
Making Connections: Teaching Information Retrieval

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ABSTRACT

THE FOCUS OF THIS ARTICLE is on the necessity of making connections when teaching information retrieval—i.e., connections between graduate library school education and the practitioner; between learning strategies and library staff development and library user education programs; between basic library user education and lifelong learning skills; and between the library and the classroom, the library and media services, the library and computer centers, and the library and its users.

In order to assist library users in successfully accessing a host of local and remote systems—in both online and CD-ROM formats—library professionals are encouraged to accept a leadership role. They must facilitate end-user instruction in meaningful ways so that independent, individualized learning through electronic access is assured.

A comprehensive framework has been described to teach the process of online and other electronic-based information retrieval. Educational content incorporates cognitive, conceptual, and mental models. Communications analogies and a database model are stressed as being fundamental to teaching. Progressive and continuous

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learning and development of expertise will lead from personal knowledge to societal knowledge through enhanced searching expertise.

INTRODUCTION

College and university librarians have a commitment to the provision of quality service to faculty, students, and other constituencies. Library-user education is usually high on the list of priorities of an academic library. Yet a large majority of graduate schools of library and information study do not teach prospective librarians how to teach (Pastine & Seibert, 1981, pp. 169-71; Larson & Meltzer, 1987, pp. 9-16). Graduate library schools need to incorporate learning theories, psychological and sociological behavior theories, and lifelong learning skills into their curricula or encourage students to enhance their education outside of the library school curricula in this area. Without a broader perspective on the teaching role, practicing librarians have had to develop on-the-job theories which are relevant to user education. In part, at least, this explains why much of the early (and even some of the current) library-user education programs focus on physical library orientation and offer only tool specific instruction. Library school students have been taught how knowledge is created, structured, organized, and manipulated, but more emphasis could be placed on learning behavioral theories so that, as instruction librarians, their ability to teach others can be strengthened.

Despite this situation many of these graduates have been creative in their work environments (see, Schon, 1983, for a discussion of this phenomenon in other fields). Independently, they have exhibited the skills necessary for lifelong learning and ferreted out literature—much of it outside their own field—which is useful in assisting and teaching users. Most recently, many have embraced the challenges of humanizing information technologies. As one university administrator remarked: "On this campus, the librarians are the leaders in initiating the implementation and use of new technologies and telecommunications activities that have led to improved lifelong learning and innovative research and teaching."

On many academic campuses, the technologies first implemented in libraries have brought together new work groups that cross disciplines and/or administrative units. New ties have been created among the library, the classroom, media and instructional services, and computer centers. And further ties are almost certain as campuses adopt highly developed telecommunication systems in preparation for interactive and integrated voice, video, and data information

sources. Technologies are changing the ways in which we function, the ways in which we think, and the ways in which we access and manipulate information (Vondran, 1990, pp. 27-36).

In today's society, individuals must be sophisticated enough to formulate appropriate access strategies for information in diverse disciplinary fields. This strategy formulation requires understanding of the structures of information and bibliography. It also requires the ability to judge the contextual adequacy of retrieved information, given the purposes underlying information needs. Ultimately, retrieval is inextricably linked to individuals' knowledge growth and development and society's cumulative knowledge base development (Huston & Oberman, 1989, pp. 199-212). As new technologies, automated systems, and electronic formats replace labor-intensive manual systems, the need for greater expertise in learning theories and behavioral motivations becomes a necessity for information professionals executing both routine and specialized job duties, especially user education programs. Librarians as experts in the organization and retrieval of large stores of information must assume leadership responsibility in teaching computer literacy to students (Aluri, 1989, pp. 213-22). The focus of this article is on the necessity of making connections related to end-user instruction—connections between graduate library school education and the practitioner; between learning strategies and library staff development and library-user education programs; between basic library-user education and lifelong learning skills; and between the library and the classroom, the library and media services, the library and computer centers, and the library and its users.

In order to assist library users in successfully accessing a host of local and remote systems—in both online and CD-ROM formats—library professionals are encouraged to accept a leadership role. They must facilitate end-user instruction in meaningful ways so that independent, individualized learning through electronic access is assured.

Because users must possess interdisciplinary perspectives to function in the contemporary information environment, librarians have expanded user education programs to accommodate a broad overview of the information environment, including necessary technological competencies. Again, without their having a background in educational theory and psychosocial behavior, progress has been slow (Baker, 1986, pp. 35-41; Baker & Sandore, 1990). Recently, however, user-based conceptual instruction has been developed for educating and training users "today for tomorrow's systems" (Huston & Mazuca, 1990, pp. 77-84).

EVALUATION OF ELECTRONIC RESEARCH INSTRUCTION

Various user studies have found that instruction for searching must provide not only basic procedural information but also conceptual knowledge. Knowledge of database structure, for instance, is fundamental to retrieval in diverse systems.

End-users can now expect to interrogate multiple files to satisfy their information needs. Increasingly, integrated systems are being seen as the mechanism for managing and interrogating local resources and, as well, for reaching beyond the boundaries of immediate collections to other libraries' OPACs and to commercial CD-ROM and online databases. Realizing the enhanced potential of these linked systems requires considerable expertise among both library staff and library users.

In the use of online systems, literate inferences and predictions are facilitated by both procedural competence and conceptual understanding. More specifically, instruction must provide appropriate conceptual concepts of the information universe in general and the electronic environment specifically. In order to respond to changing information needs and to help users formulate appropriate search strategies, instruction must convey the distinguishing characteristics of various media, telecommunications, and databases.

Technology based developments have rapidly increased the records of human experience and access to this knowledge. Digitized libraries could support independent, individualized learning through electronic access to information. Much, then, is at stake in properly employing these technological innovations and this, in turn, relies on staff and users who have been taught to exploit the new systems to their fullest extent.

For users to realize the power of the technology, staff must receive advance and ongoing education. Yet, libraries often fail to recognize the human requirements which are the foundations for successful new information technologies. This is unfortunate because the installation of any new system in the library can be traumatic and proper orientation can reduce resistance to change. In this sense, since the success of a technological innovation depends to a great extent upon the cooperation, interest, and expertise of those who manage and operate it, "changing technology is as much about changing attitudes as it is about bits and pieces of equipment" (MacMorrow, 1987, p. 104). Every staff member, regardless of his/her responsibilities for and relationship to a new system, needs a basic understanding of computerized retrieval. End-users, too, must be adequately oriented in order to operate effectively in the increasingly integrated and rapidly changing information environments.

Library staff and users must receive enabling education; training alone is not enough. Mastery of the mechanical aspects of operating a system may ensure some results, but it is only when the conceptual aspects are understood that users can truly exploit systems. Without proper instruction, "the necessity of adjusting to the library's way of representation can act as a barrier to success and satisfaction." In other words, "users need a comprehensive framework in order to assimilate all the seemingly discrete activities that take place in the process of information retrieval" (Dalrymple, 1990, pp. 272-81).

Questions concerning educational content are certainly a frequent preoccupation of those who teach, a mission which cuts across all disciplines. There are many unanswered questions in the educational process. How do people learn? How and what should be taught? What constitutes a learning experience? and Does that differ from the traditional concept of "being taught" in the strict pedagogical sense (Baker & Sandore, 1989)? The educational challenges implied by these questions have provided the impetus for the research-based programs reported in this article.

TOWARD INTERCONNECTIVITY IN END-USER EDUCATION

Both research and experience have demonstrated the difficulty of using any one teaching method, given the diversity and range of users' learning styles and knowledge levels. However, it is now generally agreed that information storage and retrieval systems instruction should be based on concepts which are transferable to teaching about information retrieval systems. Concepts address users' greatest difficulties: formalizing their information needs, selecting appropriate terminology, and developing search strategies that can exploit the interactive power of any system.

How is it possible to determine what to teach about systems? The most practical approach is to observe some of the common problems that users experience with online searching, either directly or through online system transaction monitoring techniques (Nielsen, 1986, pp. 28-34). Research findings suggest that users are rarely aware of a large portion of available search options, nor do they necessarily understand or correctly employ search options even if they are aware of them. Users are often confused over too many search options—e.g., when does one use a Boolean search technique over a keyword title access search? In lieu of a theoretical understanding of how to make such a judgment, many users rely on their previous experiences when making decisions. Current research also suggests that users are not aware that subject searching can be accomplished by means of controlled vocabulary terms. Similarly, Boolean search techniques and set building are usually techniques known only to seasoned online system users. Furthermore, users tend to make mistakes in clusters, so one error is likely to be followed by another error in online searching

(Borgman, 1986, pp. 387-400). Without professional guidance, then, the same errors are made repeatedly.

THE UTILITY OF MODEL BUILDING AND ANALOGY

Users need a framework in order to organize mentally all of the steps and problems involved in information retrieval. This framework must be capable of adjustment both in the correct approach to, and the process of, retrieving information. It should be a framework that can be easily employed and understood by the user. Therefore, a teaching model must be capable of addressing not only how information can be retrieved successfully, but also how a user approaches this process. Employing an "andragogic" teaching approach, where the teacher acts primarily as a resource to guide and encourage the learner, rather than "teaching" in the strict pedagogic sense, seems to be an effective teaching process for students and faculty members. In *College & Research Libraries*, Glogoff and Flynn (1987) crystallize the andragogic teaching process and its merits for adult learners:

These authorities contend that adults learn best through a complex process that includes references to past experiences, acceptance of the value of the learning, involvement in directing the process, and hands-on experimentation in a non-threatening environment. In such a system, the role of the trainer becomes primarily that of a resource, someone who supports and validates the competency of the self-directed learner. This experience-based learning methodology is termed andragogy. (p. 530)

In response to the teaching challenges discussed here, user-driven instructional approaches have been developed to mediate between the needs of information seekers and the requirements of information systems. Their evolution reflects consideration of three interrelated dimensions of effective teaching—cognitive models, conceptual models, and mental models.

Cognitive models describe the mental processes by which tasks are performed. They deal with the thoughts, feelings, and behavioral processes that transpire in searching. Conceptual models describe to the user how and why a system functions as it does, as the user is intended to understand it—not necessarily as the system actually behaves. A conceptual model is the framework instructors strive to create with the students. Conceptual models are often built around analogies, graphical displays, and other descriptive techniques designed to communicate to the learner an overall context for system behavior as well as specific aspects of system operation. Mental models embody the user's understanding of the system, which may or may not conform to either actual system behavior or any accurate conceptual models of that behavior (King & Baker, 1987, p. 8).

Thus, there exist three scenarios, but often only one crucial opportunity to help the user create a correct mental model which will enable him or her to search successfully. The more that is understood about the behavioral processes involved in searching, the more likely appropriate conceptual models will be created. Understanding behavioral processes goes just beyond observing how users input searches but also to gaining insights into the way users function cognitively.

The term *model* is often mistakenly assumed to be synonymous with analogy. An analogy points to similarities and also helps to establish an initial link between the familiar and the unfamiliar. Once the critical link is established, it is important to move beyond the analogy to a model. For example, in an instructional setting where users are accustomed to manual searching, a librarian may say that the card catalog is similar to the online catalog. However, while they may have the same basic function, they do not have the same structure. In contrast, a model need not have the same function as the system being taught, but it will represent the same structure as that system. As such, a model provides the necessary framework for building an understanding of the system's architecture. The crucial difference between analogies and models is that a model allows a user to move beyond partial, sometimes nonreinforcing, similarities to a foundation that provides a picture of what the structure of the new system will be (Baker & Sandore, 1987, pp. 192-206).

Rather than checking the new system against the old system, a conceptual model enables the user to apply a set of general guidelines in constructing his or her own mental model for the operation of the system. Because instruction is most effective when it is built on an individual's experiential frameworks, for users not yet conversant with either databases or computers, a preliminary explanation must reference everyday experiences of storing and retrieving information. Such an approach presupposes that "when an individual first acquires information about a computer-based system, the way in which the resulting knowledge is represented will be affected by knowledge of other noncomputational systems" (Foss & DeRidder, 1987, p. 159). Thus, the overall goal is to cultivate the development of mental models in users which enable them to make appropriate inferences and predictions during search decision-making.

THE COMMUNICATIONS ANALOGY

For individuals unfamiliar with computers—or even the scholarship to which these retrieval tools provide access—a preliminary introduction can prepare them to appreciate instruction about the databases which serve as the building blocks of information

systems. In other words, before learning about the technical components of computer applications, users must possess a contextual appreciation of their purposes. The communications analogy describes how human communication purposes and patterns have been used to effectively bridge what novices know from their own experiences to what they need to know about scholars' communication practices and resultant research processes. It follows that instruction should be broad enough to include concepts that relate to more than one tool and to organize the concepts into a functional model that is familiar, that can be easily taught, and most important, has a structure that is transferable to learning about the use of numerous research resources. In so doing, the instructor recognizes and extends the user's existing knowledge base.

Comparing a novice's experiential knowledge with a scholar's expert knowledge demonstrates that information transfer is integral to the communication which supports inquiry among both scholars and users. Inquiry through both everyday conversation and scholarly discourse depends on the observation and analysis of experiences, the framing of appropriate investigatory foci, the sorting and weighing of acquired facts, and communication of findings through appropriate channels to interested others. Ultimately, also, it is this knowledge navigation which is the purpose underlying all library information systems. In the scholarly domain, these transactions are, furthermore, organized into a structure of subjects represented through written language and recorded in a published literature. The elements of this structure are books, journals, proceedings, and other documentary forms. In response, librarians are engaged in the collection, organization, and dissemination of this recorded information. They study the particular properties it possesses—i.e., the ways in which it is produced and processed—so as to facilitate its optimum accessibility and usability. They are particularly interested in the bibliographical control of a discipline or subject literature—how well it is indexed and abstracted so that easy access and retrieval can be assured.

BUILDING EXPERTISE THROUGH THE DATABASE MODEL

In extending this information transfer framework, the database can be explained in terms of references from familiar database interactions from users' lives. Baker and Sandore describe the database model in a number of publications. The highlights of the model are described in the following paragraphs from their work.

Users encounter databases in their daily routines—via automated banking transactions, talking cash registers, mail order, data processing, and airline and hotel reservations, to name just a few

commonplace functions. As a beginning point in an instructional session, the librarian can draw on some of these everyday experiences to illustrate the concept of a database—i.e., a collection of records in machine-readable format, accessible in a number of ways by a defined set of commands and protocols. Every database potentially has a unique function, but all databases share the same general structure. It is this common structure of the database that makes it an important and particularly successful model in teaching all types of online system use.

Through an overview of the online information environment, individuals can be taught generally what systems can and cannot provide and how they can be manipulated. They can then be told the importance of knowing the scope and content of particular databases, as well as each database's limitations. Users must next learn how to match information needs with appropriate databases, given the variability in research questions and, as well, in access points. Lastly, they need to know about characteristic access protocols and search commands. Because of the lack of standardization among retrieval systems, instruction must include information about systems' documentation, such as user manuals, and the retrieval implications of different hardware and software combinations. Building on this concept of the database, two dimensions of instructional content have been identified: (1) teaching a decision-making framework which can be applied when approaching any file of information; and (2) teaching the general structure of how systems operate. Neither dimension is mutually exclusive and both use concepts associated with online catalog and information retrieval system usage.

In teaching each of these dimensions, it is important to actively delineate elements of the learning session that are the teacher's responsibility and those that become the learner's responsibility. The teacher describes the concepts and provides examples; the learner remembers the key concepts and applies them successfully. The student, for instance, should become well versed in the access protocols and search commands, which are not standardized across systems. They can cultivate their search efficiency through exploration of the types and formats of information in particular systems. By this means—active discovery—individuals learn to choose between controlled vocabulary searching and free-text or keyword searching. Individuals also learn how to interpret system responses and search output.

In turn, cultivating users' development of mental models of the structure of the electronic information environment requires that instructors discuss file structure, index generation, database updates and maintenance, and sorting principles. This approach provides

knowledge about system features which is transferable. Its conceptual, problem-solving orientation also supports use of the higher order thinking skills necessary to analyze needs and synthesize strategies.

However, this decision-making framework alone does not convey to students all they must know to effectively use an online system. It does not convey to students how information within the database is processed during searching. Although most people recognize that computer logic does not mirror human logic, the less one understands about this processing, the greater the tendency to accept output without questioning its accuracy. Database instruction must therefore be extended to include this background material. The database model can communicate any number of concepts. Cognitive knowledge about a system's design can enhance the users' searching ability through the development of the sound mental models necessary to negotiating complex interactive systems. This model has been successfully used in a number of instruction programs—e.g., at the University of Illinois at Urbana-Champaign and Northwestern University libraries.

TOWARD A SYNTHETIC TEACHING MODEL

An integration of the communications analogy and the database model assumes that what is fundamental to a search decision is an understanding of the forces animating the scholarly environment. Conducting successful research requires comprehension of both "who" and "what." This includes recognition that the knowledge represented by the bibliographic database entries is an outcome of interaction among members of intellectual communities who advance ideas in ways particular to their fields and disciplines. Additionally, search decisions require an understanding of why information is sought. Users must recognize the role of both formal and informal communication in transferring disciplinary information, supporting diverse interpretations, and creating new knowledge. From such a contextual framework, users can successfully develop strategies on how to retrieve online information, given the attributes of relevant information sources and the access characteristics of storage and retrieval systems.

This approach also recognizes that individuals search within an extended information environment containing resources of many media, both recorded and unrecorded. By explaining the kind of information produced in scholarly cultures, novices can then successfully decide when needed information is likely to be bibliographically controlled as published literature. Offering such a contextual framework through analogy prepares students for an

introduction through the database model to the organization of the larger information environment and to the capabilities of systems' search operations.

Through understanding that retrieval relies on an organization of data that facilitates appropriate selection through defined sets of commands and protocols, system users can begin thinking like searchers. This emergent expertise can be used strategically to situate the context of the question, to navigate the interface, to formulate one or more search paths, and to shift the search to a different pathway.

These teaching approaches build on users' familiar conceptual frameworks. Additionally, unlike tool and format-specific instruction, these approaches provide generic information for finding, evaluating, and using information, regardless of storage and retrieval media. By acknowledging both bibliographic and nonbibliographic entities through the linking of information retrieval with knowledge creation, they appropriately convey to individuals an image of an expansive information universe.

These approaches are illustrative of the experienced based instructional methods necessary to prepare library staff and users to exploit emerging system applications. They were constructed from concepts that relate to more than one automated library system or electronic database. These commonalities were organized into a functional model that was familiar and therefore intellectually accessible to users. Such context-sensitive educational approaches can cultivate users' thinking like searchers about the purposes which drive the construction of both information and systems. They can learn to proceed in a manner which is transferable to learning about access through integrated online library systems both today and tomorrow.

CONCLUSION

Success in navigating the rapidly changing information terrain requires significant ongoing learning by both librarians and users. Since even the most user-friendly systems will require that end-users consult with professional searchers, at least occasionally, broad based enhancement of information access requires that librarians continually build their expertise. Graduate library schools have the opportunity to prepare prospective librarians by ensuring that the curriculum emphasizes the necessity to teach intellectual self-sufficiency among library users.

Success in the information age requires a theoretical understanding of how people come to know and how they use new information; how they assimilate it into their existing conceptual schemes; and how these schemes may be modified in light of new knowledge. So that many may benefit from the insights of others, the professional

must better understand the way in which society comes to know and the nature of the processes by which personal knowledge becomes societal knowledge. Similarly, the process by which ideas are communicated from mind to mind, directly or through various media and methodologies, must be better understood. In this way, as our own horizons expand, we can better enlarge the world view of others (Gassol de Horowitz, 1988).

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