Learning Styles and Information Seeking Behaviors in Online Information Retrieval Environments: Focusing on the Use of Online Library Catalogs and Electronic Databases

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Abstract*:* Studies on user characteristics claim that individuals are different in their abilities and reacting to a system. Certain types of individuals are flexible and efficient in their uses of online catalogues and databases while others are not. There are many individual variables affecting information seeking behaviors. Among other user variables, this study focused on cognitive styles, competency in using computer technology, and online search experience, and examined how these variables influence users' search performance and choice of navigational tools in online retrieval environments. This study also examined how students utilize the features of academic library online retrieval systems, particularly online library catalogs and databases.

Introduction

Information technology has had a great impact on research and development in many academic disciplines, providing a wide variety of resources and many powerful tools to search for resources. Transforming text-based information into a digital format and making it available online has improved information seeking environments for users by overcoming many barriers such as feasibility, accessibility, efficiency in time, space, etc. Recently, as an increasing number of individuals and organizations use online tools as their main channel for information resources, skills in retrieving electronic information become necessary for successful learning at school and performance at work. Over the years, techniques for information retrieval systems (IR) have been tested and developed, and modified for online environments in order to support people's needs and inquiries in information seeking activities and the traditional systems have been modified for online environments (Rasmussesn, 2003). However, in spite of a variety of tools, IR systems, especially the online library systems, may not accommodate users' needs, particularly users with certain cognitive styles. Recent studies on user characteristics in user-system interaction claim that individuals are different in their abilities and ways of reacting to a system. Certain types of individuals are flexible and efficient in their uses of navigation tools while others are not. Thus, some may get lost or be disoriented in hypermedia environments due to an inability to understand salient cues or an overload of excessive stimuli through multiple channels. Yet, web-based information retrieval systems (i.e.online catalog and databases) may not take into account individual differences in cognitive styles. Therefore, it is important to explore the relationship between individuals' cognitive styles and their information seeking behaviors in order to improve the performance of information retrieval systems by identifying factors that influence the information retrieval process.

Individual differences in cognitive styles

Information related activities are heavily subjective and user-focused activities; individuals differ in their needs, value judgments, and styles of seeking information. The use of information system is the personal decision of the inquirer, depending on situations and contexts. Furthermore, according to Kim (1997), in system evaluation studies, individuals with different characteristics react to systems differently. Particularly, learning style is one of the characteristics that greatly influence performance in systems. Literature suggest that learning styles are the composite of cognitive, affective, and physiological factors that serve as relatively stable indicators of how individuals perceive and respond to their learning environments.

The outline of field–related learning styles suggested by Witkin, Oltman, Raskin, & Karp (1971) is one paradigm of cognitive styles, measuring individuals' perceptual characteristics of information processing. Witkin et al., (1971) claimed that individuals have varying degrees of field dependency. In that cognitive style, three types of learners (field independent, field dependent, and field neutral) are identified by their levels of field dependency. They have different characteristics in their ways of perceiving, processing, storing, and recalling information; field independent (FI) learners tend to be more analytical and organized in their learning, possessing strong problem solving skills while field dependent (FD) learners are less structured, presenting difficulties in reorganizing information and attending to salient cues. In addition, FI learners are not easily influenced by surrounding environments, separating objects discretely from their backgrounds while FD learners are easily distracted by backgrounds.

Many people interpret that an IR process is a problem solving activity. Studies focusing on relationships between cognitive styles and individuals' success in retrieving information on the Web have revealed that FI learners with strong problem-solving skills perform more efficiently in a searching process, spending less time (Kim 1997). Furthermore, FI learners feel more comfortable with navigating in multifaceted hypermedia environments while FD learners can be cognitively overloaded by excessive stimuli or dissonant cues contained in multiple channel messages, and thus feel lost in hyperspace (Daniel & Moore, 2000). On the other hands, many studies failed to detect any significant interaction between learning style and students' performance in online learning environments (Brenner 1997, Wang et al, 2001). While many studies did not find any correlation between learning styles and learning achievements in online environments, still a majority of studies find individual differences in information seeking behaviors in online IR systems.

Information seeking behaviors

Studies propose several different models of information processing and seeking behaviors on the Web. In spite of a great variety of architectures of IR systems, when examining the stage of information process, users seem to experience similar stages in their ways of processing in each stage as a whole; yet they are very different within the context of searching strategies, sequencing the steps, accessing, extracting, and evaluating information. Thus, many researchers agree that technical and operational aspects of systems may not be sufficient enough to explain an IR process. Instead, investigation focusing on users' mental activities such as sense-making (Kulthau, 1993), cognitive, and behavioral approaches (Choo et al., 1997; Ellis, 1997) should be employed in order to deal with the complex nature of user's information retrieval activities (Wang et al., 2000).

Kulthau (1993) interprets information seeking behaviors as a sense making process. Information seeking is a process of constructing understanding from a state of uncertainty. While Kulthau focuses heavily on human cognitive status based on a traditional IR process, Ellis (1997) describes information seeking patterns, balancing both human and system approaches based on the Glaser and Strauss's (1967) 'grounded theory' approach. His model was derived from the observations of engineers and research scientists and includes eight categories; (1) surveying, (2) chaining, (3) monitoring, (4) browsing, (5) distinguishing, (6) filtering; (7) extracting, and (8) ending. Choo et al., (1998, 1999) adopted Ellis' version in order to create a behavioral model on the Web by comparing his patterns with Web moves. Through several studies focusing on user behaviors, the researchers agreed that "each mode of information seeking on the Web is distinguished by the nature of information needs, information seeking tactics, and the purpose of information use". The information seeking process is a personal activity that is situated by individual circumstances. Thus, the variables that influence an IR process depend on a

combination of internal and external factors that users might have; familiarity with IR systems is one of the important factors in the success of IR activities along with their abilities in evaluating information.

Online Information Retrieval Systems

Information retrieval systems (IR systems) provide a means of access to databases that contain vast amounts of information, responding to a user inquiry. The objectives of IR systems are to support users to generate search queries and present those results in a format that helps users determine relevant items. The process of IR systems includes item normalization (normalize the value of word using stems), selective dissemination of information, document database search, and index database search.

The online library systems are composed of many features such as catalogs, databases, loan services, reserved materials, etc. Usually, resources are arranged by subject areas and groups of related fields. All the features have menu-driven interfaces that allow searching by author, title, author/title combination, subject heading, and call number. Certain systems allow Boolean combinations of these; however, there is a great variety in the types of command for search techniques. Most systems are sensitive to case, word-order, space, and symbols such as slash and hyphen. Certain systems limit the number of characters in the search box. The retrieval rate varies by the amount of data that the systems carry and the number of databases and electronic resources (i.e. e-journal) the libraries subscribe to or purchase. The number of steps required to complete a search varies by systems as well. Therefore, if students are not familiar with the library systems, "the overhead" to obtain the information they want will increase, not because of the actual searching process, but because of the system analysis. Online library systems serve thousands students everyday as a primary tool for research and academic performance. Graduate students particularly are required to be systems competent in order to produce quality work. However, students often encounter difficulties in using the systems, complaining that unless they intentionally learn how to use the systems, they will not be able to use the systems effectively. Each school has different library systems and online catalogues and the databases that are used most frequently have different ways of operating depending on vendors. Most students do not exactly know how the systems work, but depend on their own instinct, navigating through the systems, and spending a great amount of time.

Research questions
1. Are there individual differences in the use of library systems and information seeking behaviors based on learning styles? What individual variables are correlated with information seeking behaviors?
2. How do the patterns of information retrieval activities in online environments compared to the Ellis's model?
3. How do students perceive and evaluate online library retrieval systems?

Participants and methods of data collection

The participants of this study were graduate students who have enrolled in the IS[Information Science] 580 and EP[Educational Psychology] 662 during the fall semester 2003. IS 580 introduces theoretical foundations to graduate students in information science, examining the nature of information and problems associated with its behavior, representation, retrieval and use. EP 662 is a research design course for doctoral students dealing with issues related to designing, conducting, and evaluating research methods. Data were collected using three instruments: (1) Group Embedded Figures Test (Witkin et al., 1971), (2) An information seeking behavior survey, and (3) Information retrieval activity. The GEFT was developed by Witkin, Oltman and Raskin (1971) to measure individual levels of field independency by tracing simple forms from the larger complex figures containing them according to the instruction. The information seeking behavior survey was based on Ellis's (1997) behavioral model of information seeking and modified by investigators. The information retrieval activity was designed to examine students' information seeking and retrieval processes by conducting research using the UT online library catalogue and databases.

Findings

1. **Individual differences in the use of library systems and information seeking behaviors based on their levels of field independency**

Person's correlation analysis was employed in order to examine whether individuals are different in their ways of information seeking behaviors. The correlational analysis was also run to discuss whether variables such as technology competency in using online resources and search engines, and competency in using online library systems are related to each other and to information seeking behaviors.

Table1. Correlations among cognitive styles and information seeking behaviors

	Competency in using			Information Seeking Behaviors		
	GEFT Scores (n=36)	Computer technology (n=36)	IR systems (n=36)	Success of IR process (n=36)	Overhead (n=8)	Satisfaction (n=8)
GEFT Scores (n=36)	.	.184	.480	.461	.613	.836
Computer technology (n=36)	.184	.	.004**	.013*		
IR systems (n=36)	.480	.004*	.	.274		
Success of IR process (n=36)	.461	.013*	.274	.		
Overhead (n=8)	.613					.028*
Satisfaction (n=8)	.836				.028*	

* Correlation is significant at the 0.05 level (2-tailed).

As Table 1 shows above, individuals' cognitive styles were not correlated with their information seeking behaviors defined success in IR performance based on Ellis' model (1997), the amount of time they spent for the research process [overhead], and satisfaction with their search results in the IR activity. The cognitive styles were not also correlated with other variables such as individuals' technology competency and the use of library systems. On the other hand, competency in using computer technology was correlated with individuals' information seeking behaviors and their perceptions in using library systems were correlated with competency in using IR systems and success in IR performance (p=0.004, p=0.013). Particularly, the students with high levels of technology competency reported being more comfortable using online library systems (i.e. online catalogue, databases, online library loan services, reserved materials) and they can efficiently use their time and strategies in retrieving relevant information. Furthermore, the observations from the information retrieval activity revealed that students' satisfaction with their search results was correlated with the amount of time and effort they spent on the research. However, ironically, the relationship between the overhead and their satisfaction was inversed: the more time students spent searching, retrieving, and evaluating information the less satisfaction they had with their results. It was also observed that students had their own navigation styles in using interface and used personal judgment in selecting and extracting information; even though they brought up the same pages using the same databases, they selected different articles related to the given topic. However, since the observations were not quantified, those data could not be tested for correlations with cognitive styles.

2. Patterns of information searching behaviors

As table 1 shows, individuals' cognitive styles were not related to their information searching patterns while overhead affected the satisfaction of the search results. Examining students' information seeking behaviors in detail was based on eight categories: (1) surveying, (2) chaining, (3) monitoring, (4) browsing, (5) distinguishing, (6) filtering; (7) extracting, and (8) ending; in the case of formal research, all eight stages were not clearly distinguished in the students' activities. They simultaneously went back and forth stages according to their needs. The stages such as chaining and filtering were not found: they did not use articles as a source in order to find more publications by the same authors or subcategories for chaining, or extract articles from the retrieved data directly without filtering. When the students did not

find enough information from the retrieved information, they went back to the browsing stage and started searching more information with the same key words using different IR systems. The students who seemed to be familiar with the IR systems did not spend much time in browsing while the students without knowledge about the systems spent more time in browsing by surfing around the catalogue and databases. Interestingly, the students tended to select resources by scanning the subjects only without reading the abstracts and did not use a variety of IR systems available; they used one or two types of databases or e-journals even though they knew that many other options were available. In using the features of the systems, the students used the basis search function by typing a keyword; nobody attempted to use advanced search options in order to narrow down the search options. For navigation, they used the back button on the toolbar rather than using the specific interfaces on the web page. Particularly, the students did not use the functions to filter the information, but extracted the articles immediately from the list of retrieved documents by scanning the subjects only. In general, the students tended to spend one third of total research time to browse the information using the IR systems and chaining did not occur in any cases; the students did not use authors or journals in order to find more resources but relied on the information that was retrieved by the systems automatically through keyword searching.

3. Students' perceptions of online library retrieval systems

Regarding the use of the library systems, students reported to be comfortable using the library systems. 72% and 67% responded that they felt confident in using the UT online library catalogue and databases. A similar number of students reported that they have been successful in retrieving necessary information using the systems. However, only 50% of the students perceived that the UT online library systems are designed to be user friendly, allowing them to access and retrieve information as they needed; only 56% and 64% reported that the online catalogue and databases retrieved as they request.

The results of the open-ended question about the students' favorite aspect of the library systems revealed that students preferred databases to other IR systems such as catalogues or E-journals because of the easy access and operation, full text options, a wide range of collections, and the capabilities that retrieve and organize information. Overall the students favored convenience of accessing and collecting data without having to search the stacks of periodicals.

Regarding students' help seeking behaviors, the students did not seem to seek help from information librarians or use information in a help menu or hints even though they felt that they needed help: 56 % responded that they need help from an information librarian to use online library resources and 64% have considered attending library workshops or training sessions to be able to utilize library systems more effectively. However, in fact they do not attend the classes or ask for help from librarians because of the time constraints and other private reasons. In addition, they do not use help functions in the systems; only 47% reported using a help menu or search hints for their research. Interestingly, in examining the use of a help menu between IS major students and non-IS major students, 63% IS students reported to use a help menu or search hints while 17% students with other study areas (i.e. education, audiology, etc.) did not.

Comparing students' perceptions between the use of internet search engines and the library systems, the students' preference of using library systems were slightly higher to internet search engines; 57% students chose library systems while 41.6% chose internet search engines for their preferred research tools. In ranking retrieval systems in detail, students ranked library online databases as the first, Internet search engines as the second, and online library catalog as the third. For the actual retrieval activities that restricted the use of Internet search engines, library databases were most frequently used (72.7%); and then online catalogues (18.2%) and E-journals (9.1%) were used by the students for their research project.

Conclusion

This research failed to demonstrate correlations between individuals' cognitive styles and their information seeking behaviors, but it was able to detect the individual differences in using the IR systems, particularly the selection of navigation tools, use of function keys, time to spend for each IR

stage, and evaluation of the retrieved information. This study also revealed that competency in using computer technology is the most important factor in the use of IT systems and success of IR activities. Students tended to skip the "filtering" stage due to lack of knowledge about the function keys to save the relevant documents and recall the saved documents to extract the necessary documents. In addition, students perceived that the IR systems are not designed to be user friendly and felt they needed help to utilize the system more effectively. The information seeking process is an individual activity. Users have to develop their own strategies and tactics based on their needs. In schools, most students do not know exactly how the systems work and struggle with them, spending a great deal of time for their research projects. In many cases, students' skills in using IR systems affect the precision of search results and the quality of work that they produce. Therefore, it is important to provide user friendly IR systems and opportunities for students to learn about the systems through mandatory workshops or training.

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