Association for Library and Information Science Education (ALISE)

Online Searching in Transition

The Importance of Teaching "Interaction" in Library and Information Science Education

Hong (Iris) Xie and Colleen Cool

Recent developments in information retrieval technology have created a new searching environment in which "interaction" is a central process. A new generation of interactive interfaces and Web-accessible databases challenge the traditional search strategies employed by users and require new interactive searching skills. In order to help future librarians and information scientists adapt to this new searching environment, it is the responsibility of library and information science educators to introduce "interaction" into online searching training. The topic of interaction is currently receiving much research attention, and the authors suggest the need to incorporate these research results into teaching and practice.

This paper focuses on issues involved in training online searchers in this new interactive searching environment. Based upon several empirical studies of information-seeking behavior in new information retrieval contexts, the following issues are discussed: (1) characteristics of new search environments produced by interactive system technology; (2) the nature of interaction in the search process and how this relates to both old and new information-seeking strategies; and most important, (3) how to incorporate the results of this interaction-based research into programs to teach students and online searchers to effectively interact with information, systems, and patrons. The extent to which interaction is currently incorporated into the curriculum of the top ten library schools in the United States is exam-ined. Suggestions for further development of interaction-centered courses in other library schools are made.

The Emergence of a New Searching Environment

In 1996, there were 1,805 vendors, 2,938 producers, and 10,033 databases. The growth in online database use for databases on the major U.S. systems offering word-oriented databases increased from 750,000 searches per year in 1974 to a high in 1995 of 72.4 million searches per year. The number of searches is larger if transactional databases and consumer service systems are added.[1] This explosion in the number of new databases and new database uses underscores the importance of studying

About the Authors

Hong (Iris) Xie is Assistant Professor, School of Library and Information Science, University of Wisconsin–Milwaukee. *Colleen Cool* is Assistant Professor, Graduate School of Library and Information Studies, Queens College/CUNY. This paper was presented at the 1998 ALISE conference.

this newly expanded searching environment. One of the most significant characteristics of this new environment is the change in systems themselves, in particular, the nature of the user-system *interactions* they not only provide but require.

This new generation of interactive information retrieval systems, which includes experimental information retrieval (IR) systems, Web-based, and new graphic commercial online systems, is characterized by the new system features and new access mechanisms.

New System Features

At this time, we are also witnessing the emergence of a new generation of interactive information retrieval systems that have sophisticated system features for searching and manipulating information from a variety of databases. Some of the most significant new system features of these new generation IR systems are that they:

- Encourage the use of unstructured "natural language" queries;
- Rank documents based on the probability of relevance to the query;
- Offer automatic relevance feedback, as a process in query formulation and reformulation;
- Display full texts of documents;
- Present search results in a variety of new forms, such as visualization and document clustering.

All of these system features can be described as new forms of interaction between users

and systems and between users and information items themselves.

New Access Mechanisms

Along with this growth of commercial databases, World Wide Web *access* to them is becoming more pervasive, and this development is one of the most important factors influencing the database producers, vendors, and users. Fundamental characteristics of Web-based searching are that it is inherently *interactive* and that it facilitates a variety of ways for users to interact with both information and systems. Significant characteristics of new access mechanisms across a variety of IR systems include:

- Navigation to a variety of databases;
- A variety of ways to select databases;
- Facilitation of multiple interactive search strategies, such as browsing, searching, etc.;
- Mapping to thesaurus terms;
- Multiple manipulations of output
- Iterative movement between screens by links.

Problems Posed by This New Interactive Searching Environment

A new generation of interactive interfaces and Web-accessible databases challenges the traditional search strategies employed by users, requiring the development of new interactive searching

skills and new understandings of the search process itself. Recent work in this area has demonstrated that users are constrained by their perceptions of the traditional information retrieval system and their existing mental models of the search process.[2] Users may not interact effectively with these new systems or make use of the interactive features and facilities these systems provide because of their perceptions and mental models. Recent studies of Web searching have identified similar problems people have in interacting with Web interfaces.[3]

These and other studies of searching behavior in new interactive system environments suggest the following problems:

1. Users are constrained by the traditional conceptual perceptions or models of search process and retrieval system.
2. Users often apply old search strategies to the new system environment, which may not support such behaviors, resulting in poor search outcomes.
3. New system environments confront users not only with new features but also new forms of interaction; effective performance depends upon searchers developing competence as interactants in these environments.

The Problem of Interaction in Information Retrieval: Traditional IR Systems

It has been recognized that information retrieval is increasingly an inherently interactive activity, in contrast to traditional noninteractive batch mode process systems. Theoretically and empirically, more and more research demonstrates that people cannot specify their information needs and, moreover, that people

engage in multiple information-seeking strategies within an information-seeking episode and across a variety of contexts.[4] The idea that a single best query presented by a user should be matched with document representations in the system has been criticized, and researchers have begun to study IR interactions, which include users, their problems, and the situations that lead to the selection and modification of information-seeking behaviors. Uncertainty is a fundamental characteristic of information-seeking behavior that can be reduced only through interaction.

While the importance of understanding IR interaction is generally well accepted, actually studying and, therefore, teaching this process can be difficult because interaction itself is so multidimensional. In his review article on modeling interaction in IR, Saracevic points out IR interaction is a complex process that is very much situation or context dependent: it starts from and relates to users, their tasks or problems, competencies, knowledge states, and intents, on the one hand; but it also involves characteristics and capabilities of the system, the information resources, and the interface, on the other hand.[5] Mantovani claims that understanding interaction is difficult, because what keeps changing in interaction is not just things in the world or things in the actor, but the very structure of their connection.[6]

The Problem of Interaction in New Information Retrieval Environments: Recent Research

Newly interactive system environments focus our attention to the study of how users perceive IR systems and also how they adapt to the new search environments. There is a growing body of research addressing how users

understandand use new interactive features and facilities. A set of studies conducted within the "Interactive Track" of the TREC program (see the relevant papers in Harman[7]) have tended to concentrate upon the effectiveness of particular experimental system features in interactive searching.

Koenemann and his associates observed experienced searchers in their interactions while searching on five different topics each in a system that supported both structured and unstructured searching within a best match, ranked output, full text retrieval environment. They identified three different approaches in which the searchers adapted to the new search environment: (1) use the new system features in ways that support routine searching strategies; (2) develop new searching behaviors that match the capabilities of the system; and (3) attempt to use both routine strategies and new features in combination.[8] The first two seem to have been more effective than the third in terms of performance, suggesting that different adaptive strategies have different effects on search performance.

In a similar study, Cool, Park, Belkin, Koenemann, and Ng investigated how people with varying degrees of familiarity with information retrieval systems, and varying models of the information retrieval process, interacted in an information retrieval system that did not support exact match retrieval with structured queries, but that did support best match, ranked output retrieval with unstructured queries and automatic relevance feedback. In this study, a majority of searchers had a mental model of the search process that was based on Boolean query formulation.[9] When placed in a system environment that did not support this strategy, searches exhibited a variety of adaptive behaviors similar to those identified by Koeneman and his associates.[10] The importance of this study is that it draws attention to the importance of understanding searchers' pre-existing mental models of the search process and the routine search strategies they employ.

In one recent study of Web-searching behavior, Bates compared Web-based packages—DIALOG Web and DataStar Web DIALOG—with the Classic, ASCII, dial-up version on which most experienced online searchers learned. She recognized the benefits of the Web-based product, but also considered the Web-based product to be less efficient and responsive for the experienced searcher than the ASCII product.[11] Xie raised the question of how to provide searchers with ease-of-use systems and at the same time allow searchers to have a certain degree of control based upon an investigation of experienced users' evaluations of Web-based interfaces of online systems.[12]

Incorporating Interaction into LIS Education

All three of the problems mentioned above are centrally related to interaction in information retrieval. They are the consequences of lack of understanding for the nature of interaction in information retrieval, resulting in the inability to effectively interact with new information systems. These problems can be addressed by placing greater emphasis on teaching interaction in LIS programs. In order to help future librarians and information scientists adapt to this new searching environment, it is the responsibility of library and information science educators to introduce "interaction" into LIS training, and, furthermore, to teach students and online searchers how to effectively interact with information, systems, and patrons in a variety of contexts.

Teaching Interaction: Dimensions and Challenges

This section outlines three dimensions of teaching online interaction that the authors believe to be important in interaction education and that address the problems discussed above. These three dimensions relate to: (1) different types of online interactions typically encountered by users now and in the future; (2) the problems of these types of interaction that should receive greater attention in teaching; and (3) suggested methods of teaching interaction skills, based upon our own research and teaching experiences and the experiences of others. The authors draw heavily upon experiences in actually studying interactive searching behavior in new system environments.

Table 1 presents types of information-seeking interactions and their problems or challenges. The three types of information-seeking interaction are *searcher-patron interaction, searcher-system interaction,* and *searcher-information interaction.* Because the topic of searcher-patron interaction has received so much attention in the literature, e.g., reference interview studies, etc., attention is focused more on the newer areas of searcher-system and searcher-information interaction.

Many of the interaction elements and problems are not unique to this discussion. Certainly, the subject of searcher-patron interaction and associated issues of problem specification have been well treated in the literature. However, a relatively new area of concern within the context of searcher-patron interaction is important; this is the problem of assessing users' tasks, goals, and domain knowledge. Historically, the focus of attention on searcher-patron interaction has been on the development of good interpersonal communication skills, toward the goal of eliciting user information needs that may not be concretely stated. More recently, however, it has become recognized that an important objective of the interaction between librarians/searchers and patrons is the assessment or description of the larger task and goal environment that may precipitate the information-seeking episode.

The description of user-system interaction and the interaction problems

Table 1
Information-Seeking Interactions and Their Challenges

Types of Information-Seeking Interaction	Types of Interaction Problems
Searcher–Patron Interaction	Problem specification Task/Goal profile Knowledge structure elicitation
Searcher–System Interaction	Understanding database contents and structure Understanding access mechanisms Understanding forms of interaction, i.e., feedback, ranked output Understanding appropriate language and search strategies of communication
Searcher–Information Interaction	Judging relevance of items and evaluating sources Understanding meta-information Interacting with information objects in different media

associated with this form of interaction are directly related to the problem of assisting searchers to adapt to new information system environments. Table 1 lists some of the most common problems associated with interactions in these new searching situations. As mentioned earlier, the new information retrieval environment with which we are concerned, with its variety of access mechanisms, organizational structures, and interface modalities, presents a significant challenge to both novice and experienced searchers. Experienced searchers who have developed routine searching strategies must learn to identify the contexts in which these strategies can be employed and those in which alternative strategies must be developed. Similarly, new searching environments such as described present both novice and experienced searchers with problems of understanding just what "language" to use in order to effectively interact with the system. Perhaps even more significant, some new system features such as automatic relevance feedback and ranked output require that users develop an understanding of how the information retrieval system is interpreting and responding to them as interaction partners. A significant challenge in training online searchers is to instill in them a sense of the *mutual* roles of searchers and systems as interactants.

Finally, the interaction between searchers and information items themselves is the most recently studied topic in this area, and much is yet to be known. This is characterized as the direct interaction between a searcher and some information object or item such as documents, texts, or elements of texts. Such interaction may take place through any medium, including visual, audio, and textual. In discussing this type of interaction, one significant problem area has to do with developing an understanding of how to evaluate, or make relevance judgments, about documents and information sources based upon interactions with partial elements of texts.

All of these examples stress the need to train library and information professionals involved in online searching and LIS education more generally, to become sensitive to, and skilled at, their role as an interaction partner with both systems and information objects or items. The question is, how to effectively introduce interaction into LIS programs?

Teaching Interactions: Techniques

One approach is to make use of actual empirical studies of online searching behaviors—in particular, studies of direct user-system interaction—and to introduce this naturalistic data into the classroom. Some of the techniques found to be especially effective as heuristic devices are the following:

- Role playing;
- Videotape analysis of actual search sessions and "thinking aloud";
- Diaries of search sessions;
- Computer transaction logs.

Among these techniques, *role playing* has long been used in classroom and workshop settings not only to train librarians but also to help them communicate effectively. This is an especially effective method for teaching skills in searcher-patron interaction. However, if the desire is to teach skills in searcher-system and searcher-information interaction, other teaching methods must come into play.

In our own research, cited above, we have used videotape recordings and *"verbal protocol" analysis* to illustrate to students many of the dynamics of end-user online searching. Verbal protocol analysis is a method that is frequently used in cognitive psychology to

understand what people are thinking while they are engaged in some problem-solving activity. During online search episodes, this method involves asking searchers to "think aloud": that is, to provide a running verbal stream of what they are thinking about and why they are doing what they are doing while interacting with a system or with some information item. Through this method, much insight is gained into the problems encountered by searchers and the adaptive strategies they employ in such situations.

Finally, computer-generated *logs of search sessions* can be a very valuable source of information about the types of interaction moves searchers make during their encounters with a variety of new systems and system features. Student search logs can be generated and then brought into the classroom for illustration and analysis.

These examples are just a few of the methods suggested as effective ways to introduce interaction into the classroom in LIS programs.

Teaching Interaction in LIS Education: Who's Doing It and How

This final section provides a cursory look at the extent to which interaction appears in the LIS curriculum at library schools around the country. Analysis is based entirely upon a review of the LIS curricula in schools ranked by *U.S. News & World Report* as the top ten library schools in the United States.[13] For each of these top ten library schools, the authors examined the published catalogs and evaluated each of the courses listed to determine how many courses focused explicitly on interaction, in some way or another. Analysis

Table 2

Interaction Courses at Top Ten Library Schools in U.S.

Name of University	No. of Courses	Titles
Univ. of Illinois at Urbana–Champaign	0	
Univ. of Michigan at Ann Arbor	1	Human-Computer Interaction Software Projects Lab
Univ. of North Carolina at Chapel Hill	0	
Syracuse University	1	Human Interaction with Computers
Univ. of Pittsburgh at Main Campus	0	
Indiana University at Bloomington	2	Introduction to Human-Computer Interaction Visualizing Information: Interface Design for Human-Computer Interaction
Rutgers Univ. at New Brunswick	1	Information Interaction, Mediation and Searching
Univ. of Wisconsin–Madison	0	
Univ. of Texas at Austin	0	
Drexel University	2	Information Retrieval Systems Cognition and Information Retrieval

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is based on the title of the course as well as the written description of each course as it appears in the catalog. Table 2 lists courses by each school that mention "interaction" in their titles or quite explicitly mention interaction in the catalog description.

Among the top ten library schools in the country, five of them offer at least one course dealing with interaction. Table 2 also reveals what aspects of interaction are treated most frequently in the LIS curriculum among these schools. Most of the focus is on the general study of human-computer interaction, especially on interface design. Rutgers provides a course that directly connects the study of interaction to the online search context. Drexel offers two courses, with one emphasizing systems that involve user-computer interaction, and another focusing on cognitive process and concept formation applied to the case of human interacting with IR systems. These results indicate that while interaction is being given attention at major library schools in the United States, gaps remain. In particular, some of the problems identified in table 1 do not appear to be addressed in the current courses offered among the schools examined. It is hoped that library schools across the country will pay more attention to the problems of interaction in the new information retrieval environment.

Conclusion

The development of Web-accessible databases and interactive information retrieval systems has created a new interactive search environment. The new interactive search environment poses new problems to online users. Constrained by their perceptions of traditional search processes and information systems, users often apply old search strategies to a new system environment.

Simultaneously, new search environments also require users to be able to use new features and new forms of interaction to perform effectively.

These problems can be addressed through teaching "interaction" to future librarians and information specialists in any library and information program. In order to efficiently teach "interaction," the three types of information-seeking interactions and corresponding interaction problems should be considered. In addition, the methods of teaching interaction skills based upon the authors' research and teaching experiences and the experiences of others are recommended.

Further studies need to investigate how users interact with new interactive information search environments and obtain more information about what users need to adapt to the new search environment. Moreover, research results of interaction in information retrieval need to be increasingly incorporated into teaching "interaction" in LIS programs.

References

1. Martha E. Williams, "The State of Database Today," foreword in *Gale Directory of Database* (Detroit: Gale Research, 1997), xvii–xxix.
2. Bryce Allen, "From Research to Design: A User-Centered Approach," in *Proceedings of Second International Conference on Conceptions of Library and Information Science: Integration in Perspective*, eds. Peter Ingwersen and Niels Ole Pors (1996), 45–59; Gary Marchionini, *Information Seeking in Electronic Environments* (Cambridge: Cambridge Univ. Pr., 1997); Colleen Cool, S. Park, Nicholas J. Belkin, Jurgen Koenemann-Belliveau, and K.B. Ng, "Information Seeking Behavior in New Searching Environments," in *Proceedings of Second International Conference on Conceptions of Library and Information Science: Integration in*

Perspective, eds. Peter Ingwersen and Niels Ole Pors (1996), 403–16; Micheline Hancock-Beaulieu and Stephen Walker, "An Evaluation of Automatic Query Expansion in an Online Library Catalog," *Journal of Documentation* 48 (1992): 406–21; Jurgen Koenemann-Belliveau, R. Quatrain, Colleen Cool, and Nicholas J. Belkin, "New Tools and Old Habits: The Interactive Searching Behavior of Expert Online Searchers Using INQUERY," in *Proceedings of the Third Text Retrieval Conference (TREC-3)*, ed. Donna Harman (Washington, D.C.: Govt. Print. Off., 1995), 145–77.

3. J.B. Jansen, Amanda Spink, J. Bateman, and Tefko Saracevic, "What Do They Search for on the Web and How are They Searching: A Study of a Large Sample of Excite Searches," unpublished manuscript; Mary Ellen Bates, "Knight-Ridder on the Web: A Brave New World for Searchers?" *Searcher* 5 (1997): 28–37; Martha P. Courtois, William M. Baer, and Marcella Stark, "Cool Tools for Searching the Web: A Performance Evaluation," *Online* 19 (1995): 14–32.

4. Marcia J. Bates, "The Design of Browsing and Berrypicking Techniques for the Online Search Interface," *Online Review* 13 (1989): 407–24; Nicholas J. Belkin, Colleen Cool, A. Stein, and U. Theil, "Cases, Scripts and Information Seeking Strategies: On the Design of Interactive Information Retrieval Systems," *Expert Systems with Applications* 9 (1995):

379–95; David Ellis, "Effectiveness of Information Retrieval Systems: The Need for New Explanatory Frameworks," *Social Science Information Studies* 4 (1984): 261–72; Robert N. Oddy, "Information Retrieval Through Man-machine Dialogue," *Journal of Documentation* 33 (1977): 1–14.

5. Tefko Saracevic, "Modeling Interaction in Information Retrieval (IR): A Review and Proposal," *Proceedings of the American Society of Information Science* 33 (1996): 3–9.

6. Giuseppe Mantovani, "Social Context in HCI: A New Framework for Mental Models, Cooperation, and Communication," *Cognitive Science* 20 (1996): 237–69.

7. Donna Harman, ed., *Trec-4 Proceedings of the Fourth Text Retrieval Conference* (Washington, D.C.: Govt. Print. Off., 1995).

8. Koenemann-Belliveau, and others, "New Tools and Old Habits."

9. Cool, and others, "Information Seeking Behavior."

10. Koenemann-Belliveau, and others, "New Tools and Old Habits."

11. Bates, "Knight-Ridder on the Web."

12. Hong Xie, "Access to Online Databases: An Exploration of Users' Experiences with Web Interfaces," in M. E. Williams, ed., *Proceedings of the 19th National Online Meeting, 1998* (Medford, N.J.: Information Today, Inc., 1998), 481–94.

13. "America's Best Graduate Schools," *U.S. News & World Report* (March 18, 1996): 79.

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