Computers & Education 77 (2014) 134–144

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Effects of student characteristics and question design on Internet search results usage in a Taiwanese classroom

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ARTICLE INFO

Article history:
Received 8 March 2014
Received in revised form
27 April 2014
Accepted 28 April 2014
Available online 9 May 2014

Keywords:
Human–computer interface
Interactive learning environments
Media in education
Multimedia/hypermedia systems
Navigation

ABSTRACT

A large percentage of students who use Internet search engines accept the results they are given without challenge, which conflicts with many learning theories that emphasize exploration. Longer and more in-depth searches require critical analyses of results as part of a process that is thought to produce better learning outcomes. With the development of social media, social motivation is increasingly considered an important factor in learning. To boost motivation for knowledge exploration, many instructors are adding elements of high interest to students to their teaching materials and activities. Here we investigate the effects of social motivation-associated priming on learner behaviors involving search engine results, using differences in learner characteristics (peer relationships and math skills) and search question type (add-on and integrated) as the main distinguishing factors. Our sample consisted of 81 students between the ages of 14 and 15 in a junior high school located in northern Taiwan. All of the participants were experienced in using computers, the Web, and search engines. Our results indicate (a) no significant effects of peer relationships or prior math achievement on the use of search results in that subject area; (b) the use of add-on questions (i.e., presenting math questions after presenting interpersonal relationship questions) encourages the appropriate use of summary results; and (c) the use of integrated questions (i.e., learners read stories involving a mix of interpersonal relationship and math information before addressing search questions) encourages students to read more information from search results rather than focusing on finding single "correct" answers. We interpret the third finding as evidence of greater enjoyment of exploration.

1. Introduction

Search engines are standard features in today's classrooms, but as Merrill (1997) notes, "information is not instruction," therefore the information presented by search engines must be modified to have value. Search engines are much better for disseminating facts and ideas than for providing learning materials. Many students never learn how to analyze search results in terms of accuracy and trustworthiness, resulting in lower learning efficiency and occasional feelings of helplessness (Liu, Chin, & Ng, 2003; Spink, Wolfram, Jansen, & Saracevic, 2001). Sparrow, Liu, and Wegner (2011) contend that most search engine users understand more about how to find information than how to analyze, use, or select appropriate content.

According to Bruner (1996), learning by discovery requires students to use inferences, solve problems, and find facts on their own; the main job of instructors is to encourage curiosity (see also Dodge, 1995). However, the most popular search engines tend to hinder knowledge exploration by arranging orders of hits based on paid placement or the number of previous clicks on existing links. In a study involving the Google search engine, Lorigo, Hembrooke, Joachims, Granka, and Gay (2006) found that 96% of their participants only looked at the first results page, which usually contained ten hits. Most only looked at the first two hits, and none went beyond the third page. In other words, they accepted hits at the very top of any search engine return list as containing trustworthy information, and made little (if any) effort to test or challenge them.

For the present study we assume that greater search depth (i.e., longer search times) is an indicator of greater effort to explore information so as to achieve better learning efficiencies. Several research teams have observed that the motivation to use search tools is either

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http://dx.doi.org/10.1016/j.compedu.2014.04.020
0360-1315/

extrinsic or intrinsic. Extrinsically motivated students passively search for answers to questions designed by their instructors and focus their efforts on finding "correct" responses; intrinsically motivated students actively search for information based on personal requirements or interests (Segev & Baram-Tsabari, 2012; Song & Zhang, 2011; Taksa, Spink, & Goldberg, 2008; Thatcher, 2008; Wang, Zhang, & Zhang, 2009).

Today's instructors and knowledge facilitators must deal with challenges associated with a third type—social motivation, exemplified by Facebook and other social network websites. Thus, they may benefit from greater understanding of the learning effects of peer interaction in terms of assistance and priming (Mazer, Murphy, & Simonds, 2007). Our primary research focus is the potential effects of peer relationships on learner behaviors tied to search engine-based learning. Second, we will investigate the effects of social motivation, question order (add-on), and situated questions (integrated) on the learning of problem-solving skills involving search engines. For add-on questions, learners respond to search tasks involving interpersonal relationships before performing searches for math-related information. For integrated questions, learners read stories containing a mix of interpersonal relationship and math information before performing searches in response to a math-related prompt.

Our main goal is to understand the combined effects of question design and interpersonal relationship topics on the ways that learners use search engine results in order to enhance learning and information processing. Our primary research questions are

1. Do peer relationships affect learner behaviors involving the use of search engine results?
2. Does previous math achievement affect learner behaviors involving the use of search engine results?
3. In math-related search tasks, can specific learner behaviors involving search engine results be encouraged by the use of add-on questions directed at interpersonal relationship topics?
4. In math-related search tasks, can specific learner behaviors involving search engine results be encouraged by the use of integrated questions directed at interpersonal relationship topics?

2. Previous research

2.1. Information searches

Most search engine users, including students, are more interested in finding information in response to specific problems than general knowledge accumulation. Today's students must develop capabilities to search for, process, and evaluate information (Bilal & Kirby, 2002) while integrating prior knowledge (Brand-Gruwel, Wopereis, & Vermetten, 2005). Toward these goals, Web-based information searches are now considered an essential skill for problem-solving (Park & Black, 2007). Kuhlthau (1993) describes Web-based search engine searches as examples of constructive self-knowledge expansion by users dealing with questions or issues, while Marchionini (1997) views them as responses to learning tasks in which the goal is to modify existing knowledge. They both note that individuals who conduct information searches must establish goals that they can use to evaluate search results, with task completion based on metacognitive judgments.

2.2. Online information search issues

Henry (2006) is among many researchers who have commented on the challenges the Internet presents in terms of reading and information search strategies. According to Hölscher and Strube (2000), Internet users who lack experience tend to make decisions regarding objective information too quickly, at the expense of correctness and completeness. Many students find it difficult to master the concept of "keywords," while others lack the motivation to perform anything more than superficial searches (see also Bilal, 2000; Hirsh, 1999). Teevan, Alvarado, Ackerman, and Karger (2004) report that American university students in their study were unlikely to systematically analyze search engine information due to their lack of knowledge about organizing concepts during the search process. Younger students can easily get lost if they fail to organize concepts when performing searches, which explains the growing number of studies on Web-based information integration and application.

Eisenberg and Berkowitz (1990, 2000) "Big Six Skills" approach to using information tools, which is currently popular in computer integrated instruction, emphasizes learning outcome evaluation, assisting the parents of learners in homework direction, and helping teachers learn and implement project design strategies. The six skills are task definition, information seeking strategies, location and access to information, use of information, synthesis, and evaluation. As part of the Big Six Skills curriculum, the term "use of information" separates reading information (i.e., Web-based information that users browse to perform a task) from summary information (i.e., information that users extract from browsed information to solve a problem) (Donham & Steele, 2008; Eisenberg, 2010; Eisenberg & Berkowitz, 1996; Jansen, 1997; Spitzer, 2000; Wolf, Brush, & Saye, 2003).

2.3. Information-seeking behavior

Kakai, Ikoja-Odongo, and Kigongo-Bukenya (2004) define information-seeking behavior as methods for gathering and sourcing information for personal use, knowledge updating, and development. For Web-based information searches it also involves the integration of browsing and search behaviors (Bates, 2002; Choo, Detlor, & Turnbull, 2000). For this study we will define information-seeking behavior as ways that individuals transform thinking into action so as to create paths for fulfilling their information needs.

Accordingly, our focus will be on methods that learners use to establish search engine strategies and to generate usable search results.

2.4. Factors affecting search behaviors

Seven factors that affect Web-based search engine behaviors are information needs, tasks, search systems, knowledge fields, environment, search results, and obstacles (Marchionini, 1989). White and Iivonen (2001) list of factors includes search task comprehension, task type, Web experience, and background knowledge. After reviewing English-language studies of Web search behaviors published between