SUPPORTING LEARNERS WITH LOW DOMAIN KNOWLEDGE WHEN USING THE INTERNET*

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ABSTRACT

Having low domain knowledge is a significant constraint when using the Internet. This study examined the effectiveness of three potential supports for learners with low domain knowledge, including having plenty of time to search the Internet, using notes taken during the search when writing an essay about the topic, and having high levels of motivation to use the Internet. Sixty undergraduate students were randomly assigned to: a) search the Internet for 60 minutes prior to writing an essay with notes present; b) search the Internet for 60 minutes prior to writing an essay without notes present; or c) write an essay with no prior search of the Internet. Participants completed two essays, one in a high knowledge domain and another in a low knowledge domain. Searching the Internet facilitated learning regardless of domain knowledge. The significant support for low domain knowledge was providing plenty of time to search the Internet.

INTRODUCTION

The Internet, a type of hypermedia, is a widely used resource for finding and retrieving information, particularly for high school and university students (Dryburgh, 2001; Jones, 2002). Prevalence of Internet use, however, does not mean that the Internet is an effective learning tool. That is, just having information

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available may not translate into learners being able to retrieve or use information effectively. Currently, there is limited research identifying whether the Internet is a valuable resource for all learners, or if not, under what conditions the Internet may be beneficial. One significant constraint on its effectiveness may be when domain knowledge is low.

Domain knowledge is a critical foundation for higher level cognitive processing. Learners with a rich knowledge base tend to recall more relevant information in memory tasks in comparison to their less knowledgeable peers (Spilich, Vesonder, Chejese, & Voss, 1979). When domain knowledge is low, corresponding schemas, or interrelated networks of information, typically are insufficiently developed (Bjorklund & Schneider, 1996). Not only does this make finding and extracting information less effective (Downing, Moore, & Brown, 2005), but the process of creating new connections is more challenging, less efficient, and less automatic in comparison to more knowledgeable learners (Chi, 1978). As a result, fewer working memory resources are available for the sophisticated processing of the material. Experts, on the other hand, experience fewer challenges in allocating working memory resources because they auto-matically engage in more elaborate processing. For example, when knowledge-able learners encounter novel to-be-learned information, they often create meaningful associations in order to connect the material to an existing knowl-edge base (Stein, Morris, & Bransford, 1978). In contrast to experts, therefore, novices may be more likely to be overwhelmed when faced with a challenging or unfamiliar task.

Searching for information on the Internet may be an example of the kind of challenging task that is likely to separate expert from novice learners, specifically because of its nonlinear and non-hierarchical structure, dynamic nature, and lack of quality control (Dias & Sousa, 1997; Lidstone & Lucas, 1998). That is, unlike traditional sources of information such as textbooks, information on the Internet is not arranged in a linear format with an introduction, body, and conclusion, nor does it come with a readily available table of contents, index, or summary—all of which would logically guide the reader through the information. Similarly, the Internet does not organize or layer information in the way that traditional sources organize information, for example, from most critical to least critical points, or from general to specific points (i.e., it is non-hierarchical). Therefore, learners are left to their own resources to figure out the relation among the material they access, both within and across individual websites. In fact, novices' recall of information is negatively impacted when hypermedia lacks an overview (McDonald & Stevenson, 1998) or the information is not organized and structured in a way that is consistent with students' learning goals (Shapiro, 1999).

The lack of organization may also create difficulties for learners when identi-fying relevant information from hypermedia. Indeed, novices have been shown

to have inferior techniques when trying to identify relevant information within an online database. Although Marchionini, Dwiggins, Katz, and Lin (1993) only examined the search strategies of eight participants using an online database, they found that less knowledgeable adults had a tendency to judge the relevancy of full-text articles based on the type and date of the article, the nationality of the author, the comprehensiveness of the title, and whether the title contained key terms. On the other hand, experts used more appropriate strategies such as judging whether or not the information addressed the question at hand.

In addition to a lack of organization, the Internet is dynamic and constantly changing, with sites appearing, changing, and disappearing unpredictably. Finally, the Internet is missing a critical editor—no reviewer, agency, or governing body is responsible for screening the quality of material and evaluating the content in terms of bias, accuracy, and accessibility of the material for readers at different levels of literacy. This may be a particularly challenging problem for novices, as they likely would not be able to determine whether the information presented is valid.

All of these features of the Internet may impose high cognitive demands on the learner and cause difficulties in comprehension (Lidstone & Lucas, 1998). According to Foltz (1996), because domain knowledge is central to comprehension, a lack of domain knowledge may lead to even greater comprehension problems with hypertext than with linear text. Indeed, some researchers have found that learners do not benefit from searching for information on the Internet when domain knowledge is low. For example, Willoughby, Anderson, Wood, Mueller, and Ross (2006) asked participants in their study to complete two written assignments after studying on the Internet. One assignment was based in an area for which they had high domain knowledge, and the other low domain knowledge. In addition, a control group of students completed both written assignments without access to the Internet. As expected, students had superior performance on the assignment corresponding to their area of expertise than to the unfamiliar topic, regardless of condition. However, most importantly, learners who searched the Internet for information pertaining to the topic in which they lacked domain knowledge wrote assignments similar in quality to the control group. In contrast, when learners had high domain knowledge, being able to search the Internet resulted in superior performance in comparison to the control group. Willoughby et al. concluded that low domain knowledge appears to be an important barrier to successful learning with the Internet (see also Lawless, Schrader, & Mayall, 2006). Yet, it is clear that Internet use is prevalent among children and adults, and is used widely in classroom contexts. Any recommendation to limit use when learners are novices, therefore, is not likely to be useful. Moreover, it also is clear that learners often are novices in many domains. It is critical, therefore, that we find ways to support learning for less knowledgeable learners when searching the Internet for information.

Methods to Support Low Domain Knowledge
When Searching the Internet

The current study specifically examined the effectiveness of three potential supports for learners using the Internet to search for information: a) having plenty of time to search for information on the Internet; b) providing an opportunity to use notes taken during the search when subsequently writing an essay about the topic; and c) having high levels of motivation to use the Internet.

Available Time to Search the Internet

Researchers have indicated that more time may be needed to search for information when domain knowledge is low in comparison to when learners are more knowledgeable. For example, in interviews, eighth graders expressed that they typically require more time to search the Internet when they are less knowledgeable about the research question (Watson, 1998). Similarly, experimental studies have indicated that less knowledgeable learners spend more time browsing hypermedia in comparison to their more knowledgeable peers (Ford & Chen, 2000; Patel, Drury, & Shalin, 1998).

Willoughby and colleagues (2006) provided a maximum of 30 minutes for participants to search for information on the Internet corresponding to a particular topic prior to writing an essay. They found that learners who lacked domain knowledge performed the same on the essay as learners who just wrote the essay without searching the Internet for the information. Thirty minutes, however, may have been insufficient for less knowledgeable learners when completing this challenging task. By providing learners with more time to search for and retrieve information from the Internet, learners have the opportunity to spend time reviewing information on websites and information they recorded. Learners, therefore, may be more likely to formulate connections between novel information and existing knowledge, leading to a deeper understanding of the material.

The Presence of Notes While Writing an Essay

Students in Willoughby et al.'s (2006) study searched the Internet for information pertaining to a specified topic and then wrote the essay from recall, even though they were allowed to record notes while searching. In this case, the measure of learning resembled a testing situation. Allowing students to use their notes when writing an essay, however, may not only more closely resemble their typical actions when studying new information in a natural setting, but also may make the task less cognitively demanding. For example, in preparation for academic tasks that require the recall of information, such as exams, learners likely would memorize information from their textbooks and lecture notes rather than from the Internet. In contrast, the Internet may be used as a resource when

searching for information to complete a written assignment such as an essay or term paper—a situation in which learners are able to rely to their notes in the event they cannot remember.

In addition, the ability to refer to notes while completing the assigned task eliminates the need to memorize information (Kiewra et al., 1991), and thus may reduce memory load (Kellogg, 1988). Less knowledgeable learners then may be able to manage the cognitive demands associated with the Internet and allocate resources to comprehending the information. In fact, Benton, Kiewra, Whitfill, and Dennison (1993) identified that undergraduate students who were able to use notes they recorded during a lecture while completing an assigned essay included more idea units that were expressed in the lecture, as well as a greater number of contrasting and comparison idea units that addressed the assigned question (indicating cohesion) in comparison to learners required to write the essay from recall. Therefore, the presence of notes may not only be more appropriate but also may facilitate recall of information retrieved from the Internet.

Motivation

Researchers have indicated that students tend to be more motivated to learn when information is presented using a computer compared to paper-based materials (Shuell & Farber, 2001; Small & Ferreira, 1994; Yang, 1991-1992). When university students, for example, were asked to rate their motivation for using technology in their courses, almost three-quarters of the students agreed that the technology increased their motivation, their interest, and their attention during the lectures (Shuell & Farber, 2001). Similarly, in empirical examinations of student motivation, students who were assigned to study information from the computer indicated higher levels of motivation compared to students studying from a paper-based version (Small & Ferreira, 1994; Yang, 1991-1992). Therefore, some learners may be highly motivated to complete an assigned task, such as an essay, if they are able to use the Internet to gather information. Given that a higher level of motivation to complete a task has typically resulted in superior performance on school-related tasks for students compared to the outcomes of learners who were less motivated (Pintrich & De Groot, 1990), higher levels of motivation to use the Internet may result in increased performance. This may be especially important for novices when searching the Internet.

In addition, given our earlier discussion that having low domain knowledge may make searching the Internet a difficult endeavor, an increased level of motivation to use the Internet may result in persistence to learn and in turn increase performance for the task at hand. Therefore, a high level of motivation to use the Internet may be especially important for novices, since they are more likely than experts to become disoriented or lost in hyperspace. Indeed, McDonald and Stevenson (1998) found that novices experience uncertainty regarding where they had been or where they could go to retrieve the information they need when

searching for information in a hypermedia learning environment more often than their more knowledgeable peers. Such search difficulties may lead to feelings of frustration (Last, O'Donnell, & Kelly, 2001) and result in earlier termination of the learning process for novices who are less motivated in comparison to their more motivated peers. Therefore, students who have low domain knowledge and are highly motivated to use the Internet may outperform learners lacking both domain knowledge and motivation.

The purpose of the current study was to investigate the effectiveness of these three supports when learners completed two essays after searching the Internet for information. One essay was based in an area for which they had high domain knowledge, and the other low domain knowledge. The supports examined included providing plenty of time (60 minutes for each topic) to search the Internet and study the retrieved information, having notes present while writing the essays, and being highly motivated to search the Internet. Given the large research literature outlining the benefits of having a rich knowledge base when learning new information, it was hypothesized that students would perform better on the essay corresponding to their high knowledge domain than their low knowledge domain. In addition, we expected that learning from the Internet could be supported when domain knowledge was low. First, having notes present while writing the essays was expected to result in superior performance in comparison to writing the essays from recall, specifically for less knowledgeable learners. Second, it was expected that having plenty of time to search the Internet would enhance essay performance in comparison to a control group who were not exposed to the Internet, regardless of level of domain knowledge. Finally, learners with higher levels of motivation to search the Internet were expected to outperform their peers who were less motivated, particularly when domain knowledge was low.

METHOD

Participants and Design

The participants were 60 undergraduate students (37 females) with a mean age of 20.33 years ($SD = 1.97$ years). Thirty participants were in the process of completing a major in Political Science, Policing and Criminal Justice, or History. These students (hereon referred to as Political Science students) had completed a first-year Political Science undergraduate course and did not complete nor were currently completing any courses within Physical Education and Kinesiology, Biological Sciences, and Community Health Sciences. The remaining 30 participants were in the process of completing a major in Physical Education and Kinesiology (hereon referred to as Kinesiology students). These students had completed a first-year Physical Education and Kinesiology course

and did not complete nor were currently completing any courses in Political Science or History.

The students in each discipline were randomly assigned to one of the following three conditions: a) 60-minute Internet exposure prior to completing an essay with notes present (i.e., Internet-notes; $n = 20$); b) 60-minute Internet exposure prior to completing an essay without notes present (i.e., Internet-no-notes; $n = 20$); or c) no Internet exposure prior to completing an essay (i.e., control; $n = 20$). Thus, within each condition, half the participants were comprised of Political Science students and the other half of the participants were comprised of Kinesiology students. An equal proportion of males and females were assigned to each condition. Each participant completed two essays, one corresponding to a high knowledge domain (i.e., political topic for Political Science students and sports topic for Kinesiology students) and another related to a low knowledge domain (i.e., political topic for Kinesiology students and sports topic for Political Science students). Participants were drawn from two fields of specialization (Kinesiology and Political Science) in order to control for potential differences in topic difficulty. The order in which participants completed the essays was counterbalanced across conditions, such that half the participants completed the essay corresponding to their high knowledge domain first.

Materials

Previous researchers who examined students' learning from the Internet often did not define what they meant by "using the Internet." A definition may be necessary given that using the Internet may refer to accessing information on the World Wide Web, online databases, WebCT, chat rooms, etc. Online databases or library websites, however, are simply an online version of the library. This online library includes card catalogs and journal article databases which permit students to search for information that has undergone some form of quality control. This is distinctly different from the information presented on the Internet. To avoid confusion, therefore, learners in the present study were instructed that the Internet referred to websites on the World Wide Web, and excluded e-mail programs (e.g., hotmail, yahoo), chat rooms (e.g., MSN Messenger), library databases, journal article databases (e.g., PsycINFO), and WebCT. Based on this definition, participants rated their level of motivation for using the Internet to search for and retrieve information to complete an essay rather than using print sources such as books or journal articles (0 = very low, 4 = very high). The Internet participants also rated the level of difficulty to search for and retrieve information from the Internet corresponding to each essay topic (0 = very low, 4 = very high).

All learners were assigned two essay topics. For the political essay, learners discussed how the role and powers of the American President are different from the Canadian Prime Minister. For the sports essay, learners were required to discuss how the athleticism of Ancient Greece and the sport spectatorship of

Ancient Rome are similar/different from contemporary sport and physical activity in the 21st century.

Procedure

Instructions and procedures varied between the Internet groups and the control group. Although all participants had 20 minutes to complete each essay, the two Internet groups were instructed to search the Internet for 60 minutes prior to writing the essay.

Internet Groups

The duration of the study session for the Internet condition was approximately 180 minutes. To avoid fatigue, the session was divided into two phases in which the second phase was completed on a separate day. In phase one, participants rated their level of motivation to use the Internet. They were then assigned an essay topic (either sports or political topic, order was counterbalanced across participants) and were given 60 minutes to search the Internet for corresponding information. All Internet participants began their searches at the Microsoft network home page (http://www.msn.com), and were given the opportunity to record notes during their searches. The Internet-notes group was instructed that they could refer to their notes while writing the essay, whereas the Internet-no-notes group was instructed that they would not be able to use their notes when writing the essay. After 60 minutes, the learners' activities were stopped and they were given 20 minutes to record their answer for the essay topic. At the outset of the first phase, participants rated the level of difficulty to search for and retrieve information from the Internet corresponding to the essay topic.

Participants completed the second phase of the study an average of 3.95 days (SD = 2.95 days) later. To be able to accommodate participants' variable schedules, the number of days between the two phases of the study varied. During the second phase, learners searched the Internet and wrote an essay for the topic not completed in the first phase. The procedure was identical to the first phase.

Control Group

The control group attended a single session lasting approximately 60 minutes. Participants rated their level of motivation to use the Internet, and then immediately completed the two essays (sports and political essay) without searching the Internet. Willoughby et al. (2006) found that learners randomly assigned to control groups who did not search the Internet performed the same whether they completed the essays immediately or reflected on the topic for 30 minutes prior to essay completion (the latter group was designed to control for the amount of time provided to the Internet-search groups to search for information prior to writing the essay). Given the lack of difference in performance between the two

control groups with Willoughby et al.'s study, the control group in the present study immediately completed the essays.

We were not concerned with the control group becoming fatigued, and therefore, they completed the tasks in one sitting. However, the order of essay topics was counterbalanced across participants to ensure that performance differences would not be attributable to when the essay was completed (i.e., first or second; completed in phase 1 or phase 2). Because the control group did not have any exposure to the Internet, they served as a measure of students' base domain knowledge prior to searching the Internet.

Scoring of the Essays

Previous researchers have calculated a score for each essay by counting the number of acceptable statements or phrases that the participant produced that directly addressed the assigned question (Moreno & Mayer, 2002; Willoughby et al., 2006). This method was adapted for the current study. Participants were given one point for a correct answer with detail, half a point for providing a partial answer, and no points were awarded for incorrect or irrelevant information. Essay quality was calculated by adding these points together. Two raters scored approximately 30% of the political essays to determine inter-rater reliability. Similarly, two raters scored approximately 30% of the sports essays. One rater scored all of the remaining essays. For the political essay, agreement between both scorers was 80% for the political essay and 82% for the sports essay (80% agreement is considered an acceptable level; see Riffe, Lacy, & Fico, 1998). Discrepancies were resolved through discussion.

RESULTS

Preliminary Analyses

Preliminary analyses were conducted to determine whether essay performance was affected by: a) participant ratings of how difficult they found it to search the Internet for the topics; b) order of essay completion; and c) sex.

Difficulty to Search the Internet

Two multiple regression analyses (one for each essay topic) were conducted to determine whether difficulty ratings predicted essay scores. Discipline and the difficulty ratings were entered in one step. Discipline was dummy-coded such that the Political Science domain was coded as 0 and Kinesiology was coded as 1. For the political and sports topics, the regression analyses were significant, $F(2, 37) = 6.30, p < .05, F(2, 37) = 7.55, p < .05$, respectively. However, discipline was the only significant variable for the sports and political essays. Thus, difficulty to search the Internet did not significantly predict essay performance regardless of domain knowledge.

Order and Sex Effects

To ensure that the order of essay completion and sex did not effect essay quality, a 2 (order of presentation) × 2 (discipline) × 3 (condition) × 2 (sex) × 2 (essay topic) mixed measures ANOVA was conducted with essays scores as the dependent variable. Discipline (Political Science and Kinesiology), condition (Internet-notes, Internet-no-notes and control), sex (male and female), and order of essay completion (less knowledgeable essay completed first and second) were the between-subjects factors, and essay topic (political and sports) was the within-subjects factor. All main effects and interactions involving order and sex were not significant with the exception of two three-way interactions and one four-way interaction; essay topic by condition by sex, $F(2, 37) = 6.91$, $p < .05$, essay topic by discipline by order, $F(1, 37) = 6.09$, $p < .05$, and essay topic by discipline by condition by order, $F(2, 37) = 6.03$, $p < .05$. Post hoc analyses of these interactions, however, revealed no significant differences due to sex, and no discernible patterns due to order of essay completion. Regardless, order of presentation and sex were included as covariates in all further analyses.

Main Analyses

Three sets of analyses were conducted. The first set examined the effectiveness of having notes present while writing the essays by comparing the essay performance between the Internet-notes and Internet-no-notes groups. The second set examined the impact of having plenty of time to search the Internet on essay quality in comparison to writing the essays without searching the Internet first. Finally, the third set investigated the impact of motivation to search the Internet for information on essay scores.

The Presence of Notes

To directly test whether the presence of notes while writing the assigned essays significantly improved essay quality in comparison to an absence of notes when completing the essays, a mixed measures ANCOVA was conducted. Discipline (Political Science and Kinesiology) and Internet condition (notes and no-notes) were the between-subjects variable, essay topic (politics and sports) was the within-subjects variable, and order and sex were entered as covariates. The essay topic by discipline interaction was the only significant effect, $F(1, 34) = 28.83$, $p < .05$, $\eta^2 = .46$, indicating that students performed significantly better when the essay topic corresponded to a high knowledge domain. Follow-up analyses indicted that Political Science students performed significantly better on the political essay ($M = 3.68$, $SD = 1.92$) in comparison to the sports essay ($M = 2.00$, $SD = 1.43$), $t(19) = 4.02$, $p < .05$. Similarly, Kinesiology students obtained significantly higher scores on the sports essay ($M = 3.80$, $SD = 1.48$) than on the political essay ($M = 2.03$, $SD = 1.08$), $t(19) = 3.80$, $p < .05$. Therefore,

our hypothesis that students would perform better on the essay corresponding to their high knowledge domain than their low knowledge domain was supported.

Although the Internet-notes group had the opportunity to use information that they recorded during their Internet searches in their essay, in the event they could not remember, they did not outperform their peers who were required to recall information. Having notes present, therefore, did not provide an effective support for learning from the Internet when domain knowledge was low.

Internet Exposure for 60 Minutes

Learners in the Internet-notes and Internet-no-notes condition did not differ significantly in essay quality for the two topics, and therefore, these conditions were collapsed into a single Internet group for subsequent analyses. To directly test whether less knowledgeable learners benefited from searching the Internet when provided with 60 minutes to search for and study information, a mixed measures ANCOVA was conducted. Discipline (Political Science and Kinesiology) and condition (Internet and control) were the between-subjects factors, essay topic (politics and sports) was the within-subjects variable, and order and sex were entered as covariates. Both the main effect of condition and the interaction between essay topic and discipline were significant, $F(1, 54) = 30.25$, $p < .05$, $\eta^2 = .36$ and $F(1, 54) = 33.15$, $p < .05$, $\eta^2 = .38$, respectively. The Internet group ($M = 2.88$, $SD = 1.13$) significantly outperformed the control group ($M = 1.35$, $SD = 0.59$), and learners performed significantly better when the essay topic corresponded to a high knowledge domain. Table 1 shows the mean essay scores and standard deviations. In contrast to Willoughby et al.'s (2006) findings but consistent with our expectations, therefore, the Internet group in the present study outperformed the control group for both the high knowledge and the low knowledge topics. When domain knowledge is low, learners may benefit from Internet exposure in comparison to learners who are not exposed to the Internet if learners are provided with plenty of time to search the Internet and study information prior to writing the essay.

Table 1. Mean Essay Scores as a Function of Discipline and Essay Topic

Discipline	Political essay Mean (SD)	Sports essay Mean (SD)
Political Science	2.95 (1.98)	1.72 (1.25)
Kinesiology	1.45 (1.22)	3.28 (1.54)

Note: Means are based on the inclusion of all participants (i.e., collapsed across Internet and control participants).

Motivation

The mean motivation rating across all participants was 1.98 ($SD = 1.15$), indicating that learners in the current study were moderately motivated to use the Internet rather than print sources to retrieve information. To test whether motivation to use the Internet to search for and retrieve information to complete an essay rather than using print sources such as books or journal articles may have enhanced essay performance, two hierarchical multiple regression analyses were conducted—one for each essay topic. For both analyses, order and sex were entered in the first step of the regression model as covariates, followed by motivation and discipline as predictors in step 2. The interaction between motivation and discipline was entered in the final step. Discipline was dummy coded, such that Political Science was coded as 0 and Kinesiology was coded as 1. For both the sports and political topics, only the second step was significant, $\Delta F(2, 34) = 6.88$, $p < .05$, $\Delta F(2, 34) = 5.91$, $p < .05$, respectively, and discipline was the only significant variable in the second step. Thus, motivation did not significantly predict essay performance regardless of domain knowledge, and was not a significant support for learners with low domain knowledge.

DISCUSSION

Consistent with previous research (e.g., Bjorklund & Schneider, 1996; Downing et al., 2005), learners in the present study demonstrated the effectiveness of having a rich knowledge base when learning new information. Students performed significantly better when the essay topic corresponded to their high knowledge domain than their low knowledge domain. Having a rich knowledge base encourages more efficient and elaborate processing, as well as increased memory for the new information (e.g., Chiesi, Spilich, & Voss, 1979; Schneider, Korkel, & Weinert, 1990). Most critical to the present study, however, was whether supports could be provided to learners to facilitate learning from the Internet when their knowledge base was low. Three potential supports were examined, including the presence of notes while writing essays, providing plenty of time to search the Internet (60 minutes for each topic), and having high levels of motivation to use the Internet. Under these conditions, learning from the Internet was hypothesized to be less challenging.

Available Time to Search the Internet

Interestingly, providing individuals with plenty of time to search the Internet for information was the only support that facilitated learning when domain knowledge was low. Learners who were exposed to the Internet for 60 minutes prior to writing the essay scored significantly higher on the essays (both high and low knowledge domains) than the control group who wrote the essays without exposure to the Internet. By providing learners in the present study with plenty of

time to search the Internet, they had the opportunity to think about and effectively process the novel information. For example, learners may have benefited from the extra time by elaborating on or summarizing the material, and making connections between novel information and existing knowledge (Kiewra, 1985). In effect, they may have gained a deeper understanding of the material. While an assessment of the specific learning strategies that participants in the Internet group enacted while searching for information was not possible in the present study, it is clear that less knowledgeable learners can benefit from Internet exposure.

The Presence of Notes While Writing an Essay

Surprisingly, the opportunity to refer to notes during the writing of the essays was not an effective support for less knowledgeable learners when searching the Internet. Learners in the Internet-notes condition were expected to have an advantage over the Internet-no-notes group, since they had the opportunity to access information while writing the essays in the event they could not remember. These results are consistent with Slotte and Lonka (1999), however, who provided high school graduates with time to read an article corresponding to a topic in philosophy and record notes. Learners who completed philosophy courses in high school were excluded from the study, and therefore, only students with low domain knowledge were included. Immediately after studying the article, participants completed an essay question pertaining to the content of the article. Half of the students were provided with the opportunity to refer to the notes recorded while studying the article during the essay writing stage, whereas the remaining students were not able to refer to their notes. Essay quality, however, did not differ whether learners were required to write the essay from memory or could refer to their notes. The opportunity to refer to notes may not have supported learning when domain knowledge was low because learners (in both our study and Slotte & Lonka's study) were informed beforehand as to whether or not their notes would be present during the essay writing stage. Since learners were aware of the task demands, they might have used strategies they believed would maximize task performance and minimize forgetting. Further research is needed to examine this hypothesis.

Motivation

Individuals' motivation to search for and retrieve information from the Internet in comparison to print sources was also examined as a potential support for less knowledgeable learners. Domain knowledge rather than motivation, however, significantly predicted essay performance. Therefore, motivation to search the Internet was not an effective support. Lawless, Brown, Mills, and Mayall (2003) found similar results, such that domain knowledge rather than learners' interest in using a computer program predicted recall of information. Although motivation

may not predict performance, it is possible that motivation may affect navigation styles. Lawless and Kulikowich (1996) identified three different navigational profiles, including knowledge seekers, feature explorers, and apathetic users. Individuals may navigate through websites differently depending on their profile. For example, feature explorers tend to spend more time with the special features in a hypermedia environment rather than gathering information, and knowledge seekers tend to spend their time searching for information. In contrast, apathetic users tend to be disinterested in searching for information or exploring the features (Lawless & Kulikowich, 1996). Learners who are more motivated to use the Internet than paper-based materials may be specifically attracted to the features of the Internet. Feature seekers, therefore, may have a higher level of motivation to use the Internet in comparison to other navigational profiles. Further research is needed to examine this hypothesis.

Implications

The present study has implications for educators, librarians, students, and general Internet users. The Internet provides access to a vast amount of information at any time and from almost anywhere, and therefore, has the potential to be a valuable learning resource. However, simply providing learners with access to the Internet may not always be beneficial, especially when domain knowledge is low. Results of this study suggest that having notes present or being motivated to use the Internet may not facilitate learning from the Internet. In contrast, less knowledgeable learners may benefit from searching the Internet if they have plenty of time to explore and review the information.

Allowing plenty of time to search the Internet for information, however, is not always feasible, especially in a classroom setting. If time is of concern, then searching the Internet when domain knowledge is low may not be beneficial. In this case, it may be necessary to provide learners with additional scaffolding, such as working with more knowledgeable peers while searching the Internet (e.g., Winters, Azevedo, & Levin, 2004), or enhancing their knowledge base prior to searching the Internet (e.g., Lawless et al., 2006; Mayer, Mathias, & Wetzell, 2002). Working with more knowledgeable peers, for example, would permit novices to ask for clarification regarding concepts and relationships between concepts (Winters et al., 2004). Similarly, pre-training may permit novices to identify not only relevant information but also how the content fits together in a website, even when information is non-hierarchically organized. However, to be able to determine the supports that promote successful learning for novices when using the Internet, researchers need to first investigate the relation between cognitive processes and domain knowledge when using the Internet. Once we fully understand what makes the Internet too cognitively demanding, we can then create appropriate scaffolding to enhance learning for novices.

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