

Understanding Help Seeking Within the Context of Searching Digital Libraries

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To date, there has been little empirical research investigating the specific types of help-seeking situations that arise when people interact with information in new searching environments such as digital libraries. This article reports the results of a project focusing on the identification of different types of help-seeking situations, along with types of factors that precipitate them among searchers of two different digital libraries. Participants ($N = 120$) representing the general public in Milwaukee and New York City were selected for this study. Based on the analysis of multiple sources of data, the authors identify 15 types of help-seeking situations among this sample of novice digital library users. These situations are related to the searching activities involved in getting started, identifying relevant digital collections, browsing for information, constructing search statements, refining searches, monitoring searches, and evaluating results. Multiple factors that determine the occurrences of each type of help-seeking situation also are identified. The article concludes with a model that represents user, system, task, and interaction outcome as codeterminates in the formation of help-seeking situations, and presents the theoretical and practical implications of the study results.

Introduction

There has long been a concern in the information retrieval (IR) literature, broadly construed to include search engine technology, information objects and users, about how to effectively support people in their interactions with digital information resources which are often unfamiliar to them. In these new searching environments, users face a variety of requirements. They must learn to use new IR systems, including how to browse or create search statements, refine their searches, and evaluate results. Through direct interaction

with IR systems and information objects stored in the systems, users attempt to resolve problematic situations that initially lead them to engage in information-seeking episodes. As direct user-system interaction has become the central dynamic in the information search process, researchers have turned their attention to the specific interface features that might assist users in their search interactions, by identifying when and why people historically have had difficulty using systems they newly encounter, from as far back as early library Online Public Access Catalogs (OPACs) (Borgman, 1996) to today's Web search engines and newly created digital libraries. To effectively assist people in their information interactions, we first need to identify the types of problems people experience for which they require help and to better understand the nature of these help-seeking situations. While previous research has evaluated the variety of help features in different types of IR systems, less attention has been focused on more complete understanding of the help-seeking situations that give rise to help-seeking interactions.

While information seeking refers to purposive behavior involving users' interactions with either manual or computer-based information systems to satisfy their information goals, information searching refers to the microlevel of behavior when interacting with different types of information systems (Wilson, 2000). Information retrieval is a broad and general concept encompassing information searching. This research focuses on the information-searching context. The help-seeking situation is characterized by a person, who is engaged in the process of information searching with an IR system to achieve his or her tasks/goals, and finds him- or herself needing some sort of help in that process. In this context, help refers to assistance or clarification from either an IR system or a human in the search process when people encounter problems. The problem we address here is that help-seeking situations are not well understood, and at the same time, the design of help functionalities has proceeded without the benefit of such knowledge. There is a vast body

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of literature which has concluded that most searchers in help-seeking situations do not use the standard help features present on most IR systems, for a very good reason: This existing form of help is simply not helpful (Cool & Xie, 2004; Dworman & Rosenbaum, 2004; Monopoli, Nicholas, Georigou, & Korfiati, 2002; Slack, 1991; H. Xie & Cool, 2006). To be helpful to users in help-seeking situations, the design of help mechanisms must place people first and systems second, and perhaps more importantly, they must make interactions between systems and users a central dynamic to be supported.

We suggest that at this point in time, IR research has not adequately directed its attention to the issue of how best to support people in help-seeking interactions, particularly in new searching environments such as digital libraries. Digital libraries represent one type of IR system in terms of interface design and content coverage. To develop supportive help mechanisms, a focus on the types of problems and help-seeking situations encountered by novice users and the strategies they employ to resolve these situations is needed. The central argument of this article is that such research is necessary to better inform design principles that will generate better, more supportive interactive help systems for the general public. The focus of this investigation is on digital libraries as one type of IR system that is not yet commonly used by the general public and therefore provides a fruitful ground for investigating the variety of help-seeking situations encountered by new users. Novice users of digital libraries are likely to experience a variety of help-seeking situations not yet studied, which may provide insight into the problems they encounter, the patterns of interactions they engage in to resolve them, and the evaluation criteria they use in a variety of these interactions (Chowdhury, Landoni, & Gibb, 2006; Saracevic, 2000).

Related Literature

To better understand help-seeking situations in information searching, we need to examine related literature on IR. This includes literature that not only addresses information searching in general but that which focuses on help use in different IR systems, including digital libraries, and the nature of help seeking within this context. In addition, related human-computer interaction (HCI) literature also is introduced.

Help Use in Different IR Systems

In trying to understand help seeking and help use in information searching, IR researchers “refer to systems designed to assist the user in overcoming searching issues or better utilizing advanced searching methods by a variety of names including intelligent IR systems, explanation systems, intelligent IR interfaces, contextual help systems, recommender systems and relevance feedback systems” (Jansen & McNeese, 2005, p. 1481). Much of the existing research on help use in IR has focused on the evaluation of existing help features and users’ experiences with different help

functionalities. Previous research has shown that help mechanisms are often not helpful to users, for a variety of reasons. In early research on this topic, Trenner (1989) examined the help facilities of 16 interactive IR systems, finding the assistance offered by these functionalities to be inadequate in many cases, leading to the conclusion that the design of help systems is given a low priority in terms of overall system design and is therefore destined to be less than optimally effective. According to Nahl (1999), novice searchers are the main users of help mechanisms, and these users require different types of assistance, including help in learning about new IR systems. After studying the effectiveness and use of online help features in five different OPACs, Slack (1991) found that the help feature was utilized by only one third of novice users, and it did not assist these searchers in their help-seeking situations. It has been suggested that utilizing natural language searching abilities may improve a user’s interaction with the help feature; however, a study reported by Kreymer (2002) found that although natural language may be useful for average end-users during some parts of the searching episode, overall, when using system help, the results vary widely and are generally not very effective. Derived from users’ evaluations of retrieval features of 12 online databases, Othman (2004) found that users desired far more context-sensitive help such as relevance feedback, a list of similar terms or synonyms, and assignment of weight values for search terms.

Clearly, novice users encounter many types of help-seeking situations in new searching environments. The situation of novice users working within a new search environment creates more challenges for help seekers and for the design of effective help functionalities. In a study reported by Monopoli et al. (2002), only 34.6% of 246 respondents used the online help feature of a digital library, and 20% of those preferred human help. Based on a series of user studies on the user interfaces of another digital library, Hill et al. (2000) found that users preferred the following help features: (a) presenting search examples to assist users in formulating queries, (b) offering context-sensitive help, and (c) providing tutorials and frequently asked questions (FAQs). Frumkin (2004) suggested that a useful approach might be to start with the user interface and make digital libraries and user interfaces complement one another. To design a usability evaluation of an automated help mechanism in a digital library, it is important to understand the searching behaviors of novice users and the help-seeking situations that arise while using it (Borgman & Rasmussen, 2005).

Within the broader environment of IR, an earlier study was conducted by the authors (Cool & Xie, 2004; Xie & Cool, 2006) to examine some of the issues described previously. Results of this research further demonstrated the importance of developing better interactive help mechanisms to support people using IR systems of all kinds. The major finding of these earlier results is that while people generally view help systems as important, they find these systems to be lacking in usefulness in a variety of areas, and consequently tend to use help mechanisms infrequently. The analysis of reasons given for not using IR help points to general inadequacies

in the interactive capabilities of these systems as partners in help-seeking situations.

While a thorough review of the HCI literature in this area is beyond the scope of this article, several studies from this area are directly relevant to our concerns. Referring directly to general problems experienced by novice users of help systems, Dworman and Rosenbaum (2004) noted the well-cited finding that users often fail to use the help systems available to them, and argued that it is not the content of help systems that discourages their use but the ways in which users notice and access the help functionalities. To increase visibility and access, they identified five reasons for users' inability to use help. These are labeled (a) cognitive blind spots, (b) distraction aversion, (c) fear of leaving their current search task, (d) refusal to admit defeat, and (e) what the authors call "rose by another name" in which users are willing to access mechanisms with labels such as *search tips* or *quick reference guides*, but refuse to access something with the explicit label of help. In another study, Twidale and Nichols (1998) argued that the reasons users are likely to need help are clear. The quantity of information is growing rapidly, the variety of information in different forms of media also is increasing, and there is a rapid rate of change of new information systems, new functionalities, versions, and interfaces for existing systems. Consequently, even the most enthusiastic user of information-searching technology is faced with a continual need to update his or her skills.

Other HCI researchers have suggested different approaches to the design of effective help mechanisms. Houghton (1984) identified the types of assistance offered in online help systems at that time: command, help and error assistance, prompting, online tutorials, and online documentation. Krull, Friauf, Brown-Grant, and Eaton (2001) tested different phrases of an online help system and concluded that none of the help system features can thoroughly assist users to successfully accomplish their tasks, and they also identified the problems of help organization and help vocabulary. Grayling (2002) suggested providing a context-sensitive and embedded user-assistance system based on a usability study. In their investigation of why online help does not always target the problems that users encounter, Vouligny and Robert (2005) tested and found that an online help system designed on the basis of situated action theory was more effective than one that had no theoretical grounding. In other words, simply offering standard forms of assistance has not been effective for all users. An essential question that has been overlooked by researchers is "What are the characteristics of different information-seeking situations that give rise to different types of help needed by searchers in terms of both structure and content?" Although specific online help features have received much attention in a variety of contexts, the entire help-seeking situation has been studied far less.

Help-Seeking Within the Context of IR

Help seeking, as part of the information-search process, arises when a searcher needs assistance from an IR system

or a human to solve problems derived from different situations in the information-searching process. As such, it can be viewed as a multidimensional behavior insofar as it is one of the multiple behaviors that people engage in during episodes of information retrieval with the goal of interacting with information (Cool, 2006). Within the existing research, limited attention has been given to theoretically clarifying the concept of help seeking as it relates to IR generally, and to information searching more particularly. Research and development in this area has largely proceeded without attention to the precursors of help-seeking behaviors within the context of IR (Jansen, 2005). Jansen (2006) further noted that searchers only desire help at certain points in their search processes. It is these points of needing help that have to be identified and better understood.

Problematic situations and IR. Early researchers in the IR literature have discussed the role of problematic situations as precursors to information retrieval. Taylor (1968) illustrated levels of need from visceral to compromised need. To deal with a problematic situation, a user might have a vague information need, but it is not clear enough for him or her to articulate the need. The user gradually has a more focused idea about what information he or she needs even though he or she has to compromise his or her need at the end. The significance of Taylor's work is that it postulates a particular psychological state of mind of a user that may lead to an expressed need. Wersig (1979) used the concept of "problematic situation" to characterize situations in which knowledge and experience may be insufficient to resolve people's uncertainties. He identified an explicit account of precursors to information retrieval based on an individual's knowledge, beliefs, goals, and situations. Building on Taylor's levels of need and Wersig's "problematic situation," Belkin (1977, 1978, 1980) developed the "anomalous state of knowledge" hypothesis. When encountering a problematic situation, users do not have adequate knowledge to solve their problems, and their anomalous state creates cognitive uncertainty that prohibits them from adequately expressing their information need. They need additional information to clarify their thoughts. Dervin's situation-gap-use is the foundation for the sense-making approach. The elements of this approach include situations—the time-space contexts in which sense is constructed, gaps—the information needs or questions that people have when they make sense in the time-space contexts, and uses—how the information derived from an internal or external source helps or impedes bridging the gaps. Among the three components, gap-defining and gap-bridging are essential for the sense-making approach (Dervin, 1976, 1983, 1992). In sum, the driving force of IR is users' problems that lead to recognition of their inadequate knowledge to specify their information need.

Factors affecting information retrieval interactions. Cognitive uncertainty and interaction with IR systems are two major characteristics of information searching. Interactive help seeking is therefore a key element of information

searching as interaction is the central dynamic. To understand help seeking, we first need to understand what influences the information-searching process. In a recent work, Xie (2008) summarized major factors that affect the IR process that can be applied to the information-searching process as well: (a) tasks and their representation, (b) user personal information infrastructure, (c) IR systems, and (d) social and organizational context.

One of the frequently studied elements of the search context is the searcher's task. Specific tasks not only lead to information searching (Attfield, Blandford, & Dowell, 2003; Leide, Cole, Beheshti, Large, & Lin, 2007) but tasks' dimensions also influence how users search for information. Correspondingly, tasks and their representations have an impact on help seeking. Among dimensions of tasks, stages of task determine changes in search tactics, term choices, types of information sources, and relevance criteria (Kuhlthau, 1991; Pennanen & Vakkari, 2003; Vakkari, 2000a, 2000b, 2001; Vakkari & Hakala, 2000; Vakkari, Pennanen, & Serola, 2003). Complexity of tasks has a systematic relationship with the types of information, information channels, and sources needed. In addition, the higher the level of task complexity, the greater the types of information and sources needed (Byström, 2002; Byström & Järvelin, 1995; De Alwis, Majid, & Chaudhry, 2006). The nature of tasks, their time frame, and types of tasks affect how users plan and apply different types of search strategies in the IR process (Xie, 2006).

Users' states of knowledge determine how they interact with IR systems in retrieving relevant and useful information. Marchionini (1995) highlighted "personal information infrastructures," which consist of users' general cognitive abilities, their knowledge skills in relation to the problem/task domain, their knowledge and skills in general, their knowledge and skills specific to a system, and their knowledge and skills regarding information seeking. Previous research has demonstrated that a user's knowledge structure determines success or failure of IR and also influences search strategies that are used in the retrieval process. Marchionini, Dwiggins, Katz, and Lin (1993) explained well the problem-solving IR process: Domain knowledge facilitates users to understand the problems and have expectations of the possible answers, and IR knowledge assists users to develop conceptual and procedural strategies. Domain expertise has been proven to affect search behaviors and strategies and search performance (Bhavnani, 2002; Dumais & Belkin, 2005; Hirsh, 1997; Wildemuth, de Blied, Friedman, & File, 1995). Failure of keyword searching is attributed to lacking system knowledge (Hildreth, 1997). Experienced users perform better than do novice users in online searching (Lazonder, Biemans, & Wopereis, 2000; Sutcliffe, Ennis, & Watkinson, 2000). The complexity of IR requires users to apply multiple types of knowledge into their IR processes. According to Hölscher and Strube (2000), users who were able to draw upon their own expertise in both domain and retrieval knowledge were the most successful in their Web-searching process.

IR systems, as partners of IR interactions, play important roles in the IR process. To be more specific, researchers (Ingwersen & Järvelin, 2005; Saracevic, 1997; Xie, 2008) have identified interface, computational mechanisms, and information objects as the main components of IR systems that influence the outcomes of IR searching. Xie (2008) further illustrated several ways in which the design of interfaces can affect users' application of information-seeking strategies: (a) The design of the overall user interface might direct users to more or fewer applications of certain strategies; (b) the availability or unavailability of certain features controls whether users can engage in certain searching strategies; and (c) the information objects stored in IR systems that users interact with might influence the outcome of the current strategy, which in turn might affect their choices of the strategy. At the same time, it is a challenge for users to evaluate the quality and authority of the retrieved information (Henzinger, Motwani, & Silverstein, 2002; Rieh, 2002).

The social-organizational context also has an impact on IR. Fidel and Pejtersen's (2004) investigation of the information behavior of teachers in a public elementary school and the environment in which the school operates was the basis for their organizational analysis. Xie's (2006) study of employees' IR in a corporate setting revealed that dimensions of the work domain, such as priorities of the company, company philosophy, and business cycles, all had an impact on users' choices of information-seeking strategies. In addition, cultural dimensions also shape how users interact with IR systems (Callahan, 2005).

As discussed earlier, previous research in the area of help seeking in IR has been limited to a focus on system features more than it has on human searchers. It has identified the driving force for IR: problematic situations. It has investigated the factors that influence the IR process from user goals/tasks, user's knowledge structure, the IR systems as well as the social-organizational IR including information searching. The majority of research in this area has focused on help-system use and evaluation while less research has been directed towards understanding dimensions of help-seeking situations that lead users to look for assistance and the factors that define the help-seeking situations. While these studies have revealed that existing help mechanisms are not helpful because they do not support users in solving their help-seeking situations, they leave us with questions about how to make IR help functionalities more responsive to user needs.

The research cited earlier suggests the following gaps in the current literature. First, there is a need to identify the types of help-seeking situations that novice users encounter and how to best provide needed assistance for them. Second, there is a need for research to be conducted with participants from diverse backgrounds. Members of the general public are of particular importance because increasing numbers of people in all walks of life are turning to the Internet for problem-solving assistance. Digital libraries represent one type of IR system that they will encounter, perhaps for the first time in their lives. Therefore, they are likely to benefit from help

systems that truly address their searching needs in this new searching environment.

Research Questions

Lack of research on the precursors to help-seeking calls for the need to investigate what types of help-seeking situations lead users to look for help. This study attempts to answer the following research questions:

- What are the typical types of help-seeking situations experienced by novice users of IR systems, particularly digital libraries?
- What are the factors that lead to the typical types of help-seeking situations experienced by novice users of IR systems, particularly digital libraries?

Digital libraries were selected as the focus of the study mainly because digital libraries create a new searching environment in which many of the searchers are novice users. By answering these two research questions, researchers will have a better understanding of the nature of help seeking as well as the enhancement of the design of help mechanisms of IR systems. While the answer to the first question identifies types of problematic situations that lead users to look for help, the answer to the second question accounts for what prompts users to find help. The findings of these two questions will enable designers of IR systems to create more targeted and interactive help mechanisms specifically dealing with these help-seeking situations.

Methods

This study is part of a large-scale, Institute of Museum and Library Services (IMLS)-funded project. The project consists of 180 participants; 90 recruited from Milwaukee and another 90 from New York. Participants represent general users of digital libraries, with various ethnic backgrounds, education and literacy levels, computer skills, occupations, and other demographic characteristics. Recruiting messages were aimed at the general public and distributed in local newspapers and on community bulletin boards. These messages informed potential participants about a study of Web searching using several digital libraries. Potential participants were prescreened for their familiarity with the digital libraries chosen for use in the study so that novice digital library users from the general population would form the sample base. Ninety participants at each location were equally assigned to one of three groups, based on level of experience with IR systems: two groups of novice users (Groups A and B) and one group of expert users (Group C). Group A users only used system-provided help while Group B users also accessed human help in their searching of digital libraries. Group C users were determined by their experience with using digital libraries; these participants are not included in the analysis reported here.

Criteria for the selection of the digital libraries for this project were as follows. First, we selected two digital libraries that contain a wide variety of content that represents the type of information in which members of the

TABLE 1. Characteristics of participants ($N = 120$).

Gender	<i>n</i>	Percentage
Male	67	56
Female	53	44
Age (years)		
18–21	5	4
21–29	32	26.7
30–39	36	30
40–49	26	21.7
50–59	18	15
59+	3	2.5
Native language		
English	106	88
Non-English	14	12
Ethnicity		
Caucasian	81	67.5
Non-Caucasian	39	32.5
Computer skills		
Expert	11	9
Advanced	49	41
Intermediate	53	44
Beginner	7	6

general public might be interested. Second, the selected digital libraries contain multiple media formats or multimedia coverage of various topics. Third, we looked for digital libraries that have different designs of help mechanisms. Therefore, the Library of Congress American Memory Collection (<http://memory.loc.gov/ammem/index.html>) and the New Zealand Digital Library (www.NZDL.org) were chosen for this project.

Sampling

For this study, we focus on the entire 120 novice participants. Sixty of them were recruited from Milwaukee, and another 60 were recruited from New York. Table 1 presents demographic characteristics of the 120 participants selected for this study. Table 1 shows that the selected participants do represent the general public. About 56% of the participants were male; the participants cover each different age group, from 18 to 21 years to 59 years and older; and the participants represent different racial and ethnic groups. Although these participants had different levels of computer skills, they were all novice users of digital libraries. In this study, *novice users* refers to those people who never or rarely used digital libraries before participating in the study. Participants also represent different professions including students, legal technicians, teachers, managers, retirees, and other assorted occupations.

Data-Collection Procedures

Multiple data-collection methods were used for this project: prequestionnaires, think aloud protocols, transaction logs, and postquestionnaires. All participants were asked to fill out a prequestionnaire about their demographic information and their degree of experience in using different IR systems, their perception of the importance or usefulness of

help mechanisms, reasons for use or nonuse of these mechanisms, and any other perceptions they have about using or learning to use them, including the digital libraries used in this study. The authors conducted a pilot test of all of the instruments. To test the potential for bias of the prequestionnaire, the investigators conducted searches with participants who did and did not receive the prequestionnaire. No difference was found in the average number of help-seeking situations that participants encountered.

Next, participants were asked to conduct three tasks in each of the two digital libraries: the American Memory Collection and the New Zealand Digital Library. Three types of tasks were assigned to the participants in searching each digital library, and these tasks were chosen not to cause participants to use the help systems; instead, they were selected to simulate real-life, popular search tasks: an exploring task, a task requiring searching for specific information, and a task requiring searching for information with a variety of characteristics.

- The exploring task required users to explore each digital library. The exploring tasks for the American Memory Collection and the New Zealand Digital Library were: “Use three different approaches to find an 1895 map of Yellowstone National Park,” and “Use three different approaches to find a map of New Zealand.”
- The specific information task required users to search for specific information. The specific tasks for the American Memory Collection and the New Zealand Digital Library were: “What is another name that was used for Bubonic Plague in the nineteenth century? Name three countries or cities that were greatly impacted by an epidemic of Bubonic Plague in the nineteenth century, giving the year(s) in which it was most prevalent, and if possible, how many people were affected.” “Determine how many people in Uganda have been affected by HIV during any period of time within the past 20 years. Name three risk factors for HIV.”
- The third type of tasks required users to search for information that had a variety of characteristics related to content, format (audioclip, videoclip, etc.) and search strategy required. The search tasks for the American Memory Collection and the New Zealand Digital Library were: “Identify at least four issues regarding immigration policy in the U.S., using as many sources from the digital library as you can. Each issue you identify should have a different source.” “Identify at least four issues regarding immigration, using as many sources within the digital library as you can. Each issue should have one source.”

All participants were given a 15-min time limit to complete each of the six tasks. More than 95% of the participants performed their search tasks in computer labs, and about 5% of them searched for information at their offices or homes. They all used computers provided by researchers because of the use of Morae software. The entire search sessions were logged and recorded unobtrusively by using Morae software to capture data for further analysis of the interactions between users and the digital library systems. This software recorded video and audio of each participant’s interaction with a digital library with “think aloud” protocol. Morae also captured a visual footage of the participant’s computer screen during the search session and generated a transaction log of each participant’s search session. These recordings were combined into a single file for each individual participant.

After finishing their search tasks, participants were instructed to complete postquestionnaires. Postquestionnaires solicited information related to: (a) how participants learned to use help mechanisms, (b) the most useful and least useful help features, and (c) the evaluation of interactivity of help features in identifying problems, locating and providing relevant information, and explaining information.

Data Analysis

The investigators analyzed qualitative data collected from the transaction logs, “think aloud” protocols, and prequestionnaires. Qualitative data were analyzed by using open coding (Strauss & Corbin, 1990), which is the process of breaking down, examining, comparing, conceptualizing, and categorizing unstructured data. Descriptive analyses also were conducted to analyze the frequency of help-seeking situations and demographic characteristics of participants. Table 2 provides a detailed illustration of how data were collected and analyzed.

The data analysis began by using Morae Manager to extract important help-use data. This software allows for the audio and video files created in Morae to be viewed, paused, rewound, and advanced and for coded markers in the form of small flags to be placed at any point during the video. The Morae Manager permits the researchers to create a custom coding system specifying flag color, type of event, and specific event type for these markers to identify specific events for analysis. A coding sheet developed by the researchers was employed to record these events for data collection and analysis. The coding sheet mainly focused on

TABLE 2. Data collection and analysis plan.

Research focus	No. of participants	Data collection instruments	Data analysis methods
Demographic data	120	Prequestionnaire	Descriptive statistical analysis of demographic characteristics of participants
Types of help-seeking situations	120	Think aloud protocol, and transaction logs	Taxonomies of types of help-seeking situations by open coding Descriptive statistical analysis for each type of help-seeking situation
Types of factors that define help-seeking situations	120	Think aloud protocol, and transaction logs	Taxonomies of types of factors that define help-seeking situations

marking participants' problems that led them to look for help, their interactions with help mechanisms, and their outcomes. The coding sheet covers each help-seeking situation, associated factors defining each situation, interaction norm or help feature used, outcomes of the interaction, and next steps. This article concentrates on help-seeking situations and associated factors. The unit of analysis is each help-seeking situation conceptually defined in the Introduction. Operationally, the help-seeking situation begins when a person who is engaged in some information-seeking task encounters a problem that prevents him or her from continuing the search task, and ends when a person moves on in the search task. Evidence for this is provided by verbal comments of expressing problems and use of help mechanisms.

To ensure that the boundaries of the units of analysis were correctly isolated, a research assistant first selected and flagged the beginning and end of each help-seeking situation. The primary researcher at each location went through the first five transcripts with the assistants to correct any errors such as missing incidences and wrongly flagged incidences. After this initial training session, the process of checking each transcript was conducted by the researchers. To test the intercoder reliability of assigning help-seeking situations and associated factors, two researchers independently coded 60 selected cases randomly selected from the 120 cases. The intercoder reliability was .94 for help-seeking situations and .91 for associated factors according to Holsti's (1969) reliability formula.¹

Taxonomies of types of help-seeking situations were identified based on each individual help-seeking situation identified from 120 participants' search processes. After identification of types of help-seeking situations, researchers also calculated frequency and percentage of each type of help-seeking situations (Figure 1). Simultaneously, types of factors that define each help-seeking situation also were identified. Sixteen types of factors that represent four categories emerged from the data. To avoid repetition, detailed data analysis with examples is illustrated in the next section.

Results

The results are presented to answer the two research questions stated earlier: What are the typical types of help-seeking situations experienced by novice users of IR systems, particularly digital libraries? What are the factors that lead to the typical types of help-seeking situations experienced by novice users of IR systems, particularly digital libraries?

Types of Help-Seeking Situations and Affecting Factors

While engaged in information searching, users have to apply their knowledge and skills to achieve their task and goals; however, their existing knowledge and skills are not always enough to deal with all situations that may arise. This

¹Reliability = $2M/(N1 + N2)$, where M is the number of coding decisions on which two coders agree, and $N1$ and $N2$ refer to the total number of coding decisions by the first and second coder, respectively.

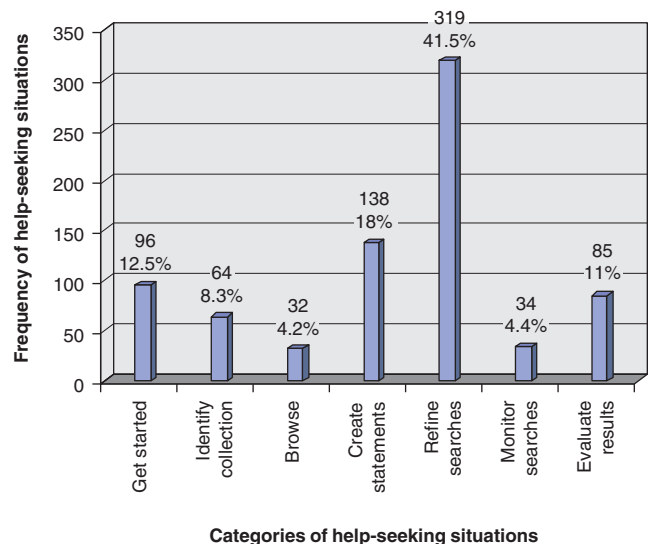


FIG. 1. Frequency and percentage of help-seeking situations.

study identifies 15 types of help-seeking situations that lead novice users to look for help. These 15 types of help-seeking situations can be classified into the following seven categories (Table 3): (a) inability to get started, (b) inability to identify relevant digital collections, (c) inability to browse for information, (d) inability to construct search statements, (e) inability to refine searches, (f) inability to monitor searches, and (g) inability to evaluate results. Participants encountered help-seeking situations 768 times in this study. On average, each participant encountered 6.4 help-seeking situations, ranging from 3 to 10 situations. Figure 1 illustrates the frequency and percentage of help situations identified from this study. Data show that help-seeking situations occur in every stage of the information-search process. Among them, inability to refine searches and inability to construct search statements accounted for the most frequent help-situations that participants encountered, 41.5 and 18%, respectively. Multiple factors determined the occurrences of each type of help-seeking situation.

In addition to isolating different types of search situations, this study also revealed 16 factors that define the different types of each. These 16 factors represent four categories: personal knowledge structure, task dimensions, system design, and interaction outcome. Table 4 presents 16 types of factors and their definitions.

Help-seeking situations were identified from participants' think aloud data and the logs captured by Morae. In the following examples, quotes related to help-seeking situations are presented in standard font, and quotes related to factors are underlined and specified with the factor abbreviation (see Table 4). Notes from researchers are added in brackets.

Inability to Get Started

Participants of this study were novice users of digital libraries, although many of them had information-retrieval experience from other types of IR systems such as general Web search engines. The first type of situation they

TABLE 3. Categories and types of help-seeking situations.

Categories of help-seeking situations	Types of help-seeking situations
Inability to get started	Inability to get started—unclear about the topic Inability to get started—unfamiliar with digital libraries
Inability to identify relevant digital collections	Inability to identify relevant collections
Inability to browse for information	Inability to browse for information
Inability to construct search statements	Inability to correctly formulate search queries Inability to select appropriate terms
Inability to refine searches	Inability to correctly formulate search queries Inability to select appropriate terms Inability to limit searches to certain fields Inability to refine searches for different aspects of the search topic Inability to identify other approaches for information Inability to refine searches in general
Inability to monitor searches	Inability to monitor search
Inability to evaluate results	Inability to identify relevant documents Inability to identify specific information Inability to compare items Inability to verify relevant documents

TABLE 4. Types of factors and definitions.

Types of factors/ Abbreviation	Definitions
Personal knowledge	Participants' knowledge, skills, and past experience related to information retrieval
Domain knowledge (DK)	Knowledge related to the search topic
System knowledge (SK)	Knowledge related to the digital library that participants interact with
Retrieval knowledge (RK)	Knowledge related to how to search for information
Previous experience (PE)	Participants' past experience in searching for information in different types of IR systems
Search style (SS)	Participants' preference in searching for information
Task dimensions	Attributes that define a task
Task requirements (TR)	Special condition for a task, such as time, identify different approaches, etc.
Task type (TT)	Different types of task such as look for specific information, look items with common characteristics, look for different aspects of a topic, etc.
Task complexity (TC)	Level of difficulty of a task
System design	Different aspects related to the design of a digital library, from interface, information objects to search mechanisms
Interface design (ID)	The design of user interface of a digital library, such as intuitiveness of the interface, etc.
Search mechanism (SM)	The design of search and browsing functions
Content coverage (CC)	The coverage and representation of information objects in a digital library
Interaction outcome	The search results derived from user–digital library interaction
Too many results (MR)	Overwhelming results
Too few results (FR)	Not enough results
No results (NR)	Zero result
Irrelevant results (IR)	Unrelated results
Confusing results (CR)	Perplexing results such as multiple answers to a question, contradictory results, etc.

encountered in searching digital libraries was related to how to get started. Inability to start the search process was due to a lack of domain knowledge on the topic or a lack of system knowledge about the digital library. Searchers needed guidance to get them started in their searching process. The results show two types of help-seeking situations related to inability to get started: while participants were unclear about the topic and while participants were unfamiliar with the digital library.

Inability to get started—unclear about the topic. A good start is half done. Domain knowledge is essential for users' effective information retrieval. However, users often search for information in unfamiliar domains. When they need to clarify their knowledge of the search topic, they need help. Some

participants could not get started because they did not have adequate domain knowledge. Therefore, they did not know how to proceed with their searches. Lack of domain knowledge on the search topics is the main reason that led to this type of help-seeking situation. In addition, participants were not sure how to get help for their domain knowledge from these digital libraries.

Ok, nothing is going to help me because I don't know where
DK
Yellowstone is . . . I should know that, but I don't. (s10)
I don't know if New Zealand is part of the United Nations
DK
or what. (s22)

I am not familiar with issues of immigrant policies. I do
DK
know how to get started. (s33)

Inability to get started—unfamiliar with digital libraries. As novice users of digital libraries, participants were not familiar with this type of IR system. We might say that they lacked mental models of digital libraries and how to search within them. Without such knowledge, searchers were put in help-seeking situations depending on their past experience and the intuitive design of the interface to get them started. The following example illustrates how a lack of system knowledge creates this type of help-seeking situation.

I don't know where to search on this. A lot of people don't
SK
want to spend all their time learning how to search when they're looking for something. (s9)

At the same time, past experience also affects the situation because these digital libraries do not have the same design as other types of IR systems that the participants were used to, as shown in the following examples.

I am not sure how to search collections like I did in online
PE/SK
databases. I would like to use how to . . . I don't know where
to start that's the problem. (s6)

Huh . . . I don't know probably if I was actually just searching for something on my own . . . and I came to this site . . . because it's like . . . I don't know. I think just because it is a different way it is setup . . . it's really frustrating. (s24)
PE/SK

More important, the design of interfaces to some extent makes the situation worse as these examples present.

I do not know how to start [issues regarding immigration] . . .
SK

This is not as intuitive as the other one. [American Memory]
ID
and it really does not make me feel good to use it at all. (s12)

[New Zealand digital library] is not user friendly at all
ID
[compared to American Memory]

If I used more often I would become familiar with the digital
SK
library. (s30)

I am unable to figure out the system easily, no clue on how
ID/SK
to look and where to look. (s54)

Inability to Identify Relevant Collections

Novice users are not always sure which collection(s) to start with, especially in digital libraries that contain multiple collections. The existing digital libraries do have information about collection(s), and the question we addressed is whether the collection information is clearly presented.

Identifying relevant digital collections is an essential task in searching for information because if users searched information in irrelevant collections, they might never find the right information. Not every participant was able to select the right digital collections. Some were confused about how to select the appropriate ones.

Inability to identify relevant collections. A lack of system knowledge is no doubt responsible for this type of help-seeking situation; however, interface design and content coverage also have an impact on the creation of this type of help-seeking situation. Participants would like to know more about the coverage of each collection and be able to search for specific collections. Here are some examples:

I think there might be an immigration collection. I am not
CC/SK
seeing it . . . I wonder why that was not listed in the
collections. [The participant clicks help.] (s86)

It would be a good feature if once you get into the collections,
you could actually had [sic] a search for the specific
SM
collection. (s30)

Of course, domain knowledge is also helpful in determining appropriate collections. Otherwise, users could not connect collections with their search topics, as shown in the following examples.

I guess I looked at all the different categories [collections]
especially for the last question. I could not in my mind figure
DK/SK
out how it would relate to any of those subjects so I'm miss-
ing something there, I think. (s10)

I do not know anything about immigration policies, and [am]
DK
unable to identify collections. (s51)

Inability to Browse for Information

Browsing is an alternative approach for users to find information. Digital libraries in general have created browsing mechanisms for their collections, but not all users can make good use of them. This study shows that participants did encounter problems in browsing information.

Inability to browse for information. Interestingly, while participants of this study did use browsing mechanism for the exploration task, they did not use browsing mechanisms very much for the other two types of tasks, probably because they were used to searching in other types of IR systems. This type of help-seeking situation was mainly caused by a lack of system knowledge, poor interface design, and unintuitive browsing mechanisms. Here are the examples from the study:

Maybe I'll just browse periodicals. I don't know really what
SK
I am doing. (s40)

I'm browsing here. I didn't see a map of New Zealand [in Humanity Development Library]. I don't know how to
SK
browse. The interface looks confusing to me. (s84)
ID

Let me try to browse particular sections of the collection.
How is it organized? I cannot find the answer. (s117)
SM

Inability to Construct Search Statements

Constructing search statements is no doubt the most challenging task for users. Participants had to construct queries to represent their search tasks. They needed sufficient retrieval, system, and domain knowledge to construct their search statements. Two types of help-seeking situations emerged regarding inability to construct search statements: inability to correctly formulate search queries and inability to select appropriate search terms. Interestingly, these two types of situations also occurred in refining searching categories when results were not successful. To avoid repetition, the authors discussed these situations only under the inability to construct search statements category.

Inability to correctly formulate search queries. Although there are some similarities in search features of different types of digital libraries, each type of IR system, even each digital library, has its own design of search features. That poses challenges for novice users of digital libraries. One of the issues in constructing search statements is that some participants did not know how to formulate their search queries mainly because of their limited system knowledge. Here is a typical example:

I am unable to construct a query. I do not have much search
SK
skills [sic]. (s54)

Simultaneously, participants constructed queries based on past experience using other types of IR systems, which might not work in these digital libraries; in particular, Boolean operators, quotes for phrases, and “+” must be present.

I'm doing a string of free text searching putting in only the
PE/SK
quotation marks so . . . I am going to see why I can't do that.
(s7)

Maybe this plus thing is screwing this up [keyword search
PE/SK
on HIV issues in Africa]. (s18)

The search results also influenced help seeking among these searchers. When participants found no results or irrelevant results, they needed to review their formats for the original search statements.

I'm having trouble understanding why there isn't anything
NR
[results]. Is there a way to make sure those words are all
SK/PE/SD
together [as a phrase in titles or chapters]? (s5)

I type keywords and that doesn't to me bring up relevant
IR
information . . . I don't even know if I can use Boolean
SK
searching. You think of a typical search engines . . . they
would consider This . . . aren't most searches based on
PE
Boolean searching anyway . . . ? (s75)

Inability to select appropriate terms. To construct search statements, participants had to come up with appropriate search terms. For that reason, lack of domain knowledge is the main cause for this type of help-seeking situation. Interestingly, this type of help-seeking situation also is highly related to the task type and task complexity, particularly when users have to look for specific information. For example, participants were required to find another name for the bubonic plague, and many of them had problems finding answers for that topic. Here are some examples:

I try to figure out how to come up with search terms that are
DK/RK
effective. (s94)

looking for the bubonic plague . . . so I need another name for
DK/TT
the bubonic plague. I am frustrated by this search topic. (s16)
TC

In some cases, participants could not find any relevant results because they were not certain that they had adequate retrieval knowledge. Here are two examples:

I'm not finding anything. I always put too many words or
NR
RK
being too specific. (s15)

I'm not sure I'm being specific enough . . . New Zealand
RK
Map. (s25)

Inability to Refine Searches

It is common that users have to refine their searches after their initial search statements; however, sometimes they are not able to do this. Three types of help-seeking situations were related to their inability to refine searches: inability to limit their searches to certain fields, inability to refine searches for the same search topic, and inability to refine searches for different aspects of the search topic. In more cases, participants just could not refine their searches.

Inability to limit searches to certain fields. Irrelevant results and lack of system knowledge led participants of this study to look for help in relation to how to limit their searches to certain fields such as publication year, title, format of documents, and so on.

What I really need is a search just on maps . . . see now I get
SK
IR
all the results but not the map of New Zealand. (s1)

I am not getting desired results. How do I find a way to do
IR SK/RK
numbers . . . for dates and that kind of thing? (s90)

Problems in system design worsen the situation, particularly counterintuitive interfaces and lack of information offered in the results. The examples present some of these problems.

Oh no, it's back to that same search thing which I don't even
SK/ID
understand [reads chapters, titles, paragraphs from "search for" in the Medical and Health Library]. I'm trying to figure out what these chapters, titles, paragraphs . . . I'm not really sure what I'm searching in. (s24)

National park reserve, this is not user friendly. I don't see
ID/SK
maps, where are they located? (s37)

None of these maps are dated. I guess I could . . . I'm
CC
frequently not looking at the help. (s4)

Inability to refine searches for different aspects of the search topic. In real life, users sometimes need to find different aspects of their search topics, which always poses a challenge for them. In this study, participants were instructed to find different aspects of a search topic. Many of them had problems in achieving this task mainly because of lack of retrieval and domain knowledge as well as the task requirement. The examples illustrate the problems.

I have to have different sources for each issue . . . I mean . . .
TR
I guess I am a little stuck just on getting to the point [of]
how I can find four issues. For me it would take time,
RK
but I only have 15 minutes for this. (s79)
TR

[found a different name for bubonic plague, tried to find
TT
countries and cities impacted by the epidemic] I used more
specific terms, which I kind of did and got the exact same
RK/DK
results. (s16)

At the same time, retrieval results and lack of support from digital libraries both in interface design and in search mechanism make it worse for participants to deal with these situations.

[look for relevant results using keyword searching and browse the results] Holy Cow, I am overwhelmed by the amount of
MR
the results. I don't want to read all the results to identify
RK/DK
multiple issues of immigrant policy. (s20)
TT/TR

I'm going to perform a new search on immigration policy,
TT/TR
issue but this digital library does not show me how to do it.
ID/SM

I'm going to look for tips for how to search for different aspects of a topic. (s21)

Inability to identify other approaches for information. Users cannot always find relevant information from just one approach. The more access points that a digital library offers, the more opportunities that users can find what they are looking for; however, they are not always aware of or know about multiple approaches. Identification of other approaches for information is useful when users have problems in finding information. It is also helpful for users to become familiar with digital libraries. That is why one of the search tasks for this study required participants to apply three different approaches to find the same information. Of course, not everyone could find more than one approach for information. In addition to task requirements, users' system, retrieval and domain knowledge are essential to overcome these situations.

Let me try to browse through the collection [another
TR
approach] and see if I can find the map. What's going on, so
much useless information. (s52)

I'm not having a problem with how to search, just having a problem with how to do it a third different way.

TR
I'm trying to think of another collection besides con-
SK
servation or maps that would include a map of Yellowstone.
(s3)

In many cases, participants exhausted all their knowledge in finding an alternative approach for information.

I tried this before . . . yea I don't know. I really can't think
RK/SK/DK
of anything else to find other approaches. (s24)

I can't find a map of New Zealand. I tried different
IR RK/SK/DK
approaches, and cannot find the answer. (s32)

Sometimes, looking for other approaches is not required by the task; instead, it is caused by irrelevant results from the original approach, as shown in the following example.

Maybe it's just me but I don't think these searches are
IR
extremely relevant to the word that I just put in so I will
try a different way to do this, but do not know how to do
RK/SK/DK
it. (s12)

Find a collection named 19th century periodicals 1815
TT
to 1900. [looking at home page literature] Well this topic
doesn't show me periodicals, it just shows me literature
IR
so it's not very explicit. I don't know. It would be worth
visiting help to see if there are other ways of finding the
RK/SK
collection. (s8)

Inability to refine searches in general. Not every help-seeking situation related to refining searches can be defined. In many cases, participants got lost in the refining process because of inadequate knowledge on retrieval and the system as well as task requirement and task complexity.

Everything's spelled right... isn't that interesting? I still can't find the correct information. (s17)
IR/RK

Of course, too many results also forced participants to refine their searches.

Found over 100 hits. Let's try narrowing my search. (s49)
MR RK/SK/DK

Time limit on task requirement also is a factor that led to this type of help-seeking situation.

Only five minutes left. I don't think I could find it. I have no idea. (s51)
TR SK/RK

I do not appear to be getting the correct information I am looking for in this search. It is very difficult to find information for this HIV question. (s118)
IR TC

Inability to Monitor Search

Information searching consists of continued and interrelated actions. In the search process, users have to know where they are and how they got there to select the next appropriate step.

Inability to monitor search. In this study, participants sometimes were lost and unable to monitor their searches. In that sense, lack of retrieval and system knowledge is the main cause for this type of help-seeking situation. In some cases, participants got lost; other times, the unsuccessful retrieval results forced them to go back where they were. Here are two typical examples:

I lost track. Let's see what else I can look for. (s2)
RK
I don't think this is going to work... it doesn't seem to work.
NR/IR
I'm going to go back to the beginning. How do I go back?
SK/RK
(s8)

Often times, digital libraries did not support users in monitoring their search process. The design of digital libraries sometimes made it more difficult for participants to continue their searches, in particular between the main site and the help site as well as between the digital library site and the browser site, as presented in the following examples.

[tries searching within help, clicking on the image of a search box in help (many if not all participants tried this)]
it might be useful for help pages to have more than just
SK ID

images, like giving a hyperlink to get back to a search mechanism. I think that would be really helpful... (s28)

I click home, get out of the site to MSN. How do I go back to American Memory site? (s59)
SK/ID

How do I get here? Is this the beginning of the homepage?
RK ID
Um... I'll try help. (s70)

Inability to Evaluate Results

Assessing relevance and usefulness of the search results is a key component in the search process. In this process, searchers have to identify relevant information, specific information, compare results, and verify relevant and useful information depending on the type of search task. For example, if searchers look for items with common characteristics, they need to verify whether the retrieved results contain relevant and useful information. If searchers look for specific information, they need to find specific information from the results. Four types of help-seeking situations were identified from this study: inability to identify relevant documents, inability to identify specific information from the retrieved results, inability to compare items, and inability to verify relevant documents.

Inability to identify relevant documents. When participants were unable to identify relevant documents, they normally were affected by either overwhelming results or irrelevant results on the first page.

I clicked on different links, but they were unable to answer what I was asking for, immigration policies. (s40)
IR
Many results, unable to identify the relevant answers. (s50)
MR

Sometimes, they needed more information to assist them to make relevance judgments. Titles were not enough, and they also needed abstracts to offer more information.

I think they should have abstracts here because if I looked at these whole books that's too many books. (s88)
CC

Inability to identify specific information. Compared to other types of help-seeking situations, it is more complicated to determine what leads to the inability to identify specific information. From the task side, participants were required to find specific information to answer search questions. From the user side, retrieval, system, and domain knowledge is needed to identify the specific information from the retrieved results. The results made it impossible for participants to effectively identify specific answers to the question. From a system perspective, these digital libraries did not help users to effectively evaluate specific information.

Many results. I did not like what I saw. It is difficult to locate
MR TT/ID/RK/SK

the correct information [how many people were affected by the disease]. (s38)

HIV in Africa, HIC in Uganda, I cannot locate how many
TT/ID/RK/SK
people in Uganda have been affected by HIV. (s54)

Not every participant had the patience to read through the retrieved documents. Some desired to search within the results, but they did not know how. Moreover, the design of digital libraries selected in this study does not incorporate search mechanisms for evaluation.

That's another bad thing about me. I don't like to read all this
SS
stuff to find the answer. I want to search it and find what I'm
ID/SK/SM
looking for. How do I search? (s2)

Inability to compare items. One problem in evaluating search results is that participants could not tell whether two items were the same. This problem is caused by several reasons. First, the digital library did not offer more detailed information. Second, the digital library presented confusing information. Third, participants did not have the domain knowledge to make a relevance judgment. Here are three examples:

I just wonder what the difference between this and the other
SK
one is [the participants' search results]. I think they should
CC
have some abstracts on there because this looks like the same thing . . . if I take the time to read for differences . . . I wouldn't want to do that. (s2)

I'm not sure of the correct item. Multiple sites with many
CR
pages on the plague, and many answers. (s42)

I am unable to compare the results [because] I do not
DK
understand the results. (s43)

Inability to verify relevant documents. It is a challenge to verify the authority and accuracy of the results, particularly when participants found multiple answers or confusing results. It would be worse if participants did not have adequate domain knowledge. For example:

There are many answers for the question HIV in Uganda, but
CR
I am not sure which result is correct. (s35)
DK

I'm unable to identify an eligible answer. Very confusing
DK CR
results. (s46)

Search yielded many results but not exactly sure what I got
MR/CR/DK
and even if they are correct. (s54)

Discussion

Model of Help-Seeking Situations and Its Theoretical and Practical Implications

Figure 2 illustrates types of help-seeking situations and factors that lead to these situations. The results of this study have both theoretical and practical implications. This study demonstrates that people do engage in multiple types of search strategies. In the information-searching process, people need to get started, identify collections, browse for information, create search statements, refine their searches, monitor the search process, and evaluate information. More importantly, the findings show that participants did need help to achieve the search strategies listed earlier.

Another interesting finding is that the factors that affect the information-retrieval process also influence the formation of help-seeking situations. Users interact with IR systems, including digital libraries, to find relevant information to achieve their tasks. No doubt, users' personal information infrastructure defined by Marchionini (1995), such as domain, system, and retrieval knowledge, plays a major role in determining whether they need to seek help. In addition, this study indicates that past experience of participants in using other types of IR systems also is responsible for the help-seeking situations. Lack of knowledge is the basic condition for help-seeking situations. As interaction partners with users, IR systems which are poorly designed, particularly with respect to the design of interfaces, the unclear coverage and representation of information objects in digital libraries, and the ineffective search mechanisms of digital libraries, unavoidably cause the creation of multiple types of help-seeking situations.

This study enhances previous research on task (Byström, 2002; Vakkari, 2001; Xie, 2008) to further identify dimensions of task, especially its influence on help seeking. Dimensions of the tasks, such as task requirements, task type, and task complexity, also affect whether participants need to overcome help-seeking situations. For example, based on our observations, it appears as if participants in this study encountered more help-seeking situations while searching for specific information than while accomplishing the other two tasks; however, these data are not enumerated here, and this observation provides opportunity for future analysis. Finally, the outcomes of user-digital library interactions are normally the first signs for help-seeking situations. When participants encountered too many results, too few results, no results, irrelevant results, and/or confusing results, they had to look for help if they did not have adequate knowledge structures to overcome these situations. The specific relationship between task and help seeking is a fruitful area for future research.

User, system, task, and interaction outcome codetermine the formation of help-seeking situations. More importantly, the results show patterns between factors and types of help-seeking situations. For example, while domain knowledge and system knowledge with good interface design are essential for participants to get started, retrieval knowledge, past experience, system knowledge, and domain knowledge

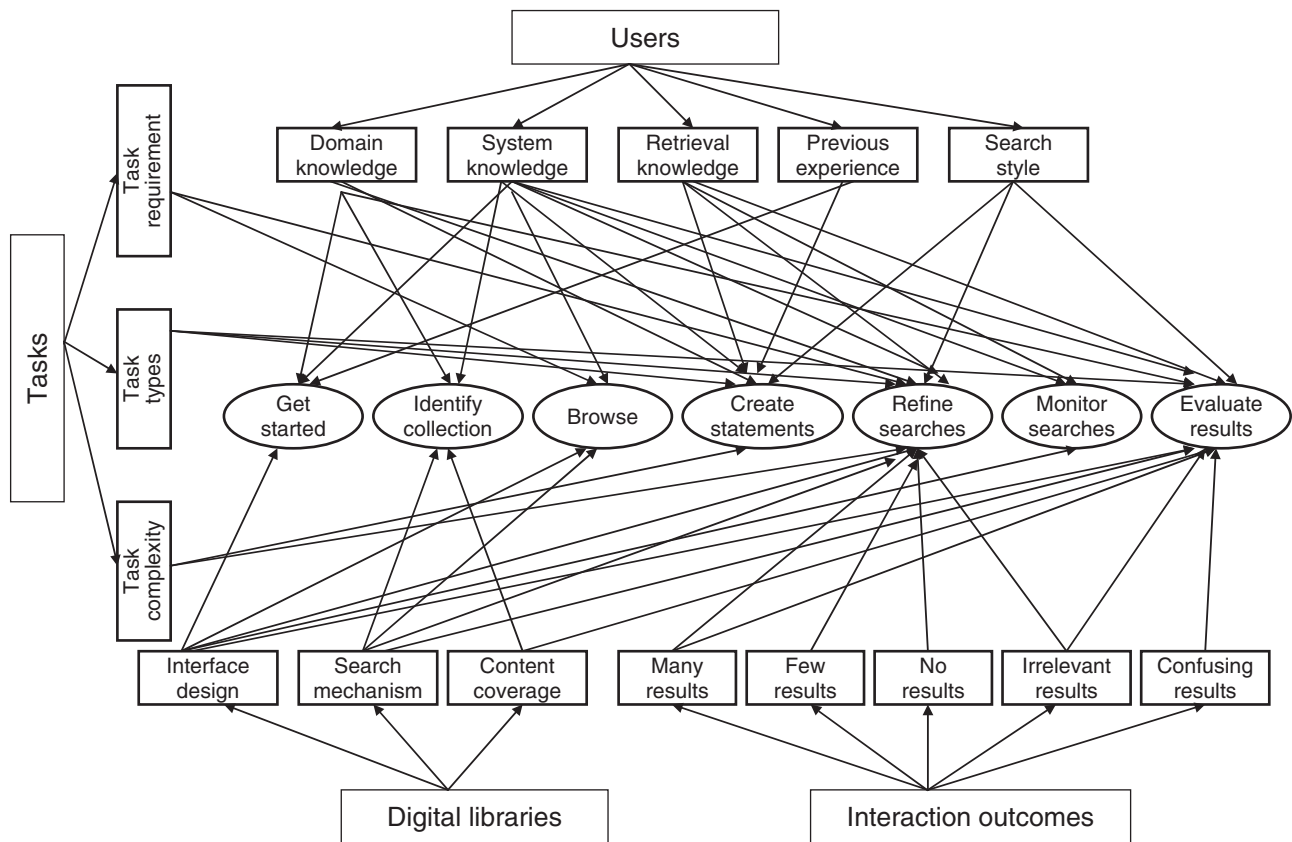


FIG. 2. Model of help-seeking situations and affecting factors.

TABLE 5. Summary of help-seeking situations, influencing factors, and design implications.

Help-seeking situations	Influencing factors	Design implications
Inability to get started	DK, SK, PE	<ul style="list-style-type: none"> Context-sensitive domain knowledge Overview of the structure and design of an IR system Intuitive interface design
Inability to identify collections	DK, SK, SM, CC	<ul style="list-style-type: none"> Linkage between collections and different subject areas Search mechanism for identifying specific collection(s)
Inability to browse	SK, ID, SM, TR	<ul style="list-style-type: none"> Demo of browsing options and structure FAQs regarding when to browse
Inability to create search statements	DK, SK, RK, PE, SS, TY, TC	<ul style="list-style-type: none"> Templates of searches based on task type and complexity Context-sensitive knowledge assistance Examples of how to create search statements
Inability to refine searches	DK, SK, RK, SS, TR, TY, TC, ID, SM, MR, FR, NR, IR	<ul style="list-style-type: none"> Explicit and implicit feedback mechanisms Interactive dialog protocol Integrating the help page into actual browsing and searching page
Inability to monitor searches	SR, IR, ID	<ul style="list-style-type: none"> Search history and search path options
Inability to evaluate results	DK, SK, RK, SS, TT, ID, SM, CC, MR, IR, CR	<ul style="list-style-type: none"> Different evaluation mechanisms for different types of tasks Context-sensitive knowledge assistance FAQs/examples for dealing with unsatisfied interaction outcomes

are key for them to construct search statements. The unsuccessful outcomes of interactions and task requirements force participants to refine their searches. At the same time, system design, overwhelming results, and confusing results are mainly responsible for the problems of evaluation of search results.

The findings of this study offer insight for the improvement of interface design as well as help mechanisms of IR systems. Table 5 presents types of help-seeking situations, influencing factors, and design implications. The help situations and factors offer suggestions for the design of help topics for users to solve help-seeking problems in their information

interactions. On one hand, each type of help situation is a type of help topic that users might have to consult. In that sense, the 15 types of help-seeking situations can be used to design 15 help topics in a variety of formats. For example, FAQs can be organized under each type of help-seeking situation, implicit context-sensitive help can be offered, and so on. On the other hand, factors that lead to these types of help-seeking situations determine what type of help users need. If it is a system design problem, then IR systems can be improved to overcome it. If problems are related to the task requirements, then templates of different types of tasks can be implemented into IR systems to help users to accomplish these types of tasks. Lack of knowledge is the main cause for different types of help-seeking situations. The following paragraphs offer some examples of types of help related to different types of knowledge.

Different types of help-seeking situations are not equally supported. Most help design focuses on offering support for system knowledge instead of domain knowledge. The help function labeled *about a collection* is the only way that users can obtain some knowledge about a collection that might contain information about a topic. As there were no choices for users to acquire domain knowledge of the search topic from the existing help of the digital libraries, they had to consult search help, which does not offer any domain-knowledge help. In addition, domain knowledge needs to be provided in a context-sensitive format, in a way that users do not have to look for it.

Even though system knowledge is the focus of help design, novice users of digital libraries are not familiar with digital libraries, as discussed earlier. The first thing they need to know is that there are different approaches to finding relevant information. For that purpose, the general help of digital libraries should provide not only searching but also browsing guidance. One element lacking in the existing help of digital libraries is the provision of information to users who bring different mental models of IR systems to search digital libraries. In the previous examples, one participant wanted to use Boolean operators, and another one was not sure if using “+,” which is used in Web search engines, caused a problem in searching digital libraries. This information could not be easily identified from the help offered by existing digital libraries. Some of the help-seeking situations indicate that participants were unable to specify a format, such as maps or periodicals, but the help did not explain to users how they could limit their searches. This also is related to the design of digital libraries, which should offer users options to search for specific formats.

Help-seeking situations related to information-retrieval knowledge require users to master enough knowledge in constructing queries—and more importantly, to reformulate queries—when their initial queries do not generate relevant/useful results. The existing help of digital libraries did have many help sections offering assistance in searching for a phrase, how to format search terms, search preferences, and so on. In helping users create and refine their search statements, different types of retrieval knowledge need to be

incorporated into the help of digital libraries, such as how to effectively construct a query, how to deal with no results, how to deal with overwhelming results, and so on.

The design of digital libraries also makes a difference in whether users need to look for help during their search process. Our results suggest that participants did not have enough support for their evaluation efforts. The design of digital libraries has its limitations; so does the help in digital libraries. Some of our participants were looking for a way to conduct full-text searching for the retrieved items to identify specific information. They tried to compare abstracts of different retrieved items, but they could not find any feature that allowed them to do so. Some help-seeking situations, such as those related to results evaluation, are caused by the limitations of digital library design because it does not support users' evaluation of retrieved items for different types of search tasks. Interestingly, this study also reveals that some participants could not tell the difference between help pages and actual search pages. They tried to search within the help page, and became frustrated when they discovered that the search box was just an image and not interactive. It is important to integrate the help page into the digital library interface, thereby enabling users to easily link to actual browse and search functions when they visit the help page.

Conclusion

This study takes an important step in the identification of different types of help-seeking situations that lead users to look for help in digital libraries. Help-seeking situations are determined by users, mainly their knowledge structure related to the domain of the search tasks, system knowledge, and information-retrieval knowledge. Interestingly, it is not only lack of knowledge but also the presence of users' knowledge about using other IR systems that creates help-seeking situations for users when they try to bring their mental models of one type of IR system to another. Some help-seeking situations are led by knowledge problems for which general help can adequately assist; however, some help-seeking situations require context-sensitive assistance because users cannot easily identify their knowledge problems. In such cases, users need to interact with help mechanisms to clarify their problems and find solutions.

Some help-seeking situations are caused by the design of digital libraries. To some extent, the overall design of an interface itself is the best help for the IR system. In general, the better a system is designed, the less help-seeking situations will occur. Haas, Brown, Denn, Locke, and Shneiderman (2006) showed that a well-designed tool or interface for a well-defined task is the best help that users desire. A well-designed digital library can avoid user confusion with the interface. Users need more implicit as well as explicit help. The history of studies related to automated help systems was discussed at length by Jansen (2005), who focused on implicit feedback as a way to activate automatic assistance. A benefit of automated help is that it can offer user assistance with minimal cognitive burden. However, before we can turn to

implicit feedback as a source of data in the design of effective automatic help, we need to understand the specific behaviors that play a role in this process.

Help-seeking situations also are influenced by the tasks that users intend to fulfill. Some tasks require more cognitive engagement than do other types of tasks, as discussed in the literature cited earlier. Different types of tasks and different requirements for tasks require different types of help. Additionally, the more complex the task, the greater the possibility that users fall into help-seeking situations.

This study has its limitations. First, although the tasks simulated real-life searches, participants were working on preassigned rather than on self-generated search tasks, which might affect the identification of factors that lead to help-seeking situations. However, this study is part of a larger project that compares users' system help use and human help use; therefore, some level of controlled tasks is needed to make the comparison possible. Second, participants performed their searches in computer labs. The unnatural setting might influence the way they normally search for information. Third, while verbal protocol analysis can truthfully record what participants were thinking during their information-retrieval process, particularly their thoughts related to help seeking, not every participant provided the detailed information related to what defined help-seeking situations and what led to these situations. That is why only qualitative data were analyzed for the factors affecting help-seeking situations. Finally, although digital libraries offer a good context for researchers to examine help-seeking situations encountered by novice users, the findings of this study might be limited to one searching environment. More research in other types of searching environments is needed to identify the similarities and differences in the formation of help-seeking situations.

This study calls for further research on the identification of help-seeking situations and associated factors based on real users with real problems in real settings as well as in a variety of IR environments, from online databases to Web search engines. Future research needs to identify the most important factors that lead users to seek help so that a predictive model can be developed. More importantly, the complexity of help-seeking situations calls for the need to design interactive help mechanisms to facilitate user-system interactions to clarify users' help-seeking needs in the information-searching process. Finally, more research should examine the best design principles to overcome different types of help-seeking situations, and further implement these best design principles into the design of IR systems to assess their usefulness and effectiveness.

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