in some detail the role that mental models, metaphor, and analogy play in constructing an anticipatory framework within which learning about complex information networks can occur most effectively. Drawing extensively upon the theoretical and experimental literature describing what we know about mental models and creative learning, both offer possibilities for new instructional strategies and approaches to teaching by and through the Internet.10

Library Trends does not ordinarily reprint papers already published elsewhere, but several recent articles in literature not usually on the regular reading list for most librarians, and in one case from a part of the world about which we often know too little, are directly relevant to the problems and controversies taken up by the original contributors to this issue. Fourie,
for example, describes a series of novel experiments in the use of computer-assisted instruction for distributed learning in library and information science. This program is all the more interesting because it is part of the extensive distance education program offered by the University of South Africa. Many of the same conclusions reached by others in widely dissimilar environments nevertheless emerged from this study, including important indicators of how and when computer-managed instruction is most appropriate as a function of learner readiness and independence.

Pyle and Dziuban make what should be the intuitively obvious point that what can be computerized (or taken online) need not be. Enlarging on the experiences of Fourie, they consider just exactly what kinds of teaching and learning really are best suited for delivery and management by computers. Not surprisingly, they find that, while online and computerized instruction can sometimes just be an instance of seduction of the unwary (perhaps by the unaware), it may also be true that the very appeal of online learning for many of our students can be effectively exploited in drawing students into self-paced and independent learning environments.

Well, once we get them there, what is the “ideal” online course? Clearly, it is not just a transfer of traditional course elements and design to the electronic environment. If a classroom lecture is boring, it will be equally tiresome online. Careful consideration needs to be given to a whole array of new design and content issues when a course is moved from the traditional classroom to, for example, the Internet.

Carr-Chellman and Duchastel survey both the obstacles and the opportunities in making this kind of transition and in the process offer a formal model for an online course that has at least a very good chance of succeeding in a wide variety of learning and teaching environments.

Computers have become ubiquitous in our lives, but more importantly they have also become pervasive. Micromachines and nanotechnology are rapidly transforming what it was once fashionable to call the “mind appliance” into an everyday artifact, scarcely distinguishable from our most common assistive devices. Just how this trend will play out in the storage and delivery of information, and in teaching about these and many other things, remains to be seen. But the potential for increased and enhanced learner initiative and independence, along with vastly greater flexibility in how and where (and when) instruction can be delivered, is clearly enormous. This issue of Library Trends can begin a new conversation among librarians about how to participate in the opportunities offered by these rapidly developing instructional and networking technologies.

Notes

1 An early attempt to get a handle on the concept of “information literacy” was the general topic of the Winter 1991 issue of Library Trends.

2 The Association of College and Research Libraries approved, in January 2001, a model
statement of objectives for information literacy instruction. It is remarkable how similar these objectives are to traditional standards and practices described somewhat more elegantly in, for example, Barzun and Graff (1957)—some things never change. See ACRL Instruction Section (2001).

It is worth remarking that this is not about (or just about) requiring undergraduates to take one or more courses in computer science.

Undergraduates, in particular, routinely express a preference for learning in this way, especially if what is being taught are computer skills of some kind.

Pressey had demonstrated this machine at the 1924 and 1925 meetings of the American Psychological Association.

Other useful surveys of the history of teaching machines are Fry (1963) and Vargas and Vargas (1992). An excellent early literature review is presented by Morrill (1961).

What they do not have in common is any implied commitment to behaviorism, either as a heuristic or as an ontology of mind.

It is important to note that the “distance” in question does not have to be much—across the campus, for example, is quite far enough to count (Moore, 1973, p. 674).

One way to get at the difference is to consider the distinction between an “online course” and a “distance education course,” which might be described as:

**Online Course** = def A course in which all or most of the following is presented to the student(s) through an electronic medium (e.g., the World Wide Web):

1. the persona of the instructor;
2. the pedagogical content of the course;
3. the management of the course;
4. communication between each student and instructor;
5. communication between or among students; and
6. assessment tools.

It is important to note that a course might satisfy this definition even if the instructor and the class are on the same campus—even in the same building, although that would be odd. The conceptual content of the course, such as would be delivered in a textbook, might or might not be presented to the student(s) through an electronic medium. It might also be the case that any examinations are administered by an actual person in a supervised location.

An offline course is simply one that fails to satisfy this definition. Hence a course, online or offline, might turn out to be a mixed online or mixed offline course, depending on the emphasis of the instructional mode. Thus a classroom-based course might have part of its content and instruction delivered online, with some of the interaction among class, content, and instructor occurring both online and offline. Or a largely online course might have part of its content and instruction delivered offline, with a requirement that some kind of physical encounter among class, content, and instructor be part of the conditions for passing the course.

**Distance Education Course** = def A course in which the presentation of all or most of the following to the student(s) does not require (for all or most of the course) that the class and the instructor be in the same place at the same time:

1. the persona of the instructor;
2. the pedagogical content of the course;
3. the management of the course;
4. communication between each student and instructor;
5. communication between or among students; and
6. assessment tools.

A distance education course thus understood might also be an online course but need not be. And, contrariwise, an online course as defined might also be a distance education course but need not be.

In fact, one of the differences dividing proponents of linear and branched programming, respectively, in the development of teaching machines was just this question of how much one should try to anticipate the mental geography of users of programmed sequences (McLaughlin, 1964; Hoth, 1961).
References
Development, Delivery, and Outcomes of a Distance Course for New College Students

NANCY O'HANLON

ABSTRACT
A four-week online information literacy course for new college students at Ohio State University enrolled almost 500 students during the 1999-2000 academic year. The course, Internet Tools and Research Techniques, utilizes net.TUTOR interactive tutorials as an electronic text, along with Web-based tests and practice-oriented worksheets that are graded automatically by the course management software. This article presents an overview of the course, provides data about the student population, and examines various measures of success, including performance on assignments, final grades, and student attitudes toward the course. Communication challenges, student self-regulation, and the value of flexible assignment schedules are also considered.

INTRODUCTION
Distance education, defined by Boettcher (2000) as a process “characterized by the separation, in time or place, between instructor and student” (p. 37) is increasingly popular on college campuses across the United States. This trend is documented in a study of 1,600 post-secondary institutions released by the U.S. Department of Education’s National Center for Education Statistics (1999). According to this report, 34 percent of the institutions surveyed offered distance courses in 1997-98. The study estimates that there were 1,661,100 enrollments in all distance courses offered by two- and four-year institutions, with most of these at the undergraduate level. Another 20 percent of institutions reported that they
planned to offer distance courses within three years (p. 15). The Internet is the engine of this growth. Of the schools that offer, or are planning, courses, 82 percent intend to provide these primarily through "asynchronous" Internet instruction using e-mail and the Web (p. 39).

A parallel trend in higher education is the movement to define student computing and information literacy requirements for undergraduates in order to prepare students for the workplace. For example, Mendels (1999) notes that students at the University of Texas at Arlington must master five computer-related skills: use of spreadsheet and word processing programs; ability to use the school’s online library research services; ability to use e-mail; and ability to conduct Internet-based research. At Ohio State University (OSU), the vice-provost for Undergraduate Studies convened a faculty Committee on Student Computing Competencies in 1999. This group created a list of recommended competencies (http://gateway.lib.ohio-state.edu/cscc/) that extends beyond computing skills to encompass the following research skills:

- use a Web browser to search for information efficiently,
- learn to use the libraries’ print and online information sources,
- choose appropriate research tools,
- evaluate and choose the best information sources, and
- use key information sources for your major field.

The OSU Committee also recommended that students have access to different methods for acquiring these skills, from self-paced learning resources to credit courses. In response to that need, University Libraries, in partnership with University College (the unit that enrolls most freshmen at Ohio State) developed a one-credit distance course, Internet Tools and Research Techniques. This course serves a dual purpose related to both of the trends discussed here. It helps students to develop the recommended research competencies and also prepares them to participate in other distance courses or courses with online segments offered by the university. Development, delivery, and outcomes of that course are the focus of this article.

**EVOLUTION OF THE DISTANCE COURSE**

Although the Libraries’ Office of User Education has worked with new students enrolled in University College at Ohio State for the past twenty years, the distance course Internet Tools and Research Techniques (offered as UVC 120) is a new type of partnership for both units. It is the first credit course in research skills offered by the libraries as well as the first distance offering for University College. Additionally, this new course appears to fill a perceived need by students for instruction in this area.

Most new students have had some contact with the Internet before coming to Ohio State, but their experiences are not uniform. Those who
are familiar with Web browsing are not usually proficient at searching adeptly in this new medium or evaluating the information they find. Few high schools provide significant instruction in these techniques, so students typically learn what they can on their own or from peers. In a recent study of middle and high school students' Internet use, Ebersole (1999) asked media specialists to review Web sites that students used for their research. The reviewers found only 27 percent of the sites to be suitable for that purpose (see abstract). He suggests that these students are ignorant about how to conduct an effective search online and how to distinguish between reputable and questionable information (see chapter five).

Many students admit that they frequently fail to find what they are looking for when searching the Web. A recent e-mail message from a student enrolled in UVC 120 confirms this assertion:

What I hope to get out of this course is a better understanding of what I spend many hours a week playing on. I have been "online" since 1996 and have spent many hours cruising down the "information superhighway." However, I don't know how to do effective research, so that is mainly what I want to learn about. (S. Irwin, personal communication, April 18, 2000)

Thus student interest in improving their searching skills provides the libraries with an opportunity to offer instruction to a willing audience on a whole range of research competencies.

During Winter quarter 1999, the author developed the syllabus and initial assignments for the course, which was offered for the first time to a small group during the Spring quarter 1999. After revisions based on student comments, the course was offered to larger groups of students in academic year 1999-2000. In Fall 1999 and Winter 2000, 407 Ohio State students took this distance course for one credit. Eighty-seven students completed the course in Spring 2000.

Course Profile

The course begins during the fourth week of the ten week academic quarter. This allows students who are new to the university several weeks prior to the beginning of the course to establish their computing accounts and become familiar with the campus e-mail system. The course consists of eighteen required assignments that are completed over a period of four weeks. Each week that the course is in session, new assignments are made available to students. All must be completed by the end of the course, when Course Sorcerer, the OSU-developed software used to manage the online assignments, closes access to them.

A course Web site (http://gateway.lib.ohio-state.edu/tutor/120/) is the jumping off point for students to learn more about how the course works, read answers to frequently asked questions, find instructor contact
information, and connect to the course assignments. Students are added to a course mailing list that enables the instructor to communicate easily with them by e-mail several times each week while the course is in session. This course mailing list is used primarily to distribute announcements and reminders about assignments. It is also used to disseminate additional information that will help students as they complete assignments, such as details about how to connect to library databases from off campus using the university's proxy server.

Registered students are also added automatically to a roster that resides within the course management software and controls access to the online assignments. Students must have a university computing account (used for authorization) and must also be listed on the official roster for the course before being permitted to view or complete any assignments.

Each of the four weeks is devoted to a different topic. The focus of the first week is becoming competent with Internet tools such as the Web browser, e-mail and online discussion groups, with the campus Web environment, and with course requirements. During the second week, students learn searching techniques that are effective in various types of online sources and become more familiar with different types of Web search tools and with specialized databases. The third week focuses on research skills, including research strategy, evaluation of sources, intellectual property issues, and citation of online sources. Finally, during the last week of the course, students complete a Capstone Exercise that allows them to demonstrate their searching and evaluation skills.

net.TUTOR (http://gateway.lib.ohio-state.edu/tutor/), a program of interactive Web-based tutorials developed by the author, forms the content core of this course. Ten of the net.TUTOR tutorials are assigned as required reading during weeks one through three. Students must also complete the online tests that are associated with each tutorial. Online worksheets, which provide additional practice using the skills and concepts taught by the tutorials, are also required. The tests and worksheets use multiple-choice questions so that they may be automatically graded by the course software. Results and feedback are thus immediately available to students. The Capstone Exercise utilizes short answer and essay questions but is structured so that it can be easily graded by the instructor and teaching assistant.

Active Learning

Carlson and Repman (2000) note that effectiveness of Web-based instruction (WBI) is contingent on the ability to establish an active learning process. They state that "WBI alters not only the method in which information is presented to the learner but also changes the way in which the learner interacts with information . . . . It is necessary to design instruction which engages the learner in interactive activities" (p. 13).
UVC 120 uses several methodologies for providing a range of interactive assignments. First, each net.TUTOR tutorial that is assigned as required reading is laced with practice activities which have proven quite popular. A clear majority of users who submit tutorial evaluations indicate that they complete all or some of the suggested activities (see net.TUTOR evaluation data at http://gateway.lib.ohio-state.edu/tutor/about.html). Ehrmann (1997), director of the American Association of Higher Education's Flashlight Project, reports that use of computer-based tutorials "results in a substantial improvement in learning outcomes and speed, perhaps around 20% or more on average... Few other teaching methods have demonstrated such consistently strong results as this type of self-paced instruction."

Six online worksheets assigned during the course are also practice-oriented, as the following sample task from the Web Search Worksheet indicates:

Most Web indexes allow limiting of searches by different variables.
Use HotBot to find an audio recording (MP3 format) of the Beatles' song "Yesterday."
• Check the box next to MP3 (on the left side of the page)
• Type these words in the search box: Beatles yesterday
How many matches does HotBot return for this search?

LEARNER PROFILE

Thus far, most students have been solicited primarily from the ranks of those freshmen and transfer students already enrolled in University College's UVC 100 course. UVC 100 provides an orientation to the campus and academic life, including research. The OSU Libraries' long-standing Library Instruction Program (LIP) is integrated with UVC 100. As an added incentive for these students to consider taking the new one-credit distance course (UVC 120), they have been excused from the requirement to complete the two library assignments associated with the UVC 100 course.

In course evaluations, students expressed a variety of reasons for taking the course, as shown in Table 1. Approximately half of the respondents (who comprised about one-third of the total registered for the course) indicated that their primary reason for taking the course was the need for an additional one hour course in order to remain a full-time student. The ability to enter a new course that is just beginning during the fourth week of the quarter is attractive to students who have dropped a course.

A study by the Institute for Higher Education Policy (1999) that examined effectiveness of distance learning notes that: "Learner characteristics are a major factor in the achievement and satisfaction levels of the distance learner" (p. 6). Some data regarding learner characteristics for
UVC 120 gathered from online student surveys and course evaluations are presented in Table 2.

**Table 1. Student Reasons for Enrolling in Course.**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needed 1 hour course</td>
<td>46%</td>
<td>56%</td>
<td>45%</td>
</tr>
<tr>
<td>Interested in course topic</td>
<td>19%</td>
<td>19%</td>
<td>25%</td>
</tr>
<tr>
<td>Will help with major field</td>
<td>0%</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td>Recommended by advisor</td>
<td>22%</td>
<td>14%</td>
<td>17%</td>
</tr>
<tr>
<td>Other</td>
<td>13%</td>
<td>7%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Table 2. Learner Characteristics—Prior Computing Experience.**

<table>
<thead>
<tr>
<th>Total Years of Experience:</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>10+</td>
<td>37.6%</td>
<td>31.7%</td>
<td>37.5%</td>
</tr>
<tr>
<td>6-9</td>
<td>26.6%</td>
<td>26.0%</td>
<td>28.8%</td>
</tr>
<tr>
<td>3-5</td>
<td>27.5%</td>
<td>32.5%</td>
<td>23.8%</td>
</tr>
<tr>
<td>1-2</td>
<td>8.3%</td>
<td>9.8%</td>
<td>10.0%</td>
</tr>
<tr>
<td>TOTALS</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level When Introduced:</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before grade 1</td>
<td>8.8%</td>
<td>4.1%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Elementary school (1-8)</td>
<td>70.8%</td>
<td>68.3%</td>
<td>70.0%</td>
</tr>
<tr>
<td>High school (9-12)</td>
<td>12.4%</td>
<td>17.1%</td>
<td>16.3%</td>
</tr>
<tr>
<td>College</td>
<td>6.2%</td>
<td>8.1%</td>
<td>6.3%</td>
</tr>
<tr>
<td>No introduction</td>
<td>1.8%</td>
<td>2.4%</td>
<td>3.8%</td>
</tr>
<tr>
<td>TOTALS</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

One characteristic likely to have an impact on student success in a distance course is prior computing experience. In brief student surveys, data on total years of computing experience and grade level when students were introduced to computers were gathered. Less than 10 percent of respondents indicated that they had two or fewer years of computing experience or had been introduced to computers in college. More than 30 percent indicated ten or more years of prior computing experience and approximately 70 percent reported that they had been introduced to computers in elementary school.

Another survey question asked respondents how many hours per day they used computers. As Table 3 indicates, almost half of the respondents answered that they spend between one and two hours each day using computers for various tasks (the question did not specify Internet use alone). Another 25 percent indicate that they spend three to four hours per day at the computer.
Table 3. Learner Characteristics—Daily Computer Use.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>8+</td>
<td>5.3%</td>
<td>3.3%</td>
<td>7.5%</td>
</tr>
<tr>
<td>5-7</td>
<td>14.0%</td>
<td>9.8%</td>
<td>10.0%</td>
</tr>
<tr>
<td>3-4</td>
<td>26.3%</td>
<td>26.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>1-2</td>
<td>47.4%</td>
<td>47.2%</td>
<td>53.8%</td>
</tr>
<tr>
<td>&lt;1</td>
<td>7.0%</td>
<td>13.8%</td>
<td>3.8%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

In Spring 2000, an additional source of data on students was incorporated into the course registration process. This new registration survey form asked students where they expected to complete assignments for the course. Of those responding, 75 percent indicated that they planned to use their own computers, 15 percent intended to use a roommate's computer, while only 7 percent expected to use those in campus computer labs or libraries. Students were also asked to characterize their prior experience using Internet tools. Only 7 percent indicated that they had little or no prior experience, 67 percent said that they had moderate experience, and 24 percent noted that their prior experience was extensive (the remainder did not respond to these questions).

MEASURES OF SUCCESS


For UVC 120, the question of whether students could learn the concepts and techniques taught in the course better in a traditional classroom is moot, because the course was never offered in a traditional format. Indeed, two aspects of this distance course that makes it attractive to students is convenience and the flexibility to fit course work into their schedules rather than schedule their lives around class times. This is a "significant" difference to students, one that affords the library the opportunity to teach research skills to a new audience on their own terms. The measures of success that will be considered in this article are learner outcomes (performance on assignments and grades) as well as student attitudes and satisfaction.
Table 4 indicates overall course performance for the three academic quarters during 1999-2000 for a total of 494 enrolled students. Roughly 90 percent of students attained passing grades each quarter, with the number of drops after the course began limited to around 10 percent, considerably lower than the 30 to 50 percent drop rates cited in some studies of distance education (Cornell & Martin, 1997, p. 93; Carr, 2000). In a report from a year-long faculty seminar on distance learning at the University of Illinois (1999), it was noted that “by using a self-paced, asynchronous online approach with plenty of opportunity for the review of difficult material, retention of remedial students was much higher than in a traditional classroom.” Perhaps course methodology for UVC 120 may be related to a relatively low dropout rate.

Table 4. Course Data Summary.

<table>
<thead>
<tr>
<th></th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number enrolled</td>
<td>225</td>
<td>182</td>
<td>87</td>
</tr>
<tr>
<td>Class rank = freshman</td>
<td>76%</td>
<td>64%</td>
<td>54%</td>
</tr>
<tr>
<td>College = University College</td>
<td>92%</td>
<td>91%</td>
<td>84%</td>
</tr>
<tr>
<td>Number of drops during course</td>
<td>21 (9%)</td>
<td>17 (9%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Number passing</td>
<td>182 (89%)</td>
<td>142 (87%)</td>
<td>78 (90%)</td>
</tr>
<tr>
<td>Number failing</td>
<td>22 (11%)</td>
<td>21 (13%)</td>
<td>8 (9%)</td>
</tr>
<tr>
<td>Number of failures with no work</td>
<td>11</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Number incomplete</td>
<td>0</td>
<td>2 (1%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Performance on Course Assignments

Table 5 shows section averages for course assignments over three quarters. The percentage of correct answers (out of 100 percent) is indicated for specific assignments, along with a weekly average for each group of assignments. These assignments were reasonably consistent from quarter to quarter, although specific test and worksheet questions were revised when analysis of student answers indicated possible confusion or lack of clarity.

In Fall 1999, the course was offered with a Satisfactory/Unsatisfactory grading option at the request of University College. Some students simply stopped completing assignments or did them in a haphazard manner once they had attained enough points to receive a Satisfactory grade, as averages for the third group of assignments (56 percent) in the Fall demonstrate. In later quarters, a regular letter grade (A – E) option was used. Because of the difference in grading strategies, it is more useful to compare Winter and Spring quarter averages in Table 5.

In Winter 2000, the Web site evaluation worksheet (65 percent) and the test on the “Using Web Search Tools” tutorial (66 percent) were the
Table 5. Performance on Assignments.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Section Averages</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall 99</td>
<td>Wtr 00</td>
<td>Spr 00</td>
</tr>
<tr>
<td>Test: Getting Started (optional)</td>
<td>83%</td>
<td>77%</td>
<td>83%</td>
</tr>
<tr>
<td>Test: Browser</td>
<td>79%</td>
<td>83%</td>
<td>89%</td>
</tr>
<tr>
<td>Test: E-Mail</td>
<td>87%</td>
<td>81%</td>
<td>88%</td>
</tr>
<tr>
<td>Test: Online Groups</td>
<td>75%</td>
<td>75%</td>
<td>79%</td>
</tr>
<tr>
<td>Test: OSU Sites</td>
<td>82%</td>
<td>82%</td>
<td>91%</td>
</tr>
<tr>
<td>Worksheet: Campus and Course Tools</td>
<td>85%</td>
<td>85%</td>
<td>90%</td>
</tr>
<tr>
<td>WEEK 1 OVERALL AVERAGE</td>
<td>82%</td>
<td>81%</td>
<td>87%</td>
</tr>
<tr>
<td>Test: Searching 101</td>
<td>63%</td>
<td>70%</td>
<td>77%</td>
</tr>
<tr>
<td>Test: Web Search</td>
<td>63%</td>
<td>66%</td>
<td>75%</td>
</tr>
<tr>
<td>Test: OSCAR</td>
<td>76%</td>
<td>75%</td>
<td>83%</td>
</tr>
<tr>
<td>Worksheet: Web Search</td>
<td>80%</td>
<td>73%</td>
<td>76%</td>
</tr>
<tr>
<td>Worksheet: Library Databases</td>
<td>80%</td>
<td>74%</td>
<td>81%</td>
</tr>
<tr>
<td>Worksheet: Adv. Web Search (optional)</td>
<td>55%</td>
<td>60%</td>
<td>n/a</td>
</tr>
<tr>
<td>WEEK 2 OVERALL AVERAGE</td>
<td>70%</td>
<td>70%</td>
<td>78%</td>
</tr>
<tr>
<td>Test: Research Strategy</td>
<td>65%</td>
<td>74%</td>
<td>82%</td>
</tr>
<tr>
<td>Test: Web Site Evaluation</td>
<td>64%</td>
<td>75%</td>
<td>81%</td>
</tr>
<tr>
<td>Test: Citing Sources</td>
<td>50%</td>
<td>73%</td>
<td>80%</td>
</tr>
<tr>
<td>Worksheet: Research Strategy</td>
<td>57%</td>
<td>68%</td>
<td>76%</td>
</tr>
<tr>
<td>Worksheet: Web Site Evaluation</td>
<td>54%</td>
<td>65%</td>
<td>73%</td>
</tr>
<tr>
<td>Worksheet: Citing Sources</td>
<td>45%</td>
<td>70%</td>
<td>71%</td>
</tr>
<tr>
<td>WEEK 3 OVERALL AVERAGE</td>
<td>56%</td>
<td>71%</td>
<td>77%</td>
</tr>
<tr>
<td>Capstone Exercise</td>
<td>n/a</td>
<td>75%</td>
<td>71%</td>
</tr>
<tr>
<td>AVERAGE OF ALL ASSIGNMENTS</td>
<td>70%</td>
<td>69%</td>
<td>74%</td>
</tr>
</tbody>
</table>

most difficult required assignments for students. In Spring, these assignments were again among the most difficult, although Spring section average scores improved somewhat.

Was one type of assignment more difficult for students than another? The tests are "open book" quizzes, where links to open the related tutorial are provided and questions relate directly to the practice questions or text in the tutorial. Thus one might expect that average test scores would be consistently higher than those for online worksheets, which require students to put concepts and techniques into practice. In Spring quarter, this expectation was borne out. However, Winter quarter students performed better on worksheets during the first two weeks of the course. During the third week, this trend reversed itself.

A Capstone Exercise, requiring students to demonstrate their ability to evaluate Web sites and search for specific information, was introduced in Winter 2000. Unlike other course assignments that employ multiple-choice questions that are graded automatically, this assignment requires students to write short answers and brief paragraphs, which are then evaluated by course instructors. Average performance on this assignment was 75 percent in Winter and 71 percent in Spring.
Evaluation of Web sites seems to be the most difficult piece of the puzzle for students to solve. In the first part of the Capstone assignment, students are asked to evaluate a Web site chosen by instructors. Questions related to the primary purpose of this site (information versus advocacy) have proven consistently difficult for students to answer correctly, even though the sites used are from easily identifiable advocacy groups (such as Amnesty International USA) or are clear examples of informational sites from publishers or universities.

Finally, looking at the average of all assignments for each of the sections, Fall and Winter quarter student performance was similar (approximately 70 percent), while Spring quarter overall performance improved to 74 percent. Some of this improvement may be attributed to the fact that fewer Spring quarter students were freshmen (54 percent) and thus had more familiarity with the campus computing environment and perhaps better study habits. Also, a new process for registering for the course was initiated for the Spring quarter. Students were required to register in person rather than online. This additional hurdle may have discouraged some less motivated students from taking the course in the Spring.

**Final Course Grades**

The following tables examine the relationship of gender, class rank, and previous experience to final grades for the course. Table 6 compares final grades by student gender for Winter and Spring 2000. In both quarters, the distribution by gender for those receiving a grade of A roughly matched the distribution by gender of the student population for the course. That is, in Winter, 56 percent of students were male and 40 percent female (gender could not be determined from the student's name for 4 percent of students). Of those earning a grade of A in Winter, 57 percent were males and 37 percent were females. The same type of pattern prevailed in the Spring for those receiving an A. Males were more highly represented at the low end of the grading scale (D or E) in both quarters.

<table>
<thead>
<tr>
<th>Gender</th>
<th>% of total</th>
<th>Grade A</th>
<th>Grade B</th>
<th>Grade C</th>
<th>Grade D</th>
<th>Grade E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wtr  Spr</td>
<td>Wtr  Spr</td>
<td>Wtr  Spr</td>
<td>Wtr  Spr</td>
<td>Wtr  Spr</td>
<td>Wtr  Spr</td>
</tr>
<tr>
<td>Male</td>
<td>56% 58%</td>
<td>57% 55%</td>
<td>46% 71%</td>
<td>43% 43%</td>
<td>75% 50%</td>
<td>62% 75%</td>
</tr>
<tr>
<td>Female</td>
<td>40% 38%</td>
<td>37% 42%</td>
<td>50% 29%</td>
<td>57% 57%</td>
<td>25% 50%</td>
<td>33% 13%</td>
</tr>
<tr>
<td>Unknown</td>
<td>%  %</td>
<td>%  %</td>
<td>%  %</td>
<td>%  %</td>
<td>%  %</td>
<td>%  %</td>
</tr>
</tbody>
</table>

Although students in rank 1 (freshmen) heavily dominate enrollment in all three quarters, students at every other rank (including non-degree, graduate, and professional students) have also registered for the course. Table 7 compares distribution of final grades for each level. Again, in both
quarters, the distribution by rank for those receiving a grade of A roughly matched the general pattern of enrollment. In both Winter and Spring, roughly two-thirds (64 percent) of students were freshmen. In Winter, 58 percent of students who received an A were freshmen; in Spring, 62 percent of students earning an A were freshmen. One might expect students of higher rank to do better in this course because they are more acclimated to the university computing environment. As Table 7 indicates, new students were more strongly represented at the low end of the grading scale (D or E).

Table 7. Grade Distribution by Rank.

<table>
<thead>
<tr>
<th>Rank</th>
<th>% of total</th>
<th>Grade A</th>
<th>Grade B</th>
<th>Grade C</th>
<th>Grade D</th>
<th>Grade E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Win Spr</td>
<td>Win Spr</td>
<td>Win Spr</td>
<td>Win Spr</td>
<td>Win Spr</td>
<td>Win Spr</td>
</tr>
<tr>
<td>Rank 1</td>
<td>64%</td>
<td>64%</td>
<td>58%</td>
<td>52%</td>
<td>67%</td>
<td>50%</td>
</tr>
<tr>
<td>Rank above 1</td>
<td>36%</td>
<td>36%</td>
<td>42%</td>
<td>38%</td>
<td>33%</td>
<td>50%</td>
</tr>
</tbody>
</table>

A third filter for viewing grade distribution for this course is prior Internet experience. Beginning in Spring 2000, UVC 120 students completed a survey when registering. One question asks them to characterize their previous experience using Internet tools (the Web browser and e-mail). Response choices are “little or no experience,” “moderate,” or “extensive experience.” The majority of students (68 percent) characterized their previous experience as moderate, while only 7 percent noted that they had little or no previous experience. Figure 1 depicts the distribution of final course grades for each of these three groups during the Spring quarter.

One might assume that students who had some prior Internet experience would be more likely to succeed in an online course than those who had this additional learning task. Those students with little or no prior experience are fairly evenly distributed across the grade spectrum from A to D, although none failed the course. Of those with moderate prior experience, 55 percent earned either an A or B grade. Those with moderate experience were also more likely to fail. Overall, 9 percent (eight students) failed the course in Spring quarter. Seven out of eight individuals who failed were in the “moderate” experience group. This may be related to the ambiguity of the survey question. Since no quantifiers were offered to help students make this judgment about their prior experience, the moderate experience group is quite likely to include some students who really belong in the little/no experience category.

**Student Attitudes**

Each quarter, students in UVC 120 are encouraged to complete an anonymous online course evaluation at the end of the four-week session. Response rates have varied from 31 percent of those enrolled during Fall
and Winter quarters to 54 percent in Spring. Evaluations provide demographic information (student rank, grade point average, and OSU College affiliation), reason for enrolling and student perceptions of course management, content, their own learning, and the overall value of the course in their college curriculum. Table 8 shows questions and responses to three questions related to course management and content.

One important aspect of course management for an online course is the ability to distribute adequate information about the course to students so that they can begin successfully. In a traditional course, this is not difficult to accomplish. Students learn the class location from a schedule, attend class on the first day, and receive important information, usually contained in a syllabus from the instructor. In an online course with no required meetings, it is quite difficult to ensure that basic information (for example, the URL of the course Web site and instructor contact information) is distributed to all before the course begins.

Until Spring 2000, Ohio State students registered for UVC 120 in the same manner as other classes, using a computerized registration program named BRUTUS. The master schedule of classes that students consult to learn the room location for a traditional course did not provide the Web address for the online course. Academic advisors either did not have access
Table 8. Course Evaluation—Management and Content.

<table>
<thead>
<tr>
<th>Q. Adequate information available to begin course</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>43%</td>
<td>39%</td>
<td>60%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>38%</td>
<td>40%</td>
<td>23%</td>
</tr>
<tr>
<td>Neutral</td>
<td>12%</td>
<td>16%</td>
<td>13%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>4%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q. Course subject matter was well organized</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>54%</td>
<td>63%</td>
<td>55%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>39%</td>
<td>30%</td>
<td>38%</td>
</tr>
<tr>
<td>Neutral</td>
<td>4%</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q. net.TUTOR tutorials appreciably aided learning</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>49%</td>
<td>63%</td>
<td>55%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>41%</td>
<td>28%</td>
<td>36%</td>
</tr>
<tr>
<td>Neutral</td>
<td>10%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

to this information or were inconsistent in sharing it with students. After changing course registration procedures in Spring 2000 to require students to register in-person (and receive handouts at that time), student perceptions that they had received sufficient information to begin the course improved significantly.

Each quarter, 93 percent of respondents felt that the course subject matter was well organized. Similarly, approximately 90 percent of respondents each quarter agreed that the tutorials used as an e-text for the course were helpful. About 10 percent of respondents were neutral on this question. Since almost one-fourth of enrollees in Spring characterized their prior Internet experience as significant, it is not surprising that some may have found little benefit in the tutorials. As one student stated in the comment space of the evaluation form, "I feel that I didn't learn too much from the course. I have years of previous Internet experience, however, so I simply already knew most of the information covered." This student may have registered for this course simply to fill a one hour schedule gap. It is also reasonable to suspect that the preferred learning styles of some portion of the neutral respondents were not well supported by the predominantly visual online tutorials.
Table 9 provides additional data from student course evaluations. Approximately 90 percent of respondents each quarter agreed that the course met its goal—i.e., to develop the skills needed to use the Internet effectively. Opinion varied on whether the UVC 120 course will help them succeed in other OSU courses. Between 19 and 33 percent of respondents were neutral on this question. Some of this response may be attributed to the fact that relatively few courses require students to do independent research. Some may be due to the hesitancy of instructors to allow students to use Internet resources in research projects. And finally, since many students are freshmen, they may not yet know much about the other courses they will be required to take and so be unable to formulate a response to this question.

<table>
<thead>
<tr>
<th>Q. Course developed skills to use Internet effectively</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>39%</td>
<td>46%</td>
<td>56%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>49%</td>
<td>45%</td>
<td>36%</td>
</tr>
<tr>
<td>Neutral</td>
<td>7%</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>6%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q. Course will help me succeed in other OSU courses</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>22%</td>
<td>34%</td>
<td>30%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>38%</td>
<td>38%</td>
<td>49%</td>
</tr>
<tr>
<td>Neutral</td>
<td>33%</td>
<td>20%</td>
<td>19%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>4%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q. I learned a great deal from this course</th>
<th>Fall 1999</th>
<th>Wtr 2000</th>
<th>Spr 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>23%</td>
<td>26%</td>
<td>43%</td>
</tr>
<tr>
<td>Moderately agree</td>
<td>49%</td>
<td>42%</td>
<td>47%</td>
</tr>
<tr>
<td>Neutral</td>
<td>17%</td>
<td>25%</td>
<td>11%</td>
</tr>
<tr>
<td>Moderately disagree</td>
<td>7%</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Student perceptions of their own learning improved significantly in Spring 2000, with almost 90 percent of respondents indicating that they learned a great deal. This may be a reflection, to some extent, of improvement over time in our ability to manage the course and enhancements to various assignments.

Johnson, Aragon, Shaik, and Palma-Rivas (2000) analyzed learner satisfaction and learning outcomes for online and face-to-face learning
environments in a recent article. They cite studies that indicate that online students are most satisfied when courses offer flexibility, when the technology functions reliably, and when the instructor acts as a facilitator (p. 32). The authors also note that: "In terms of learning, the frequency or depth of exclusive student/instructor interaction may have some bearing on how much students feel they have gleaned from the course" (p. 45). Instructor/student communication is a critical component of any course, but particularly so in an asynchronous self-paced online course such as UVC 120. The instructors in UVC 120 initiated regular contacts by e-mail with students as a group and individually and also responded to individual student e-mail questions or phone calls promptly (usually the same day). This accessibility was frequently noted in the student comment portion of evaluations. Issues related to course communication, along with other challenges presented by this course, are discussed more fully in the following pages.

**COMMUNICATION CHALLENGES**

Teaching an online course presents unique challenges in two important areas—communication and student self-regulation. Communication-related issues that surfaced in this course include:

- lack of critical information needed to contact problem students;
- students not reading their OSU e-mail accounts regularly;
- use and misuse of the course mailing list by students; and
- difficulty in solving certain types of problems using e-mail.

The UVC 120 course begins in the fourth week of the ten week Ohio State academic quarter in order to give students new to the university some time to activate their Internet account and become familiar with reading and sending e-mail using their university accounts. Despite the fact that they had registered for an online course during Fall and Winter quarters, some students had not activated their OSU Internet accounts by the time the course began. These students were not receiving any e-mail from the instructor and were unaware of important information being distributed to students. The course management software utilizes this account information in order to authorize students to view course assignments so that students without OSU Internet accounts were also not able to complete any course work. Because the instructor did not have access to the university's student information system, obtaining local address and phone information in order to contact these students was difficult.

During Fall and Winter quarters, it also became apparent that some students who had activated their OSU Internet accounts were not reading the e-mail sent to their OSU e-mail addresses. Many of these students had other e-mail accounts (America Online, Yahoo Mail, and so on) but were unable to configure their e-mail programs to retrieve e-mail from Ohio
State's pop mail server. The university's technology center also provides an e-mail forwarding service that is easy to set up using a Web-based form, but students did not take advantage of it. The instructors concluded that they could overcome these problems by requiring students to register in-person for the course. This allows instructors to verify that students have activated their Internet accounts, obtain important contact information from them, and assure that basic information about the course, including the requirement to read their OSU e-mail or have it forwarded, is distributed to everyone. This new system, instituted during the Spring quarter, has helped to surmount these critical barriers to communication.

A mailing list is used to facilitate easy communication by the instructor to the students in the course. The manner in which this list is structured and used has changed since the first quarter that the course was offered. At that time, more than 200 students were enrolled in the course and students were asked to subscribe themselves to the list (directions were provided). Some students never succeeded, and many others required help to accomplish this task. The mailing list was set up to allow posting by subscribers without review by the list owner. During Fall quarter, students were required to post a message to the list, either in response to a discussion topic or simply introducing themselves to classmates. This requirement proved to be a strategic mistake. There were 200 students that generated a significant amount of daily traffic on the mailing list. Although it was possible for students to receive their list mail in a daily digest rather than as individual messages, many never succeeded in making this change and were inundated with e-mail from other students. While this did facilitate some students getting to know others taking the course and feeling more connected as a group, it also generated a great deal of frustration. Much of the discussion was not course-related in any way and required frequent interventions by the instructor to resolve conflicts or admonish students about list etiquette. In mid-course, the instructor changed the list configuration to moderated and the problems largely disappeared. Future group discussion assignments will utilize a Web-based forum rather than a mailing list.

Most students did not hesitate to get in touch with the instructor whenever they had problems. Despite the fact that these students were on campus and able to visit or call during the instructor's office hours, most preferred using e-mail for questions and problems. Table 10 provides an overview of student contacts during the Winter quarter.

Despite the fact that 66 percent of these students were able to complete the course without any additional help from the instructor, e-mail is often not the most efficient way to resolve problems for those who do need assistance in an online course. For example, one student sent multiple e-mails of increasing urgency as he became more frustrated at not being able to login to view course assignments. Each message was answered
Table 10. Overview of Student Contacts.

<table>
<thead>
<tr>
<th>Student contacts</th>
<th>Winter 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># students</td>
</tr>
<tr>
<td>One email message</td>
<td>27</td>
</tr>
<tr>
<td>Multiple (2-5) emails</td>
<td>24</td>
</tr>
<tr>
<td>Other mode*</td>
<td>5</td>
</tr>
<tr>
<td>No contact</td>
<td>109</td>
</tr>
<tr>
<td>TOTAL</td>
<td>165</td>
</tr>
</tbody>
</table>

*Instructors logged 7 telephone calls and 7 visits from students. Many of these students also sent email. Only 5 students used a mode other than email exclusively.

promptly by the instructor, who offered very specific instructions and also encouraged the student to come in to discuss this problem. The instructor was unable to help until she met with him in person and he walked through the steps he was taking to connect to assignments. It quickly became apparent that he was viewing a page on the course Web site that contained an illustration of the entry form on the login page and was repeatedly attempting to click on that image.

**Student Self-Regulation**

*Quality on the Line*, a recent report on benchmarks for success in distance education from the Institute for Higher Education Policy (2000), includes this comment from an administrator: “Self-directed study, which is prevalent at the graduate level, is being pushed down to the undergraduate level because of online learning” (p. 17). The report seeks to determine the relative importance of the benchmarks presented in a previous study to faculty, administrators, and students at six institutions with strong distance learning programs. Respondents did not strongly support the need for specific time requirements in distance courses, citing capacity of students to pace themselves. “Hard and fast rules on how much work should be accomplished in a specific time period” were viewed as inappropriate. Students highly value the flexibility that online courses afford. One student respondent in the study noted that “I enrolled in an [online] course so I would have the freedom to study at my pace and when I wanted to study. I did everything at my own pace for the first course and I got an ‘A.’ Therefore, stressing a strict pace is ‘not important’” (p. 18). Comments from students in course evaluations for UVC 120 echo this sentiment.

UVC 120 is structured in a manner that permits students great flexibility with regard to assignment completion. A new group of five to six
assignments opens each week, so students cannot complete all assignments
during the first week of the course. But they are allowed the full four
weeks to finish assignments. Although students are encouraged to keep
up a weekly pace, and those who lag behind are contacted individually by
the instructors to determine whether they are having problems, none of
the assignments are actually due until the final day. Table 11 provides a
snapshot of student progress on assignments at the end of week two, the
mid-point of the course. During both Winter and Spring quarters, roughly
half the students kept pace with the recommended schedule. Approximately one-fourth of students had not begun any assignments, and the
remaining one-fourth were somewhat behind.

Table 11. Student Programs at Course Mid-Point.

<table>
<thead>
<tr>
<th>Assignments completed</th>
<th>Number of students in range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wtr 2000</td>
</tr>
<tr>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>1-5</td>
<td>32</td>
</tr>
<tr>
<td>6-12</td>
<td>94</td>
</tr>
<tr>
<td>TOTAL</td>
<td>173</td>
</tr>
</tbody>
</table>

From a practical viewpoint, forcing students in an online course to
adhere to a fixed schedule is difficult. The course management software
used for UVC 120 does not provide support for automatic deduction of
points for late assignments, so this must be done manually. For a large
enrollment course, keeping track of assignments completed late and sub-
tracting points from grades is a significant additional workload for the
instructor or teaching assistant. From a pedagogical viewpoint, maintain-
ing a fixed schedule is of dubious value. Of the students in Spring who
had done no work at the mid-point of the course, 52 percent received a
final grade of A. Procrastination did not seem to affect their ultimate suc-
cess in the course.

CONCLUSION

By offering an online credit course that helps students improve both
computing and information-seeking skills in a format that is convenient
and flexible, Ohio State University Libraries is meeting institutional goals
for developing student competencies as well as filling a perceived need.
Although this course is an elective and thus fulfills no specific curricular
requirement, almost 500 students (primarily freshmen) completed the
Internet Tools and Research Techniques (UVC 120) course during the
1999-2000 academic year. Timing the course to begin later in the aca-
demic quarter gives new students an opportunity to establish their university
computing account and learn about the university’s e-mail system. It also allows those students taking the course as a replacement for one that they dropped to begin on an equal basis with everyone else.

The number of students dropping out of the UVC 120 course has been much lower (10 percent) than the rates cited for other distance courses (40 percent). Gender and academic rank seem to bear little relationship to student final grades for the course. Prior Internet experience is difficult to interpret as a factor in success or failure. Thus far, student evaluations of the course indicate that their expectations are being fulfilled. Approximately 90 percent of respondents agreed that the course helped them develop or improve their Internet research skills.

One communication challenge for the instructors has been the difficulty of assuring that all students registered for the course receive the information they need to get started. Requiring that students register in person solved this problem. Students have primarily used e-mail to communicate with the course instructors. More than half were able to complete the course without contacting the instructor (by any method). Apparently information on the course Web site about the course and assignments is presented clearly enough to forestall problems and answer questions for the majority of students.

Students in online courses seem to value highly the flexible timetables for completing assignments. In UVC 120, students are allowed the full four weeks to complete all assignments. About half of these students kept up a weekly pace, while the remainder lagged behind, catching up at the end of the course. There seems to be little benefit, practical or pedagogical, in forcing students to adhere to a strict schedule.

This course is fairly easy to administer for large groups because of the self-paced approach, clear instructions on the course Web site, and use of automatically graded assignments. During the first year the course was offered, enrollment each quarter was limited to a maximum of 200 students, and it was promoted in a cautious manner to avoid over-enrollment. Now that the curriculum has been tested and improved, larger sections will be permitted. During Fall 2000, the expected total enrollment is 500 students. A section for 200 students will be offered during the month of August as a true distance course aimed at new students who wish to complete the course in Summer before they come to campus for the first time. The course will be promoted more aggressively at Summer orientation for new students to increase enrollment. Finally, through an internal grant program, the university recently provided funding for an additional instructor to assist in managing the course and increasing enrollment. Enhanced staffing will enable us to expand on-campus enrollment and reach out to new audiences beyond the boundaries of Ohio State University.
REFERENCES
Teaching from the Web: Constructing a Library Learning Environment Where Connections can be Made

SUELLEN COX AND ELIZABETH HOUSEWRIGHT

ABSTRACT
Faculty librarians at California State University, Fullerton, collaborated with Management Science and Information Systems and Computer Science faculty to develop a new course, “Introduction to Information Technology and Presentation.” This course has been taught to 125-150 freshmen each Fall for the last three years as part of the pioneering Fullerton First Year program. Several elements inherent in the process of designing and teaching this course have contributed to changes in the library’s large formal instruction program. These include collaboration and feedback from team teaching, formal assessment and student evaluations and, above all, the increasing use of Web-based resources and state-of-the-art technology. This article will focus on the evolving nature of the instruction program, which is informed by the elements listed above as well as by ongoing experimentation with innovative, student-centered, active learning methods.

INTRODUCTION
California has a three-tiered system of public education, including the University of California system, the community college system, and the California State University system, which occupies the middle tier. The twenty-three California State schools enroll students from the top one-third of high school graduating classes and offer baccalaureate and master’s degrees in both traditional liberal arts and applied fields.

Suellen Cox, Pollak Library, California State University, P.O. Box 4150, Fullerton, CA 92834-4150
Elizabeth Housewright, Instruction & Information Services Unit, Pollak Library, California State University, P.O. Box 4150, Fullerton, CA 92834-4150
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California State University, Fullerton (CSUF), is a large, diverse, commuter campus located in Orange County in southern California. The campus currently has an enrollment of 27,000 students. Over the next few years this enrollment will increase due to a tidal wave of more than 700,000 additional students expected to enter California public college and university campuses by 2010. According to the *Los Angeles Times* (1999), the new incoming students will be more ethnically diverse than in the past, with an increasing percentage comprised of Latinos. In addition to being an ethnically diverse campus, CSUF has a broad range of ages represented in the student body. Many students transfer in at the junior level from community colleges and many are more mature re-entry students. In fact, each year less than 10 percent of the entire student body is traditional 18-year-old first year students. CSUF is a commuter campus, with the inherent challenges of building a sense of community and maximizing retention rates, in contrast to the built-in campus connections more easily achieved in a traditional educational environment.

To give further coherence to the educational process, the university is currently in the process of defining “Marks of a Cal State Fullerton Graduate” (California State University, 1999). These marks attempt to succinctly describe the distinctive characteristics of a CSUF education. These characteristics include graduates who are experienced contributors on teams and in collaborative settings and who are skilled in using technology for research, analysis, and presentation. As a step toward actualizing these goals, the university president has made technology a priority for our campus. In 1997, an ambitious initiative was launched to fully network the campus. All faculty and staff received state-of-the-art computers with a common suite of programs and applications.

**Overview of the Library Instruction Program**

In July 1996, the Pollak Library opened a new library wing. The new building added 130,000 square feet, almost doubling the size of the facility. Seating space increased from 650 to more than 3,000. In keeping with the president’s technology initiative, the building was outfitted with new computer workstations, docking stations, fiber-optic cabling, and four fully equipped library instruction rooms. The library is often a campus leader in the rollout of new equipment and programs and has the support of a large and responsive library computer systems section. These elements contributed to a growth and expansion of the library instruction program. Since 1996, the section has been on what Dupuis (1999) refers to as “a fast track of change that has challenged instruction librarians to continually develop new services and methods for teaching” (p. 288).

The Pollak Library has a very vigorous proactive instruction program that has been designated the number one priority for the library. The opening of the new building, with its state-of-the-art instruction rooms,
provided enhanced opportunities for innovation in library instruction and in what Gresham (1999) has termed “dynamic learning environments” (p. 28). Instead of one room with one portable projector, there are now four rooms with varied technological capabilities. Two rooms have student computer workstations that will accommodate twenty students or forty students working in pairs. These rooms have ceiling mounted projection units, and fully equipped instructor stations, with a computer console, an ELMO overhead projector, video capability, and a v-net control system that allows for alternative teaching techniques. The instructor can control all workstations, permit the students to have local control of their computers, or project any device to the overhead screen. Two additional rooms can accommodate larger classes. Each has a fully equipped instructor station, with the exception of the v-net system. One room has lecture seating for over 150 students. The other room has seventy-five tablet armchairs facing the screen and ten independent computer workstations around the perimeter. The room can be used in a lecture configuration or with up to five students, working in teams, at each station. The flexibility of this room offers instructors multiple choices in instruction techniques.

Building on the campus technology initiative and the enhanced facilities available because of the library expansion, the library instruction program has increased dramatically since 1995. Prior to the expansion, ten instruction librarians were teaching 125 faculty-requested sessions per semester. In Fall 1999, thirteen instruction librarians taught over 300 sessions in most disciplines and at all levels from remedial to master’s level. In addition to these sessions, other learning opportunities include one-on-one research consultations, workshops, and the Fullerton First Year library component described below. The experience gained over the last three years has given instruction librarians at CSUF expertise in innovative student-centered, technology-based teaching.

Within the CSU system there has been a strong initiative to incorporate information competence into the curriculum. This is considered by librarians to be a critical skill for all students. Our current instruction program has evolved with this initiative in mind.

**FULLERTON FIRST YEAR PROGRAM**

Due to the CSUF campus demographics, there is an ongoing need for programs that will foster a stronger sense of community, improve the first year experience, give students the tools necessary for academic success, and increase student retention. The Fullerton First Year (FFY) program was designed to address these needs. With support from the university president, the program was planned as an academically integrated year-long experience with a service learning component that was open to all incoming first year students by application. In reading the applications, the selection committee looked for interest, motivation, and com-
mitment and selected a diverse cross-section of students. The initial co-
hort of 125 students was extensively profiled during this first year, 1997/
98. According to Walker-Guyer (1999), results showed that these students
would indeed benefit from such an integrated community-rich program.
Most were 18 years old, over 65 percent were non-Caucasian, 75 percent
were female, many commuted to campus, and 27 percent worked over 21
hours per week during the academic year.

The integrated nature of this program ties courses together with a
central theme—"Education, Social Responsibility, and Community"—and
encourages collaboration across disciplines. An initial call went out for
campus faculty and student affairs professionals who would be interested
in working collaboratively to shape this program. The FFY program was
clearly addressing several of the "hot initiatives" mentioned by Ianuzzi
(1998)—i.e., student retention, learning communities, and technology in
the classroom (p. 99). Due to the library's strong commitment to informa-
tion competency, the existing and very successful library instruction pro-
gram, and the technological tools available, the library was in a good posi-
tion to help this initiative succeed. Because of the collaborative nature of
the project, a team of six librarians applied to the program. The FFY steer-
ing committee had not previously thought of including the library in the
program, but realized the potential value of having a library component.
The library's ongoing participation in the program, including the week-
long FFY summer planning retreats, has built alliances with discipline fac-
ulty and student affairs professionals across campus and has increased
library visibility.

The library team was paired with one faculty member from Computer
Science (CPSC) and one faculty member from Management Science and
Information Systems (MSIS). This group worked together to design a
course that would include elements from each discipline—i.e., informa-
tion competence, computer competence, and presentation skills. The new
course, "Introduction to Information Technology and Presentation (IITP)"
was designed as a two-unit class to be taught in one two-hour session each
week during the fall semester. There were six sections of the course with
approximately twenty-five students in each section. This course joined the
roster of several other required courses planned for the FFY program and
has been taught each Fall for the last three years.

MSIS and CPSC faculty taught computer competency, including com-
puter basics such as Windows, e-mail, and Internet searching, and presen-
tation skills, including PowerPoint and Web page creation. This compo-
nent was taught in computer-equipped classrooms for eleven weeks. Li-
brary faculty team-taught electronic library resources, the distinction be-
tween popular and scholarly sources, interpreting and citing electronic
resources, evaluating information on the Web, and electronically
requesting books and articles. The six sections of this component were
taught by one or two librarians each for a four-week period in the library’s state-of-the-art computer classrooms. The library team has worked collaboratively to create and modify the syllabus, in-class exercises, group activities, homework assignments, final exams, and Web materials. Student performance in the FFY library component was assessed using graded assignments and a final examination. These counted for 20 percent of the total IITP grade.

**FFY and Library Instruction Evolution**

The design and implementation of the FFY library component initially reflected experiences gained in the existing library instruction program. Both have changed dramatically during the past three years. In working collaboratively through issues of assessment, class structure and content, exercises, and assignments for the FFY library component, a more student-centered approach to instruction has evolved. Ideas generated and techniques used during each Fall’s FFY library component were tested and refined during the following Spring’s general library instruction sessions. The reciprocal lessons learned and changes made have greatly strengthened each. The most significant change has been the increased use by students and instructors of Web technology in all facets of the instruction program. Librarians have created both general and subject specific Web guides that augment general instruction. FFY library component course materials, including the syllabus, in-class exercises, assignments, and ultimately the final exam, were modified in the third year and posted on the Web using Blackboard CourseInfo software.

**Assessment**

The concept of assessment is central to the overall instruction program. A variety of assessment techniques are used to measure student learning and program effectiveness in order to determine what changes are desirable and to ascertain the effectiveness of changes. These techniques include both objective and subjective measurements such as class profiling, grading, and student and program evaluation. Increasingly, Web technology is being considered as the medium to assess student learning and acquisition of information competency.

In order to build a profile of FFY students, an assessment instrument was used to collect information on students’ experience and confidence with technology and their attitudes toward technology. Data collected and shown in Figure 1 indicate that FFY students entering CSUF in 1998 were far more familiar with computer and Internet use than students entering in 1997. Although they are increasingly confident in their ability to effectively use these tools prior to taking the class (see Figure 2), performance on assignments and tests that measure student learning indicate that instruction in the area of information competency is still needed.
CONTENT, STRUCTURE, AND DELIVERY OF INSTRUCTION SESSIONS

The decision to include the FFY library component within the IITP course influenced the choice of library component course content and the method of delivery. While the component was designed to provide students with a working knowledge of the library, whenever possible, students were introduced to Web-based, instead of more traditional paper-based, resources. A specialized Web guide was developed to create a well-defined and manageable set of introductory resources and explanatory materials. Experience teaching from this Web guide led to the modification of existing discipline-specific instruction Web guides, the creation of additional instruction Webs, and a more student-centered approach to teaching.
The FFY students came to the library in the tenth week of classes, after the computer component, with a good foundation in computer basics and general Internet use. The library component syllabus articulated specific learning goals for the four-week course module. Students would learn to identify principal library services and major collections as well as learn to access and use relevant library electronic resources. These included the library home page, the online public access catalog (OPAC), basic full-text background resources, full-text article and newspaper resources, and a discipline-specific citation database. Students would also be able to use and evaluate relevant World Wide Web sites, distinguish between popular and scholarly periodicals, interpret electronic bibliographic citations, and cite electronic materials. These learning goals have changed relatively little during the three-year period. The methods used to achieve them, however, have been modified significantly.

Library Home Page and OPAC. The library home page was used as a launch point to introduce students to library services, materials, and policies. Students were briefly shown how to locate floor maps, library navigation aids such as location codes, and general information such as library hours. This virtual tour was followed by a brief exploration of the OPAC. Students were then given a homework assignment designed to provide them with practice searching the OPAC and familiarity with one of five key areas of the library: reference, periodicals, audiovisual materials, curriculum materials center, and two floors of circulating books.

In this assignment, each student was asked to go to one of the five designated areas, explore the physical environment, and identify any existing service points such as help desks or reshelving areas. While in the area, they were required to pull an item randomly off the shelf, find the record in the OPAC, and print it. This gave them a better idea of the connection between the OPAC record, with its fields and controlled vocabulary, and the physical item and its location in the library. To ensure that they could read and interpret the bibliographic record, they were also asked to use the citation to find additional materials in the OPAC under the same subject heading. This engaged students in a more active way than a traditional library walking tour. The following week this homework assignment was followed by an in-class exercise in which students were grouped according to which of the five areas they had visited. Students were given time to discuss their findings and observations and answer several preselected prompts. Each group’s recorder then reported to the class as a whole, giving everyone, including librarians, a more three-dimensional picture than is possible using the online maps.

Both the homework assignment and the group exercise provided a student-based perspective of the library and the OPAC and highlighted unexpected challenges. Students were often unable to select required in-
formation from the formal bibliographic record and provide full information on titles and/or subject headings. Although much of the information needed for the assignment was available on the Web, such as location codes and floor maps, students often relied on more immediately accessible (and low tech) materials such as people at help desks and signs posted in elevators.

An assessment of the experience with Fullerton First Year students, and taking a cue from Dupuis' (1998) maxim "Call it what they'll understand and put it where they'll find it" has led to an evolution of the home page (p. 16). Twelve major links have been reduced to eight, providing more streamlined navigation. The language has been changed to reduce the amount of library jargon, making the page more easily understood by students. For example, "Indexes/Abstracts/Full-Text" changed initially to "Electronic Information Resources" and now reads "Find Articles and More." The "Introduction to Library Research" Web guide, originally created for FFY, has been modified and expanded, renamed, and given a prominent place on the home page.

An overview of the library given in most general library instruction sessions has also changed based on the Fullerton First Year experiences. Most sessions requested by faculty do not offer the luxury of eight hours of intensive library instruction. Introductory walking tours, as a result, have become briefer and are sometimes eliminated altogether unless they add significantly to the ability to complete a specific assignment. Instead, in-class hands-on exploration of the home page is used to address typical questions. Students who have previously experienced the sometimes frustrating process of finding library materials are often excited about and appreciate the ability to access floor maps and location codes.

Web Evaluation. During the first year of FFY, students were relatively inexperienced in general with using the Web to find information. A lecture/demonstration of useful sites was included to show them the potential of the Web for research purposes. During the second FFY year, a change was made. Due to the explosion of information on the Internet and its increased availability, and in response to some faculty concerns about the growing student use of inappropriate Web sites for assignments and papers, librarians sensitized students to the need for appraisal and together explored ways to evaluate sites on the Web. Many excellent Web evaluation resources exist. The library team surveyed these resources and chose the criteria established by Jim Kapoun in his "Seven Criteria for Evaluating Web Sites" (1998). These criteria were modified with the author's permission, retitled "Six Criteria for Evaluating Web Sites," used in a demonstration, applied by students in an assignment, and discussed during a group exercise.

The demonstration modeled for the students indicated how a team librarian evaluated and rated two contrasting Web sites on the use of alcohol
among teenagers using the seven criteria: authority, objectivity, accuracy, currency, content, relevancy, and aesthetics. For each of the criteria, evidence was provided from the sites to substantiate the evaluation. This was a preview for their homework assignment. For the homework, students received one of three versions of the assignment; each version listed a different URL for an informative site dealing with the issue of smoking. Students evaluated and rated the site using the seven criteria. The previous group exercise on the OPAC had been so successful that library team members created a similar exercise for this assignment, allowing students to interact informally, discuss their evaluations, and present the group's consensus rating of their site. Discussion was lively as students used different evidence to defend their rankings. As concluded by Sholz-Crane (1998), students need more than a simple checklist of criteria for evaluating Web sites, and the modeling of the assignment and subsequent group discussion provided this.

A review of final exam results by the library team showed that students had at least gained an awareness of the necessity to evaluate Web sites. In fact, the exam also indicated a strong student preference for library subscription databases that had been evaluated and selected for them. The "Six Criteria for Evaluating Web Sites" is accessible from the home page and now serves as the basis for most instruction involving Web evaluation. It has proven very popular with discipline faculty, who often request this learning module as part of the general library instruction session.

Online Full-Text Background Sources. The core classes that Fullerton First Year students take during the first year experience have varied over the three-year period. In addition to the IITP and University 100 courses, other required core courses have included basic English, political science, speech communication, ethnic studies, math, and science. In order to help students with assignments for written and oral presentations given in these courses, the library team decided to include instruction on two basic online full-text background resources: Britannica Online and CQ Researcher. Many students are familiar with encyclopedias and weekly publications and understand the structure and the concepts associated with them, such as authority and currency. In addition, both resources include citing examples, which makes it easy to introduce one of the IITP course learning objectives—the correct use of citations and style manuals. Students appreciated the ease of use and comprehensiveness of these resources, and immediately grasped the utility of both Britannica Online and CQ Researcher for completing assignments in their other introductory classes.

During the first year, both resources were demonstrated during a class session, and students were given homework assignments for each. There was no hands-on practice time allotted. Previous assumptions about student learning via lecture-style presentations were challenged. Students
were not able to apply immediately what had been demonstrated, and they found the lecture-demonstration boring and excessively long. Because they often did not begin to work on the homework assignment until almost a week after the demonstration, they had trouble navigating to and within both resources. They also had difficulty interpreting the assignments' sometimes ambiguous wording. In grading the homework, which had been considered relatively straightforward assignments, team librarians discovered these problems, but were unable to correct misconceptions in a timely manner.

To address some of these challenges, this learning module was modified to include more active learning. Demonstrations were kept to brief segments, followed by frequent practice searching and in-class exercises that modeled the upcoming homework assignment. The exercises were structured, with step-by-step instructions for navigating to the database, performing specific searches, and locating relevant information that would answer the exercise questions. This guided exploration activity, which highlighted the mechanical process rather than more conceptual thinking, assured the library team that students could follow instructions and effectively use the resources. Students were actively engaged, serious, and focused as they worked through the exercise. Librarians were able to observe navigating problems first hand, give useful browser tips like how to find words in a page, and immediately clarify any misconceptions. Difficulties in navigating and interpreting on-screen information can be discussed and resolved to the benefit of the entire class.

As is the case when utilizing Web technology, additional challenges were encountered. License agreements sometimes precluded extensive hands-on use because of limits to the number of simultaneous users. Moreover, too many users could sometimes slow the loading of information to the screen. To address these issues, several techniques were used: for example, having students work in groups of two or three, or having students volunteer or be selected to keyboard and project their work to the class. Additionally, due to the fluid nature of the Web, resources often changed without much advance notice. This necessitates designing or reviewing exercises and assignments as close to class time as possible.

Due to these experiences in FFY, our general library instruction sessions have changed dramatically. Most library instruction now includes hands-on practice, student keyboarding, formal in-class exercises, and group work, which reinforce course material and help students develop and apply information competence skills. This often means covering less in any one session but assures librarians that students learn what was explored more effectively, and that they enjoy the sessions more. Our experience corroborates the conclusion of Bren, Hilleman, and Topp (1998) that using a guided hands-on method increases student retention of information.
Full-Text Broad Periodical and Newspaper Indexes. To meet several other learning goals, students were next introduced to electronic full-text article and newspaper resources, including Expanded Academic ASAP, Lexis/Nexis, and Proquest Direct. These resources were used to illustrate concepts such as the distinction between popular and scholarly materials, the effective use of subject headings and journal indexes to conduct library research, and the interpretation and use of citations. Active learning techniques were expanded on a constructivist model.

These three resources were chosen because they are user friendly, have significant full-text content and broad subject coverage, and can be used to gather information for other FFY course assignments. In addition, Expanded Academic usually defaults to a subject search with the capability of narrowing by subdivision. Students conversant with using Internet subject directories such as Yahoo find the hierarchical approach of this database familiar, and librarians appreciate the ability to reinforce the utility of controlled vocabulary subject headings. Expanded Academic includes several publication types, and there is a limit function to restrict results to refereed publications. This provides an opportunity to discuss the distinction between popular and scholarly sources.

Students learned Expanded Academic quickly and appreciated the ability to focus their searches and e-mail complete articles. In grading assignments from the first two years, library team members noticed that students were still having difficulty distinguishing between popular and scholarly sources. They were unable to utilize elements in the citation and abstract to determine whether or not the item was likely to be from a scholarly source. Due to the electronic nature of the article, students saw it out of context and many of the clues normally utilized in this evaluative process, such as extensive advertising or author submission requirements, were missing.

To meet this challenge for the second year, a handout was modified and placed on the Web, which detailed the scholarly, versus popular, distinction. This was, however, too passive, and the students still had difficulty with the concept. Librarians endeavored to shift their role toward King's (1993) vision of "a facilitator who orchestrates the context, provides resources, and poses questions to stimulate students to think up their own answers" (p. 30). For the third year, a group exercise was created that would afford students the opportunity to physically handle and discuss different publication types. These included a newspaper, a popular weekly, a trade journal, and a scholarly journal. Each group was given a sample issue and asked to discuss what constituted the defining elements of the publication and report their findings to the class. They were asked the following questions:

- Who publishes or owns the periodical?
In their group discussions, students came to understand and appreciate the different processes that go into creating these publications and the different audiences that they target. They gained skills that they could use to better interpret online citations and full-text material. As electronic journals evolve and proliferate, however, students new to the research process may have increasing difficulty evaluating the relevance of these online materials for their academic needs. As new models of publication are created, new techniques will need to be developed to ensure that students have the necessary tools to place these materials in an academic context.

In using Expanded Academic, students are also exposed for the first time to periodical citations without accompanying full-text. They need to correctly read and interpret the article citation to find successfully a copy of the article in the CSUF library. Predictably, this proved to be difficult. Although the students had used the OPAC for other purposes in a previous session, few of them thought to utilize it for this task. Moreover, it was problematic for them to know which term from the article citation to use for their OPAC search. Actually, they needed to start with the journal title. In addition, once the journal record was located in the OPAC, they had difficulty interpreting it to find the necessary issue availability and location information. Graded assignments revealed that, despite repeated in-class discussions on this, students often had problems.

During the past three years, teaching techniques for this critical series of steps have been altered for FFY sessions. To negotiate these steps, students are now taught to open two browser windows and switch between the OPAC and the article citation to obtain the information they need more efficiently. This also makes the distinction between the two resources more visually apparent. Brief and frequent hands-on modules are used to ensure that all students are more successful with the process. Finally, the library team has decided that the OPAC fits more naturally at this periodical citation stage of the process rather than in the customary first session. Students are naturally excited by full-text databases and, at this stage, more readily grasp the utility of the OPAC to augment and find additional materials.
Lexis/Nexis Academic Universe and Proquest Direct were selected as examples of online full-text newspaper resources. Students could use these to find information on current topical issues for many assignments in their other FYF courses. Also, because of the prior group activity in which they explored various publication types, students were familiar with the defining elements of a newspaper format. The varied ways to search these full-text resources provided both a challenge and an opportunity. Keyword searching of full-text information often results in too many hits and may also miss relevant articles. Library team members and students briefly utilized techniques to search within specific fields like headline and lead paragraph to make results more focused and precise. Brainstorming was used to find appropriate synonyms to broaden their results.

Many of these techniques have also been adapted for general library instruction, from fifty-minute introductory level to three-hour graduate level sessions. Abbreviated group discussions based on the popular/scholarly distinction exercise provide students with concrete representations of this sometimes abstract concept. A two-minute critical thinking exercise can often clarify the task of interpreting periodical citations and locating library materials. Discipline faculty attending the sessions are often surprised at the difficulty students at all levels have with this process. As more citation databases integrate library holdings and links to full-text journal articles, this difficulty will most likely be eliminated. Some library team members are introducing students to the OPAC at a more relevant stage—at the point when cited material must be found in the library.

Discipline-Specific Resources. To reflect the IITP course content, Microcomputer Abstracts (now called Internet and Personal Computing Abstracts) was selected by librarians as an example of a more typical discipline-specific periodical database. Due to their prior exposure to the citation and abstract format in Expanded Academic, students quickly grasped how to use this resource to locate technology-related articles and product reviews. This provided another opportunity to reinforce the use of the OPAC to locate materials in the CSUF library. In fact, in the third year, at the beginning of the final class session, students were given an exercise and asked to explore this resource independently without a brief introductory demonstration. The in-class discussion that followed the independent hands-on exercise focused on techniques that could be used to approach any new or recently changed electronic resource. For example, reading the introductory material that explains the scope and content of the database may be useful for determining its utility for a specific assignment. Also, all online resources have help screens that can explain various functions or search tips that can make searching more efficient and precise. Finally, use of limit functions or searching within specific fields can lead to more relevant results.
Librarians are experimenting with this in-class group exploration and subsequent student demonstration of databases that have not previously been discussed in class. Although the Web is a very dynamic medium, lecture demonstrations and step-by-step in-class exercises are typically controlled and linear. These student explorations have the advantage of presenting a variety of unscripted scenarios that may mirror far more realistic student information-seeking behavior. This unscripted exploration can provide a bridge for students to move from terms and techniques chosen by librarians to conducting their own research in unfamiliar databases. It also gives librarians insight into how students search and how well user interfaces work.

THE EVOLUTION OF THE LIBRARY COMPONENT WEB AND OTHER LIBRARY RESEARCH WEBS

In the third year, library component materials, such as the syllabus, in-class exercises, homework assignments, component grades, and the final examination, were made available via a Blackboard CourseInfo Web site. From this site, students could also link to the “Introduction to Library Research” Web page, which had been created for the second year. This introductory Web included links to resources used in the class and explanatory materials such as the criteria for Web site evaluation and guidelines for distinguishing between popular and scholarly materials and citing sources.

This CourseInfo Web site provided several advantages to both students and librarians. The syllabus, with course objectives, course requirements, schedule, and contact information, was always available. Students could access the site twenty-four hours a day and, if absent, were required to retrieve necessary class materials. They could also check the status of their grades. Students could review concepts presented in class and refer to examples given. Library team members found it an advantage no longer to have to bring copies of the previous week’s handouts, exercises, and assignments to class. They also felt that this site provided a more manageable library universe for these beginning students.

Because so much of the FFY library component is Web based, it was deemed a natural progression to experiment with migrating assessment instruments, such as the final exam, to the Web. In the third year, the library component final exam was given electronically. This had several benefits. Students were able to utilize and reinforce skills, such as interpretation of on-screen information, that had been practiced over the four weeks. In addition, students were given instant feedback on their exam results. Benefits to librarians included automatic grading and recording of exam results and the ability to analyze answers from individual questions in order to discover ambiguities or areas needing further explanation. From this experience, additional Web-based instruments are being
developed to assess student learning during general library instruction sessions as well as electronic workshops.

Although students and library team members responded very favorably to the course component Web site, several potential disadvantages must be noted. The elimination of paper handouts and twenty-four hour reliance on electronic access and delivery makes the course vulnerable because server or online access problems can make information unavailable. The protected CourseInfo software requires students to register with user name and password, and although students were cautioned to remember or record this information, many did not. The necessity of posting library documents in both HTML and Word formats, to ensure wide access while preserving efficient formatting and printing, created additional work for the library team. With each new release of the software, considerable time and effort by the library team will be required to take advantage of new features. The site was successful in providing easy and convenient connections to all course-related resources and explanatory materials. However, the library team is concerned that small, extremely focused Webs, such as this one based on librarians' assumptions about student research needs, may be too restrictive and could inhibit student exploration of a wider array of useful resources. Also, multiple paths to a resource sometimes confuse students.

Despite these drawbacks, the library team and other instruction librarians continue to create and expand on Web-based library research guides for specific majors, specific classes, and special topics. The guides for majors contain pages that provide information on finding relevant books, articles, journal holdings, recommended and related Web sites, and annotated reference sources. Although each guide is organized in a standard format, information is tailored to the major, and the guide may include other relevant links and explanatory material. These guides are useful in several ways. Library instruction sessions often begin with an introduction to a specific major's guide, which provides an overview of discipline-appropriate resources. After the library session, students can refer to these guides when they are working on course-related assignments. The guides can be quickly modified and updated as resources change or new ones become available. The guides are prepared by a subject bibliographer and are useful to non-subject specialists who may do library instruction or provide reference assistance.

In working with students during FFY and library instruction sessions, librarians gain firsthand knowledge of how students navigate and use these Webs. From these observations, Webs have changed to become more student centered. For example, the Communications Web provides scanned images of the cover and sample pages from selected communications reference sources. This facilitates student recognition and use of these resources. Library jargon has been replaced with vocabulary that students
more readily understand. This will also make the sites more useful to any student doing research remotely. Faculty preparing Web sites for distance education courses would be well advised to field test their course Web to avoid constructing artificial roadblocks for their targeted users.

**FFY Component and Library Instruction Evaluation**

In order to monitor, evaluate, and improve the library component, feedback was sought from library team members and FFY students. During informal wrap-up discussions immediately following the second and third years of FFY, library team members reviewed the course objectives, individual sessions, and course materials.

Concerns were raised on the issue of standardization, including presentation of materials, attendance, and other classroom management policies, and grading of assignments and exams. Moving course materials, including the final exam, to the Web, has facilitated the standardization process. Team members found this "structured brainstorming" approach, as used by Keyser and Lucio (1998), to be very beneficial (p. 225).

Librarians also developed and administered an instrument in order to obtain direct student feedback on the library component. Evaluations were generally positive, although many students commented that they would have liked even less lecture and more hands-on practice with the Web. This reinforced the observation from graded assignments that students learned better when more actively engaged.

Lessons learned from FFY library component evaluations have also informed the general library instruction program. Prior to the session, library and discipline faculty often discuss and agree on common objectives. At the beginning of the class, these objectives are communicated to the students. The sessions often begin with some type of short informal assessment to determine such things as student expectations, experience with computers, and prior library use. With this knowledge, the librarian can modify the session to better meet the needs of the student.

An information competence pilot project was developed, and a Web-based instrument was created to assess student learning during selected library instruction sessions. Classes represented a cross-section of disciplines and grade levels. Data from this pilot program will be analyzed to determine if the library instruction program is meeting information competence objectives. The instrument will be modified for use in future library instruction sessions.

Workshops are offered throughout the semester to introduce students to the library and several basic electronic resources. Every participant now completes a short Web-based evaluation of the workshop. Feedback will be used to revise the workshop program to meet student needs more effectively. A more objective instrument to measure student learning is being developed for use in workshops and general library instruction sessions.
Recommendations

Librarians need to remain committed to the primary goal of academic library instruction—i.e., providing students with the tools necessary to use the library in order to succeed in college and beyond. But students are changing, technology continues to evolve, higher education is adapting to these changes, and librarians need to anticipate the effects of these changes and continually re-create library instruction:

• Because of the constantly changing Web environment, which requires continuous learning, librarians need to remain strong advocates for information competence.
• Whenever possible, librarians and faculty requesting library instruction sessions should synthesize library instruction, course, goals, and objectives for the session. This approach ensures that librarians can help provide the tools necessary for students to complete research assignments that meet discipline-specific learning goals.
• Although students will have differing levels of experience with technology, increasingly students will arrive in college equipped with basic computer skills. This allows librarians to spend more time on the research process, including evaluation and interpretation.
• As more campus labs are equipped with computers, and as Web-based library resources proliferate, librarians should consider providing instruction through these labs. The library can remain central to the educational experience while becoming more fully integrated with subject-based learning.
• Because students do not all have access to state-of-the-art equipment, care should be taken when creating interactive materials so that as many students as possible can take advantage of them.
• Because many students learn best by doing, online exercises should be structured to provide guidance, practice, and feedback. This also makes the learning experience available to distance students.
• Librarians should encourage students to make connections between resources and techniques learned during a specific library session and ways these can be applied to other assignments or other courses.
• Chat rooms or group Web sites can be added to class Web sites to substitute for, or augment, group activities.
• Assessment is fundamental in order to determine if goals are realistic and if they are being met by the instruction session. Distance education faculty should take advantage of Web-based instruments to profile their class and should also utilize synchronous or asynchronous methods to elicit student feedback.
• Assessment instruments should be administered online for ease of data collection.
• Librarians should lobby publishers to provide basic reference sources
online to facilitate ease of access any time, anywhere.
- Librarians should provide feedback on student perceptions and use and should lobby database publishers for changes that would promote standardization, such as truncation symbols and ease of use.

CONCLUSIONS

The library instruction program has benefitted in several ways from participation in FFY. Many connections have been made with discipline faculty and student affairs professionals that have provided opportunities to understand campus needs and to communicate that library faculty have the skills, knowledge, experience, and vision to help address these needs. Library faculty have worked collaboratively to design and implement effective library instruction techniques for FFY and have learned from each other, and been supported by each other, when proposing new ideas that can lead to enhanced student learning during these sessions. The responsibility of constructing goals and objectives and grading students in FFY has led to a growing appreciation of the role that assessment can play in determining the effect of all library instruction. Librarians who have participated in FFY over the last three years have worked with students increasingly familiar with the Web. To accommodate this familiarity and student information needs, most library instruction materials have been moved to the Web. The library component of FFY continues to function as a laboratory for new materials, better instruction techniques, and increased sharing of ideas among discipline and library faculty.

The convergence of a newly built library wing, campus administrators who had a vision of a technology enhanced environment, and faculty committed to connecting students to the campus and building community, have enhanced the experience for first year students. Library faculty, using technology and active learning, are creating an environment where students are encouraged to think for themselves and to construct a meaningful understanding of how the library and its resources can contribute to the success of their academic experience.

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Web-Based Library Instruction for a Changing Medical School Curriculum

JOAN R. KAPLOWITZ AND DAVID O. YAMAMOTO

ABSTRACT
This article describes how librarians at the UCLA Louise M. Darling Biomedical Library adapted to changes in the Medical School’s curriculum, developed new ways to support the school’s instructional goals, and provided information literacy instruction. Encouraged by the school’s growing awareness of, and reliance upon, computerized information to support the educational process, librarians worked with faculty to develop new approaches that would meet the changing needs of both student and teacher. Advances in information technologies provided alternative instructional delivery methods that accommodated both the numbers of students (150 for each of the four years of medical school) and the range of issues being explored by these students.

BACKGROUND
Delivering information literacy instruction to students who generate their own problems, do not meet in large groups, and who study topics that change on a monthly basis can be problematic. This was the challenge faced by reference librarians at the UCLA Louise M. Darling Biomedical Library when the UCLA School of Medicine’s curriculum began to evolve from the traditional lecture-based approach to one that focused on a more interactive self-directed mode of instruction known as problem based learning (PBL.)
An initial survey of available options revealed that live classroom instruction would not be adequate in addressing the problem based learning approach with the large number and variety of topics being explored. An ideal medium would deliver information and instruction when and where the students needed it. But, if you build it, will they come? This has been the age-old question facing information professionals who develop and provide instruction. The most successful instruction programs are those that teach skills relevant to the learners' immediate needs and whose objectives are linked to those of the academic or professional program the instruction is supporting. As with most things in life, timeliness tends to be everything. For librarians at the UCLA Biomedical Library, the move toward PBL offered both challenges and opportunities. Just as information literacy was becoming a major theme in librarianship in the mid-to-late 1980s, medical educators were exploring ways to reframe their methods and curriculum to promote the development of a different, more responsive, self-directed type of physician.

Although information literacy was first named by Paul G. Zurkowski (1974), it was the publication of the American Library Association's Presidential Committee on Information Literacy Final Report in 1989 that focused the information profession's attention on this concept. A few years earlier, the American Association of Medical Colleges had published "Physicians for the Twenty-First Century" (AAMC, 1984), which highlighted the need to develop students who were active independent learners and problem solvers rather than passive recipients of information. Just as the ALA defined the information literate person as one who had developed lifelong learning skills, the AAMC encouraged medical educators to re-examine both the priorities underlying the traditional content of the curriculum and the ways in which instruction was being delivered. As medical schools around the world began to revamp their programs, problem based learning was explored as a way to address the concerns raised by the AAMC report (Albanese & Mitchell, 1993; Donner & Bickley, 1993; Braunstein, 1997/1998).

Problem based learning is a student-directed active learning approach. Cases are presented in a small group setting, and students are encouraged to work in a collaborative fashion to identify and solve learning issues related to these cases. Two of the major goals of PBL are to enhance problem-solving and lifelong learning skills (Albanese & Mitchell, 1993; Barrows, 1985, 1986; Kaufman et al., 1985, 1989; Neufeld, Woodward, & MacLeod, 1989; Walton & Matthews, 1989; Wilkerson & Feletti, 1989). Medical educators expected that students who engaged in PBL would not only be able to solve the immediate problem, they would also develop the strategies and skills necessary to solve problems they encountered in the future. These students would have learned how to learn.

An examination of the goals of information literacy as defined in the ALA 1989 report revealed a number of similarities. The emphasis here is
also on problem-solving and lifelong learning. As the report indicates: "Ultimately information literate people are those who have learned how to learn" (ALA, 1989, p. 1).

These two parallel lines of thinking offered medical librarians an excellent way to incorporate teaching information literacy skills into the newly evolving medical education curriculum. Because students in PBL environments are encouraged to research and uncover answers on their own using resources outside the standard textbook material, they tend to make more use of the libraries associated with their schools. As a result, these students are more likely to need instruction in how to best access and locate the information needed to solve their PBL cases (Marshall et al., 1993).

A PBL curriculum, with its emphasis on individual problem-solving and self-directed learning, poses a multitude of problems for any library. Delivering appropriate and timely instructional support to a large number of students with a wide variety of information needs is particularly difficult given finite resources. UCLA's School of Medicine began evolving toward a PBL approach in 1993 (Wilkes, Usatine, Slavin, & Hoffman, 1998). This new educational approach offered the library a unique opportunity to become involved in the early stages of curriculum development. Reference librarians at the Louise M. Darling Biomedical Library began working in partnership with faculty to develop an integrated cumulative library program that would be responsive to this new educational endeavor.

To ensure that the library's collections and services would support this new initiative, meetings between the medical curriculum developers and the representatives of both the library's collection development and reference divisions were scheduled. This gave the library the chance to become involved in curriculum development from its beginning. Furthermore, associating with this problem based learning approach allowed the library to promote the idea of including information professionals among community resource experts who could assist students in their problem solving endeavors. It also reinforced the link between information literacy initiatives and the goals being promoted by the new medical curriculum.

Finding a method to deliver appropriate and timely library support for student developed objectives generated in a problem based learning curriculum was particularly problematic. Because students generate their own questions, the library was faced with the necessity of developing an approach that would be generic enough to address a wide variety of topics and yet specific enough to respond to an individual student's information needs. The variety of topics coupled with the fact that students do not meet in large groups made this a particularly difficult task. How could the library develop and deliver efficient effective support that anticipated students' needs and at the same time enable them to develop lifelong
learning skills? In addition, how could the information be delivered to the students at their moment of need?

**Technological Solutions**

When PBL first began to be incorporated into UCLA's School of Medicine curriculum in 1993, the library responded by offering individual personal consultation hours with reference librarians. While this approach addressed the problem presented by wide-ranging questions, it quickly became clear that it was an inefficient way of reaching the large number of students involved. Only a small percentage of students took advantage of these consultations. The bulk of the students were still either trying to research on their own or were using the reference desk services as a means of dealing with their learning issues. Although the reference desk staff could and would attempt to assist the student with whatever specific problem he or she might have, we felt the students were not gaining the lifelong learning skills that are the goals of both PBL and information literacy through this approach. Clearly a different mode of instruction was needed that could be widely distributed to the students at their most pressing point of need.

The library's search for a new mode of instruction coincided with the campus' nearly universal acceptance of the Internet as a medium for communication and information dissemination. In 1994, librarians began using electronic mail to provide reference assistance that focused on specific cases assigned to groups of medical students. Other medical libraries as well have used electronic mail to supplement their reference services (Schilling-Eccles & Harzbecker, Jr., 1998). The first step in preparing e-mail reference assistance involved acquiring from medical school faculty a set of the cases students were working on with accompanying learning issues. Examples of these cases ranged from "substance abuse" to "breast cancer" to "tuberculosis." Librarians then developed a one-to-two page set of library hints based on the learning issues for each case. Examples of learning issues included diagnosis, treatment, and psychosocial components. The hints included information on how to locate relevant reference books, books in the general collection, and appropriate Medical Subject Headings to apply to MEDLINE searches. Where appropriate, librarians would include research and information retrieval concepts rather than simply "spoon feeding" the students with solutions. Working closely with faculty, two differing approaches were developed for first- versus second-year students: hints targeted for first-year students emphasized locating more general information typically found in textbooks, while hints targeted for second-year students emphasized more specialized resources such as the journal literature.

E-mail proved to be an efficient medium for library instructions. Furthermore, because librarians were already using e-mail routinely, a learn-
ing curve for this "new technology" was nonexistent. However, e-mail did present certain limitations. Because messages were sent out in advance of when students conducted their library research, reference assistance was often lost or deleted prior to when it would actually be useful. In addition, working within the confines of electronic mail (essentially an ASCII analog of the printed page) resulted in messages that were very linear and "step-by-step" in nature. Furthermore, limiting the information contained in a single message to a digestible amount necessitated the omission of a high level of detail. Thus, library support using electronic mail reaching students "just in case" as opposed to "just in time," offered no advantage over the printed page, and was not universally relevant to a wide range of knowledge and experience levels.

An ideal medium would facilitate the delivery of library support anytime the students needed it, as well as feature random nonlinear access to information of varying levels of depth and detail. The World Wide Web, which was in its early developmental stages at the time, presented itself as a medium holding great promise. Other institutions, such as the University of Utah Spencer S. Eccles Health Science Library, Johns Hopkins University William H. Welch Memorial Library, and the University of Florida College of Medicine, have also turned to Web-based educational programs (Hriinya Tannery & Wessel, 1998; Schell & Rathe, 1996). The Web, with its hypertext navigational schema, made it possible to present an easily digestible amount of information on the surface, yet offered more in-depth detail should the student need or choose to seek it. Because the actual instructional content resided on a server, it was accessible to students from home or library computing facilities. Furthermore, the graphical capability of the Web offered exciting and creative options not previously available using electronic mail.

After gaining proficiency in HTML, graphics applications such as Adobe Photoshop and Illustrator, and Web site design, librarians began developing instructional content. Initial Web projects involved taking existing printed handouts available in the library and manually converting them to HTML. The conversion of these documents took an inordinate amount of time, and the end results did not offer much advantage over the printed handout. A more cost-effective approach would have been simply to convert the documents into Adobe PDF files.

Creating instructional Web pages up to this point involved taking materials designed and destined for print and converting them to HTML. To exploit fully the strengths of the Web, however, it was necessary to completely rethink how visual instructional materials were designed and abandon the mental constructs applied to creating printed pages. Breaking away from the paper realm and arriving at what we felt were effective design principles for Web tutorials required some trial and error. As an example, a printed tutorial on searching the MEDLINE database was
converted to HTML. The paper document lent itself nicely to hypertext since it consisted of step-by-step instructions. A simple numbered list of topics (e.g., “how to do a keyword search,” “how to refine a search,” “how to expand a search,” and so on) appeared on an opening page with hypertext links to other pages containing the actual tutorials. This appeared to be a vast improvement over initial efforts: embedded throughout each of the pages were one or two cross-reference links to other relevant pages, and graphics helped students visualize what an actual search session might look like on the computer screen. However, the Web pages still resembled their paper ancestor. While users could select topics randomly from the numbered list, the structure and presentation encouraged a linear predetermined path throughout the site. In addition, to minimize the number of individual pages that needed to be created and interlinked, the density of text on each of the pages was increased, making scrolling to relevant information cumbersome.

The process of working on these initial projects led to the realization that it is important to avoid emulating courses taught in the classroom when creating Web-based tutorials. Information in the classroom is usually presented in a pre-determined sequential order; to do so on the Web would undermine one of its primary strengths—random access. It is difficult to predict the point of entry a user might use to access a series of Web pages; therefore, the content of each page should stand on its own and not be dependent on a contextual relationship to other pages in a series. Furthermore, the comprehension of information should not be predicated on the place it holds in a sequential order of presentation. Rather than creating a series of pages with hypertext links from navigational phrases such as “next step” or “previous step,” it is more effective to create links from important terms or concepts requiring further elucidation. Also, pages that are rich in links are more effective than those that are dense in text. Hypertext can empower users to seek more in-depth information on a particular topic and free them from scrolling through line after line of irrelevant text to arrive finally at the kernel of information that fills the gap in their knowledge. While such a design principle might be more labor intensive, the resulting pages will be more useful to a broader group of users with a wide range of knowledge and experience levels. More importantly, the inherent nature of a hypertext medium is in line with independent learning behavior.

Much experimentation led to the application of an “object oriented” approach to designing and planning Web-based tutorials. The term “object oriented” is borrowed from the programming world and (in a very simplistic definition) approaches the creation of large programs (or Web sites, in this case) by breaking them into many smaller self-contained modules or objects, each performing a specific task. A similar approach can be used for developing instructional Web pages. If an object-oriented
(as opposed to linear) approach is used, the creation of each new subsequent tutorial will require less time and effort than the previous, because many tutorials will share similar topics or concepts; links to previously created modules covering recurring topics can simply be embedded in newly created tutorials. The only time that it is necessary to create a completely new page from scratch is when a new topic not previously covered surfaces. A synergistic effect emerges from employing this technique, where each completed series of pages acts as "seed crystals" around which other new pages may grow. Eventually, a "critical mass" of Web pages covering various topics will be attained. Librarians can then draw on this collection when creating new tutorials on different, or similar, topics.

**INSTRUCTIONAL CONTENT DEVELOPMENT**

Deciding on the Web as the primary mode of delivering instruction necessitated a rethinking of how best to organize instructional content. Of most concern was the balancing of the "just in time" versus "just in case" approaches. The library hoped to design Web pages that allowed users to develop quickly strategies for answering specific questions at the point of need. In addition, librarians wanted to provide more detailed instructional material for learners who wished to develop more global skills.

The first step was to look at the type of questions typically posed by medical school students and try to categorize these into groups or themes. In consultation with medical school faculty, the following categories were identified: diagnosis and treatment; ethical and legal issues; psychological aspects of health and disease; statistical and epidemiological matters; social services; and health promotion, health education, and illness prevention.

A Web site called "Finding Basic Clinical Information" (FBCI) [http://www.library.ucla.edu/libraries/biomed/clinicalinfo/] was then developed. The site is composed of pages that combine information about specific resources, both print and electronic, with some basic strategies about how to use those resources, thus allowing students to meet their just in time needs. Links to more detailed instructional Web pages for those who wish to further develop their information literacy skills (just in case) are also provided.*

These pages have been particularly well received by the School of Medicine faculty. The work on these pages has profoundly influenced the way Web-based instruction in general is developed and delivered. In particular, it has resulted in a revision of the library segment of the School of Medicine's Foundations Program (the first year medical students' orientation experience). During the orientation sessions, the students are presented with their first problem based learning experience. They are given a case to discuss and are led through the process of working with a group to identify issues and generate questions. Students are then expected to
spend some time in the library researching the answers to these questions.

The students all attend a 45-minute session in the library during which the librarian leads them through the process of matching resources to their questions. In collaboration with the orientation faculty, librarians have developed a session that demonstrates how the library and its resources support the problem-based learning style of learning and models the information-seeking behavior the students need to use. As part of the session, librarians show the students the special Foundations Web site [www.library.ucla.edu/libraries/biomed/foundations/index.htm] and model how to use it for their case. These pages are similar to our FBCI pages both in content and approach. Like the FBCI pages, the orientation pages are divided into themes or categories of questions and provide both just-in-time information and links to additional just-in-case instruction.*

The orientation sessions are brought to a close by indicating some of the other Web resources available through the Biomedical Library Web site. These include a list of standard medical textbooks available on reserve in our library and available through subscriptions to MDConsult and Stat!Ref, online tutorials, and the many journals, textbooks, and other full-text resources available to them. The goal of these sessions is modest: to alert the students to what the library has to offer and to encourage them to visit the library's Web site when they are in need of assistance. The orientation sessions are viewed as a means of promoting the distance education potential of the library's Web site and a way to demonstrate how these pages could be of use as a support of students' PBL experiences. More in-depth specific course-integrated instruction occurs at points in the curriculum where there is a specific course-related need to acquire additional information literacy skills. For example, a Web tutorial on searching PubMed (MEDLINE) was developed for the Human Biochemistry and Nutrition Laboratory course taken by first year medical students [www.library.ucla.edu/libraries/biomed/bc204/]. The Web tutorial supplemented an in-class lecture that covered the same material. However, since the Web pages are always accessible, students can use them any time they need to review this information or wish to develop additional information literacy skills.

In many ways, this approach, which is reflected in both the Finding Basic Clinical Information (FBCI) pages and its Foundations counterpart, fits in nicely with the adult learning theory basis of the medical curriculum. The students are viewed as active responsible participants in the learning process and are allowed to choose what to learn and when to learn it (Wilkes et al., 1998). Using the Web as the mode of delivery allows students to access the information any time, from any computer with Internet capability. So when students are motivated to learn and/or need to discover some specific information, the help they need is readily available.
to them. It is the authors’ hope that this design appeals to UCLA medical students. We believe it encompasses the best of both worlds by providing answers to their immediate information needs, and the opportunity for continued growth and development of their lifelong learning skills. Furthermore, since these types of information literacy skills are incorporated into the medical school’s curriculum competencies [www.medsch.ucla.edu/som/gradcomp.htm], the relevance of what the library is teaching is further reinforced. Of particular concern are such competencies as:

- the ability to identify and use reliable authoritative sources of medical information;
- the ability to use computer-based techniques including specified online databases and peer reviewed medical journals to acquire new information and resources for learning;
- the ability to organize personal resources efficiently and systematically using electronic tools and other methods; and
- the ability to understand the importance of lifelong learning to care adequately for patients, to participate in patient education, and to pursue creative scholarly endeavors.

LESSONS LEARNED

Keeping up with the changes in the UCLA School of Medicine’s curriculum and the methods being used to present this material has been an exciting and challenging experience. More changes and more challenges are anticipated in the future. A good faculty is always looking for better, more effective, ways to teach, and the UCLA School of Medicine faculty is no exception. However, it is clear that more and more information technology will be incorporated as a means of delivering and supporting instruction. Medical school students are now required to have their own computers, and many classes have computer-based components built into the course work such as online discussion forums, case presentations, practice exams, laboratory exercises complete with pathology slides, copies of PowerPoint presentations from classroom sessions, and student online evaluation feedback forms (these examples were collected from a review of the 2000-2001 courses listed at the UCLA School of Medicine site and are restricted to current UCLA School of Medicine Faculty and students).

So the pedagogical and Web design skills, knowledge, and abilities that librarians have developed should allow the library to continue to provide a program of integrated and appropriate instruction. The World Wide Web has broadened the library’s ability to deliver information to library users. It has also challenged existing ideas about the ways information is organized and structured. The Web and its ever changing, ever growing, nature has also created a fluid work environment. This is both frustrating
and exciting. The bad news is that efforts must be constantly monitored and re-adjusted to keep current with the times. The good news is that this fluidity challenges librarians to grow along with it, and to develop different ideas that take advantage of these new options. Web pages, therefore, are never done. They should be responsive to, and reflective of, changes both in the information technology arena and in the users’ information. The authors view current and emerging technologies such as Macromedia Flash, WebCT, Internet Relay Chat, Allaire’s Cold Fusion, and so on as exciting possibilities for developing additional instructional approaches that will appeal to a wide variety of learning styles and information needs. The reader is invited to visit the UCLA Louise M. Darling Biomedical Library’s Web site [www.library.ucla.edu/libraries/biomed/] to see the evolution of efforts to provide Web-based support to UCLA School of Medicine students.

Note
* Neither the FBCI nor the Foundations pages are currently available from the Biomedical Library’s home page. Both pages have been superseded by a subject guide entitled “Resources in Medicine” available through the “Learn” tab on our home page or directly at http://www.library.ucla.edu/libraries/biomed/litreview_med/index.html.

References


The Internet Navigator: An Online Internet Course for Distance Learners

Carol Hansen

ABSTRACT

The Internet Navigator (www-navigator.utah.edu) online course is a cooperative effort to use new technologies to teach information literacy competencies. The Internet Navigator has been used successfully by thousands of students since 1995. A team of librarians and Web development professionals in Utah continue to work together to develop the Web course for online and distance learning students. This article describes the history and recent developments of this course. In 2000, the course was redesigned and revised to meet changing needs of students, to include the latest information resources and technologies, and to focus on information literacy competencies, particularly for distance learners. New developments to manage the ongoing maintenance and funding of this multi-institutional online course are also described.

INTRODUCTION

Librarians are at the center of the intersection of new technologies, products, and services. Librarians select, provide, and deliver the information resources critical for academic education and scholarship. Librarians not only provide access to resources but also teach students, faculty, academic staff, and the general public about information literacy—i.e., how to find, evaluate, and effectively use information. For distance and other online learners, this information is primarily made available on the World Wide Web. Instruction librarians develop detailed information literacy competency programs and methods for teaching and assessing these...
educational programs (Oberman, Lindauer, & Wilson, 1998). Librarians increasingly use online resources to support information literacy competencies and basic library and Internet skills instruction. Students increasingly access library resources at a distance, and library instruction programs must meet the needs of distance learners (ACRL, 1998).

A major challenge facing reference and instruction librarians is providing students with excellent quality and up-to-date Web-based library and Internet skills instruction while not duplicating time-intensive efforts at every academic institution within a state or region. This is important in Utah where academic institutions cooperatively purchase and share a core group of online information resources through the Utah Academic Library Consortium (UALC). Utah librarians have found cooperative efforts to be a practical alternative in this era of dynamic change (Kochan & Lee, 1998). The Internet Navigator course, cooperatively developed by UALC librarians, was created to meet this challenge (Hansen & Lombardo, 1996).

In 1995, although many library catalogs were accessed via the Internet, primarily through Telnet, most traditional library resources, such as periodical indexes, article databases, or online reference resources, were not available on the Internet. From 1995 to 2000, many traditional library research tools, including major periodical indexes, article databases, and many important reference books have been republished for access on the World Wide Web alongside millions of new and unique Web site information resources. Distance learners are able to access many more scholarly academic resources through library Web sites than they were five years ago. New technologies and trends in collection management regularly impact instruction programs. For example, after the widely used Infotrac article database announced its remote access service to home patrons on June 1, 1997 (Rogers, 1997), students needed to learn about remote access to full-text article databases. Since 1995, many students, faculty, and the wider community are exposed to the Internet for e-mail, entertainment, business, and shopping through mass media. Students in 2000 have a much better understanding of the Internet—what it is and how it works. These same students may still have difficulty understanding how to use the Internet to access valuable library resources such as article databases and reference resources not found through popular search engines and Web directories.

Utah's population of distance learners has grown significantly, and the medium of instruction has changed. In 1995 there were several hundred distance learning students at Weber State University (WSU), primarily engaged in correspondence courses. In 2000, there were over 2,000 students enrolled in WSU Online, Weber State's online campus for distance and online learners. On campus students are also using remote access services to access online resources. The numbers of students physically
entering the library are decreasing while Web usage is steadily increasing at Weber State University’s Stewart Library. At WSU, most students work off campus more than thirty hours a week. At WSU and many other similar campuses, “on campus” students engage in the library experience as if they were distance learners, and the line between distance and not distance students becomes very blurred. Most of the students enrolled in online courses at WSU live in the local area but choose online education for reasons other than distance. Accurate statewide data on the actual numbers of distance learning students in Utah are unavailable; newspaper accounts have estimated that more than 25,000 students were enrolled in distance education courses in Utah in 1998, with more than 8,000 distance students enrolled at Utah State University (Egan, 1999, C1).

These factors have caused a major shift in what students most need to learn within the realm of information literacy in an online and distance learning environment. In 1995, students needed to learn about the Internet itself. In 2000 they needed to know how to effectively find and use the scholarly content found in Web-based library resources. The Internet Navigator, Utah’s first online course, has undergone a major revision to meet the current and future needs of Utah’s students. This article summarizes the revision process. Although much of the written and graphical revision has been completed, final editing was done over the Summer of 2000. The New Internet Navigator was launched in Spring 2001. Curricular revisions have coincided with critical changes in the administration and funding of the course for online and distance learners in Utah. Cooperative funding and shared administration and maintenance of the course have been strategically planned to help ensure its ongoing success.

UALC: A Model for Academic Library Cooperation

How could reference, instruction, and outreach librarians from fourteen diverse institutions with various funding sources come together to meet the challenge of cooperatively developing an online course? UALC was the organizational unit that provided the umbrella structure for their efforts.

There is a long history of cooperation among libraries in Utah. UALC includes fourteen academic libraries at nine public and two private higher education institutions plus the Utah State Library. There are four universities: the University of Utah (Salt Lake City), Utah State University (Logan), Weber State University (Ogden), and Southern Utah University (Cedar City). The four community colleges are: Salt Lake Community College, College of Eastern Utah (Price), Dixie College (St. George), and Snow College (Ephraim). Utah Valley State College (Orem) is the sole state college. “Along with private school UALC members, Westminster College (Salt Lake City) and Brigham Young University (Provo), UALC libraries serve over 151,000 students” (Brunvand et al., 2000, p. 50). The
State Librarian of Utah is also a member of UALC, providing an important communication link with public and school libraries.

Statewide cooperative initiatives to support online and distance learners are not unique to Utah. A number of other states are also using collaborative efforts to better meet the instruction needs of online and distance learners. Of particular note is the Florida Initiative (Madaus & Webster, 1998).

UALC has been able to overcome traditional bureaucratic barriers and has developed many cooperative projects and programs including cooperative borrowing agreements, statewide licensing of databases, document delivery options, cooperative collection development, and the Internet Navigator online library skills course (Morrison et al., 1995). The success of these programs has enabled UALC to receive a statewide pool of academic library funding from the Utah Legislature. Through this funding, students at academic institutions in Utah have access to the same set of core resources, known as Academic Pioneer. Academic Pioneer comprises a wide range of full-text article databases, online periodical indexes, and reference tools (Utah Academic Library Council, 1999).

The availability of a group of databases, shared statewide, reinforced the idea of creating a shared instruction program to support the effective use of these databases. Through cooperation rather than competition, the UALC libraries are able to offer every student a base level of information resources and instruction no matter what tier of institution they are attending and with support for the distance learner.

**THE EVOLUTION OF THE COURSE CONTENT**

In August 1995, a group of librarians, representing each academic library in the state, met to discuss the possibility of designing an online course. Over the next few months the first draft of Internet Navigator was created. This group hoped to accomplish more with less effort by combining their talents, and expertise, and by sharing their work load and the results of their efforts. Although dividing the overall work load may have made the challenge more manageable, there were still many problems. The challenges in creating an online course for use statewide are theoretical, technological, and bureaucratic. These include:

1. understanding the needs and learning styles of a very diverse student body, including distance learners;
2. cooperatively developing a curriculum that could be used at any institution for multiple purposes;
3. managing a cooperatively developed Web site;
4. integrating the latest Web technologies, including very well-designed graphics;
5. integrating the latest pedagogies for onsite and distance learners; and
6. managing, maintaining, and funding a course that would be simultaneously delivered at multiple and diverse institutions.

The development team of librarians addressed each of these challenges. Development of the course required librarians to accept their new responsibilities for providing services to distance and online learners, and to see these learners as equals to the face-to-face learners they were more accustomed to serving. It also required the development team to engage in the paradigm shifts caused by this new learning environment. This was sometimes a difficult transition, as most members of the team had never had the opportunity to be distance students themselves. Miller (1997) offers an excellent overview of this new learning environment:

This new [distance] learning environment will be marked by several common characteristics. It will:

• Be lifelong, supporting learners through their individual lives as well as their career changes;
• Be learner-centered, giving lifelong learners greater control over the time, place, and pace of study;
• Emphasize both formal and informal collaboration, providing a communications-rich environment for students to work together in teams and to form informal study groups at great distances;
• Emphasize individual inquiry and use of original data and resources rather than lecture and use of prepared texts; and
• Be structured to ensure that learners gain direct experience in solving problems, making decisions, and exploring values both as individuals and as members of teams.

The Internet Navigator development team, through the process of course development, and by engaging in this statewide collaborative experiment, became distance learners themselves. Much of the collaborative development work was Web based, at a distance, and team driven. As the team became richly enmeshed in the new distance learning environment, they were able to use this experience to better understand and assist distance learning students.

The Internet Navigator course is delivered over the Internet using the World Wide Web as its primary protocol. Librarians communicate with students primarily through e-mail. Students work through a series of modules to complete the course. Individual modules are also used as independent teaching tools for self-guided learning. The original Internet Navigator course consisted of six modules. These were:

• Module 1—Introduction to the Internet: Introduction to basic Internet Concepts, Netscape Tutorial, Internet Overview.
• Module 2—Communicating Over the Internet: Electronic Mail, Newsgroups, Mailing Lists.
• Module 3—Internet Information Systems: Telnet, Gopher.
• Module 4—Resource Discovery: Internet Catalogs and Directories (Search Engines), Library Catalogs, Evaluating Information.
• Module 6—FTP and Remote Access: Downloading files and dial up access to the Internet.

The overall design of the course was meant to be flexible so that sections of the course could be used independently of the larger course as needed. Each module contained a glossary and a quiz. Students were asked to complete assignments in two of the modules and a final research project. The final research project required students to find five Web sites on a topic of their choosing, write a brief description and evaluation (using established criteria) of the sites, and then use a Web form to create an HTML document.

The course receives up to 35,000 hits a week on the Eccles Health Sciences Library server. Course enrollment and evaluations show that the course is very popular with students. The Navigator has received national and international acclaim as an early model of online instruction.

The Internet and the World Wide Web are both content and delivery mechanisms. In 1995 it was critical for students to understand the Internet as a delivery mechanism. By 1998 the Internet Navigator course was inadequate in its approach to library-based Web content. While students continued to like the class, librarians were dissatisfied with the limitations of what was being taught. The course did not adequately describe the Internet as a content mechanism nor fully address new technologies such as full-text databases or information literacy competencies.

The Internet Navigator was initially created at a time when much of the academic library information was still being delivered primarily in print. In 1998 and 1999, many more traditional library resources, full-text article databases, and reference tools were made available on the Web. A whole new set of information content and instruction needs developed (Oberman, Lindauer, & Wilson, 1998). The critical instruction need had shifted, and students now needed to know how to access the rich scholarly content contained in the many traditional library resources now available on the Web. The Internet navigator needed to be enhanced to facilitate access to scholarly academic resources newly available on the Web.

Beginning in late 1998, the UALC Distance Learning Committee and the UALC Reference/Instruction Committee worked together to discuss providing better online instruction for distance learners statewide. Their efforts were aided by the recent and fortunate influx of new instruction librarians at several institutions in Utah, and the recent gathering of instruction librarians for the LOEX of the West Conference held at Southern Utah University in June 1998. Several new and exciting online
information literacy tutorials were developed outside Utah, including EIL, RIO, TILT, Santa Cruz's Net Trail, and others, providing additional inspiration (see Appendix). The UALC Distance Learning Committee subcommittee on Information Literacy Competencies developed a standardized list of information literacy competencies. By March 1999, a new task force, the Information For Life Task Force, was formed from members of the UALC Distance Learning and Reference/Instruction committees, and work began on rewriting the Internet Navigator Course. The major goals of the project are to:

- promote information literacy in this global and dynamic information technology environment for all types of learners; and
- provide shared library instruction to support each institution's needs, such as a required writing course (English 2010 at most institutions) and the statewide computer and information literacy competencies. These competencies are in accordance with the recommendations established by the Utah State Board of Regents Technology Subcommittee in 1995 (unpublished).

The expected outcomes of the project include:

- the nationally and internationally respected statewide Internet Navigator course will continue to meet the needs of future students and the community at large;
- the latest Web technologies and pedagogy will be used to provide active and creative online experiences for learners;
- this initiative will heavily promote the use of databases and collections supported by UALC and Pioneer funding;
- syllabi, lesson plans, and assignments for the core English writing course (English 2010), and other library instruction will be shared among Utah libraries in order to minimize duplication. This will save an enormous amount of time for instruction and reference librarians across the state;
- standardized learning objectives and information literacy competencies will be established and promoted statewide; and
- this initiative will provide guidelines for faculty to integrate this ready-to-use module in any course, on campus or at a distance.

The Information For Life Task Force met from Spring 1999 through Fall 2000 to completely rewrite and revise the course. As of June 2000, drafts of significant content additions have been written by task force members and posted on the task force Web site/intranet.

The new course will be launched in January 2001. The team evaluated content based on shared goals and specific instructional objectives that promote information literacy competency.
The new Navigator consists now of four modules:

- **Module 1 - Introduction to the Internet**: Introduction to basic Internet Concepts, Netscape Tutorial, Internet Overview. Understanding the Value of Information.
- **Module 3 - Information Navigator**
  - Lesson 1. Introduction
    Intro to the course—How to use this class
    Getting started (tips on choosing and refining a research topic)
    Understanding library services
  - Lesson 2. How To Search (Common Search Strategies)
    How to search (includes Boolean, keyword, subject searching, controlled vocabulary, field searching, truncation, proximity, etc.)
    Format differentiation (books, articles, etc.)
    Databases versus search engines
    Developing search statements
  - Lesson 3. Finding Information
    Using search engines
    Finding books
    Using catalogs, LC call numbers, classification systems, Library of Congress Subject Headings
    Locating books on the shelf
    Interactive call numbers exercise
    Finding a magazine or journal article
    Choosing and using electronic indexes and reference tools
    Finding other types of information: government documents, media, special collections/archives
    Finding experts
  - Lesson 4. Using Information
    Evaluating information
    Understanding popular v. scholarly information
    Note-taking tips
    Documenting sources (including plagiarism and copyright issues)
    Interactive documentation aid
    Remote access and licensing
    Information ethics for students
- **Module 4 - Web Publishing** (revised and rewritten from the old Modules 5 and 6)

Each of the four modules contains several content lessons; each content lesson has interactive exercises and appropriate printable handouts. Each module contains a glossary and a quiz. Content in the old Modules 1
and 3 will be reduced to minimize instruction on telnet and gopher and combined into the new Module 1. The old or original Module 4 (Resource Discovery) was significantly revised in 1996, yet it was this same content that most needed updating again in 2000 due to the advent of so many newly available Web-based library resources and to reflect the latest approaches to teaching information literacy. The old Module 4 is now the new Module 3 (Information Navigator). This content is greatly expanded and enhanced with details on shared full-text article databases, online reference tools, and appropriate research strategies as outlined and summarized earlier. Separate easily printable handouts are being designed for frequently taught topics such as “Using Boolean Logic” and “Understanding the Difference: Scholarly vs. Popular.” Students will now be required to effectively find, evaluate, and use online article databases, library catalogs, and reference tools in order to complete their final project. In the old Navigator, students were required to find Web sites only.

The new Module 3 (Information Navigator) is being designed to be used as a stand-alone information literacy course. In particular, it is designed to meet the needs of English 2010 library instruction sessions. Every academic institution in Utah requires students to complete a library skills component within a basic writing course. This course is often, but not always, called English 2010. Although the methods and strategies employed by each UALC institution to teach the library instruction component of English 2010 may differ, lessons within the new Navigator are being designed to be useful to each institution.

The new course will take advantage of Web technologies, including HTML, PERL, CGI scripting, CGIEmail form conversion, electronic mailing lists, and e-mail communication. Web professionals, to simplify usage and further engage online and distance learners, have redesigned the graphics and interactive assignments.

**Administration and Funding of a Multi-Institutional Online Course**

The administration and funding of the Internet Navigator online course had been problematic from the beginning. Librarians in Utah realized in 1994 that they needed to work together to create excellent online instruction tools that could be used statewide and beyond. They were also well aware that Utah Governor Mike Leavitt had recently asked the Utah education community to “invest less in bricks and mortar, and more in technology.” Leavitt’s interest in online and distance learning was strong. He went on to initiate, in cooperation with the governors of thirteen western states, the widely publicized, and controversial, Western Governors [virtual or online] University (Egan, 1999, C1). The Governor’s interest in technology also resulted in important legislative funding in Utah, known as the Utah Higher Education Technology Ini-
Hansen/The Internet Navigator

Academic faculty, staff, and librarians were able to apply for HETI funds to explore ways in which new technologies can enhance academic quality and increase learner access to higher education in Utah. HETI funds provided the seed money for the Internet Navigator course from a grant written by Nancy Lombardo and Wayne Peay of the Eccles Health Sciences Library at the University of Utah in cooperation with UALC in 1995.

The initial grant support from HETI was for course development only. One serious problem with the original Internet Navigator course was the lack of a definite plan for ongoing maintenance and support. The authors of the initial grant were more focused on getting one-time funding to cover the start-up costs as there were no readily available funding sources for ongoing maintenance and support. Although each of the UALC library directors expressed verbal support for the course, there was no official ongoing financial support for the course from UALC.

Most of the technical and administrative support for the course has come from the Eccles Health Science Library at the University of Utah. Wayne Peay, library director at Eccles, supported the time and effort devoted to basic maintenance of the course by Nancy Lombardo, a primary author of the course and the systems librarian at Eccles Health Sciences Library. Peay and Lombardo also arranged to house and oversee the HTML server for the course on one of the Eccles computers. Due to their ongoing efforts, several major administrative problems have been overcome. For example, during the beta test period in 1995, the Eccles server crashed for three weeks. Lombardo and Peay worked with library directors and systems librarians at the University of Utah Marriott Library and the Salt Lake Community College Markosian Library to establish mirror sites. It was a valuable lesson, and the course has since maintained these mirror sites. Distance learners appreciate knowing that if one university's server is down, two others are available to access course materials.

One of the biggest problems was getting the course listed in each of the college and university catalogs. Some libraries (WSU, SUU) had their own academic departments and a history of teaching for-credit courses. With a history of offering for-credit instruction, they understood the process of getting a course accepted through the academic channels at their institution. Other libraries (U of U, Dixie) did not have past experience or a mechanism for adding a new course and needed to work with other academic departments outside the library to take the course through the curriculum process and to ultimately house the course. Decisions regarding where and how to list the course in course schedules was another challenge. At Weber State University, the Internet Navigator was the first online course offered, and it was initially listed with traditional correspondence courses in the course schedule. A year later it was listed in a new section of the course schedule with other online courses.
The continued maintenance of such a course, with its many ever-changing hyperlinks, was much more time consuming than was originally anticipated. Keeping the course up to date, given the dynamic information environment of the last five years, was also a huge task. Maintenance and updates were completed sporadically by a few individuals. Although the course continued to flourish, it became increasingly difficult to make significant revisions due to lack of statewide planning.

The development of the Information for Life Task Force within UALC offered a major impetus to develop a long-term management plan. This task force includes at least one member from each UALC library and a representative from the Utah State Library Division. The grant proposal of $25,000 to revise and revitalize the Internet Navigator course was funded in May 1999 by the UALC directors. Three phases of the project were designated: (1) the development phase, (2) the implementation phase and, most importantly, (3) the ongoing maintenance phase. The critical development in the management process was the Information for Life Task Force proposal requesting UALC’s commitment to ongoing funding for the maintenance phase. The proposal includes a plan for annually rotating management of the course among institutions. This will relieve the burden from one institution (Eccles Health Sciences Library at the University of Utah) and take advantage of the wealth of talent and interest among reference, outreach, and instruction librarians throughout the state of Utah. Through this funding initiative, it is clear that library directors in Utah see the value of the course and realize the benefits of the collaborative efforts. Funds will be used primarily to support the project director and the development team, primarily UALC librarians, and for other personnel described later.

UALC Information for Life Task Force member librarians are responsible for creating the content, maintenance, and updates. In addition, a freelance programmer and a Web designer/graphic artist have been hired to assist with improving the look of the content, to produce any needed graphics, interactive pages, scripting, and/or programming.

A brief summary of the job descriptions for the three major phases follows:

Project Director (UALC Librarian, will rotate annually)—Oversees project and personnel, reports to UALC directors.
- Development Phase—Hires and trains project personnel with input from the development team, manages content development team, sets up the server.
- Implementation Phase—Trains the maintenance team to load and update modules and units, oversees implementation phase.
- Maintenance Phase—Oversees maintenance team
Content Development Team (UALC Instruction and/or Reference Librarians)—Provides detailed complete content for learning units and assessment tools.

- Development Phase—Selects resources for unit development, develops content to meet standardized Information Literacy Competencies criteria, develops assessment tools, works with graphic designer to develop agreed upon layout, plans for marketing and promotion of site, meets with UALC instruction/reference librarians statewide to get input on content needs (meetings in Logan, Cedar City, and Salt Lake).
- Implementation Phase—Meets deadlines on content development and assessment tools, implements marketing plan.

Maintenance Team (UALC Instruction and/or Reference Librarians and Graphic/Web Designer)—Provides updates and revisions (may overlap with Development Team in the beginning). Members will rotate in as Project Director.

- Maintenance Phase—At least one person per module or major unit. These people will monitor changes in resources and review assessment data. Update links, content, and graphics as required.

Graphic Artist/Web Designer (Part-time, Consultant or Contract—possibly student—should also know HTML and be proficient in graphics layout and design software).

- Development Implementation, Maintenance Phase—Work with content development team on design.

Programmer (Part-time, Consultant or Contract—possibly student)—PERL, CGI, HTML, JavaScript, and possibly Java and XML

- Development Implementation, Maintenance Phase—Work with content development team on programming needs.

The development and implementation of an Intranet for the task force greatly enhanced team efforts during the 2000 revision. This had not been used previously as a management tool. Due to the extreme distances between some academic libraries in Utah, face-to-face meetings were very time consuming for some team members, and meetings, therefore, occurred approximately every three months. The task force Intranet greatly facilitated team communication. The Intranet consisted of:

- list of team members, names, addresses, phone numbers, and e-mail links;
- copy of Information for Life proposal to UALC Directors, including budget;
- link to team mailing list;
- agendas and minutes of development team meetings;
list of links to useful information literacy and distance learning Web sites;
job descriptions;
drafts of new content outline, with names of those assigned to develop;
drafts of new content;
timelines; and
list of agreed upon information literacy competencies (Utah Academic Library Consortium Information for Life Task Force, 1999).

The development team's efforts to communicate via the Web have enhanced our understanding of many of the issues that students face when studying in a Web-based distance learning environment.

CONCLUSION
The Internet Navigator is a long-term experiment in cooperative online course development and in providing library and Internet instruction for online and distance learners. Librarians throughout the state of Utah are committed to the continued development of the course. This course enables each individual institution to independently utilize collaboratively developed instruction modules based on a proven model of delivery. Instruction modules emphasize shared resources and, through collaboration, librarians share their skills and knowledge about serving the instruction needs of distance learners. A major advantage of the Internet Navigator is the flexibility it provides for those students who wish to develop their information literacy competencies through independent study. This course provides access to the many new Web-based resources and provides instruction in why and how these resources are used for academic scholarship.

The development of an online course in this dynamic information environment requires a strategic plan for regular updates and revisions. Through collaboration and cooperation, reference, instruction, and outreach librarians in Utah have developed and implemented an effective planning process to revise and provide ongoing funding, updates, and maintenance for the Internet Navigator course. This exercise in teamwork has enabled Utah librarians to provide and enhance information literacy competencies for distance learners and for the wider academic community in Utah.

REFERENCES


APPENDIX
Selected Online Library Instruction Tutorials

EIL—Electronic Information Literacy (http://library.austin.cc.tx.us/research/Guides.htm#tutorials)
RIO—Research Instruction Online (http://dizzy.library.arizona.edu/rio/)
UCSC NetTrail—(http://www2.ucsc.edu/nettrail/master/)
University of Iowa Library Explorer—(http://www.lib.uiowa.edu/libexp/)
Information Technology Literacy: Task Knowledge and Mental Models

D. Scott Brandt

ABSTRACT

This article describes the importance of information technology literacy as a precursor to information literacy. It discusses the differences between the two literacies and makes comparisons and contrasts. It suggests a methodology for identifying task knowledge that might be used to build an information technology literacy program or curriculum. It examines how mental models can be used to facilitate acquisition of task knowledge and thus plays an important role in developing an information technology literacy.

INTRODUCTION

To be “information literate” in networked environments, users must be “technology literate” as well. There are few places where information retrieval—a primary element of information literacy—does not involve sophisticated information technology. Understanding how to use the technology must be a prerequisite to proficiency in finding, using, and evaluating information successfully. This understanding should be “conceptual,” not simply functional. Just as information-seeking skills alone are not adequate outcomes for information literacy, technology skills alone are not adequate outcomes for information technology literacy. A broader perspective must be embraced.

INFORMATION LITERACY

The need for information literacy has been well documented in the literature of library and information science, and a definition is well es-
tablished (Dupuis, 1997). It has been argued for some time that information literacy goes beyond the skills and knowledge involved in information seeking and retrieval, and strives for higher levels of understanding regarding the context of information in today's society, its composition and organization, as well as its use in lifelong learning. In its 1989 Final Report of the Presidential Committee on Information Literacy, the American Library Association (ALA) (1989) emphasized the importance of understanding how information is generated, organized, and used to the degree that an information literate person could teach others.

Dating back to times before the proliferation of computers and the Web, librarians often taught bibliographic instruction lectures and courses on how to use the library for research (Pask, et al., 1993). By 1990, as information became more and more digital and remotely available, some questioned the effectiveness of limited programs and called for a wider set of approaches than "how-to" lectures. Many institutions now embrace information literacy as a necessary component of the general studies portion of curricula in the Information Age (Loveless, 1998). With information systems becoming more and more complicated, it is possible that, at the college level, a technology literacy course would be a prerequisite for information literacy, if not other courses that require use of the Internet and the Web.

ALA's 1989 report was released a few years before the World Wide Web exploded on the scene. Since then, others have argued that not only are skills and knowledge of information itself important, but so are skills and knowledge of the technology that is often heavily integrated with the information. The Association of College & Research Libraries' (ACRL) (2000) Information Literacy Competency Standards for Higher Education notes: "Information technology skills enable an individual to use computers, software applications, databases, and other technologies to achieve a wide variety of academic, work-related and personal goals."

The ACRL Standards distinguish information literacy from information technology by noting that the literacy "is an intellectual framework for understanding, finding, evaluating and using information," focusing on information, not "on technology itself." Similarly, the National Research Council (NRC) (1999) distinguishes between basic technology literacy ("minimal level of familiarity with technological tools like word processors, e-mail, and Web browsers") and fluency ("persons understand information technology broadly enough to be able to apply it productively at work and in their everyday lives, to recognize when information technology would assist or impede the achievement of a goal"). The two definitions are not that far apart and yet are used differently. The NRC uses the term "literacy" to describe basic competency, whereas ACRL uses the term to describe a much more sophisticated understanding.
Information Technology Literacy

Information technology literacy is described here as a precursor to information literacy. The proper context is that an information technology literacy curriculum feeds directly into an information literacy curriculum. It has a different focus and aim than one that NRC describes as feeding into a management information systems or computer technology curriculum. As a precursor, students achieve skills and knowledge in information technology that allow them to enter an information literacy program at the appropriate and required learning level. It is not enough that students have rudimentary skills in using a given technology—instruction could be given one day in how to use a system, but the interface or underlying technology could change overnight.

Attention has not been given in the past to what a learner should bring to an information literacy program. Because technology is ever changing, competence is illusive—information systems change, software interfaces are upgraded or replaced, new technologies are invented and introduced. To anticipate and problem solve in such a constantly evolving environment, there is a need for a level of knowledge beyond simple competence (Brandt, 1997). Broader conceptual understanding about information technology should be a focus of a program that addresses information literacy while it takes into account information technology literacy. Turkle (1997) notes that students’ motor and cognitive skills using computers allow them to quickly move through learning scenarios the way they move through computer games—by guessing, using trial and error, or simply finding the fastest way to the end result—and that this simulates learning, but does not foster it or facilitate knowledge acquisition.

Since computerized and networked information resources are an integral part of information seeking, there is a knowledge area which must be dealt with—some expertise in using the technology. Learners must have an understanding of the technological environment in which information resources are set, integrated, and used. Simple skills are not enough. Without some conceptual understanding, it is likely they will not attain a level of comfort and familiarity that can lead to expertise. Frustration with, and confusion about, information technology can impede access to acquiring knowledge in information literacy. For instance, without an understanding of how relevancy ranking works, naïve users of Internet search engines are likely to accept the claim that “best responses are shown first.” Or, given “404 errors” in their results, they may assume there is nothing to match their request and fail to see the need for improving search heuristics to generate more results. In this way, the technology can interfere not only with the user’s needs but the mission of information literacy.

A variety of difficulties with using information technology play havoc with information seeking and gathering. The blame for interference can be put on the Internet and correctly lies with the unreliable and changing
nature of its technology. The underlying protocols that allow platform diversity contribute to a number of user problems. Much of the technology is still fairly new, and some is basically "shareware." Programs are often written by individuals as a hobby and are then offered to others. These, and more established software, are continually adapted to meet new demands. New software, or changes in older versions, continually present new situations to users. And since there is no single way to use the Internet, users constantly find themselves facing unfamiliar situations and all-too-familiar error messages. Internet technology is not sophisticated enough to adequately inform users about what has gone wrong (or what they should do next) when errors are encountered.

Little has been said in the literature about how to identify and integrate the use of technical skills as a component of information seeking. In the past, criticism has stemmed from the lack of effort in determining and utilizing measurable learning outcomes (Eadie, 1992). Even less effort seems to have been directed toward identifying or measuring prerequisite skills for a curriculum. It has been assumed that only rudimentary technical ability, minimal critical thinking skills, and minor problem solving are needed to undertake the learning in the information literacy curriculum. Until recently, few have adopted the use of a structured approach to developing a literacy curriculum to ensure that proper attention is paid to systematic needs. Some have noted that systematic attention can be focused on developing overall objectives using instructional systems design (Nahl-Jakobivits, 1992). Others have shown that such design can be used to match outcomes to instructional strategies for learning (DeWald et al., 2000). But a formal approach should also ensure that prerequisites for the learner are identified, analyzed, and accounted for in the instruction.

**Instructional Systems Design**

A generalized model of instructional systems design (ISD) requires at least five processes: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (ASTD, 2000). Complex models of ISD, such as that of Dick and Carey (1993), break down the approach even farther into ten or more steps. The important piece for many designers is to end up with a result that includes attainable objectives and measurable outcomes. Often given less focus are those prerequisite skills or entry-level behaviors required to undertake the objectives and thus achieve the outcomes. A quick review of systems design shows where and how to include these in the overall process. (Note: in the discussion below, the term "instruction" is used to describe any aspect—training, instruction, or teaching—involving in the curriculum.)

Analysis can be performed in several areas. Gap analysis identifies a problem area by looking at skills and performance at the current level, projecting where they should be, and determining what is needed to move
to the optimal condition or level. Learner analysis identifies characteristics of those who will participate in, and benefit from, the instruction. This can include demographic information, learning styles or preferences, prior skills and experiences, and attitudes or beliefs. Analysis of the environment looks at the setting and context of the learning—conditions related to where the learners will learn or apply the learning, social factors (peer pressures, work ethic, and so on), and the tools they will use. Analysis is the phase in which data and information is gathered, elements are compared and contrasted, and alternatives and options are explored.

The design phase takes trends and ideas generated from analysis and uses them to design a program or system. This is similar to drawing a blueprint, where a designer strives to take all the information into account concerning the learner, situation, and other elements identified in the analysis. This is the phase in which the vision, direction, and outcomes are pulled together to create an abstract plan that is often represented in a workflow diagram or storyboard. Design is fluid and abstract, as opposed to development, which is structured and concrete. The audience and expectations for a learning activity for a particular skill might be identified and ideas generated explaining how to achieve success, but the exact how and where it is carried out would be relegated to the development phase. For instance, based on students' use and requirements of their courses, it may be determined that it is important to teach how to use both search engines and indexes. However, which ones or how would be determined in the development phase.

With all the design elements laid out, the development phase involves choosing and building component parts such as the instructional materials, activities, tests, and so on. Foremost is the development of the objectives needed to meet outcomes and then matching components to the objectives. Within each objective, the steps needed to fulfill that objective are identified and listed. A starting point is determined for the steps. The prerequisites, or entry-level behaviors, needed to begin are also identified and listed. Figure 1 indicates the process for determining prerequisite needs.

An example is an objective such as, "When searching for a current in-depth information source, freshman students will be able to identify the library's indexes Web site and find a category which matches their topic to identify indexes that will lead to retrieval of a pertinent article." Steps involved in this process might include: (1) enter a URL in a Web browser, (2) retrieve a library's site and click on the "indexes" link, (3) browse categories to find an index that relates to your topic, and (4) match categories to topic.

A crucial step often overlooked in development is the identification of the behaviors or skills that are a prerequisite for undertaking the task involved in this objective. In this case, skills could be differentiated as
### Objective

Describe objective for learning outcome indicating the behavior expected, the degree to which it must be mastered, and the conditions under which it is accomplished

Student will be able to move to a higher level directory [behavior] when presented with a URL [condition] to identify the homepage for a site when one exists [degree]

### Steps to accomplish objective

1. Click inside of Location box
2. Use backspace key to delete parts of the URL (from right to left)
3. Stop after a slash and load page

### Prerequisites

<table>
<thead>
<tr>
<th>Identify entry level behaviors which the learner has to know in order to begin the first steps: ...</th>
<th>Can use a mouse to click inside a text box</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Can backspace and reload a Web page...</td>
</tr>
<tr>
<td></td>
<td>Can define URL, directory, slash</td>
</tr>
</tbody>
</table>

Figure 1. Establishing Prerequisite Behaviors.

Information-seeking skills (identifying topic and generating synonyms) and technology skills. For instance, information-seeking prerequisites might include generating broad or narrow terms, whereas technology skills required prior to starting include: (1) maneuvering a mouse to enter text and click on links, (2) typing URLs in a Web browser and retrieving Web pages from other servers, and (3) scrolling up and down pages and selecting items from drop-down menus.

The importance of identifying prerequisite skills or entry-level behaviors is two-fold. First, it forces the designer to consider where instruction begins for a given module. It also causes the instructor to think about how prerequisite abilities should be assessed. Second, it allows learners to identify where the instruction begins so that they have an idea of the starting point. This allows them to self-assess their placement within the instruction. While there are several ways to assess entry-level behaviors, the most common one seems to be self-assessment by students. However, there is always the concern that students will self-assess themselves higher (or sometimes lower) than their actual abilities. For instance, when asked if they can evaluate Web pages, students often report in the affirmative, yet when asked what criteria they would use to do so, they are sometimes unable to list substantial elements.
**Task Knowledge.**

Identifying the tasks and skills associated with information technology literacy is important. There are a variety of technology competence checklists and standards used in the workforce (DeBourcy, 1989). However, industry lists are usually set in a context that is performance-related (on-the-job requirements) for a specific industry or driven by a specific curriculum (education course-related outcomes that build on each other for mastery). One could use these as a starting point to identify outcomes on which to build an information technology literacy but, because the context is not an information setting, they might have little transfer or applicability.

A systematic way to identify pertinent tasks and outcomes in an information-seeking setting is to analyze the elements required to perform tasks, noting steps, sequence, requirements, and results when not performed correctly. For instance, in order to choose between two file formats for a document—HTML and pdf—users must be able to open files with the appropriate program. A requirement is that programs that open the files are available, and the user can indeed use them. The steps vary based on the program and how well it is integrated into the system at hand. But there is something additional that will help users to be successful in accomplishing their goals: knowing the difference between the formats, which comes with experience. Likewise, it helps to know the advantages or disadvantages of manipulating information with either of them. Experience helps to build a broader understanding of when and why to use a task, which is generally called task knowledge. The knowledge associated with a task allows a user to understand a context and establish relationships between a task and the setting in which it is placed. For instance, while anyone might be able to follow a recipe to bake a soufflé, task knowledge would influence the choice of baking utensil and oven or how well (and why) to beat the eggs based on prior experience and conceptual understanding.

Task knowledge is analyzed by observing novices performing a task and then watching experts perform the same task. The difference indicates the gap between beginner and advanced users but also gives insight into the lack or presence of task knowledge. One of the goals in identifying task knowledge is to describe the mental models of experts, specifically as it relates to using information technology. Figure 2 shows a conceptual representation of the relationship of tasks to task knowledge and mental models. If approaches can be described or shared with novices, it would help accelerate learning—when novices are shown expert ways, they can become experts faster.

As shown in Figure 3, experts and novices often have different approaches to problem solving based on their experiences and knowledge. Experience provides a set of problems from which comparison and contrast
<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Knowledge</th>
<th>Mental Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>(repeatable, concrete, usually sequential, skills)</td>
<td>(conceptual understanding of steps as process and where/when to apply)</td>
<td>(universal knowledge base which is a tool for problem solving)</td>
</tr>
</tbody>
</table>

Figure 2. Relationship of Tasks, Task Knowledge, and Mental Model.

<table>
<thead>
<tr>
<th>Context for Task</th>
</tr>
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<tbody>
<tr>
<td>Having identified a possible link that may fill user’s need, Web page takes over a minute to load.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Novice Task</th>
<th>Expert Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>After waiting impatiently, novice hits the Back button and tries another link.</td>
<td>After waiting to see if graphics are a problem, expert hits the Stop button and then forces the page to reload. Also considers changing options to stop graphics from loading.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Novice Task Knowledge</th>
<th>Expert Task Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>A page that won’t load is the result of a problem with the page or the server.</td>
<td>Graphics are bandwidth intensive. A slow page transmission is associated with current request—a subsequent transmission may not be slow and load normally.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Novice Mental Model</th>
<th>Expert Mental Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servers are like ATMs—when they are out of order user must go somewhere else.</td>
<td>Server interactions are similar to telephones, only the duration of a transmission is very short.</td>
</tr>
</tbody>
</table>

Figure 3. Analyzing Task Knowledge.

...can help build a knowledge set. Such knowledge is compiled over time, which allows a person to reflect upon not only what works, but why or when certain approaches work better than others. As noted previously, knowledge associated with a task can then be applied to similar tasks or compared to different tasks in a way that allows breakthroughs in problem solving. With more experiences and breakthroughs, a person eventually develops a conceptual understanding of groups of tasks or applications in a larger context. Task knowledge can lead to conceptual understanding of the bigger picture. Well-developed conceptual understanding—for instance, how clients and servers interact—becomes a tool with which users can relate to or solve problems in other areas.
The goal of information technology literacy is to move from simply following steps to applying concepts when using technology. Conceptual understanding is solidified in a model that learners use to anticipate and solve problems in other situations and settings. Figure 2 indicates that task knowledge is enhanced when users have more conceptual understanding.

How does one teach for a conceptual understanding of technology? By focusing on the general idea of what it is that technology helps us do, instruction can begin to focus on concepts. This can be done by looking at the function a technology is supposed to fill, not just the end result of using it. For instance, if a learner looks at Windows as a way of organizing and accessing files by using menus and graphical representations, it becomes a little easier to explain the difference between Windows 3.1 and Windows NT. One can relate the menu and graphical nature of the two and then discuss the differences in using them. However, if a user sees Windows simply as the graphical way information is presented, he will have a hard time learning how to organize and manipulate files and folders. Another example is that, while making a bookmark or emptying the cache for a Web browser may be performed differently for Netscape than Internet Explorer, the concept behind the two is quite similar. A user could learn a recipe for saving a bookmark but not understand what a bookmark is or does. Once it is accepted that teaching for conceptual understanding can facilitate learning, attention can be turned to techniques for doing so.

Contemporary educational practice reveals a trend of borrowing from several disciplines to develop new approaches for dealing with technology. Criticism in the field of education has argued for some time that lecture-style methods of teaching are not effective. Current trends focus on learner-centered education where the emphasis is on the learner’s perspective and how it helps them connect to the learning at hand (Resnick, 1989). More emphasis is being placed on activities such as hands-on labs, small group work, active participation, and exercises (Prorak et al., 1994). These approaches aim to engage learners by having them actively take part in the learning experience. Such approaches seem to be good at reinforcing both skills and concepts.

One approach, constructivism, goes a step further. It argues that learners are not passive vessels for receiving knowledge but are active participants who bring various tools to use into the learning process. In particular, they use mental models as the tools for constructing knowledge, and teaching should aim to build, strengthen, or alter those models (Tobin, 1993). The term “mental model” is borrowed from the cognitive science world, where it is defined basically as a system of outlooks or knowledge that a person uses to define the world in general or, specifically, a problem at hand (Seel, 1995). For example, a mental model of gravity allows
one to determine that if an object floats it is either lighter than air (e.g., a helium balloon) or has some kind of propulsion that allows it to break away from gravity’s pull (e.g., a helicopter).

MENTAL MODELS

Mental models are more than mere internal representations of external systems; these are complex schemas comprised of components and the relationships among them. It is argued that learners build and develop mental models over time as they interact with different systems (Gentner & Gentner, 1983). It is believed that people develop them through analogy by identifying and relating similarities and differences between known systems and facts and the new information or domain encountered (Greeno, 1983). Experts differ from novices in that they can use their mental models to produce strategies for dealing with problems that may be different from previous experiences on the surface level but that are conceptually similar.

A classic example of a mental model is revealed through the analogy that electricity is like water. Instructors can use students’ basic understanding of water flowing through pipes to explain how electrons flow through wires (Gentner & Gentner, 1983). Another common example is that atoms are similar to solar systems. Other effective analogies include showing how gravity is similar to buoyancy or air pressure is like water pressure. In each of these examples, new knowledge is presented and related to other, already acquired, knowledge. However, mental models are more than just analogies. Students use their models as both knowledge base and toolbox for solving problems. The models allow them to make comparisons, understand exceptions, predict variations, and project scenarios to solve or avoid problems.

A student’s mental model of an online catalog may be very limited. In high school, he or she may have been shown how to use the card catalog as a “look-up” tool which points to books. Classification in manual systems is usually limited to author, title, and subject. Thus, his or her mental model is of a very simple system analogous to a telephone book’s white and yellow pages. When shown an online catalog, he or she will not understand the complexity and power of new generation systems. He or she have no model for understanding keyword searching, Boolean operators, or field limiting.

In fact, if students have used Internet search engines, their models for relating to online catalogs may be more like a slot machine or shopping at Amazon.com. They are probably used to typing in one word and taking their chances that something related to their need will rise to the top of the search results list. And if they cannot find something they want, just as they do with other shopping results, they may settle for what they find or even revise their needs to accommodate whatever is convenient and available.
Studies of mental models related to information seeking have supplied insight into how various groups understand and apply broader concepts and contextual knowledge related to information retrieval. One study found that a sophisticated searching system did not substitute for mental models of naive users—the more complete the conceptual understanding, the less system errors users confronted (Dimitroff, 1992). Another group of studies showed that students could use and strengthen their mental models to help information seeking and lifelong learning when the focus was on process, not product (McGregor, 1994). Information literacy seeks to alter, shape, or develop mental models.

Users often create their own mental models in order to understand technology. Students sometimes view the Internet as a maze of rooms, like an arcade game, rather than a series of devices connected like the drives of a workstation. A primary step to building effective teaching approaches—a key ingredient of a literacy program—is to assess or survey existing models used by a given population. Once these models have been analyzed, teaching methods can be developed that help learners to adjust, extend, and alter these models. Constructivism argues that learners must be provided with carefully designed experiences to adjust their mental models and to construct knowledge for themselves. Experiences present the learners with a variety of situations that force them to test and, if necessary, alter their mental models. These experiences should, like the teacher's conceptual model, be designed with the learner’s current mental models in mind.

Hands-on problem-solving experiences will move the learner toward expertise but will take time. Sharing conceptual understanding will accelerate learning and shape mental models. Figure 3 indicates the difference between task knowledge and mental models—but simply describing that difference will not promote knowledge building. There must be a way to influence knowledge growth. Some experts point to the use of analogy to do so.

Analogy itself can be compared to a concise articulation of a mental model—it represents a concept and serves as a tool to foster comparison and contrast to further promote understanding. An example of an analogy might be that accessing Web pages is like making a phone call. It can quickly express the ideas behind packet switching and relate the problem of error messages resulting from calls that are interrupted, cannot be placed, or result in busy signals. Analogy works best when numerous comparisons and contrasts can be made.

CONCLUSION

The inability to understand information technology in various settings and applications impacts the information literacy learner on several levels. First and foremost, students may not be prepared to begin an
information literacy course or program—without comfort and competence, information technology can be a barrier to learning. Second, with only cursory skills (following "recipes"), they can get frustrated, waste time, and end up with hastily produced results for their information needs. Third, they may be unable to discern between technology literacy and information literacy, mistakenly thinking that mastering a particular interface is all they need to do to achieve long-term success. Combining analysis, task knowledge, mental models, and analogy can be useful in developing a program.

Learner analysis is a valuable, but often overlooked, tool. Students must be surveyed to better understand their knowledge levels, mental models, and learning styles. Generalizations regarding learner mental models or task knowledge may be found elsewhere (McGregor, 1994), but it is most useful for instructors to be directly in touch with their learners. A variety of techniques could be used to do so, ranging from random individual samples to representative focus groups.

As a part of learner analysis, it would be most useful to observe learners trying to accomplish information retrieval on their own. Even if they are able to articulate their mental models, insight into their approaches and techniques is best gained through empirical observation. By watching a variety of participants in the act of trying to search, for instance, one can get an idea of how they apply their mental models. By understanding task knowledge, instructors see firsthand the techniques and tools students prefer to use.

Knowing how learners think and act, it is easier to develop ways to influence their mental models. For instance, if students are used to searching Napster for music files, their mental model may be similar to that of selecting files from a networked jukebox and include a strong belief in simple keyword/title/author search (string or left-anchor searches in some information science parlance) while accepting information without considering its validity (no check to determine if this is an authoritative version of a song). Introducing the concept of a search engine as an intelligent jukebox that does not filter for quality may be one way to attach to and alter their mental models. Using analogies to which they can relate not only gets their attention, it allows them to bridge from the known (their mental model) to the unknown—this is also known as the "proximal distance" in educational theory (Tobin & Pippin, 1993).

The need to pursue this is twofold: information technology literacy is not found currently in curriculums, and it is a precursor to information literacy. Obviously, library and information science programs promote this literacy, but these do not seem to be addressed at undergraduate levels. As noted, this is not the same as computer literacy, although some think it is under the same umbrella (NRC, 1999). Other than general computer skills requirements, little seems to be available in the way of approaches or facilitation of information technology literacy (see Figure 4).
Of course, there is no one formula for incorporating either information literacy into any setting, let alone an information technology literacy. Some institutions, such as Earlham College or the University of Wisconsin, have formal requirements, such as courses or modules, in which information literacy competencies can be promulgated. In other places, such as the University of Oregon and Indiana-Purdue University at Indianapolis (IUPUI), formal liaison programs exist in which librarians work closely with schools and departments to develop course-integrated projects and assignments that promote such literacy competencies. In still others, such as Purdue University, libraries have taken it upon themselves to build a program and then push to get it inserted into university courses. It is hoped that the two literacies can be integrated. If an integrated perspective toward information technology grows, perhaps it is this latter approach—a "grassroots" movement—which librarians need to take to meet the challenge of developing an information technology literacy.

REFERENCES


Understanding the Internet: Model, Metaphor, and Analogy

T. G. McFadden

ABSTRACT

THE EFFECTIVE USE, BY STUDENTS AND OTHER USERS, of online and Internet resources depends crucially upon a clear understanding of the form and content of complex electronic networks. Because these networks, and related electronic systems, are often initially unfamiliar even to sophisticated users, it is important that adequate models and analogies be available to support learning and teaching of, and with, these resources. This article discusses some of the obstacles to effective learning inherent in the nature of these systems, and in the ad hoc conceptual tools that many users bring to their understanding of these systems. Particular attention is given to the nature of metaphorical explanation and comprehension in other disciplines, and the ways in which these patterns of understanding can be applied to our interaction with the Internet. Finally, a modest suggestion concerning one kind of metaphor for the Internet is proposed and described for use in classroom instruction.

THE COGNITIVE PROBLEM

What do our students know about the Internet, and when do they know it? For nearly a decade, thoughtful observers of this scene have been arguing that critical thinking is the key to successful interaction with online information resources (initially, online catalogs, but more recently the World Wide Web). This should not be news. The problem is that many students at all levels are ill-equipped to deal with abstract concepts of any kind. The concepts of evidence, of authority, of reasoned thought and narrative—and of how these are exemplified in the resources of a library
and can be intellectually exploited—are all quite foreign to a very substantial number of undergraduates. In fact, higher-order conceptual skills of any kind are uncommon for many of our students (McFadden & Hostetler, 1995, p. 224). Oberman (1991) correctly notes that most online information retrieval instruction requires students to operate in the realm of the abstract—of metaphor and conceptual models. "In every instance," she laments, "students must engage in what is most likely unfamiliar cognitive territory" (p. 196). In a recent book on the Internet, Paul Gilster (1997) finds it necessary to make this point repeatedly: "[The] tools are intellectual and attainable, for digital literacy is about mastering ideas, not keystrokes" (p. 15).

What is worse, most students have no idea that they are in trouble. This is a pipeline problem. At the secondary-school level, where the application of technology to instruction is often a vital school reform component, the focus still seems to be on information tools—that is, hardware—instead of on the cognitive processes needed to evaluate and use the information (Tyner, 1998, p. 86). This seduction of the innocent by the glamour of computers and the Internet results in a strong tendency among students to concentrate on the merely technical aspects of successful WWW use and on the details of various search protocols rather than on developing thoughtful methods for understanding the nature of their interaction with the network. Oberman (1991) found, to her dismay, that "numerous studies . . . suggest that some students view the online environment as a means of circumventing traditional mechanisms for understanding the relationships between their information needs and information resources" (p. 196). In other words, they would rather do than think about what they are doing. The online environment itself creates the most significant obstacle to comprehension (Martorana & Doyle, 1996, p. 184).  

But students certainly seem to feel good about their WWW skills. Surveys have indicated repeatedly that most students are very confident about their Internet abilities. In fact, they are nearly as confident about their Internet talents as they are about their knowledge of a vastly less complex online activity, electronic mail (Rumbaugh, 1999, p. 32; Hirt et al., 1999, pp. 22-23). Teachers routinely see this attitude at work in the bored expressions of students in bibliographic instruction classes on the Internet and online information resources. This naive ignorance is consistent with the mode of learning favored by students as the most common way in which they acquire their largely mythical Internet skills—self-teaching. Again, surveys have indicated that students, especially with respect to Internet use, prefer self-guided and independent methods of learning.

Self-taught students also have greater self-esteem with respect to their Internet skills (Duggan et al., 1999, p. 13). It is revealing that many students and researchers refer to this method of learning as "trial and error" (Davis, 1999, pp. 70-71).
For most students, indeed for most Internet searchers, the Internet is a typical black box. Very complicated things happen inside of it, but nothing about the box itself reveals what is going on. Our only "window" into the box, the computer monitor screen, is strictly one-dimensional; the scrolling metaphor is singularly apposite here. Unlike a card catalog, which at least provides some physical indication of how large the associated database is—and even sometimes of how it is arranged and therefore accessed—the WWW exhibits no such obvious clues. Sometimes it appears to be incomprehensibly vast, and at other times apparently contains nothing at all; little about the black box suggests an explanation for this seemingly random disparity of results. Even an ordinary book provides more indicators of content and arrangement than the Internet. A book has a front and back, and thus a beginning and ending; it moves, in general, sequentially through a narrative; some things come before and, therefore, introduce other things; some things come after and, therefore, conclude other things. The words and sentences have a context that is physically evident, as well as conceptually manifest; in some books there is a lot of information, and in others not very much. But the WWW essentially decontextualizes the ideas that emerge from it upon request (Birkerts, 1994, pp. 122, 123, 129; Van Hartesveldt, 1998, pp. 51-59). There is no history here, no development of ideas, no context for thinking about why some things are said and other things remain unspoken. For the user of the network, history began about a decade ago, something that is reflected in how disturbingly ahistorical many of our students are.

This is the crux. The Internet is roughly akin to a closed system without external manifestation, rather like a box filled with a substance about which we can only guess the essential properties based on the behavior of pointers and dials on measuring instruments. Students and other searchers of the Internet have cobbled together a whole array of analogies and images to explain how the Internet works. We will find that these metaphors are mostly inadequate or just downright wrong. What we need is a new understanding of the role metaphor plays in our attempts to comprehend and to teach about the Internet to students and to others who are often bereft of the conceptual tools required to grasp highly abstract concepts. Knowing how metaphors, analogies, and models contribute to the successful management of our conceptual lives may provide us with innovative approaches to both learning and teaching about networks.

**Metaphors in Ordinary Language and Thinking**

Compared to our actual experience of the world, the world in which we live and function is extraordinarily complex and abstract. We begin life, after all, with essentially no awareness that there is any ontological distinction among any of our sensations—everything is "real" and even
the separation between ourselves and everything else is arguably a learned concept. When we finally do begin to make the distinction between what happens to me and what happens in the "external" world, our picture of reality divides itself into two—and really only two—parts: there is all of that part of the world that is outside my mind (and perhaps also my body), and there is everything that belongs just to me and does not exist in a public space. We remain aggressively egocentric, but at least not everything exists only in my world; there are things that carry on whether we are aware of them or not, and eventually there are also other people who presumably have similar experiences. And, even until fairly late in this development, external things and events are often imbued with life and intention (animism). Thus the great bifurcation in nature that Descartes hardened into a strong and very plausible metaphysics.

It remains true, nevertheless, that the conceptual toolkit we evolve for understanding the world and the events that happen to us is remarkably limited. Certainly our experience of things in space is, at least initially, limited to what our unaided senses provide us. It is no naïve empiricism to suggest that the conceptual framework within which we move about the world is very much informed by our experience of macroscopic objects and events. No word, it has been remarked, is metaphysical without its having first been physical (Hutten, 1954, p. 293). And precisely because we experience objects in space, many of our fundamental concepts are also organized in terms of one or more spatialized metaphors: up/down, left/right, near/far, and so on. These metaphors are not randomly assigned (Lakoff & Johnson, 1980a, p. 464; Garnham, 1999, pp. 45-48).5

It follows that our ordinary language and, to a large extent, our technical language, must be inevitably metaphorical. Most of the metaphor embedded in our everyday expressions has been lost—if we ever knew the original meanings in the first place. But we seem to have a signal talent for inventing ways of talking about the unfamiliar in terms of resemblances between new experiences and familiar facts; what is novel is understood by subsuming it under established distinctions (Nagel, 1961, p. 108).6 What is even more important, the metaphors that we use are often not merely just a matter of alternative words but contribute importantly to the nature of the things about which we speak: the metaphor sometimes creates the similarity as much as it formulates some similarity antecedently existing (Black, 1962, p. 37).

To illustrate this point, we often speak of a "friendly argument," but the words we use to talk about arguments in general are anything but friendly. Clearly, the metaphor for an argument for most of us is that of war. We say that "he attacked every weak point," or that "I demolished his argument," and even that "she shot down all my arguments." We talk about "marshaling" the evidence for an argument as though, somehow, military
logistics were involved. In fact, the very earliest uses of this expression had
to do merely with lining (usually people) up in some kind of order (as at
a feast, for instance), but the military implication occurs in English by the
late sixteenth century. Within a short time, however, the metaphorical use
had come to mean simply arranging almost anything (material or immate-
rial) in methodical order; the original use had been lost. It is signifi-
cant, nonetheless, that the military sense has remained an implicit part of
the language of argument—and that, whatever we might say otherwise,
this is how we really view the concept.  

A metaphor is, therefore, a kind of pretense. In using a metaphor, even
when the original sense has long since disappeared or been completely
assimilated, we are pretending that something is the case when it is not
(Turbayne, 1970, p. 13). A good metaphor gives us a stance from which to
view something outside the usual limits of our experience; it is most fun-
damentally, as Kenneth Burke (1945) observed:

> a device for seeing something in terms of something else. It brings
out the thiness of a that, or the thatness of a this. [We] could say
that metaphor tells us something about one character as considered
from the point of view of another character. And to consider A from
the point of view of B is, of course, to use B as a perspective upon A.
(pp. 503-04)

**Metaphors and Models in Science**

It should not be surprising that we are strongly inclined to engage in
metaphorical expression in talking and thinking about the complex inter-
active and network systems that we confront in both using and learning
from computers. Nor should it be surprising that we are more than some-
times misled by the analogies that we use to understand human-computer
interaction. Because these metaphors are often technical analogies for
unfamiliar target systems, it will be useful to consider briefly the use of
metaphor in scientific explanation.

In the literature of the philosophy of science, as well as that of cogni-
tive psychology, the expression “mental model” is common. An elaborate
taxonomy of terms related to this concept has been developed to describe
what happens in learning, thinking, and explaining through metaphor
(e.g., Gentner & Stevens, 1983). For our purposes, the precise linguistic
and conceptual relationships among the ideas of metaphor, analogy, mental
model, and conceptual model are not really important. Even the techni-
cians are frequently willing to consider a model to be very similar to a
metaphor in ordinary language, although perhaps more detailed and for-
mal (Hutten, 1954, pp. 84, 289, 293). Certainly a model need not be men-
tal in any but the trivial sense that something is “mental” just by virtue of
being thought about; we are all familiar with the Tinkertoy constructs
chemistry students use to represent molecular structure. Whether we call
it a metaphor, an analogy, a model, or simply an image, what is important here is the function of whatever it is that plays this role in our speaking, learning, and thinking.  

There is substantial historical disagreement about the legitimate role of models in scientific reasoning, explanation, and prediction. But there can also be no doubt that historical models of various kinds have strongly influenced the development of sophisticated theoretical concepts. Whether, once elaborated and confirmed, a high-level theory still requires the original model for any conceptual, psychological, or explanatory function is at least debatable. We can learn some important lessons about the role of models in scientific reasoning from a brief consideration of two examples in the history of science: (1) the development of the concept of atmospheric pressure, and (2) the development of the kinetic theory of gases.

The Atmosphere as an Ocean of Air

The basic facts concerning what we now call “air pressure” have been known since before the time of Aristotle. We have all experienced trying to draw a liquid up through a tube and finding that, by doing so, we somehow seem to pull on the liquid. We know that we can hold the liquid in a tube after we have pulled it up, simply by closing off the top end. Anyone draining a liquid from a barrel, or similar container, is aware that the liquid will not run out unless there is an opening somewhere near the top. Why is this so? Is something actually pulling on the liquid, causing it to move upward? Or is it necessary to open up the top of the container to permit the air pushed out of place by the liquid to find another space to occupy? If the universe were a plenum of some kind, then these phenomena would make sense; no vacuum is possible if there is “stuff” everywhere all the time, just moving around to vacate and fill space as necessary. For centuries, this explanatory idea was known as the Aristotelian principle that “nature abhors a vacuum.”

This same idea could be, and was, applied to explain the action of a suction pump. The use of a simple piston pump to move water from lower to higher places, and in particular to pump water from deep mines, was widespread by the end of the sixteenth century. A crude but effective system of staged pumps in tandem, to raise water to substantial heights, was illustrated by Agricola in his famous 1556 treatise on mining (Conant, 1951, p. 68). Until Galileo, however, no one seems to have called attention to the odd fact that a single pump cannot raise water more than about thirty-two feet. Nature may abhor a vacuum, but why only to this seemingly arbitrary height? Galileo noticed this problem but missed entirely an opportunity to provide the correct explanation. On the first day of the conversations reported in his Dialogues Concerning Two New Sciences, Galileo remarked upon this difficulty concerning water raised by a pump; he seemed to regard this as simply a case of a long column of something
unable to support its own weight (just "as if it were a rope") (Drake, 1974, p. 25). But this is the wrong analogy. It is not the weight of the column of water that is important, it is the weight of something else. It was left to Galileo’s student, Torricelli, to find the right model.

It is important to notice that we do not experience the “weight” of air—certainly not in the same way we experience the weight of water. Visualizing that air exerts pressure from all sides in the same way that water exerts pressure (varying with the depth) requires a leap of the imagination and a selective transfer of properties that are not obviously connected. In a famous letter written three years before he died, Torricelli described us as living “immersed at the bottom of a sea of elemental air” and subject to the resulting atmospheric pressure (Magie, 1935, pp. 70-73). Almost certainly, Galileo also recognized that the atmosphere has weight but apparently did not believe that it exerts a surrounding pressure in the way that water does.

Thinking of the atmosphere as analogous to an ocean, although made up of something much less heavy than water, provides an explanation for the limitations of a suction pump. If it is the weight of the air that pushes down on the water at the bottom of the pumping column, to lift it up as a vacuum is created at the top of the column, then the column of water will be raised only in proportion to the weight of the column of air available to sustain it. This picture lends itself to confirmation by an obvious experiment, the one Torricelli performed in 1643 or 1644 (Middleton, 1964, pp. 29-32) and for which he is now known in every class in elementary physics. If the column of water is sustained at about thirty-two feet by the weight (pressure) of the air, then a similar column of a heavier substance, such as mercury, should be supported in a column at a correspondingly lower level (in this case, at about 2.4 feet). The experiment, performed by Torricelli and his friend Viviani, was an almost perfect success. At one stroke, Torricelli had invented the mercury barometer, the use of mercury as an experimental tool in the study of gases, and a method for producing a vacuum (Conant, 1947, p. 39). But this is only one important consequence of the hypothesis that the atmosphere is like an ocean. The philosopher and scientist Pascal was shortly to articulate, and test, another one.

If the atmosphere is analogous to an ocean, Pascal reasoned, then a short column of air should exert less pressure than a tall one. The explanation does not require a vacuum because none is created in the process simply of moving higher in the atmosphere. The obvious test, then, would be to measure the “weight” of the air (atmospheric pressure) at varying distances from the surface of the earth by discovering whether the mercury in a barometer changes in height as a function of the relative elevation at which the experiment is conducted. Here is Pascal’s own description of the analogy and the inference:
Just as the bottom of a bucket containing water is pressed more heavily by the weight of the water when it is full than when it is half empty, and the more heavily the deeper water is, similarly the high places of the earth, such as the summits of mountains, are less heavily pressed than the lowlands are by the weight of the mass of the air. This is because there is more air above the lowlands than above the mountain tops; for all the air along a mountain side presses upon the lowlands but not upon the summit, being above the one but below the other. (Schwartz & Bishop, 1958, p. 353)

In 1648, Pascal’s brother-in-law agreed to carry a mercury barometer to the top of the Puy-de-Dôme in the central mountain range of France. An observer at the foot of the mountain kept constant watch on a similar barometer while various measurements were taken at the summit under diverse conditions. Pascal’s predictions were completely vindicated. After all, why should nature abhor a vacuum more at the surface of the earth but less on a mountain top?

The final chapter of this particular tale was written by Newton’s contemporary, Robert Boyle. Boyle had heard about Pascal’s experiments in the 1650s, even though the publication of Pascal’s treatise on pneumatics was delayed until 1663 (Conant, 1957, p. 9). He rightly understood that if Torricelli had offered the correct explanation of the behavior of liquids in the presence of the weight of the air, then this theory should be testable in an artificial vacuum. Significantly advancing the techniques of building air pumps for experimental purposes, Boyle constructed an air pump and receiver to contain a mercury barometer that would respond to air pressure inside the apparatus. Taking this idea to its logical conclusion, Boyle remarked, if “we could perfectly draw the air out of the receiver, it would conduce as well to our purpose, as if we were allowed to try the experiment beyond the atmosphere” (Conant, 1957, p. 19). Not surprisingly, Boyle found the result he had expected: as the quantity of air in the receiver was reduced by the suction pump, the level of the mercury in the barometer correspondingly fell. The Aristotelian horror vacui had been dealt a fatal blow.13

Good Models

Based on this (paradigmatic) example, can we articulate any general characteristics of “good” cognitive models? Whether a model is “good” or “bad” is very much a matter of what the model is for and for whom it is intended.14 Various attempts have been made to catalog the features of a good cognitive model (e.g., Mayer, 1989, pp. 59-60; Russon et al., 1994, p. 178). But if we take the most important feature of any particular model to be its function, or value, in a given learning situation, then most of the suggested characteristics can be summarized in just two quite general concepts: explanatory power and predictive effectiveness. This conclusion follows directly from the reasonable assumption that the purpose of a
mental model “is to allow the person to understand and to anticipate the behavior of a physical system” (Norman, 1983, p. 12).

We must be careful not to identify a legitimate explanation of an event or process only with an analysis in terms of what is already familiar to us. For one thing, what counts as “familiar” to a given individual is very much dependent on time and circumstance. But, more importantly, the development of theoretical physics in the twentieth century has left most of us in the conceptual dust. It may be, as the physicist P. W. Bridgman (1936) argued, that we have lost something in the way of intellectual satisfaction with our theorizing when we can no longer supply an intuitively understandable model of a process or event (pp. 62-63). We may be able to model the process mathematically, but we no longer really understand what is going on. Richard Feynman (1964) once remarked that, while he could very well picture invisible angels, he was quite unable to visualize electromagnetic waves (p. 20:9). And certainly beginning with Sir Arthur Eddington’s notorious two tables, the theoretical content of natural science has become increasingly remote from everyday experience—and even from anything we can readily imagine (Nagel, 1961, pp. 45-46; Wolpert, 1992, pp. 1-24).

So, an adequate understanding of an event or process, particularly in natural science, probably does not require a conceptual model of the sort I have described to be an essential part of the explanatory apparatus, but it helps. And this is arguably one of the characteristics of a good cognitive model when one is appropriate: in our interpretation of the target system, the elements, and their relationships, in the model should provide some kind of intellectual satisfaction. The metaphorical light bulb turns on. Now we get it; before, we did not. Even more importantly, the analogy provides us with an explanation for what we observe. If the atmosphere is like an ocean of air in the relevant respects, then we can explain why we observe, for instance, that water in ordinary circumstances can only be raised to about thirty-two feet by a suction pump. If a gas does consist of minute perfectly elastic particles, then we can explain why, under given conditions, the sides of a container experience the “pressure” that we actually observe. It may not even matter much whether the analogy is true, only that it consistently yield the correct experimental results.

This brings us to the other important characteristic of a good cognitive model: predictive effectiveness. While a productive analogy interprets what we already know, it must also permit an extension into the realm of what we do not know. A good cognitive model helps organize our experience as we have it, but it also yields implications that are subject to experimental confirmation (or falsification). This is the heuristic function of a good metaphor (Borgman, 1986, p. 48; Hutten, 1956, p. 84; Norman, 1983, p. 12; Rickheit & Sichelschmidt, 1999, pp. 19-20). Pascal drew upon this feature of the picture of the atmosphere as like an ocean of air to predict...
what would happen when the “weight” of a column of air was varied with altitude—a prediction that was beautifully confirmed. Boyle wondered what would happen if this hypothesis could be tested at an artificial “altitude” (i.e., in a vacuum chamber); his curiosity was rewarded by careful experimentation. In each case, the model provided the appropriate analogical conditions for the test. This is sometimes called the “parallel entailments” feature of a good metaphor (Lakoff & Johnson, 1980a, pp. 457, 460). Certain things true of the model will, by implication, also be true of the target system. If time is money, then time is a limited resource (because money is); if time is money, then time is a valuable resource (because money is) (Lakoff & Johnson, 1980a, p. 457).

Alas, there are no time banks, and this brings us to the point at which a metaphor may go bad. A good cognitive model is necessarily selective; only some aspects of the target system are represented by the analogy. The analogy would otherwise be as complex as the target system, providing only a replication of the target system, not a model of it (Toulmin, 1953, p. 165). A useful metaphor suppresses some details and emphasizes others, acting as a kind of filter for our understanding of the target system (Black, 1962, pp. 41-42; Lakoff & Johnson, 1980a, p. 458; Sanford & Moxey, 1999, pp. 57-58). To say that the atmosphere is like an ocean of air is not to say that all of our knowledge of the actual ocean should be attributed to the atmosphere. Similarly, to say that the hydrogen atom is like the solar system “clearly does not convey that all of one’s knowledge about the solar system should be attributed to the atom. The inheritance of characteristics is only partial” (Gentner & Gentner, 1983, p. 101). This is where the trouble starts.

Metaphors Gone Bad: Sort-Trespassing and the Internet

It is quite possible, even likely in certain circumstances, to be ill-served by a metaphor. If a metaphor is, fundamentally, the presentation of the facts of one category in idioms appropriate to another (Ryle, 1949, p. 8), then to the extent that the idioms of the analogy are not appropriate to the target system, we will be confused by the metaphor. We might be just a little confused, as when we wonder what color are the tiny particles that make up an ideal gas, or whether the objects orbiting the nucleus of the hydrogen atom have mountains or are covered with ice. Or we might be very confused, as was the tourist in Oxford who, after seeing all of the colleges and the Bodleian Library, still asked “But where is the University?” Gilbert Ryle (1949) famously called this error a “category mistake.” Our tourist was mistakenly allocating the university to the same category as that to which the other institutions belong (p. 16). Animistic explanations of physical events are another example of what Turbayne calls “sort-trespassing” (as opposed to legitimate “sort-crossing”). We transfer our experience of how we initiate motion in ourselves to other objects without
having any evidence at all that this is a legitimate analogy (actually, even if
the other objects are people). Small children are especially liable to this
kind of myth-making (Piaget, 1929, pp. 207ff.).

Words matter here. The way we talk about a target system in terms of
a model (especially if we have not made the analogy explicit to ourselves
or others) can, to a significant extent, bias the way in which we under-
stand the nature of the target system (Hutten, 1954, pp. 286-87; Russon et
al., 1994, p. 178). In an important sense, our conceptual scheme replaces
the reality that it is merely intended to model. If our metaphor is seriously
out of line with the character of the target system, then we are sort-tres-
passing in a big way. And we will inevitably follow the associated line of
parallel entailments down an increasingly muddled conceptual path. It is
arguable that the typical language used to describe the Internet and the
World Wide Web is just such a set of sort-trespassing metaphors, and that
the implied features of this particular target system are not only wrong
but also represent a serious obstacle to a correct understanding of the
network and its capabilities. Having the wrong mental model, in this case,
is a crucial reason for the inability of many of our students to manage
their interaction with the network in a way that reflects any level of critical
thinking at all.

The most basic linguistic, and conceptual, mistake that we make about
the Internet is talking about it as though it were a thing. In fact, we can
scarcely do otherwise and say anything at all about it. But, just as Oxford
University, unlike its member colleges and other institutions, is not a thing
(but we still refer to it that way), so the Internet is, despite our words, not
a thing. This is the fallacy of misplaced concreteness. As soon as we get
used to talking about the Internet in this way, we are very likely to start
saying such other things as “the Internet is a place of learning rather than
[just] a technology” and that the Internet is a place to get information
(Owen & Owston, 1998, pp. 1, 9). This quite naturally leads to the familiar
idea that the WWW is a learning highway (again, a place), and “a pretty
super one at that” (Owen & Owston, 1998, p. 260). A natural extension of
this line of talk is to describe the Internet as an extremely large database
and before you know it, we have rashly described the WWW as “nothing
short of the world’s biggest library” (Maloy, 1999, p. 4). It becomes almost
irresistible to compare the large Internet search engines to indexes, and to
refer to them as being like encyclopedias (Owen & Owston, 1998, pp. 73,
81, 87). Having made that jump to the island of conclusions, like the
hapless travelers in The Phantom Tollbooth, it is difficult to get off again. If
an index to a document, or collection of documents, even pretends to be
complete and discriminating (as a good index should), then we might
further want to claim that, having used several of the largest Internet search
engines, we will “have left few stones unturned” (Owen & Owston, 1998,
p. 61).
If the WWW is a huge database indexed by the major search engines (that are, moreover, like encyclopedias), then we should expect that an associated array of parallel entailments would emerge from the model to help us understand the Internet and how it functions in information retrieval. If there are such parallel entailments similar to the ones we have noticed in our discussion of other productive models, then this way of understanding the WWW will be confirmed. But it is not.

To begin with, we must not assume that the meaning of "index" intended here is the most elementary sense—i.e., as an indicator or pointer. If it were, then to say that search engines "index" the WWW would be true but trivial. The network user will have something much more complex in mind (but probably never made explicit), largely from experience with indexing and indexes in books, journals, and libraries. Hence, for the model to work, there must be some relevant similarity between this concept and that of "indexing the WWW" by search engines. What does this mean?

Well, it means at least two things that are most certainly not true of either the search engines or the "indexed" pages on the WWW: (1) that there has been intelligent intervention in the choice of vocabulary with which to describe target documents, and (2) that the documents themselves have been chosen for inclusion in the database according to some premeditated design (however general). The user of a book index, an encyclopedia, or a journal database has every right to assume that at least these two conditions will obtain information of the document(s) being searched. Nothing about any such collection of documents and document surrogates, however, will help a student understand how the large search engines retrieve pages from the WWW, even under the most carefully crafted search statement. Worse yet, we have included in most of our library WWW sites, parallel with the uncontrolled Internet, databases that do in fact meet the conditions required for proper indexing and vocabulary control (Cook, 1999, p. 11). The difference is almost entirely opaque to our readers. It seems fair to conclude that thinking of the Internet as a thing, in particular as a thing in important respects like an indexed document collection, is not only a category mistake, but one having clearly pernicious intellectual consequences.

**Metaphors and Learning: Why Sort-Trespassing Matters**

Experience and research have abundantly confirmed that the understanding most users have of the complex systems with which they interact is "surprisingly meager, imprecisely specified, and full of inconsistencies, gaps, and idiosyncratic quirks" (Norman, 1983, p. 8). Even college-age students often map erroneous knowledge onto unfamiliar domains. These models may be fragmentary, inaccurate, and even internally inconsistent,
yet they strongly affect a person's construal of new information in the domain. We have already seen how this works with analogies that are inappropriate to the target system; it is not surprising that being ill-served by a metaphor is common and usually implicit. Models, whether correct or incorrect, are carried over in analogical inferencing in other domains (Gentner & Gentner, 1983, p. 126).

The use of metaphor in understanding the unfamiliar, as we have seen, is ubiquitous. Borgman (1986) has argued persuasively that users of complex interactive systems will, in spite of themselves, try to construct some kind of model or analogy to help them understand what is happening to them. But they will not take the time and effort to articulate a good model of the system, even if they know what that might be; they just muddle along, never fitting the pieces together (p. 48). I have argued that using a mistaken metaphor for a target system will inevitably lead to incorrect conclusions about the current and future behavior of the system. What if this were not true? What if a bad model of an unfamiliar system is just neutral with respect to understanding and interacting with the system, however counterintuitive that might seem? It would still be important if observation and research indicated that having a good (or better) model of an unfamiliar process or event actually improves retention, learning, and cognitive success with respect to the system. Indeed, there is every indication that this is the case.

There is abundant evidence that familiar analogies can contribute to good instruction (Russon et al., 1994, pp. 178, 184). Mayer (1989) has shown conclusively that having a good conceptual model of a system significantly improves the recall of conceptual information, decreases verbatim retention, and increases creative transfer of knowledge to problem solving in new situations (pp. 43, 49, 58-59). Borgman's own research suggested to her that a model-based approach to training is superior (although only for complex tasks that require some extrapolation beyond basic commands) (Borgman, 1986, p. 59). Pursuing the same line of experimentation, Sparks (1996) concluded that "learners with the most developed mental models, profit most from instruction" (p. 24)\(^26\).

This may seem like the truism that, the more you know, the easier it is for you to learn. In fact, the idea has a firm theoretical and experimental foundation in the work of cognitive psychologist D. P. Ausabel and his colleagues on the concept of an "advance organizer."\(^27\) As the name implies, the idea here is that of a toolkit of relevant information, and an organizing framework, provided to the student prior to the introduction of new or unfamiliar verbal material. Ausabel hypothesized that this approach to learning and retention would improve results over the presentation of unfamiliar verbal material without any advance conceptual warning. Subsequent studies confirmed Ausabel's results (Ausabel, 1960, p. 267; Ausabel, Novak, & Hanesian, 1978). There seems to be clear
evidence that the use of advance organizers, or something functionally equivalent, does contribute to the learning and remembering of complex text information (Mayer, 1979, p. 381; Anderson, Spiro, & Anderson, 1978, p. 439). So, while it may be a truism that the more you know, the easier it is for you to learn, it is not trivial.

CONCLUSION

It may be that we have finally come to a largely negative result. It is undeniable that many students, and perhaps most WWW searchers, bring to their experience conceptual skills and abilities inadequate to the task at hand. The analogical understanding many network users have of the Internet, based on what they say and how they are observed to search and report their results, seems muddled at best and seriously confused at worst. At the same time, numerous studies have shown that how one conceptualizes an unfamiliar target system, what model or metaphor represents the way one thinks about the system, plays a significant role in learning, remembering, and problem solving within and beyond that system. In the philosophy of science, cognitive psychology, and learning theory the concepts of a mental model and conceptual model have been comprehensively studied and elaborated; there can be no doubt about the importance of these tools in thinking and learning at even modestly complex levels.

It may also be true that, in this context, the Internet is more like wave mechanics, string theory, or black holes than anything with which we are even remotely familiar. There just may be no readily accessible metaphor or model for the network that will function for us as mental models do successfully in other areas of thought and experience. It is one thing to compare the Internet to a Big Mac, granny’s attic, a soapbox, an information landfill, a yard sale, a gift shop, and junk food—and quite another to say something that can be incorporated into a more formal conceptual picture for teaching and learning.

But there may be some hope. Paul Gilster (1997), in Digital Literacy, discusses a variety of ways of thinking creatively about the Internet and search engines for the novice as well as the expert user. He finds that the analogy between the WWW and a library is a limping analogy at best; for this metaphor, the network is still in the dark ages of information retrieval (p. 161). Gilster is willing to compare a search engine to a card catalog only for restricted purposes; the distinction between field-defined and full-text searching illustrates one important difference between a card catalog and a search engine, but one that makes any further comparison of only limited value. The most suggestive metaphor that Gilster (1997) identifies, I think, is the Internet as operating system (pp. 239-41). If we can develop an analogy, even if only a thin one, that exploits computing concepts already familiar to most of our students, then at least some of the
characteristics of a good mental model may be available to us to teach more effectively about the Internet. How might this work?

Instead of thinking of the Internet as a place, offers Gilster (1997), maybe it should be thought of as a kind of virtual hard disk or virtual machine (p. 240). What the network (plus a browser) amounts to, metaphorically, is an environment (like an office environment). An operating system is not an applications program itself, or a data file or collection of data files, although it links all of these at a particular time for a particular user and a particular machine. The familiar concepts of multitasking, multiprocessing, multithreading, and time sharing all apply, in analogical ways, to the network as we experience it. But perhaps the most important characteristic of an operating system, in this context, is that it is itself a pretense.

An important part of the general purpose of a computer operating system is to deceive the user into believing that the actual machine is different in important respects from what it really is. The management of resources is a central function of an operating system (Calingaert, 1982, p. 3); one way the program does this is by creating and presenting a virtual machine (and virtual resources) to the user. This has the highly desirable effect of making the programming language of the virtual machine more attractive than that of the original machine (Hansen, 1973, p. 3). The operating system achieves this result, in part, by creating virtual devices and peripherals having a merely logical relationship to the actual system hardware. The user can then concentrate on working with data files and the names of data records, for example, instead of worrying about where any of these things are actually being managed or stored. Virtual memory, imaginary memory spaces, and virtual resources in general are mixed equally with actual memory spaces and programming resources in a way that is completely transparent to the user. All of this happens so quickly that the concurrent processing and multitasking necessary to maintain the pretense is also hidden from the user.

Many of the concepts that we associate with familiar operating systems (e.g., DOS, Windows, OS2) can be applied, mutatis mutandis, to the network browser environment. The most important of these, perhaps, is that the operating system is itself devoid of content. It provides a computing and user environment, but it is neutral with respect to what information and programs are selected by the user to function in that environment. An operating system can manage, more or less, false data, incomplete data, faulty programs, and just plain bad information as easily as it can coordinate good data, well-organized files, effective programs, and quality information. This is a crucial feature of the metaphor: an operating system may create, for special purposes, a virtual disk, but it makes no claim about the content of the disk; the data on the virtual disk may be flawed, or the intellectual organization may be inadequate to the purpose,
but it is not the job of the operating system to sort out these particular problems. Neither is it the job of the network. So, while some features of an operating system can be mapped onto the Internet, others cannot—just as we have come to expect of productive metaphors. This is, I think, a promising start to developing a conceptual model for the Internet that can be used in instruction.

APPENDIX

The Billiard Ball Model of an Ideal Gas

Boyle also noticed something else during his experiments with the air pump. Air, he said, is distinctly felt to be “springy” in the operation of a compressor or a pump. In either device, the physical sensation one gets is as of pushing or pulling a spring. No such effect is observed in the pumping of water. In fact, if this were not the case, certain kinds of air pumps would not work at all (Conant, 1951, p. 95). Boyle was lavish in his use of metaphor to describe the cause of the springiness of air, the most obvious analogy being a watch spring. He also likened the particles that he assumed made up the atmosphere to a heap of wool bundles that are constantly trying to push out against any attempt to compress them, or to coiled wires of varying lengths unwound from a cylinder and therefore having “springiness” in them (Hall, 1965, pp. 381-382; Conant, 1957, p. 57).

Another way to look at this phenomenon, according to Boyle, is after the manner of Descartes: various kinds of particles are all swirled about in the subtle fluid that fills all of space. Boyle claimed that he was neutral on this issue, although he certainly was an adherent of the corpuscular philosophy (Brush, 1983, pp. 15-16). He apparently was willing, at least in print, to distinguish between the picture of air as an elastic fluid and any particular model by which this characteristic of the atmosphere might be explained (Conant, 1947, p. 47). His discussion, however, clearly anticipates the kinetic theory of gases later developed in the eighteenth and nineteenth centuries.

The typical model of an ideal gas is, at first glance, not so very far from Boyle’s springs (and pulleys and levers). As physicist Norman Campbell (1921) remarked, just the most familiar things in the world to us are objects in motion; it is through motion that anything and everything happens (p. 84). We know, in general, what happens when moving bodies collide with one another, or with a fixed object or surface, although we may not know exactly the physical laws describing these reactions. We also know that how a moving object behaves under these circumstances is partly a function of what kind of object it is: soft or hard, smooth or rough, round or otherwise. Certain kinds of objects seem to absorb more impact than others: a soft object crushes under impact, while a hard object tends
more to bounce under impact. Some objects seem to give up all of their motion when they strike a surface or another object (think of the familiar child's toy that is four ball bearings suspended in tandem from parallel, horizontal bars).

When we apply these images to a theory of gases, we quickly find ourselves talking about objects like billiard balls, grains of sand, or marbles. And what we already know is quite a lot about the laws of motion of macroscopic elastic spheres of this kind. When physicists speak of a model for a theory, generally what they have in mind is a system of things differing chiefly in size from things that are at least approximately realizable in familiar experience (Nagel, 1961, p. 110). This is precisely what the billiard ball model of an ideal gas achieves. The model gives us an interpretation of the postulates for the kinetic theory of gases in terms of theoretical expressions like "change in the total momentum of the molecules striking a unit surface" (Nagel, 1961, p. 113). We already know from the general laws of dynamics what will be the effect on the motions of the particles of their collisions with each other and with the walls of a container. We can show, therefore, that:

particles such as are imagined by the theory, moving with the speed attributed to them, would exert the pressure that the gas actually exerts, and that this pressure would vary with the volume of the vessel and with the temperature in the manner described in Boyle's and Gay-Lussac's Laws. (Campbell, 1921, p. 82)

This way of looking at the properties of a gas and, indeed, of any fluid, eventually gave rise to other questions: How many particles make up a gas of a given volume? How fast do the particles move as a function of temperature? How much mass does each particle exhibit? What exactly is heat? These and similar questions were all approached with an increasingly sophisticated array of mathematical and quantitative experimental techniques in the development of thermodynamics and the chemistry of fluids during the nineteenth century.

Notes
1 There seems no doubt that there is a clear gap between student use of Internet resources and the quality of the resources that instructors expect their students to be using (Grimes & Boening, 2001).
2 It would be ironic if it turns out that some part, perhaps a significant part, of this cognitive deficit is the result of the early (and uncritical) introduction of computers to children at home and in the schools. See the interesting work of Jane Healy, as reported in Healy (1990) and Healy (1998).
3 For an instructive comparison of printed books with the WWW in this context, see McKenzie (2000). Jamie McKenzie has written a great many sensible things about instructional and information technology; anyone interested in the application of technology to the school curriculum should visit his Internet site: http://www.fno.org/.
4 Birkerts's book is a perceptive phenomenology of reading.
5 We also talk about, for example, an argument as being "solid," a metaphor we bring over from our experience of physical objects and the world of tactile perception: what is
solid is more "real" than what cannot be touched or felt. We ordinarily judge a visual
experience to be illusory if we cannot also experience the object in tactile space.
Nowhere is our language more metaphorical than in the ways we speak and write about
computers. Consider just this small sample:
backbone
boot
clipboard
number crunching
motherboard (fatherboard?)
daughterboard
desktop
search engine
nesting
surfing
virus
It is instructive, therefore, that perhaps the most frequent model offered for neural and
mental activity these days is a computer. It would not be surprising if we eventually found
"human" characteristics in the behavior of computing machinery; we projected upon
computers a highly anthropomorphic vocabulary from the outset. Kenneth Craik started
this talk in 1943 with the publication of his brilliant but uneven The Nature of Explan-
ation. This important book defended the idea that the brain can be regarded as a kind
of calculating machine, and that neurological activity in the brain models the external
world as patterns of electrical and chemical activity.
We are not ordinarily inclined to talk about arguments in terms of armored support,
supply lines, or air cover. Time may be money, but there are no time banks into which
one may make a deposit or from which time may be withdrawn; you can't even get a
refund on wasted time (Lakoff & Johnson, 1980a, p. 460).
The contributions to Gentner and Stevens (1983) cover this ground thoroughly for
cognitive psychology. For applications in science, see especially Harré (1959), Hesse
(1954, 1966, 1967), Hutton (1956), Kargon (1969), Mellor (1968), Miller (1986), and
Nagel (1961). For useful discussions of the role of metaphor in philosophy and lan-
guage, see Beardsley (1967), Berggren (1962, 1963), Black (1962), Lakoff and Johnson
The loci classici are Campbell (1920, 1921), and Duhem (1954).
These two examples are very common in treatments of science for the popular market;
see, for instance, Conant (1947, 1951) and Derry (1999). For a discussion of the use of
analogy in biology, see Canguilhem (1963). The second example is discussed in the
appendix.
While nature may abhor a vacuum, small children apparently do not. If the wind is not
blowing in a closed room, then the room is “empty” (Piaget, 1930, pp. 3-31).
The history of the development of the air pump as a scientific instrument is briefly
sketched in Wolf (1950, pp. 99-109). It is more than appropriate to notice the important
contribution to this effort made by Boyle’s contemporary, Robert Hooke (Jardine, 1999).
Other implications of the Torricelian hypothesis were also confirmed by experiment.
Two very smooth pieces of marble when pushed together, for instance, will “adhere”
until placed into an operating vacuum receiver; at a certain point, the stones simply fall
apart. An excellent discussion of these experiments in the context of the times is Brett
(1944). For a historical and sociological analysis of the controversy between Thomas
Hobbes and Boyle on these matters, see Shapin and Schaffer (1985); a more traditional
account is Kargon (1966).
For instance, the model of electricity as a flowing liquid provides one useful way of
understanding the movement of an electric current through a conductor, while the
model of electricity as a teeming crowd provides another model for the same phenom-
omenon (Gentner & Gentner, 1983).
See also Rickheit and Sichelschmidt (1999, pp. 19-20). The idea is that a good cognitive
model should permit its user to "run" the model for additional implications and under-
standing (itself a metaphor).
This is a psychologized version of the Aristotelian requirement that the explanatory
premises be “better known” to us than the thing to be explained (Posterior Analytics, I.2)
The gulf between common sense and the scientific outlook was a persistent theme in Bertrand Russell's popular books on scientific ideas; see especially Russell (1923, 1925). Lakoff applies the concept of metaphorical understanding of the unfamiliar to the realm of mathematics in his analysis of how we acquire mathematical concepts (Lakoff & Núñez, 2000). Parallel entailments are no less important in this context (Lakoff & Núñez, 2000, pp. 56, 64, 68, 92, 97, 367). See also Piaget (1952) and Piaget and Inhelder (1964).

Or, as the famous Blue Guide to Oxford and Cambridge charmingly observes: "There is no University Building as such, the 'University' being the inward and spiritual grace of which the colleges are the outward and visible forms."

I will use the terms "Internet" and "World Wide Web" interchangeably.

I don't mean to pick on Owen and Owston here. Their book is generally a sound guide to searching the WWW, especially for secondary-school students; the authors know better than many of the misleading statements I have singled out here. But, as I have emphasized, words matter; once we start sort-trespassing, it is hard to qualify our language to reflect the caution we know is appropriate.

Of course, I can't leave out the most ubiquitous Internet metaphor of all: "surfing" the 'net. But if the metaphor surf from the sports world involves "chaotic movement in a fluid environment with no starting point of destination" (Barker, 1998, p. 262), then the idea of surfing the learning highway in a purposeful way is an instructively mixed metaphor that should be a cautionary tale. We actually know a student who replied, when asked in what database she had found a particular citation: "AltaVista." Nautical metaphors seem to be the trend in describing the WWW. It is becoming fashionable, for example, to talk about the "surface" Web and the "deep" Web. If surfing the WWW is equivalent to getting no further down than the surface WWW, then it is even less true that the largest search engines leave "few stones unturned."

Indexing languages based on the language of the indexed text are often contrasted with controlled indexing languages (based, for example, on a thesaurus). But, as Hans Wellisch (1995) has argued, "all indexing languages, being used for the purpose of rearranging the conceptual structure of natural-language texts in condensed and predictable form are, by definition, controlled" (p. 215).

This is why the client-server model of the Internet is also flawed: it makes the Internet appear to be one huge database (Devlin, 1997, p. 365).

The language we use to describe the Internet can have, it turns out, significant legal implications. In the landmark case about Internet filtering in public libraries, Mainstream Loudoun v. Board of Trustees of the Loudoun County Library (2 F. Supp. 2d 783), part of the Court's decision rested upon the conclusion that the Internet is more like an encyclopedia than it is like a vast interlibrary loan system. The Court ruled that the defendants misconstrued the nature of the Internet, and found in this regard in favor of the plaintiffs' encyclopedia analogy. The fact that neither metaphor is appropriate would make an interesting law review article.

Sparks did find, however, that presenting analogies and illustrations together in a learning problem failed to improve model quality as expected; in fact, the reverse was true. He concluded that cognitive overload was the explanatory factor, but the fact that the analogy and the illustration were unrelated to each other may also have contributed to his results (Sparks, 1996, p. 107).

This kind of filter has an analog in perceptual experience. What we take ourselves to "see," for example, clearly depends on advanced filtering by the brain/mind as a function of prior or simultaneous categorization and inferencing (Bruner, 1957). The work of Jerome Bruner, his colleagues, and his students in the 1950s and 1960s on the role of mental models in perceiving and learning provides a broad and comprehensive theoretical foundation for many of the conclusions reached here. Bruner extended his results to education after the famous Woods Hole Conference on Education in 1959 in a series of important studies of classroom learning and teaching (Bruner, 1960, 1966, 1971). Many of Bruner's most suggestive papers are included in Bruner, 1973; the development of his thinking about these and other matters is engagingly told in his informal autobiography (Bruner, 1983).

Anderson, Spiro, and Anderson (1978) concluded, however, that although Ausabel was on the right track, the "theoretical justification for the advance organizer is quite flimsy" (p. 439).
This was, despite widespread misunderstanding, largely the point of E. D. Hirsch's (1987) book about reading and learning.

Campbell (1920) discusses his own example of the dynamic theory of gases in much greater technical detail (pp. 126-30). Even Newton described his thinking about light in terms of how he noticed the way in which a tennis ball behaves after it has been struck by an oblique racket (Lightman, 1989, p. 97).

And this is why the scientist-turned-philosopher Sir James Jeans (1940) expounded on the billiard-ball model in such elaborate detail in his monograph on the kinetic theory of gases (pp. 12-16).

The model breaks down when the density is too high or the temperature too low, because other ways in which the gas molecules interact (e.g., they attract each other) then become more important. So the model requires modification for these situations (Derry, 1999, p. 74). This is why the most eminent British physicist of the nineteenth century, Lord Kelvin (1903), remarked that at this level we can speak only of rough approximations to absolute values, not "delicate differential results" (pt II, p. 500).

This history is briefly told in Toulmin and Goodfield (1962) and Einstein and Infeld (1938). For a brief chronological survey of the concept of the atom and a literature review, see L. L. Whyte (1961). The correct interpretation of one observational confirmation of the molecular theory of fluids (Brownian motion) was the subject of one of Einstein's famous 1905 papers in theoretical physics.

REFERENCES


The Use of CAI for Distance Teaching in the Formulation of Search Strategies*

INA FOURIE

ABSTRACT
COMPUTER-ASSISTED INSTRUCTION (CAI) HAS PROVED an effective method of teaching in Library and Information Science (LIS) practices such as online searching and enduser instruction. The growing interest in electronic information retrieval, and especially the Internet, as well as the emphasis on lifelong learning skills stress the need for training in the formulation of search strategies. Distance education is especially suitable for training working adult students, and should therefore also be explored with regard to the teaching of skills in the formulation of search strategies. Since 1992 the Department of Information Science at the University of South Africa (Unisa) has been experimenting with a CAI tutorial in the formulation of search strategies. The experience gained from designing this CAI tutorial and from revising it in 1998, feedback from students and a literature survey are used to report on the design of CAI tutorials in the formulation of search strategies.

1 INTRODUCTION
Computer-assisted instruction (CAI) is a well-known and accepted method of instruction for independent studies. Synonyms for CAI include computer-assisted learning (CAL), computer-based education (CBE), and computer-based training (CBT).

A number of applications of CAI have been reported in the Library and Information Science (LIS) literature, for example, by Armstrong (1984), Armstrong and Large (1987), Bourne (1990), Caruso (1981), Davis

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Ina Fourie, Department of Information Science, University of South Africa (UNISA), Pretoria, South Africa
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A Dialog search could not, however, trace many explicit references to the use of CAI in the distance teaching of LIS. Web-based training and distance teaching are, however, dealt with by Hawkins (1998) and Herther (1997). The EDUCATE program (End-user Courses in Information Access through Communication Technology) also aims at self-paced learning and distance education (Thomasson & Fjällbrant, 1996). However, it appears that this program is concerned mainly with Web-based training.

A number of the CAI programs reported on deal with aspects of online searching, the formulation of search strategies, bibliographic instruction, using the library catalogue and information literacy (Armstrong, 1984, Azzaro & Cleary 1994, Binkley & Parrott 1987, Eisenberg et al. 1978, Neilsen & Bremmer 1985, Williams & Davis 1979). There are, however, other CAI applications, such as those for cataloguing and bibliometrics (Hopkins & Blackburn 1996). Library orientation is covered by Nipp and Straub (1986), training of library staff members by Bayne (1993) and user education by Vander Meer, Rike and Galen (1996). Lawson (1990) did a cost comparison between library tours and CAI programs. She found that the majority of students using CAI learned as much, or more than, those students using more traditional methods of instruction.

The Department of Information Science at the University of South Africa (Unisa) has been using CAI since 1992 to teach the formulation of search strategies as part of a course in information organization and retrieval. Unisa is a distance teaching university which to a large extent has been based on the correspondence model (i.e., core and often even all tutorial matter is provided in printed format). For the last ten years, there has, however, been encouragement from the university management to explore other methods of teaching such as CAI and more recently the World Wide Web (WWW) and other Internet facilities.

In 1998, a new CAI tutorial on the formulation of search strategies was completed. This tutorial was designed in collaboration with The Unisa Department of Library Services. Unlike the 1992 edition, which was DOS based, the new tutorial can run under Windows 3.1 and Windows 95.

The development of the 1998 tutorial was based on:

- experience with the 1992 tutorial in terms of student feedback and observation of their reactions and behavior when working through the tutorial in a class situation (students were asked to complete an
evaluation form (see appendix A) when working through the tutorial in their own time and also when working through it during an annual workshop).

- an analysis of developments in online searching, particularly new trends in the formulation of search strategies (a number of database systems, for example, have online thesauri or word lists which make it easier to select suitable search terms).

- a study of the requirements for designing a multimedia study package for the distance teaching of information retrieval (Fourie 1994, Fourie & Snyman 1996).

- a literature survey on the use of CAI by LIS.

- a reconsideration of developments in CAI in general as well as in accepted practices (eg as reported in the papers presented at the Fourth CBE/CBT conference and workshop: information technology effective education/training, held 7-10 October 1996).

- a reconsideration of technological developments (this is one of the reasons that the 1998 edition is Windows based. The new edition also requires at least a 486 computer with a super VGA screen, 800 x 600 resolution and which can support 256 colours. This may be rather advanced for some students, but if we decided on less sophisticated technology, it may be fairly out of date when the CAI program, which is very time consuming to develop, is finally implemented. For the next few years, however, the Department will continue to supply the 1992 edition to students who do not have access to the required technology. All students who attend the annual workshop in online searching, however, will have to work through the 1998 edition of the tutorial.)

In this article, the Unisa experience with the design and use of the two CAI tutorials will be used to explore the design and use of CAI tutorials for distance teaching in the formulation of search strategies as well as the possible uses of such tutorials in programs in information literacy and enduser instruction. These considerations will serve as background to the discussion.

2 DISTANCE TEACHING AS A SUITABLE METHOD FOR BASIC AND LIFELONG TRAINING

Distance teaching is a well-documented method of teaching. Although it has been used for a long time, there was always the stigma of distance teaching being second rate and the disadvantages of distance teaching were often stressed. With the growing need for adult training and the emphasis on lifelong learning, the importance and value of distance teaching have become more widely recognized (Holmberg, 1993). This also applies to LIS, where studies by Barron (1990, 1991), for example, raised
the importance of distance teaching methods in meeting the need for continuing and lifelong education. Enquiries received by the Department of Information Science suggest that there is a particular need among practising information specialists for refinement of their search skills. Furthermore, there is an increasing need for all library users to be trained in search skills, especially as a result of the growing interest in information and library catalogues available via the World Wide Web (The challenge of Internet literacy: the instruction-Web convergence 1997, Craver 1997, Wood et al 1997).

Before considering these aspects as an incentive to develop CAI tutorials which meet the requirements of distance teaching, we shall examine distance teaching as a method of teaching displaying certain characteristics. Distance teaching is characterised by the geographic separation between the learners and the lecturers. There are other characteristics as well:

- Although the student is geographically separated from the teacher and teaching institution, contact sessions such as workshops or video conferences may occasionally be offered. Such classes, however, should not take up too much time and should be planned only for those aspects that cannot be taught in any other way (eg practical online searches). If search strategies, for example, can be mastered by means of other teaching methods, they should be employed.
- The teaching institution supports the student through the planning and development of study programmes, and it provides for the evaluation of the student's performance. It also provides guidelines, motivation and other forms of support.
- Distance students are mostly (working) adults studying separately from one another. This should be acknowledged in the teaching process. The needs, backgrounds, age groups and experiences of the students should be catered for (eg their subject interest in online searching). Although adults prefer to study independently they also need support and guidance in their studies.
- Any technology or media can be used, ranging from printed media to video conferences, computer-assisted instruction, and the Internet.
- Although distance education is based on one-way communication in which the study material is sent to students, there should also be opportunities for students to communicate with lecturers and fellow students. The latter (two-way communication) in particular can be improved by technology (Fourie 1994:52; Fourie & Snyman 1996:86).

When comparing these characteristics with those of CAI (as explained in the next section), the benefits of CAI for distance teaching will become clear. The requirements for a CAI tutorial will also be derived from these discussions.
3 What is CAI and How can It Be Used in Distance Teaching?

Thesaurus of ERIC descriptors (1995) defines computer-assisted instruction as an interactive instructional technique in which a computer is used to present instructional material, monitor learning, and select additional instructional material in accordance with individual learner needs.

CAI offers a number of benefits that can be used effectively in distance teaching and especially distance teaching in the formulation of search strategies. These benefits are discussed by Allesi and Trollip (1991), De Villiers (1989), Nipp and Straub (1986), amongst others and include the following:

- Interaction with the learner is provided (eg by including questions and options for the learner to follow) (an example is given in figure 1).
- Immediate feedback is provided on answers to questions. If necessary, a learner can select an option for more guidelines or further examples.
- Branching can be used to allow for different interests, different learning styles as well as different entry levels. In CAI tutorials, learners are often also allowed to select the order in which they want to work through a tutorial.

<table>
<thead>
<tr>
<th>Research &amp; search strategies</th>
<th>Screen 8 of 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are databases for almost all subjects, such as economics, medicine, geography, nuclear physics and chemistry. There are also different types of databases.</td>
<td></td>
</tr>
<tr>
<td><strong>Questions</strong></td>
<td></td>
</tr>
<tr>
<td>Bibliographic</td>
<td>Includes the complete text of for example, periodical articles, newspaper editions or encyclopaedias</td>
</tr>
<tr>
<td>Numeric databases</td>
<td>Include data concerning for example people and companies</td>
</tr>
<tr>
<td>Full text databases</td>
<td>Include descriptions of the sources where the information can be found, sometimes including indexing terms and abstracts</td>
</tr>
<tr>
<td>Directories</td>
<td>Include mostly statistical information</td>
</tr>
</tbody>
</table>

**FIGURE 1**
Example of an activity
Sufficient opportunities can be provided for the drilling and practice of skills. The designer decides on, for example, the number of exercises or different cases to include and once the learner feels confident he or she can skip the rest of the exercises. It is possible to provide sufficient exercises to cater for the needs of slower learners. Sievert and Boyce (1985) deal with the drill and practice possibilities of CAI.

Learners can work through the tutorial independently and in their own time. They can work through it at home, or at a workshop in a classroom situation.

Learners can work at their own pace and they can repeat or skip work as they prefer.

Simulations can be included. It is, for example, very useful in the formulation of search strategies to display the results of actual searches (an example is given in figure 2).

FIGURE 2
*Example of search results that students can interpret*

<table>
<thead>
<tr>
<th>Combining search terms</th>
<th>Screen 14 of 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is very important to use the correct Boolean operators. It can make a big difference in</td>
<td>Example of results</td>
</tr>
<tr>
<td>• the number of records you retrieve</td>
<td></td>
</tr>
<tr>
<td>• the actual records you retrieve and their relevance</td>
<td>Retrieved Children</td>
</tr>
<tr>
<td></td>
<td>Games</td>
</tr>
<tr>
<td></td>
<td>Search Children AND Games</td>
</tr>
<tr>
<td></td>
<td>Search Children OR Games</td>
</tr>
<tr>
<td></td>
<td>Search Children NOT Games</td>
</tr>
<tr>
<td></td>
<td>(Database searched: ERIC)</td>
</tr>
</tbody>
</table>

Summative evaluation can be provided for by requiring students to complete exercises and questions. Formative evaluation to get feedback on the overall acceptability of a CAI tutorial can be catered for by evaluation forms to be completed by learners (such evaluation forms can be built into the program or they can be issued separately).

CAI is especially useful when large student numbers are involved (Unisa has more than 100,000 registered students who could for example be involved in information literacy courses).

One of the main benefits of distance teaching is that students can work through the CAI at any time that fits in with the busy schedule of a working adult who may also have family and community responsibilities.
CAI tutorials also have disadvantages, which are covered by Allesi and Trollip (1991) and De Villiers (1989). These include:

- eyestrain if used over long periods of time
- the need for computer skills
- very time intensive to develop
- expensive to design
- requires large numbers of learners to make the design cost-effective
- impersonal in comparison with classroom instruction by lecturers (it can, however, be more personal for distance students who are used to studying in isolation from their lecturers and fellow students. One student evaluating the 1992 edition of the CAI tutorial commented: “It seems more personal in an impersonal sort of way than a study guide”).

The benefits of CAI make it ideal for teaching the formulation of search strategies, especially with regard to the following:

- flexible learning opportunities
- opportunities to repeat the tutorial as many times as is necessary to master the work
- examples for different target groups and topics of interest
- different levels of entry and approaches
- the use of graphics to illustrate difficult concepts such as Boolean operators and truncation
- the inclusion of simulations of online searches and actual search results.

It is especially important for distance students to have an opportunity to master the formulation of search strategies in their own time so that a workshop can focus on the practical aspects. The Department of Information Science at Unisa has found that it is extremely useful if students use the CAI beforehand to do preparatory work on the formulation of search strategies. During the workshop we can then focus on the command language and search protocols for specific systems and on doing practical searches—things that students will not be able to do on their own at first. In this way the presentation of workshops can be justified (refer to the first characteristic mentioned in section 2). Prior knowledge of the formulation of search strategies should also be an advantage in training for OPACs, Webpacs and the Internet (discussions on search engines specifically emphasise the formulation of effective strategies).

4 Design of a CAI Tutorial for Distance Teaching: The Formulation of Search Strategies

According to Vieira (1989) the design of CAI tutorials based on sound instructional design principles is non-negotiable. His views are shared by other instructional designers such as Dick and Carey (1990), Allesi and
Numerous instructional design models can be found in the literature, each having its own strengths and weaknesses. There are, however, also many overlapping components. In 1994 the author completed a study on the design of multimedia packages for distance teaching (Fourie 1994:220). The instructional design model accepted was based on an analysis of curriculum and instructional design models from both conventional and distance teaching literature. The main phases are

- determination of the need and situation analysis
- formulation of aims and performance objectives and development of items for evaluation
- design of study material, including development of a teaching strategy and media selection and integration (e.g., the inclusion of sound and video)
- development and preparation (this includes storyboarding and programming)
- implementation and use
- assessment of student progress
- formative and summative evaluation on a continuous basis throughout all phases.

Pistorius et al. (1992) also discuss a CAI design model which is used by the Department of Computer Science and Information Systems at Unisa and has been adapted for the distance teaching situation. Their design model consists of the following steps: preparation and planning for the project, predesign, design, programming and formative evaluation and summative evaluation (Pistorius et al. 1992:13).

The model by Fourie (1994) will be used in this article to explore the design of CAI tutorials for distance teaching in the formulation of search strategies. It should, however, be pointed out that the Department of Computer Science and Information Systems is responsible for the Centre for Software Engineering (Censi) which supports lecturers at Unisa in the design of CAI tutorials. Censi was responsible for the programming of the tutorials and also gave advice on the instructional design. The model by Pistorius et al. (1992) therefore had a significant influence on the development of the CAI tutorials under discussion.

4.1 Determining the Need for a CAI Tutorial

The first step in the design of a CAI tutorial is to determine whether the tutorial is really necessary, and then to do a situation analysis to decide how it should be designed to meet the needs and requirements identified.

Growing interest in the Internet and library catalogues available via the World Wide Web has increased the need for skills in the formulation
of search strategies (Wood *et al* 1996). This applies to information specialists who should be able to train LIS users as well as to LIS users searching for their own information. In general there is wide acceptance of the possibilities offered by CAI and the need for such programs:

> Computer-based learning is becoming a reality with the development of interactive multimedia study materials that are bringing together text, graphics, sound, and video into integrated tutorial packages that, with the future broadband integrated digital services network (B-ISDN), will be downloaded to students' personal computers. (Wilson 1994)

LIS departments normally have smaller student numbers, which does not really make it cost-effective to design CAI tutorials. The move toward training the wider community (eg students from other academic departments), however, has provided a larger target group. Since 1998, the Department of Information Science and Unisa Library Services have been jointly offering a postgraduate module in research information skills to students from the departments of Further Education and Chemistry.

When designing for distance teaching, the following needs in particular should be considered:

- Learners study in isolation from their lecturers and teaching institution and any medium which can help to 'bridge' this distance will be advantageous.
- Studies of online search styles and search behavior have shown that there are numerous ways to approach online searching (Wildemuth & Moore 1995, Wood *et al* 1996). CAI tutorials should therefore offer the benefit of different examples and solutions to information needs.
- The heterogeneous nature of distance students means that they have different needs. Their ages, background, working experience, cultures, computer skills and entry knowledge differ considerably.
- Problems experienced by online searchers and especially common mistakes as identified by case studies. Wildemuth and Moore (1995:294-295), for example, found that users often search inappropriately, underutilizing controlled vocabulary and using synonyms inappropriately. Both versions of the CAI tutorial consider the use of controlled vocabulary with special reference to thesauri.

4.2 **Situation Analysis**

A situation analysis is one of the most important steps in the design of CAI tutorials. A number of aspects should be considered in a situation analysis. We shall focus on the following:

- learning content (in this case the formulation of search strategies, what it implies, changes in emphasis, new methods, etc)
• learners (their styles, preferences, prior knowledge and especially their computer skills)
• available technology
• support (eg staff to develop and maintain the tutorial)

4.2.1 Analysis of Learning Content with Regard to the Formulation of Search Strategies

Major textbooks on online searching (eg Harter 1986, *Online Searching...* 1990 and Walker & Janes 1993) as well as training manuals for online services (eg Dialog) mention many of the same core aspects. These include:

• analysing the stated information need
• identifying main concepts
• identifying search terms (including the use of various resources to determine synonyms, etc)
• combining the search terms by means of Boolean operators
• truncating search terms to improve search recall
• grouping search terms and concepts together
• using proximity operators to specify word position and to increase search precision
• using different methods to expand and limit a search strategy (including field limiting)
• evaluating the search results and adapting the search strategy accordingly

Azzaro and Cleary (1994:98) identify similar but less detailed aspects. The list provided by Wood et al (1997:33) is also more or less the same. In the 1998 edition of the CAI tutorial, all of these aspects are covered. Our point of departure was the learners' research information need.

Once the learning content has been identified, it is broken down into smaller sections which can form separate or independent parts or topics of the tutorial. The benefit of a CAI is that you can follow a linear order in working through different topics, or allow students to branch according to their preferences.

Wood et al (1997:50) also emphasise the need for learners to be able to interpret search results and to be aware of the effectiveness of the searches performed. Examples of actual searches and their results were therefore included in the tutorial. An example can be seen in figure 2.

4.2.2 Analysis of the Learners

The CAI should meet the needs of the learners and especially the needs of distance learners. For the latter, it is important to bear in mind that instructions on how to use the tutorial should be absolutely clear and that the examples as well as their solutions should be unambiguous. Unlike students in a class situation, the learners are not in a position to ask
questions and get immediate answers. Since distance education is characterized by heterogeneous target groups, it is especially important to allow for different entry levels and different topics of interest. For the 1998 edition of the Unisa tutorial, the following target groups were considered:

- students in library and information science (different levels, e.g., undergraduate and postgraduate);
- students of other academic departments doing a course in information literacy;
- practicing LIS workers requiring refinement of their search skills; and
- people from the wider public interested in searching the Internet and other electronic sources of information.

When developing the CAI tutorials, the following aspects were of special concern:

- students’ prior experience with CAI;
- students’ prior experience with computers; and
- students’ prior experience with online searching and the formulation of search strategies.

Computer skills and computer literacy are a problem. In a class situation, this can easily be monitored and action taken if necessary. Fortunately the Department of Computer Science and Information Systems at Unisa has developed a CAI tutorial (Comuser) which is aimed at computer literacy (this program is also reported on by Pistorius et al. 1992). Although students are advised to work through Comuser in their own time by either purchasing it from Unisa or using it at one of the computer laboratories provided by Unisa, they are still hesitant about doing so. The first morning of the workshop is therefore put aside for students to work through Comuser and the tutorial on search strategies. This has a positive influence on their ability to keep up with others during the workshop.

When analysing the learners, it is also very important to consider the needs of adult learners (Wilson 1994) as well as different learning styles (Wood et al. 1997).

4.2.3 Analysis of Available Technology

One of the main aspects to consider is students’ access to computers. Students may have their own computers or they may have access to computers at their offices or at study centers or computer laboratories provided by the university. Technological requirements, however, should not be set too low in order to accommodate the greater number of students. It takes a long time to develop and implement a CAI tutorial. Once it has been in use for two or three years, even sophisticated technological requirements will be out of date.
4.2.4 Analysis of Available Support

Support includes funds for design and development, staff with the necessary expertise, suitable software, and time available for the design, development, and maintenance of a program. Pistorius et al (1992:14) stress the importance of the development team. They suggest that the team should consist of a project manager, instructional designer, subject expert(s), programmer, graphic artist, and language editor. Bayne (1993) also refers to a team approach.

At Unisa, the team responsible for designing the 1998 edition consisted of the following role players:

- project manager and instructional designer (head of Censi)
- subject expert with knowledge of instructional design (from the Department of Information Science)
- subject experts acting as advisers and evaluators (subject librarians from the Unisa Library Services)
- a team member with an interest in CAI but no subject expertise;
- programmer (from Censi)
- graphic artist (from Unisa Library Services)

4.3 Formulation of Objectives or Outcomes for the CAI Tutorial

The purpose of a CAI tutorial should be clear to the learners. If objectives or outcomes are clearly formulated, they will help them to monitor their progress and performance so that they can come well prepared for practical sessions. It is also important to ensure that the questions, exercises or tests which are set support the objectives or expected outcomes.

The purpose of a tutorial as well as the objectives or outcomes should also be in keeping with the findings of the situation analysis for the learning content and the needs of the target group.

While formulating the objectives, the methods and type of assessment should also be considered.

4.4 Performance Assessment

It is not essential for a CAI tutorial to include items for performance assessment, but it is the opinion of this author that if skills are involved (such as in formulating search strategies), various forms of assessment should be allowed for. In the 1998 edition of the tutorial we used multiple-choice questions and pairing of items, among others. Open-ended questions are difficult to monitor since the author cannot allow for all possible responses.

The idea of a notebook (see figure 3) was introduced in the 1998 edition. Students use the notebook to keep a record of their information
need, the sources they will use, main concepts, the combination of concepts etc. When completing the tutorial, the student can print the notebook. Unfortunately, it is not possible to provide individual feedback on students’ notebooks indicating whether they are on the right track.

From student feedback on the 1992 edition of the CAI tutorial, it was clear that most students enjoy assessment and consider it a very important component in monitoring their own progress (for distance students there is no other way to monitor their progress).

A pretest was included in the 1992 edition to allow experienced online searchers (some Unisa students do work in LIS and may therefore be competent online searchers) to establish whether it is necessary for them to complete the tutorial. The pretest was difficult, because the intention was that, if students passed it, they knew enough to skip the tutorial. Students reported that they liked the fact that the pretest challenged their knowledge, but that they also need something to relate to their prior experience and entry knowledge. As a result of this feedback, the 1998 edition includes a pretest with two components:

1. Refresher—to link to the students’ prior knowledge. We assumed that the students know something about searching the library catalogue, and based a couple of questions on this with the idea of forming a link between searching the library catalogue (which is often based on known items) and other methods of online searching.
2. Challenge—which is aimed at the experienced online searcher. Because of time constraints in the design of the tutorial, the challenge

<table>
<thead>
<tr>
<th>Analysis and main concepts</th>
<th>Screen 2 of 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first step is therefore to identify the topic. This is done by thinking about the information needed by you or your client on whose behalf you are searching. Write down a short sentence or paragraph.</td>
<td></td>
</tr>
<tr>
<td>Instruction: Click on the notepad on one of the topics or type in your own topic.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Internet and distance teaching</td>
</tr>
<tr>
<td>The effects of boycotts on academics in South Africa</td>
</tr>
<tr>
<td>Own Topic</td>
</tr>
</tbody>
</table>
questions are the same as at the final level of progress assessment. This will be changed in due course.

5 Actual Design of a CAI Tutorial

Many sources deal with the design principles for CAI, for example Allesi and Trollip (1991), Boshoff (1991), De Villiers (1989), Pistorius et al (1992), and Wood et al (1997). Among other things they cover the selection of an authoring language, screen layout and design, navigation options, and use of color and fonts. These aspects will not be dealt with here, but it is important to bear in mind that they have a significant influence on the overall success of a tutorial. Some of the aspects to consider when doing the actual design include:

- how to gain students’ attention
- order of presentation
- screen layout (which should be consistent)
- inclusion of suitable examples
- feedback and channeling of learners’ actions (eg referring students to revise a particular section)
- provision of online guidelines on how to use the tutorial
- navigation between screens
- inclusion of a glossary

6 Development, Implementation and Distribution

Because of the limited scope of this article, development and implementation will not be dealt with. In distance teaching, distribution methods should, however, be carefully considered. At Unisa we considered distributing the tutorial to

- all students, regardless of whether they have access to a computer (this can be very expensive)
- students who have access to a suitable computer (notices with reply slips should then be sent to students so that they can request the tutorial)
- study centres or computer laboratories

It should also be decided whether a tutorial will be distributed on floppies, stiffies, or CD-ROM, or whether it will be downloaded from the Internet.

7 Evaluation

Students’ performance as well as the efficiency and acceptability of a tutorial, should be evaluated.

Students’ performance can be assessed by including tests. In the 1998 edition of our tutorial we preferred to use the term ‘progress assessment.’ Three levels of assessment ranging from very basic to advanced exercises were included. Students’ comments on these will be collected in due time.
The importance of both formative and summative evaluation is stressed by Pistorius et al (1992), De Villiers (1989) and Dick and Carey (1990). Formative evaluation should be an integral part of the design and development of any CAI tutorial. After designing each section it should be evaluated by the design team and, where possible, students should be involved. On completion of the tutorial, it should also be evaluated by other experts. We used subject librarians from the Unisa Library.

Once a tutorial is implemented, students should be allowed to evaluate it. Valuable feedback can be gathered in this way. Appendix A includes the evaluation form used to evaluate the 1998 edition. Only minor adaptations were made on the form used to evaluate the 1992 edition. Although it is a detailed form, students never complained about completing it. Some even provided much more detailed feedback than required. One student, for example, drew a sketch of a student receiving a certificate from Garfield (which was the character used in the 1992 edition).

7.1 How Do Students Experience the CAI Tutorials?

From the feedback we have received, it is clear that students are excited about the new teaching medium. One student could not load the CAI tutorial because she did not have access to the required technology but commented: 'I felt as if I had the Rosetta stone in my hand! Thanks for everything.'

Words describing their feelings about CAI include stimulating, useful, clear, interesting, reinforcing, humorous, amusing, challenging, relevant, and inspiring. It is also seen as 'interesting, motivating and an aid to studies.'

Other comments included:

- Using characters enhances the relational possibilities for the user.' (In the 1992 edition Garfield and his master were used to provide dialogue around the formulation of search strategies, and in the 1998 edition the characters of a digger and geologist were designed to reinforce the analogy between the retrieval of information searching and the process of digging and mining for minerals and precious gems.)
- 'My three year old daughter kept looking over my shoulder at the characters.' There were, however, also a few students who did not like the use of characters and considered them unnecessary and boring.
- 'Relieve feelings of pressure to perform.'
- 'You don't feel embarrassed if you make a mistake because no-one is aware of it.'
- 'It forces one to learn quicker with sheer interest.'

Students also used the opportunity to point out sections where the explanations or examples were not clear enough and that online guidelines on how to use the tutorial should be included. These comments proved very valuable when revising the tutorial. Some considered the 1992 edition too
easy and user friendly and asked for more challenging tasks. We hope that the final level of assessment in the 1998 edition will be challenging enough!

7.2 Summative Evaluation

We have not yet attempted a summative evaluation of students’ performance or to compare the success of CAI with other methods of teaching. However, Vander Meer, Rike and Galen (1996:158) include an example of a post-test. This may be addressed in future research.

8 Conclusion

CAI can play an important role in helping students to become au fait with the formulation of search strategies before attending practical sessions on online searching. Since it is no longer only information specialists who are interested in the formulation of search strategies, the target group is growing to include students from other disciplines and even members of the wider public who are interested in using internet search engines. This makes it all the more cost-effective to design CAI tutorials.

The experience of the Department of Information Science shows that students enjoy CAI and find it an effective method of teaching. It is, however, very important that the needs of distance students should be considered, and that detailed feedback from students should be collected.

Note
1 The Dick and Carey model is widely accepted for CAI and is also used by Bayne (1993) with regard to LIS applications.

References


APPENDIX A

PERSONAL INFORMATION
   Name: 
   Student number: Date: 

PRIOR KNOWLEDGE/EXPERIENCE
   Indicate with crosses in the appropriate squares the level of your prior knowledge/experience:

<table>
<thead>
<tr>
<th></th>
<th>extensive</th>
<th>average</th>
<th>none</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers</td>
<td></td>
<td></td>
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<tr>
<td>Online searching</td>
<td></td>
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<td></td>
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<tr>
<td>Search strategies</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Computer-assisted instruction (CAI)</td>
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</table>

COMPLETION OF THE CAI TUTORIAL
   Did you complete the tutorial?
   If not, please indicate the reasons (e.g., do not have access to a computer).
   If you were unable to complete the tutorial, you need not complete the rest of the form.
   If you completed the DOS version, please complete the questionnaire on page 4 to 12.

CONTENT
   Rate the following aspects by ticking the appropriate column opposite each alternative:

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Very Poor</th>
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</thead>
<tbody>
<tr>
<td>Coverage of topic</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Examples</td>
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<td></td>
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<tr>
<td>Style of</td>
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<td>presentation</td>
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<tr>
<td>Logical order</td>
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<tr>
<td>of presentation</td>
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<tr>
<td>Layouts of</td>
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<tr>
<td>screens</td>
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<td></td>
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<tr>
<td>Use of colour</td>
<td></td>
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<tr>
<td>Illustrations</td>
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<tr>
<td>Navigation</td>
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<tr>
<td>(did you know</td>
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<tr>
<td>how to proceed?)</td>
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<td></td>
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<tr>
<td>Any suggestions?</td>
<td></td>
<td></td>
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</tbody>
</table>

   Indicate with ticks in the appropriate squares, the parts of the tutorial you found difficult to understand:
   • Research and search strategies
     Specify
   • Identifying search terms
     Specify
   • Combining concepts and search terms
     Specify
   • Searching on word stems
     Specify
Grouping concepts and search terms
Specify
Field searching
Specify
Specifying word position
Specify
Adapting search strategies
Specify
Did you spot any errors (such as spelling mistakes) in the tutorial?
If yes, please list them:
Which part of the tutorial did you enjoy most?
Which part of the tutorial did you enjoy least?

PREFORMANCE
Indicate with a cross in the appropriate square if you could or could not answer the refresher questions

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer the Challenge questions BEFORE completing the tutorial</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

If no, why not?

Answer Progress Assessment, level 1

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td>Answer Progress Assessment, level 2</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

If no, why not?

Answer Progress Assessment, level 3

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<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer Progress Assessment, level 3</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

If no, why not?

Underline the words that best describe your feelings about the tutorial. (Underline as many words as you wish.)

- stimulating
- confusing
- boring
- clear
- too difficult
- challenging
- too easy
- frustrating
- useful
- uninteresting
- useless/worthless
- interesting

Underline the words that describe your feelings about the use of graphics. (Underline as many words as you wish.)

- amusing
- humorous
- annoying
- inspiring
- distracting
- frustrating
- reinforcing
- relevant
- irritating
- unnecessary
- stimulating
- boring

USER FRIENDLINESSE
During the time that you worked throughout the tutorial, which of the following, if any, happened? Please tick the appropriate squares.

- Pressed the wrong keys and did not know how to continue with the tutorial.
- Did not know what was required of you?
- Looked up information in other sources in order to answer the question.

Any suggestions?

CAI IN GENERAL
What did you like about CAI as a medium of presentation?
What did you dislike about CAI as a medium of presentation?
Would you like any other tutorial matter to be presented by means of CAI?
(Not applicable for this year.)

Any suggestions?

Thank you for your time and patience
Technology: Servant or Master of the Online Teacher?*

RANSFORD C. PYLE AND CHARLES D. DZIUBAN

ABSTRACT
TECHNOLOGICAL ADVANCES ON THE INTERNET and the World Wide Web have tended to drive online pedagogy. It is time to reverse this relationship and make the needs of teaching and learning take priority. The authors propose three different formats for utilizing the Web in online and classroom instruction. These formats were developed in a program for undergraduate legal studies dealing with three levels of learning: Introductory, skills, and seminars.

INTRODUCTION
One of the dangers of recent advances in instructional technology is that instruction and instructors are often driven by technology rather than having technology serving the needs of instruction. Two causes for this inversion are apparent. First, instructors are discovering new ways to communicate with students and often are more excited by the vehicle than what it communicates. Second, each new tool requires an investment in learning and time to assess its effectiveness. Teaching on the World Wide Web is so new that most instructors are engaged in the learning phase, something that may never end, and very few have seriously addressed the assessment problem.

The comments that follow are based on three years experience in different forms of instruction using the Web in undergraduate legal


Ransford C. Pyle, Legal Studies, University of Central Florida, Orlando, Florida
Charles D. Dziuban, Educational Foundations, University of Central Florida, Orlando, Florida
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studies courses. When I began, my institution, the University of Central Florida, had no official Web-based course; we now have dozens and are planning many more. When I began, most web-authoring tools were crude and awkward; it was easier to learn HTML code than to use the authoring software. The teaching formats I developed were a natural product of what I learned to do and what I thought would be effective. I found myself using three basic formats and only gradually began to analyze how I came to develop these and assess their appropriateness and effectiveness.

Three formats are presented here for online teaching/learning. The formats are based on progressive levels of learning within a specific discipline, namely, foundation (primarily content), skills (analytical), and practice (applying content and analysis). Any course might well combine all three levels, but we hope that a student who begins as a novice will follow steps toward some level of mastery in the field, and the approaches to teaching at different steps is likely to be the most effective method. Online course may use quite different formats or styles for different levels. Finally, this paper provides some example of Web use illustrating, in particular, the application stage, which uses the Web as an enabling or preparation tool as an adjunct to a classroom course.

ANALYZING COURSE OBJECTIVES

The goal here is to address pedagogical concerns rather than either administrative goals or technological problems. This may not seem practical since courses require institutional support, but at least one format, what I call 'web-enabled' or web-enhanced, merely requires effort from the instructor, albeit that effort at times seems overwhelming. Practically speaking, institutions would prefer a technological 'cookie-cutter' or 'one-size-fits-all' solution to distance education. My answer to that desire is that it is simply premature at this point in our understanding of online teaching and learning. We must also be wary of the natural desire of instructors to enter online teaching quickly and efficiently. Veteran teachers must recognize that 'teaching online in six easy lessons' is a sham. It is not my purpose, however, to reiterate the need for institutional and technical support, the exorbitant amount of time needed to set up and maintain an online course, the dangers for tenure-seeking assistant professors in committing time to online teaching rather than research and publication.

I am concerned with the more fundamental problem of teaching and learning. In particular, I focus on a standard, three-hour, semester course taught at a university, specifically for advanced undergraduates (juniors and seniors).

STUDENT MOTIVATION

My students reflect the well-noted trend in American higher education toward decreasing motivation among students. They maximize their
efforts by minimizing their work, always aimed at tests and grades. This is
nothing new, of course, what is new is the loss of a culture of learning in
which learning is an end in itself in addition to its immediate practical
functions. The culture of learning also accorded instructors a high de-
gree of respect and trust that encouraged instructors to lead and students
to follow. The factors that have caused the decline in the culture of learn-
ing are too diverse and complex to address here, even if I were confident
that I understood them. Suffice it to say that teachers rarely motivate stu-
dents who are antagonistic to the learning process and only occasionally
motivate students who are simply complacent in their ignorance. The World
Wide Web offers an opportunity to trick students into learning by using
the novelty and stimulation of the computer and monitor, their visuality
and interactivity to create a learning environment divorced from the per-
ceived tedium of the classroom lecture.

This suggests a caveat: **Do not attempt to translate a lecture course
into a Web course.** The logic of this statement should be obvious. Many
courses now offered consist primarily of dull lectures, from which have
been removed the only interesting part of the course, namely, the person-
ality and style of the professor. All this does not necessarily mean that
every Web course can or even should be exciting. What it means is that we
should think about format before we create a course. And we should take
into account the motivation, or lack thereof, of our students. (Many in-
structors will find to their delight that online students are generally better
motivated than the general student population. I fear this may change, as
online courses become commonplace.)

**Grading**

Although not necessarily the most time-consuming of online teach-
ing problems, grading is a persistent problem. We ought to entertain the
proposition that grades have been a principal source of the decline in
higher education, particularly with reference to student motivation—they
are motivated by grades rather than learning. The dilemma for the in-
structor is constituted by the conflicting pulls of grades as a coercive tool
to make students learn and the inevitable loss of learning purpose. The
ABCDF grading system is so pervasive in American higher education that
it has become institutionalized throughout society. I suspect a very large
proportion of today’s college students are children whose parents believe
that course grades are an accurate measure of ability and achievement. I
suspect a majority of college instructors believe that GPAs (Grade Point
Average) are a good measure of a student, just as the previous generation
believed IQ tests pinpointed a person’s intelligence.

The problem with grades is aptly summed up by Alfie Kohn (1993, p.
200):
The signs of such [grade] dependence are questions such as "Do we have to know this?" or "Is this going to be on the test?" Every educator ought to recognize these questions for what they are: distress calls. The student who offers them is saying, "My love of learning has been kicked out of me by well-meaning people who used bribes or threats to get me to do schoolwork. Now all I want to know is whether I have to do it—and what you'll give me if I do."

**Testing**

The greatest challenge to the teacher today may be to devise tests that make students think rather than memorize. Testing online presents many problems that do not occur in classroom testing, but both present the underlying problem of the message given to students that student and teacher should focus on tests because tests determine grades and grades are all that matters. Long ago, Kenneth Eble pinpointed the problem when he said, "a great deal of sloppy testing exists because the true purpose of tests is to arrive at and defend a grade. The cart is before the horse. . . . . " (1968:144). A few pages following this (p. 147) he made a comment that ought to be carved in stone in Academia:

The most successful test I have ever used incorporated in the test procedure itself the substance I was trying to teach.

Eble was teaching a course in Ethics and buried in the procedure an ethical problem. It takes imagination to come up with such procedures, but we ought to try. For example, I am developing a multiple-choice test that would incorporate a set of rules requiring complicated decision-making on the part of the students. My object is to establish a testing environment that makes picking answers much more active and that reflects legal process. The daunting task which I have not yet solved concerns how to make the student think and learn about rules, justice, and fairness in the context of tests. Students are very much concerned about fairness, but mostly in a narcissistic way—to explain or justify their mistakes. I am looking for a way to turn that interest into an objective analysis of testing.

Testing offers us an opportunity for intensive learning. In general, students are the most prepared to do concentrated thinking when confronted with a final examination. We should either abandon testing (and grading) altogether or work very hard to make it the kind of learning experience that we believe in.

**The Web**

The World Wide Web is challenging in both a positive and negative way. On the positive side, the Web offers radically new means to present college courses. The challenge consists in learning how to best utilize this complex tool. On the negative side, the Web has a compelling quality that encourages an uncritical acceptance of all that could pass as knowledge, fact, or wisdom to the naive, ignorant or defiant. Those who teach online
must assume the burden of showing the path of knowledge through this vast maze of information.

This means that instructors should exercise the same skepticism toward online information as they expect from their students. It is very difficult not to be seduced by the gadgetry of available technology. For example, an instructor recently told me that some of her female students were suddenly silenced when put in a broadcast classroom. Their concern over their public appearance overcame their desire to participate in classroom discussion. Whether or not their concerns are reasonable does not matter so much as the point that technological advances may have unanticipated negative learning consequences.

The Web offers the following additions or enhancements to more traditional teaching styles: 1. **Interactivity.** The role of the student as a passive learner is no longer a necessity. Not only can teacher and student communicate synchronously and asynchronously, but also programs can be devised such that a student enters into a computer dialogue with the program. Students may also interact with each other in forms not available in the past. 2. **Visuality.** The Web is a graphic medium that employs the visual channel to a degree not experienced in even the most dazzling classroom performance of the past. Exploiting this visual channel is a monumental challenge to instructors who were brought up to believe that the authority of a text could be measured by the lack of pictures. 3. **Malleability.** The instructor who is in charge of a Web course can make changes in the Web site at any moment—every course is a work-in-progress.

**THREE MODELS OF WEB UTILIZATION IN TEACHING INTRODUCTION TO LAW**

The three models described below cannot be considered all-inclusive, nor are they mutually exclusive. By making every possible combination, we could arrive at several models, or perhaps just one since the goals of each model is arguably inherent in most college courses.

The models are presented in order of intellectual development, from lowest to highest, which ordinarily will correspond to grade level, commonly reflected in a course numbering system—e.g., Chemistry 101, 102, etc.

A social science bias may be inherent in the scheme.

<table>
<thead>
<tr>
<th>Level</th>
<th>Web Label</th>
<th>Development</th>
<th>Goal</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory</td>
<td>Enhanced</td>
<td>Acquisition</td>
<td>Foundation</td>
<td>Memory</td>
</tr>
<tr>
<td>Skills</td>
<td>Online</td>
<td>Analysis</td>
<td>Skills</td>
<td>Self-assess</td>
</tr>
<tr>
<td>Seminar</td>
<td>Enabling</td>
<td>Dialogue</td>
<td>Practice</td>
<td>Argument</td>
</tr>
</tbody>
</table>
Correspondences to the SOLO\textsuperscript{5} Taxonomy

<table>
<thead>
<tr>
<th>Level</th>
<th>SOLO Label</th>
<th>Learning Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory</td>
<td>Concrete</td>
<td>Commit content to memory</td>
</tr>
<tr>
<td>Skills</td>
<td>Generalization</td>
<td>Application exercises</td>
</tr>
<tr>
<td>Seminar</td>
<td>Formal</td>
<td>Discussion and debate</td>
</tr>
</tbody>
</table>

The SOLO taxonomy borrows from Piagetian developmental stages, applied loosely in this instance to developmentally mature persons, i.e., college students. The operational premise is that college students are led in each field through a series of stages of thought roughly corresponding to the stages of mental development they went through generally from childhood through adolescence. The flaw in this metaphor is that the students have already reached some degree of mental maturity and are quite capable of analytical thinking in general although not skilled in the language and premises of a particular field of study.

\textit{Level One: Introductory}

Typically, introductory or \textit{survey} courses emphasize the delivery of content in the form of basic information about a field, its consensual categories, terminology, definitions and concepts. At the university level, such courses are frequently large classes taught by lecture with minimal opportunity for questions and discussions and the assumed learning methodology is \textit{lecture-notes-testing}. Such courses may in fact require a very low level of thought.\textsuperscript{6} Intellectual demands are made in terms of \textit{quantity} of content, \textit{abstractness} of lecture, and \textit{trickiness} of test questions.

\textit{Level One and the Web (the Web-Enhanced Course)}:

Delivery of content may be accomplished in a variety of ways. Obviously the lecture is the traditional approach but is least efficient in virtually every respect: 1. It uses too much space. 2. Too much time is spent because of the oral channel used. 3. The inconvenience of attending class may not be compensated by what is \textit{heard}. 4. It relies heavily on the charisma of the instructor and is often judged on its entertainment quality. The advantage of the lecture consists primarily in face-to-face communication, albeit quite one-sided. For some learners this may be the most effective way to deliver content. Much depends on the personal appeal of the lecturer.

Nearly all the content may be presented in printed form or by way of computer-diskette, compact disk, or Internet. The principle advantage of the Internet is its editability; revisions, last minute additions, notifications are virtually instantaneous. The Web can be visually stimulating but very
tedious for lengthy narrative content delivery. At this point in time, most people prefer the print medium for lengthy content.

**What is a ‘Web-Enhanced Course?’**

Using a model employed at the University of Central Florida, a web-enhanced course is one which utilizes the World Wide Web to deliver content or assist in delivering content (say, in print form) accompanied by minimal class meetings. Classes are designed to solve problems with the content and the technology and to test the students’ acquisition of content.

Where content delivery is the primary aim, web-enhanced courses are most suitable for the following reasons:

1. Content is relatively stable and fixed; there may be a general consensus as to what should be learned.
2. Class time is minimized—a convenience for student, teacher, and the institution (at the University of Central Florida, for instance, classroom space is at a premium due in large part to uninterrupted major growth in the university and the region).
3. The Web is the cheapest medium for delivering content, disregarding (instructor) labor, which is a real concern
4. Hyperlinks permit quick access to a multitude of websites.

**Developmental Level (Acquisition):**

Teaching associated with this level relies on the lowest levels of mental activity. Although the professor may be presenting analysis at the peak of intellectual effort, the student is operating at the lowest. The subject might be the Whorfian hypothesis, i.e., the influence of obligatory grammatical categories over perception, but the student is obliged to replicate the statements of the professor in the expectation of tests which focus on the ability of the student to accurately capture the lecture’s notes. Objectively speaking, there is no need for a live presence. In fact, teachers who attempt to go beyond the lecture-notes-test model are resented by many students.

**Goal:**

The purpose of such courses is to provide students with a foundation for more serious inquiry into the field. Acquisition of background content, terminology, concepts basic to the field form the body of the course. Theoretical considerations are often introduced but instructors usually do not expect students to master difficult concepts.

**Reasons for Holding Classes:**

When teaching introductory or survey courses, students are operating at various intellectual levels and are new to the field. They have many questions. Also, classes provide the opportunity for testing, which is problematic when teaching completely online (self-assessment testing is
preferable in strictly online courses. See below). Not only can quizzes be given in class, but also the instructor can discuss them once they are collected. Large classes can use objective (multiple-choice, true-false) testing, short answer questions, etc, where the instructor’s time is a concern. Essay exams are unnecessary to check content acquisition but may be used to gauge understanding. If understanding is the goal, more face-to-face classroom time is appropriate.

Solo Taxonomy

The developmental level is concrete. Although the materials may contain abstractions of a high level, the learning method does not.\(^9\) Performance rests primarily on effort and secondarily on inherent or acquired memory skills. This may dismay some instructors desirous of rewarding (with grades) the good student, i.e., the student operating at higher order thinking levels but is routinely neglected in lecture-type classes. Essay tests may aim at higher-order thinking but may in reality measure writing skills and memory instead. This is not to say that writing skills, expression, and intelligent discussion should not be assessed; that is an issue perhaps best left up to the teacher. But the point here is to forestall criticism that the testing is aimed at a low level of mental function.\(^10\)

It is not difficult to devise objective questions that are conceptual in nature or that call for reasoning rather than merely memorization.\(^11\) Our preliminary data, however, suggest that such questions do not distinguish between students (Pyle & Dziuban, ms. 1998). Our findings indicate that students are distinguished merely by the number of right and wrong answers regardless of the mental skills addressed. Further inquiry may reveal a distinction, but it must be much less important than conventional wisdom would have us believe. The data was collected in an introductory undergraduate law class and it is possible that introductory courses have a leveling tendency absent in more advanced courses where accumulated knowledge and understanding affect performance.

Skill Level

An intermediate level may be identified by the learning of skills. Vocational training is characterized by a concentration on skills. In liberal arts fields, "skills" should be interpreted to mean mental or intellectual skills, although so-called "methodology" courses aim at specific practical skills, often with a minimal intellectual component.

Online instruction is particularly well suited to this level of instruction for the following reasons:

1. The acquisition of skills depends to a great extent on the preparation and ability of individual students so that the self-paced feature of online instruction allows students to comfortably acquire the skills. Motivation, effort, and self-discipline determine performance. Where these are lacking, the online course encourages their development. Attrition
problems are common and must be addressed by policy, preferably policy of the institution (it is assumed here that most institutions do not follow a policy of unqualified advancement).

2. Online courses may be designed for self-assessment. In fact, online instruction **demands** the development of self-assessment exercises by virtue of the absence of a feedback loop between teacher and student. The computer tutorial (see, for example, http://junior.apk.net/-jbarta/tutor/tables/index.html) is a fundamental example of skills training and is ubiquitous and effective on the Web, which means, of course, that web-surfing students are familiar with this method and generally accept and appreciate it.

3. The online course saves space for the institution and time for students and teachers. Online courses usually entail a great deal of e-mail, and many instructors use the time gained to offer a weekly forum or guest speaker—all of which mediates the faceless anonymity of online courses.

4. Student performance may be automated—graded on the basis of completion and timeliness.

5. Clarity of task, explicitness are required when Web courses are offered without classes.

   The developmental feature labeled “analysis” is best described in relation to an example.

   Skills include **thinking**, even very high order thinking. In addition to a variety of content and definition quizzes and self-assessment exercises in my introductory law class, I devised a complicated set of exercises based on **case briefing**, which started with fact-retention and evaluation exercises and led slowly in stages to exercises requiring students to draft a rule designed to provide for an exception to a rule that had been found to be too general when applied to a real dispute. A full discussion of the exercises and our study of the results, as well as exercise samples, may be found at: http://reach.ucf.edu/-aln/pyle.

   The stages of cognition that each exercise represents may be found at the website and are here reproduced to illustrate thinking levels as skills:

   (The **stages**, e.g., “Pre-structural/Pre-novice,” refer to cognitive developmental stages in the child hopefully, not applicable to college student except perhaps the very highest level of cognition.)

**Pre-structural/Pre-novice:**

   At this level problem solving is seriously deficient because students do not understand the context of the problem. They fail to distinguish the relevant from the irrelevant and tend to resort to guessing early in the cognitive process. They miss all the hints and cues furnished by the test developer.
Case Briefs: Students operating at this level are unable to distinguish questions of fact from questions of law, specific events from general principles.

Exercise: A complex story is told and students discover how accurately they have learned the story.

Uni-structural/Novice:
At this level, students are one-dimensional and concrete, unable to contemplate multiple causes. There is an absence of concept formation; problems are viewed as single cause and effect relationships. The student approaches learning as a memorization task. Processing multiple elements proves difficult at this stage. Structurally complex problems are reduced to independent transformations.

Case Briefs: Students at this stage are struggling with relevance of facts.
Exercise: Students must discriminate between important and unimportant facts in a story (relevance).

Multi-Structural/Advanced Beginner:
Students process multiple elements of a problem to arrive at a single solution. But the elements are processed separately in a linear fashion. As the number of elements increases, the process becomes unwieldy. This stage, however, represents the beginning of multiple-task problems.

Case Briefs: Students attempt to judge the relevance of facts with reference to one principle (rule or law).
Exercise: Students must judge relevance in reference to a rule.

Relational/Competent
Students appreciate interactions among individual elements. Although they arrive at singular solutions. Students expand the problem to reach a solution beyond the initial context, creating a variable that is a function of the originals. This level of thinking allows for planning.

Case Briefs: Students learn issue-spotting—recognizing the principle issue to be decided by the court.
Exercise: Students must choose among alternative statements the one that most accurately describes an issue in a case they have read.

Extended Abstract/Proficient:
Students combine observed elements into hypothetical constructs or latent dimensions. This process leads to multiple solutions, all of which are reasonable or at least defensible. Insight and intuition help students realize that additional information is required, information that must be hypothesized or deduced. Students must learn to deal comfortably with uncertainty while they are manipulating multiple abstract systems and concrete elements.
Case Briefs: Given an unresolved legal problem, such as a new problem presented to a lawyer by a client, or a problem imperfectly resolved, as a case on appeal, students must deal with alternative solutions to complex problems.

Exercise: Students choose between alternative choices among multiple solutions.

Latent Structure Analysis/Expert:
At the highest stage of cognition, students operate with data elements they have transformed into latent dimensions in order to manipulate solutions at the abstract or symbolic level. They think in terms of interacting hypotheses that cannot be readily proved empirically or from their experience. It is common to resolve problems by developing archetypal forms and simplified hypotheses. Reducing the problems by synthesis and interaction permits the thinker to design action despite uncertainty, ambiguity and incomplete information.

Case Briefs: This level of thinking is required for the application of law (adjudication) and the making of law (legislation).

Exercise: Students must identify the reasoning of judicial opinions and go on to analyze extraneous factors which affect results.

Seminar Level:
This model employs the Web as a supplement to the classroom and is not, strictly speaking, an online course. Nevertheless, the Web is an integral part of the process and not merely an enhancement. This approach borrows from the advanced graduate seminar course, which operates at a sophisticated level of discussion and argument. Advanced undergraduates can operate in this environment if properly prepared. The preparation uses the Web as an enabling tool. If students have done their Web homework, they come to class with knowledge and the beginnings of discussion, argument, or debate.

Advantages:
1. Maximizes functional class time. Students and instructor can go right to the heart of the subject under discussion as soon as the class starts.
2. The interactivity available through the Web and the Internet creates a new dimension to teaching and learning. Since communication can be either synchronous or asynchronous, the limits of group interaction and teacher/student interaction caused by the physical classroom are indefinitely extended by the virtual classroom, or perhaps we should call it the “virtual seminar”. At any rate, a dialogue is started that leads to the classroom and may continue even after the class time ends.

How this method may be used is best demonstrated by example. The following description refers to the course “Women and the Legal System,”
a special topics course in the Legal Studies program at the University of Central Florida. This approach has been used for a year in a course called "Law and Society" in a simpler form, which will be modified in the spring of 1999 along the lines here described.\textsuperscript{13}

The course is devoted to student presentations of current controversial issues and their legal ramifications. The issues are framed by readings from two books in the \textit{Taking Sides} series from Dushkin Publishers/McGraw-Hill Co. Each issue is introduced by the editor, followed by a "pro" and "con" analysis of the issue by authors with opposing viewpoints. Each issue is then closed with a 'postscript' statement by the editor.

The issues in the \textit{Taking Sides} series are treated in the course as a focus for open discussion following presentations by two students, one taking the PRO argument and the other the CON side. Since the course is a Legal Studies course particularly addressing the subject of women and the law, presenters and discussants are asked to consider the legal ramifications of the issues.

The presenters submit a summary of their arguments to be posted on a webpage devoted to that issue. Other students must read not only the issue in the text but must also read the summaries by the presenters before coming to class.

The webpage for each issue begins with comments by the professor along with a set of questions formulated by the professor for further consideration. Students are encouraged to access WebCT forums that are set up for each issue.

The objective is to prepare students with more than the content of the topic for discussion. Each student has ample opportunity to consider not only the issues but also underlying assumptions and legal ramifications of the issues. Any reasonably diligent student comes to class ready to discuss, debate and challenge other students and the professor.

Discussion in class mimics the Socratic questioning characteristic of law school with the professor acting as something of a provocateur.

\textbf{Hybrid Courses}

The tripartite division of courses above simplifies a more complex reality. The functions of the three types may all be desirable in a single course, or any combination of two of them. Some examples might be useful. Many courses may call for both the acquisition of content, terminology, etc., but also go well beyond into substantive discussion of the meaning and application of content in either theoretical or practical contexts. Many instructors give quizzes on reading assignments to require students to read and understand the content of their assignments so that classroom lecture or discussion may begin with a basic assumption that the students have a basic grasp of the materials. The danger, of
course, in giving such quizzes, at least in my experience, has been that students perceive the quizzes as providing the limits of the instructor’s expectations.

I have devised an approach to resolve the quiz-grade dilemma, but have not yet tested it. In order to disabuse the students of the notion that testing can be satisfied by a cursory knowledge of the materials, I give essay quizzes, i.e., I inform them that they will receive an essay question on each of the major themes of the course during appropriate weeks of the class meetings where their assignments deal specifically with a theme. For example, trial and appeal is a theme and it is also a chapter in the textbook. The week they read that chapter, they will have an essay question on that subject. This occurs long before the multiple-choice questions they will answer on their midterm examination and should prepare them for the prospect of analytical questions. The midterm examination should follow through with at least one important essay question.

ONLINE CHALLENGES

Teaching using the Web presents a special challenge older generations of teachers did not have to face. The Web and the technology associated with it changes so fast that users must run just to keep up. This diverts attention from more important problems. If we think of the World Wide Web as a medium for teaching, we necessarily move to questions of the nature of this medium, what it can do, what it can do well, how we develop teaching styles consonant with the Web and with our personal styles and pedagogies and how we integrate it, or not, with existent educational institutions. And all these questions must somehow fit the learning strategies of our students.

The Web provides a means to deliver messages far grander than anything generally imagined ten or fifteen years ago. In higher education thus far, delivering messages has constituted nearly all of what has been done on the Web. The messages are often prettier, more stimulating, and multi-directional but otherwise not much different from a good book with a good index and visual aids where appropriate. If Academia focuses on giving grades, credits and degrees, there is little reason to believe the Web will offer much more than convenience. Nevertheless, those teachers still imbued with the spirit of learning, desiring to help students become better learners and thinkers, have been given a rare opportunity to transform the cadaver we call higher education.

Online teaching demands innovative approaches to teaching that requires teachers make their procedures explicit. This is not immediately apparent to those who have not taught online. To illustrate the point, let me give an example I encountered with my first online course. I wanted to teach students how to brief judicial opinions that they were reading. A case brief summarizes a decision into its basic components. When I taught
this in class, I took a case and dissected it, giving each component its appropriate label and elaborating on what they meant, answering questions and clarifying mysteries. Online I had no such luxury. Not only was I compelled to express every facet with clarity; I also provided self-assessment exercises that worked on the computer. The students relied almost entirely on the computer to learn what I was trying to teach them to do. When something went wrong, I was inundated with email about the problem. At first this made me think that lecture classes were child's play and then as I thought more I realized that 'child's play' may not have been a metaphor but the game we often play instead of teaching.

Online teaching, then, offers the opportunity to rediscover learning. We must examine closely what we are doing, what we want the students to do, and what it will take to make them decide they want to try our way. Thus far, most online courses in higher education have been driven by institutional needs, desires, and sometimes dreams for expanding the delivery of courses based on new technologies (or new uses of old technologies). For the teaching faculty this entails a steep learning curve, especially for those in non-technical fields. Technology and technicians have dominated course development in many of its details. Now it is time for teachers who have gained a thorough understanding of the technology to take charge and explore the new ground technology offers.

NOTES

1 The extent of public awareness of the absence of motivation is demonstrated by the title of columnist John Leo's page in U.S. News & World Report, "No Books, Please; We're Students," (16 September, 1996, p. 24).

2 Sacks, 1997, categorizes the learning culture of professors as 'modern' while that of the students is 'postmodern.' The difference seems to be that of a tradition of education that seeks truth and wisdom through objective critical thinking based on a belief in the perfectability of knowledge versus a skeptical, often cynical, deconstructionist attitude that views the modern perspective as misguided and oppressive, a tool of power, class, and particularly white eurocentric males.

3 Langer, 1997, describes the Web's "epistemological anarchy" with some wit: "... as much junk and debris exist in cyberspace as in cosmic space. It may be attractive and glittering junk, but it is, even by a different name, ontologically, still, and mostly, junk." He worries that students are conducting uncritical research on the Web before they have learned critical scholarship from the printed literature that has been subject to criticism by a community of scholars.

4 The actual title of the course is "Law and Legal System" and is numbered PLA 3013. The course could be considered an overview course. It cannot be titled "introduction" because that would require a lower level course number.

5 The Levels are taken from Pyle-Dziuban's Problem Solving Stages (adapted from the SOLO Taxonomy): A model for Critical Thinking in an Asynchronous Learning Environment Based on Case Briefing, Techniques, which can be found at http://reach.ucf.edu/-alan/pyle, a presentation originally made at the Asynchronous Learning Network annual conference in New York, November 1997. The stages of cognitive problem-solving were adapted from the SOLO (Structure of the Observed Learning Outcome) taxonomy developed by Biggs and Collis (1982). We added the labels used by Berliner (1988) for the stages novice through expert that he applied to teacher training.

6 Unfortunately, the minimal intellectual expectations of students is not restricted to introductory courses. Three-quarters or more of college professors use the lecture method. Milton (1982) used a faculty sample of 1700 at a research university and found only 17
percent used essay tests and only 13 percent of the questions used by the respondents required problem solving.

Smith describes the conflict between lecturing and teaching critical thinking: "The amount of time spent listening is negatively related to change in critical thinking and positively related to memorizing" (Smith, 1983, p. 100).

Sacks, 1997, argues that students actively counter attempts by faculty to depart from the lecture and testing model that they have learned so well.

The statement of an abstraction may be memorized. Instructors who believe that the reiteration of an abstraction equals understanding it are deceiving themselves.

Tests given to lecture and online students in different sections of the same course showed performance at equivalent levels on the same test (given in a classroom setting) (Dziuban, C. and Pyle, R. 1998). Item analysis, on the other hand, revealed significant differences.

A multiple-choice question in an introductory law course that requires memory alone would be: "The jury's fact-finding is called the a. declaration, b. judgment, c. verdict, d. precedent." One that calls for thought might be: "Which of the following is the most difficult to successfully challenge on appeal? a. instructions to the jury, b. admissibility of evidence, c. jury fact-finding, d. the trial judge's statements of law."

Case briefing is a method used by law school students and, in a modified form, by lawyers and others conducting legal research to reduce the complexity of judicial opinions to their essential components, simplifying the judge's task of reconciling facts and law. For thinking of primary legal sources, the essential elements of the brief are: Cause of Action, Facts, Issues, Ruling, Reasoning, and Analysis.

This approach was the subject of a presentation to UCF faculty titled "Staging Classroom Dialogues: Web-Enhanced Critical Thinking", September 21, 1998. This approach was demonstrated through a Website that may be accessed at: http://reach.ucf.edu/-pla4932/family/staging.html.

REFERENCES


The Ideal Online Course*

ALISON CARR-CHELLMAN AND PHILIP DUCHASTEL

ABSTRACT
This paper addresses many of the key issues facing designers of web-based university level courses. Drawing from experience in distance education and web-based design, we develop a set of key components to be addressed when creating an 'ideal' online course. Such an analysis forces a consideration of what constitutes good online teaching as well as good use of the technologies that are more and more present in our instructional environments.

INTRODUCTION
Web-based instruction is a popular new form of education being adopted at all levels of schooling and it is generating a great deal of interest in the instructional technology R&D community (Kahn, 1997, 1998; Hackbarth, 1997). Creating successful online courses remains a tricky proposition at this time, however. It is easy for experienced instructional designers to recognize good courses on the Web: it is also evident that many online courses lack basic design consideration and that the web is simply being used as a medium for the delivery of instruction created within another framework. Such transposition from one medium to another may have some value in reaching certain outreach goals, but it also runs serious risks of diluting the original instruction and possibly rendering it ineffective.

*Reprinted from the British Journal of Educational Technology, 31(3), 2000, 229-241, by kind permission of the publisher and the authors.
In this paper, we begin to build a set of recommendations for the creation of web-based courses and we begin to face some of the issues that arise in such an undertaking. We consider the full spectrum of design, including both content and technology elements. Content elements are basic instructional design elements, such as objectives and other components found in traditional instructional design (see for instance Dick and Carey, 1996). Technology elements are those elements of course infrastructure which support learning, such as audio conferencing, internet chat, web pages, etc.

To focus our effort, we are trying to explicate the ideal online course. The first question to arise is 'Is there an ideal?' There is of course no single ideal; rather, we can expect many forms of "ideal." We acknowledge outright that this is merely our conception of what the ideal might be, based on our necessarily limited experiences. Together we have several years of experience in online education. Dr. Duchastel has been involved in distance education since the early 1970s when he joined the Institute of Educational Technology at the British Open University. He participated in the development of a doctoral program offered at a distance in the field of instructional technology. Dr. Carr-Chellman has taught or researched web-based degree programs for the past three years and is a relative newcomer to the field. Together we can represent a spectrum of experiences and a balance of hopeful criticism. Others are likely to have their own conceptions of the ideal, and this of course invites dialogue, debate, and further refinements, and is, in the end, a prime means of advancing the field of online instruction. We base our "ideal" on current thinking in instructional technology (Jonassen, 1996; Moore and Kearsley, 1996; Collis, 1996). In the future, as component technologies evolve and become ever more integrated within an easy-to-use general technology such as the web, other possibilities will present themselves and the view of what is ideal will shift. Vision, technology and theory are necessarily bound and evolve together over time.

What is an Online Course?

An online course is one which is primarily internet based (or intranet based within an organization). Specifically, we are dealing in this paper with web-based courses even though other components may be involved (indeed, many forms of mixed approaches exist). Our primary focus is on the ideal use of the world wide web as the main communication tool within the course. We are interested in helping others take best advantage of the web in terms of exploiting the advantages the media affords. It is useful to note, therefore, that other yet un-integrated media (e.g., email) are considered here, for it seems only a question of time before integration of all components takes place within the web: the latter then becoming the general medium for communication through digital means.
Online courses require an accessible but fairly sophisticated computer infrastructure (unlike traditional distance education in the text-based mode) to ensure that all communications occur without mishap. For instance, servers that can offer streaming for audio and video resources may be beneficial in many circumstances. Online courses should thus make the most of the opportunities afforded by the web.

**WHY ONLINE COURSES?**

An interesting quote from a recent article in Forbes magazine justly sets the context for online education within the tradition of distance education:

"Detroit makes luxury cars and stripped-down economy cars, four-wheel drives, and sport convertibles. College Inc. makes only one expensive model—with leather seats and air-conditioning. Technology is changing that" (Forbes—June 16, 1997, p. 84).

Distance education is seen as an important answer to the professional development needs of large masses of the population. As the Forbes writer aptly stated, not everyone today needs or can afford a traditional residential university experience. Instead, we must take students today where they are (often already engaged in the workforce) and work with them in ways that take best advantage of their available time, energies, and interests.

In addition, with the recent advent of web-based design tools, the economies of scale commonly used to justify distance education expenses are brought sharply into alignment with university and student budgets. The entry level costs into these newer forms of outreach education are continuing to be reduced yearly (see Daniel, 1996, for an analysis of this situation), making it feasible for all institutions or even individual professors to enter the online education world.

We see a situation evolving in which traditional distance education institutions are going online with many of their courses. A prime example of this trend is the British Open University, one of the venerable contemporary distance education institutions. Thus, traditional collegial institutions are expanding beyond university boundaries (both conceptually and geographically) to begin distance education initiatives, and established distance education institutions are using the technologies to better reach their constituencies. Because of these expansions, it is important to design carefully distance education courses which take best advantage of the available technologies.

Distance education has quite naturally had a tradition of delivery of instruction at a distance. However, given today's emphasis on access to information via the web, that tradition is likely to be uprooted. We are essentially headed towards a paradigm of "learning without distance." In fact, we need to ban the term "delivery system" in any discussion of distance
education or online instruction, and go instead with conceptual frameworks that emphasize student-initiated access: thus, terms such as “organize instruction” or “create learning materials” are more appropriate in thinking about online instruction. The new online paradigm calls not so much for providing instruction at a distance as for making available learning resources and instructional activities to students. This holds true wherever the students are (just down the street or on another continent) and whenever the students need the resources and activities. This is not dis-similar to the move toward just-in-time learning in training environments within corporate America. In fact, it is being at the right place at the right time that we need now to consider as the ideal of distance education.

One implication of the paradigm shift that we are witnessing is that distance education, as we have known it, will disappear. In its place, we will see a tremendous growth in what is becoming known as distributed learning (Bates, 1995), or flexible learning (Stacey, 1995). An illustration of the merging of the boundaries between distance education and presential (face-to-face) instruction is seen at Deakin University in Australia (http://www.deakin.edu.au/), where portions of the instruction are presential and portions are available online. The very distinction between online instruction and presential instruction is blurring. Distance education of the traditional kind (e.g., paper-based correspondence courses) may continue to be extremely useful in countries where the computer infrastructure is not yet sophisticated enough to support online instruction. But there will come a time when institutions in these developing countries may leapfrog into such an infrastructure and fully exploit the potential of the new technologies.

One of the major conflicts in online teaching today mirrors the current conflict in residential instruction—behaviorist or constructivist? Teacher or student centered? From our experiences, both orientations can reach success within online teaching and learning and there is probably not an easy answer to this debate. Because this debate is currently based on epistemological beliefs, it is our feeling that designers and instructors need to choose for themselves the best mixture of behaviorist and constructivist learning experiences for their online courses. In fact, the debate itself could be the topic for another discussion of online learning. As we see the current situation, the vast majority of online learning materials, particularly those translated directly from residential lecture notes, are behaviorist in nature. Creating constructivist or student-based courses online presents a host of obstacles that may challenge the economies of scale within universities interested in the web as a revenue generator. However, we see bright promise for student-centered and constructivist learning models in the future of online education as the need is seen in particular contexts for more interaction around student and negotiated learning. In what follows, a decidedly student-centered environment
emerges from our recommendations.

**Technologies Involved in an Ideal Online Course**

It is not enough to simply transpose traditional courses to the new medium of the web in order to create an online institution. This will not take best advantage of the opportunities of the web. There are many unfortunate instances on the web where such transposition leads to a stilted use of this medium for instructional purposes. It needs to be recognized that online education is a specific medium in its own right and thus, it will have its own design considerations for effective instruction.

The current technologies involved in the ideal online course are many. They include web-based textual materials such as study guides (these provide essential elements of traditional course syllabi), discussion forums—both synchronous (live, real-time) and asynchronous (distributed in time), email, and voice communication through either internet audio streaming or traditional telephony. It is important to remember that not all elements of an online course need to be, or probably should be, physically available online. In most cases, a traditional textbook is appropriately provided for the student to study throughout a course. Other elements, such as images and video segments, are appropriate in many areas of instruction, but not all.

**The Ideal Online Course**

We describe in this section our conception of the elements of an ideal online course. Naturally, guidelines associated with the ideal online course, or any ideal course for that matter, are only useful insofar as they are upheld by continuous quality assurance procedures. Most universities have departments associated with online education either through continuing education or distance education divisions. These departments can be tasked with the important job of following rigorous design guidelines and assuring that all online offerings are of high quality. Our experience has suggested that in some cases, more attention has been paid to promotion and advertising than to quality assurance in some online degree programs. However, explicit attention to quality assurance procedures may help to mitigate this situation. Such attention will increase quality, but may also increase costs.

*The Study Guide*

Perhaps the central element of an online course is the online study guide. The study guide is the student's main reference to the content, structure, and activities associated with the online course. The essence of an online course is the organization of learning activities that enable the student to reach certain learning outcomes. It is important to note here that the traditional delivery of instruction receives much less attention in
online courses than in the traditional context of higher education residential courses. We are moving, here, toward a more student-centered and activity-based learning environment design. The study guide must include the traditional elements of good instructional design, in particular a clear description of the instructional aims and learning objectives of the course. These latter are expressed in student learning terms as opposed to content coverage. The study guide also includes the list of learning resources, such as textbook chapters to read, associated articles to consult, supplementary readings, and web sites of interest outside those referenced within the course itself. The study guide will, of course, include the assignments or projects the students are to tackle, along with a clear indication of the quality elements making up the assessment criteria.

The online study guide, while similar to a traditional course syllabus, is in many ways quite different. Online study guides must provide a level of detail that is sufficient to enable the learner to proceed without substantial further personal interaction or clarification from the instructor. Naturally, instructor assistance is made available throughout the ideal online course; however, to the extent that independent learning is both the means and an important goal of instruction, clear descriptions and directions are imperative within the online study guide. There are many examples of online study guides available on the internet. One example is our own course on instructional design (http://www.fcae.nova.edu/duchaste/id.html).

No Online Textbook

The ideal online course should generally not have the primary learning resources online. The great disadvantage of online text materials lies in the poor interface the computer screen offers for reading, as compared to the usual interface of the textbook, which will have, presumably, been carefully designed for use as a text (Jonassen, 1982). It is, in fact, much easier for students to study from a traditional textbook than it is for them to roam through online textual materials of any length. In addition, portability of traditional textbooks makes them very attractive resources for students who are being asked to spend much of their time online with other learning experiences. Perhaps one of the few cases for online textual materials is to provide students with access to the most recent work in the field which may not yet have been published or incorporated into traditional textbooks.

There may be an advantage for some mini-lectures online, either in audio or video format, for purposes of identification with the instructor and general orientation to the subject. However, as a general rule, the active nature of online learning precludes large amounts of text via lecture notes, or lecture transcripts from being put online. If audio or video lec-
tures are used within a course, it is essential that they remain minimal (in the form of audio- or videoclips) as opposed to lengthy lectures. Their purpose is not specifically to convey information in the form of content to be learned, but instead to enhance the student's identification with the course, motivation to learn, and sense of instructor personality at a distance. Their usage involves a totally different function than that found in a traditional university lecture, and therefore takes on a different form altogether.

**Assignments**

The ideal online course is centered on the set of student tasks (projects, assignments) that constitute the learning experiences that the students will engage in, either independently or collaboratively, in order for them to master the objectives of the course. We are moving here to a mode of learning that is less dependent on the acquisition of information or content coverage via lectures, and more dependent on the application and use of such information in real world settings wherever possible. Two dimensions are central to this shift. The first is the importance of authenticity in the tasks we assign students, so as to optimize their involvement and engagement with the subject matter (Jonassen et al., 1995; Wilson, 1996). This level of authenticity is necessary to sustain interest and activity on the part of the online student, who faces the disadvantage of not having the sustaining social interaction found in traditional instructional settings. The second dimension involves a focus on searching for relevant information pertinent to one's learning goals within the wide range of possibilities offered not only by the course materials themselves, but also through the wealth of information and learning resources available on the internet.

In fact, our online education enables a much more open and less restricted form of instruction in terms of the specific learning outcomes to be achieved within the course than was previously possible (Duchastel, 1997). An online university course should provide the students with the broad goals that are to be attained, while leaving them with substantial latitude and initiative to pursue their own goals. This can lead to a diversity of learning outcomes across students who are pursuing their individual interests, all within the context of the common course. This emphasis on tasks to be accomplished as the primary structuring element within the course is aligned with the recent trend in instructional design toward problem-based learning environments and toward the general goals pursued within that instructional design framework (Savery and Duffy, 1996).

One crucial element related to assignments is the timely provision of feedback to the students—both to help them refine their learning, for instance by correcting misconceptions as they are developing, and to provide overall guidance and structure to their continuing study activities.
Feedback, in particular timely feedback, can be an important issue for the instructor or mentor teaching online. There is no doubt that online instruction is more time intensive and requires more continuous attention in order to provide timely responses to student needs than does traditional presential instruction. This also challenges the economies of scale associated with traditional administrator understandings of online education. Because work is intensified, faculty loads must be totally reconsidered in this new form of education. There is no simple guideline for this process, but it is something to be carefully considered and studied in order to free the instructor to truly teach the ideal online course.

**Examples Online**

One potentially very useful element for students in the accomplishment of their learning tasks is the availability of prior student's work online. This provides currently enrolled students with an indication not only of the level of effort required, but also of the standards of quality work that the instructor expects in the accomplishment of these tasks. Good instructional design practices warrant the availability of a range of student work, if at all possible, so as to provide a very clear indication of what is both acceptable and less acceptable. It is, of course, very important to maintain anonymity of sources of online examples, particularly in the case where an online course will be open to anyone accessing the web.

Another facet of online examples is the encouragement to current students to post their current assignments online so as to make these available to their course peers. This encourages students to learn from the current experiences of their fellow students in refining their own work. This also encourages critical exchange at a high level of intellectual discourse regarding the relative merits of particular approaches and results. Of course there may be disadvantages to this approach, including undue reliance on peer student work in the development of an individual student's assignment, or a narrowing of creative options in the initial stages of one's work. The open nature of online examples will also encourage collaboration as students post their work along the way, but may frustrate students who prefer more competitive learning modes. On the whole, it would appear that the advantages of online examples outweigh the disadvantages.

**Course Communications**

*Asynchronous Interchanges*

In the framework of distance education generally, there are three types of communication patterns that need to be considered: student-content interaction, student-instructor interaction, student-student interaction (Moore & Kearsley, 1996). Recent experience in distance
education has led to the general view that there is a benefit in facilitating the student-student interaction in order to reduce the emphasis on student-instructor interaction, thus rendering the course feasible for larger numbers of students (Tinker, 1997). The principal way of encouraging student-student dialogue in the pursuit of learning is the availability of online forums, where the entire learning community can participate in a valuable intellectual exchange profitable to all. These forums are known by many different names such as online conference boards, web discussion boards, bulletin boards, online conferences, and so on. In essence, they provide a communication medium to pursue discussion of individual topics relevant to the objectives of the course.

These discussions are asynchronous and typically threaded. Such dialogues lead to the formation of true learning communities, within which adult students share their real world experiences and learning outcomes, thereby profiting all participants within the conference. Students, in fact, learn as much from one another’s experiences as they may from textbooks and instructor-provided information. This is particularly true for online courses which typically appeal to adult students actively engaged in full-time work. Sharing these situations with peers, gaining their insights, and thinking through specific problems offers both students and their peers uniquely powerful learning opportunities.

Synchronous Interchanges

The great advantage of asynchronous interchange lies in the fact that students may participate in a very flexible manner and on their own terms. In synchronous interchanges, students participate in real time conversations through audio conferencing, internet chats, and, potentially, via video conferencing. Because of the real time nature of these interchanges, there may be greater social pressure for conformity in participation. The advantages of synchronous interchanges include a more direct sense of collegial interaction, immediate resolution to questions posed, and possibly a strong contribution to the team building required to sustain future student interactions. The synchronous mode is particularly appropriate for the inclusion of motivating guest lectures in specific content areas.

Email Communication

The traditional email function is extremely useful for student-instructor communication, for instance with respect to assignments, progress, feedback, and administration. Also peer collaboration on projects can be accomplished largely through student-student communication via email. In this respect, the emergence of collaborative software such as shared white boards and other web-based collaborative tools shows much promise for enhancing these student-student interchanges. Another promising
development lies in the potential of email technologies toward multimedia possibilities such as voicemail and videomail. Computer based telephony is another promising technology for the facilitation of peer interaction in online courses. We encourage instructors to consider all of these evolving technologies as potential ways to increase student-student interactions.

**Interactive Skill Building**

Currently, the web provides mainly for an information search and acquisition mode of learning, as far as autonomous learning materials are concerned. However, with the development of new software technologies such as Java and other computer languages, the potential for guided interactive web sessions (such as are found in traditional CBT) becomes feasible. In some cases, this sort of more traditional, narrow learning experience is important to build certain skills (such as would be built in a traditional computer lab, or in a chemistry lab, for instance). While this mode of instruction is particularly important in the area of skill building, it must not be misused in the more general area of intellectual development, as is found to be the case with a number of traditional CBT products. Our pedagogical approach should be one that emphasizes intellectual dialogue for all conceptual and advanced intellectual skills development, dialogue developed through means described previously, and that sees a more limited role for guided interactive sessions targeted at specialized or lower level cognitive and psychomotor skills. Our thinking, in this respect, is aligned with current conceptions of constructivist learning.

**Theoretical Bases**

In this section, we shall examine the underlying theoretical bases for our ideal online course. This is an issue because of the lack of consensus in the field at the present time regarding what constitutes learning and hence the best approaches to instruction. Diversity in learning and instruction naturally leads to placing boundaries on our ideal view. We shall examine each of these perspectives in turn.

From a learning perspective, why is our course ideal? To answer this question, we need to lay out what we consider learning to involve. At its most fundamental, learning is a process of transformation of knowledge that occurs through interaction of an individual with information in that individual's environment. Knowledge has associative and structural aspects and is a highly individual matter, as the constructivist educators keep reminding us. Students interacting with the same information will elaborate and interpret it differently. Students might need different elements of information from one another in order to each grasp a common element of study. Diversity and degree (potential for) of information interaction is the key here. Information can be provided by the learning materials (such
as the textbook), by the instructor (for instance in comments on an assignment), and by other students (as in an online forum discussion). The learner gradually fashions his or her knowledge through these various interactions.

Berge (1997) notes that online instruction often involves applied subjects and asks whether these subject areas are more compatible with online approaches. This is undoubtedly the case, since increased interaction, especially with fellow-students, may be particularly useful in grappling with information that is value-laden (often the case in applied settings where the practical experience of different students can be profitably shared). In dealing with highly structured and consensual information (think of the typical introductory course in a field of study), open discussion is less crucial.

This area of analysis—the intent to match learning process requirements with content types of information—has been recognized as important ever since Gagne (1965) emphasized it in his theory of learning. It remains a difficult area today and underlies a good deal of the current debate involving constructivism.

Turning now to the instructional perspective, we define instruction as the fashioning of the learner’s context to optimize information interaction, and hence, learning. Two facets exist: the first is engagement (initiating and pursuing the interaction), the second is adaptiveness (enabling access to just the right information that is needed).

Engagement itself is a function of two facets: interest in the information being interacted with (the content) and the social setting involved (institutional and group processes). The first—intrinsic interest—relates to what is called either intrinsic motivation or epistemic curiosity. Instructionally, it is generated through the choice and sequencing of the information to be provided and is largely a matter of content selection (a fundamental instructional decision). The second—social context—either creates pressure to persevere (doing well on assignments, for instance) or adds vivacity to the interaction (dialoguing with others online, for instance). The focus on authentic tasks for assignments and on collaboration in learning, both features in our ideal online course, support engagement as we have discussed it here.

As for adaptiveness, it is mostly a question of availability of information—the right information at the right time. Our ideal online course moves with the times in its emphasis on individual initiative and exploration, as opposed to the more passive stance of receptive information processing. The instructional challenge is essentially one of guidance—matching individual student needs with appropriate elements of information, whether static or dynamic. The openness of the structure in the ideal online course, encouraging initiative and independent interaction, provides much learner control and hence has the potential to optimize the
necessary matching of needs with resources.

Again, however, the nature of the information to be learned mitigates the value of the approach. Highly structured content is more amenable to a traditional teacher-centered instructional style (illustrated by the traditional classroom lecture) than is more debated and value-laden content. The troublesomeness of the learning-content analysis mentioned above carries over into the domain of instruction—quite naturally, of course, since instruction is in the service of learning.

Some Practical Debates

In this section we will examine a set of more practical concerns that remain highly debated, such as the issue of pacing students through the course, degree of adaptation to different learners, the importance of face-to-face presentational instruction, and public access to online courses.

The first issue is that of pacing. A number of online courses involve strong pacing. Students all start at once, deal with given topics in given timeframes, and are ushered on at a group-set pace. Other courses involve more time flexibility, where students may start and end at different times and even engage topics in different sequences. How flexible is ideal is difficult to say—it probably depends on a host of particulars to given situations.

A second issue is the one of presentational instruction. Basically, is a mixed approach (part presentational, part at-a-distance) more valuable than a single-mode approach—say, all at-a-distance? The issue gets more complex when we define forms of presentational interaction. For instance, what is the benefit of a synchronous component to an online course? An audioconference and an online chat are examples of such synchronous interaction forms. Some educators feel their value is minimal, while others feel not.

By the same token, many instructors feel quite tied to at least some minimal face-to-face presentational moments in distance education courses. Others are happy to have none of the face-to-face interactions. We suspect that this is more tied to the way instructors conceives of themselves as teachers. Often, if we feel that interpersonal contact is our strength, we want to increase that sort of interaction, whereas if we suspect we are not particularly good at presentational instruction, we may try to minimize this type of interaction. In the end, this practical consideration may be more important than what experiments might tell us about the right balance of face-to-face and distance interactions for the learners from an instructional standpoint.

Other issues of practical concern are the value of peer assessment and the technological look of the course. Peer assessment is seen by some as a way of decreasing (and potentially improving) student-instructor interaction while increasing student-student interaction (with potential benefits there as well). With respect to technology, some online courses are
what can be called glitzy (they might involve the latest bells and whistles in terms of multimedia effects) while others are fairly straightforward. Is there much engagement value in the former, or is there potential for distraction—not only for the student, but for the course designer as well?

One final pragmatic question remains, that of public access to online courses. Here again, there are debates and political realities inherent in the question. Many online courses require passwords to gain access while others are open to anyone who chooses to use the resources. There are certainly advantages and disadvantages to each of these approaches. In the open access case, there is the opportunity to share the instructional courseware widely with many audiences for feedback and trials and to serve a broad community including those who may need additional learning experiences but are not interested in degree granting or credit bearing undertakings. On the other hand, in most institutions of higher learning, credit is the coin of the realm and the way in which universities make money. Therefore, the issue of open access or passworded access is one that each university unit will have to make for themselves weighing both the advantages and disadvantages of each approach. These issues, like most practical ones, remain open for further experimentation.

CONCLUSION

It is quite evident that the task of defining an ideal online course is a highly adventurous and risky one. Not only do many of the issues discussed in our analysis remain open to debate, particularly so because of the fragility of learning and instructional theory at this time, but online courses as we know them today are themselves fairly new.

Networking technologies, both hard and soft, that make possible online instruction are evolving at a continuing rapid rate that keeps shifting the grounds of possibilities for increasing learner-information interaction. The evolving technologies provide not only more potential in this respect, but also often increase the ease of use factor, which makes participation in online learning all the more appealing and satisfying. In technology terms, proposing an ideal online course a few years from now will undoubtedly lead to a rather different description than the one provided here.

There is also evolution in the areas of learning and instructional theories. Constructivism has had a strong influence on instructional design in the past decade and challenged many of its previously accepted tenets. There is still strong debate as to the value of the newer approach, but certainly, it forces a level of theoretical questioning that is extremely valuable in itself. It is likely that refined models of learning and instruction will emerge out of the ongoing debate and lead to yet further perspectives in these areas. This in turn will influence what might be conceived as ideal for online courses.
We have written this paper in full acknowledgment of the risks involved in any search for the ideal. We believe that any statement of thought in as explicit a form as possible (the online course, in this case) is valuable in furthering the academic dialogue regarding this evolving technology and we invite others to join in this dialogue. Critique the vision proposed here and debate the assumptions made on its behalf. In this way, alternate visions of the ideal online course will emerge and further inform instructional practice.

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D. SCOTT BRANDT is an Associate Professor of Library and Information Science at Purdue University. His Master's degree in Library and Information Science is from Indiana University (1983). As Technology Training Librarian, he is responsible for the design, development, and implementation of a progressive training program for a staff of 200. He has been involved with training since 1991 when he won an award for Internet training while at the MIT Libraries, where he also wrote the book Unix and Libraries (1991). He is an editorial reviewer for Online Information Review, sits on several conference program committees, and currently writes a column for Computers in Libraries, "Techman's Techpage." Major publications include: (1999, with Hal Kirkwood) "A Web Page is Not a Page." In S. R. Vincent & S. K. Norman (Eds.), All That Glitters: Prospecting for Information in the Changing Library World (Stamford, CT: Jai Press Inc.); (1997), The PLACES Game: Integrating Technology Concepts. Research Strategies, 15(4), 287-292; (1997) "Constructivism: Teaching for Understanding of the Internet." Communications of the ACM, 40(10), 112-117.

ALISON CARR-CHELLMAN is an Assistant Professor of Instructional Systems in the College of Education at the Pennsylvania State University. She earned her doctorate at Indiana University and studies systemic change, user-design, and technology-assisted change. She has been involved in delivering distance education in instructional design and Internet for the classroom.

SUELLEN COX is a Reference Librarian and Library Instruction Coordinator at the Pollak Library at California State University, Fullerton. Since the inception of the Fullerton First Year (FFY) program in 1997/98, she has led the library instruction team for the program, and co-taught the library component of the FFY "Introduction to Information Technology
and Presentation" course. Since 1998 she has also co-taught an FFY Freshman seminar course. Together with her colleague, Elizabeth Housewright, she has presented at several workshops and conferences, including the California State University Symposium on University Teaching, Syllabus99, the California Clearinghouse for Library Instruction Open House, and the California Academic Research Libraries 1998 Annual Conference.

Philip Duchastel has been involved in distance education since the early 1970s when he joined the Institute of Educational Technology at the British Open University. He participated in the development of a doctoral program offered at a distance in the field of instructional technology (see http://www.nova.edu/pet/).

Charles Dziuban currently heads the University of Central Florida’s Research Initiative for Teaching Effectiveness. He has over thirty years of experience in higher education and has presented numerous conference papers and co-wrote various articles on distance learning using Web-based technologies.

Ina Fourie is currently a lecturer in the Department of Information Science at the University of South Africa where she teaches aspects of information organization and retrieval with emphasis on the use of electronic methods. She obtained the Bbibl, BBibl(Hons), and MBbibl at the Universiteit van die Oranje-Vrystaat (RSA), and the DTE (postgraduate) at Unisa. She obtained a Dlitt et Phil from Rand Afrikaans University. In addition to her teaching responsibilities, her current academic interests include computer-assisted instruction, Web-based instruction, and distance teaching of practical skills.

Carol Hansen is Professor and Instruction Services Librarian at Stewart Library, Weber State University, Ogden, Utah, where she also coordinates library services for distance learners. She is a past president of the Utah Library Association and served as an ALA/USIA Library Fellow to Malaysia. She has extensive experience teaching about the Internet in formal courses and workshops for academic faculty and business groups in the United States and overseas. She recently co-presented a paper on library cooperation to support distance learners at the Ninth Off-Campus Library Services Conference in Portland, Oregon. She currently co-chairs the Utah Academic Library Council Information for Life task force.

Elizabeth Housewright is a reference librarian and Instruction and Information Services Unit Head at the Pollak Library at California State University, Fullerton. Since the inception of the Fullerton First Year
(FFY) program in 1997/98, she has co-taught the library component of the FFY "Introduction to Information Technology and Presentation" course. Together with her colleague, Suellen Cox, she has presented at several workshops and conferences, including the California State University Symposium on University Teaching, Syllabus99, the California Clearinghouse for Library Instruction Open House, and the California Academic Research Libraries 1998 Annual Conference.

JOAN KAPLOWITZ is currently interim head of the Reference Division at the Louise M. Darling Biomedical Library at the University of California, Los Angeles. She also serves as the Psychology Specialist as well as the liaison to both the School of Medicine and the Psychology Department for the library. Dr. Kaplowitz's numerous presentations and publications have focused on the psychology of learning and cognitive styles, evaluating instruction, computer assisted instruction, and mentoring within the profession. She is currently writing a book on library instruction for librarians. Joan Kaplowitz holds a doctorate in psychology as well as an M.L.S. from the University of California, Los Angeles.

T. G. MCFADDEN is the Library Director at Union College, Schenectady, New York. He has also been Associate University Librarian at Northern Arizona University, Head of the Humanities/Social Sciences Division at the University of California/Davis, Head of Reference at Brown University, and Head of Reference at Rochester Institute of Technology. Holder of graduate degrees in both librarianship and philosophy, Mr. McFadden was the editor of the Fall 1995 issue of Library Trends and has published about indexing the Internet in Learned Publishing.

NANCY O'HANLON is User Education Librarian for Internet Instruction and Associate Professor at The Ohio State University Libraries. She is the developer of net.TUTOR, an Internet research tutorial program that has been incorporated as an instructional component of more than one hundred courses at Ohio State University. These tutorials are also used as the electronic textbook for the online information literacy course that is the topic of this article. Her research has focused on various aspects of bibliographic instruction, especially developing research competencies in future teachers. Recent papers examine student use of Web-based instructional resources.

RANSFORD PYLE has been a Professor of Legal Studies at the University of Central Florida since 1976. He has written several books on legal procedures, the most recent being Foundations of Law: Cases, Commentary, and
Ethics, 2d edition (Delmar Thomson Learning, 1995). His academic interests include what he calls the relationship between “law and society.”

DAVID O. YAMAMOTO is a reference librarian and Web manager and developer at the UCLA Louise M. Darling Biomedical Library. He holds a B.S. from the University of California, Davis and an M.L.I.S. from the University of California, Berkeley.
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