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Using the taxonomy of cognitive learning to model online searching

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ABSTRACT

In this research, we investigated whether a learning process has unique information searching characteristics. The results of this research show that information searching is a learning process with unique searching characteristics specific to particular learning levels. In a laboratory experiment, we studied the searching characteristics of 72 participants engaged in 426 searching tasks. We classified the searching tasks according to Anderson and Krathwohl's taxonomy of the cognitive learning domain. Research results indicate that *applying* and *analyzing*, the middle two of the six categories, generally take the most searching effort in terms of queries per session, topics searched per session, and total time searching. Interestingly, the lowest two learning categories, *remembering* and *understanding*, exhibit searching characteristics similar to the highest order learning categories of *evaluating* and *creating*. Our results suggest the view of Web searchers having simple information needs may be incorrect. Instead, we discovered that users applied simple searching expressions to support their higher-level information needs. It appears that searchers rely primarily on their internal knowledge for evaluating and creating information needs, using search primarily for fact checking and verification. Overall, results indicate that a learning theory may better describe the information searching process than more commonly used paradigms of decision making or problem solving. The learning style of the searcher does have some moderating effect on exhibited searching characteristics. The implication of this research is that rather than solely addressing a searcher's expressed information need, searching systems can also address the underlying learning need of the user.

1. Introduction

In this research, we investigate learning theory for understanding information searching. Specifically, we aim to discover an inferential framework based on learning theory for indentifying the cognitive category of a searcher's need based on characteristics of the information searching process. By information searching, we mean "the 'micro-level' of behavior employed by the searcher in interacting with an information system" (Wilson, 2000, p. 49). While many have studied individual differences in information searching (c.f., Saracevic, 1991), no one has proposed a model that relates individual differences to information searching. Saracevic comments, "We are still lacking a theoretical framework and/or explanation for all these findings (concerning individual differences). Without such a framework, the work on individual differences in (information retrieval) will continue to proceed as in the past, using a shotgun approach." (Saracevic, 1991, p. 85). Ford, Miller, and Moss (2003) make similar assertions concerning the need for such a conceptual model.

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There has been prior work on classifying individual searching tasks rather than the specific need that generates these tasks. Several researchers have investigated individual searching tasks classifications. For example, MacMullin and Taylor (1984) present a classification of information seeking tasks. Byström and Järvelin (1995) explore the relationship between task and complexity in a work environment. Rose and Levinson (2004) present a classification of Web searching tasks based on the type of content desired. The research presented here is related to these prior efforts (and many others in the searching task research stream); however, our focus is in discovering a framework for classifying the underlying need that leads to a specific searching task.

The most commonly presented frameworks for understanding information searching needs are problem solving and decision making. Donohew and Tipton (1973) comment on the close relationship between information seeking (of which information searching is a component) and decision making (p. 251). March (1994) distinguishes between decision making and problem solving, commenting that searching relates directly to making decisions. Many other researchers have investigated aspects of information searching from a decision making or problem solving perspective (c.f., Belkin, 1988; Kraft, 1973; Lopatovska, 2007), and Case (2007) provides a review of decision making research for information seeking research.

However, the recognition of problem solving as a conceptual framework for information searching is not universally accepted. Sperber and Wilson (1995) argue that problem solving does not apply to all information searching situations. More importantly, there is a notable lack of empirical data to support the relationship between information searching and problem solving. Most of the published works that discuss the relationship between decision making and searching are descriptive in nature (i.e., the proposed decision making model is not predictive). Few laboratory studies linking information searching behaviors with decision making currently exist.

Some researchers have questioned whether decision making and searching are actually related. For example, in investigating the relationship between decision making and information searching, Jansen and McNeese (2005) administered the Problem Solving Inventory (PSI) survey instrument to approximately 40 participants of an information searching study. The PSI consists of a 35-item self-report measured in a 6-point Likert-style format (strongly agree to strongly disagree). The PSI instrument assesses an individual's perceptions of his or her problem solving capabilities (i.e., a person's level of efficacy as a problem solver). A person's self-efficacy in a given domain is correlated to actual performance in that area (Bandura, 1994). Jansen and McNeese (2005) showed no statistically significant relationship between problem solving self-efficacy and searching performance or between perceptions of problem solving ability and searching characteristics. If prior work on information searching as a problem solving activity is correct, one would expect some relationship between problem solving and information searching behavior (Bandura, 1994). Bandura (1996) reports that self-efficacy in a particular task influences choice of activities, effort expended, and duration of effort. Jansen and McNeese (2005) failed to show a relationship, and we have found no studies that reveal a statistically significant correlation between decision making and information searching. Based on these findings, we sought potential approaches other than problem solving or decision making to describe accurately the information searching process.

One likely potential approach is that searching is a learning process. Schmeck (1988), p. 3 defines learning as "an interpretative process aimed at understanding reality". Davis and Palladino (1995) p. 194 state that learning is "a relatively permanent change in behavior potential that occurs as a result of experience". Bloom, Englehard, Furst, and Krathwohl (1956) state that learning occurs at the cognitive, affective, and psychomotor domains.

Prior work has often linked information searching, albeit anecdotally, as a learning activity. For example, Dewey's "learning-by-doing" (1916) is often used to provide the pedagogical underpinning for interactive learning environments. Wittrock (1974) describes the process of knowledge construction in which the learner relates new information to old, building enhanced knowledge structures. Yankelovich, Meyrowitz, and van Dam (1985) draw an analogy between education and hypermedia information as seeing connections and following links. Marchionini (1995) states that information searching is closely related to both problem solving and learning (p. 5–6). Budhu and Coleman (2002) consider information processing as a fundamental cognitive activity underlying the process of learning.

Are there specific searching behaviors that one can map to a particular learning model? If so, what are these mappings? What does this insight tell us about the underlying need of the searcher? These questions motivate our research. In the following sections, we present a literature review of learning as a model for understanding information searching, followed by our research questions, research results. We conclude discussion of implications for online searching systems and future research aims.

2. Review of literature

Information need is a core concept of information science (Wilson, 1981) and typically refers to the underlying motivation of the user to seek specific types of content. In this research, we replace 'information need' with just 'need, as research has shown searching is motivated by needs other than just information (Jansen, Booth, & Spink, 2008). Users select search strategies based, at least in part, on how they conceptualize the need. Moreover, need also influences a variety of factors concerning the evaluation of the usefulness, relevance, and authority of retrieved content in searching. As such, a better understanding of and a methodology for classifying needs is central to adequately addressing the variety of motivations that cause individuals to engage in searching.