Can Low Domain Knowledge be Compensated for When Using the Internet?

by

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A thesis
submitted in partial fulfillment
of the requirements for the degree
Master of Arts

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BROCK UNIVERSITY
St. Catharines, Ontario

August 2006

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Abstract

Previous researchers have found that learners do not benefit from using the Internet when domain knowledge is low. The purpose of the current study was to investigate possible methods to compensate for low domain knowledge. Specifically, the presence of notes, more time to search the Internet, and high levels of motivation to use the Internet were examined as possible compensating factors. Sixty Political Science and Kinesiology undergraduate students were randomly assigned to one of three conditions. Students searched the Internet for an hour prior to writing an essay with notes present, searched the Internet for an hour prior to writing an essay without notes present, or did not search the Internet prior to completing an essay. Each participant completed the same two essays, one corresponding to a high knowledge domain and another corresponding to a low knowledge domain. First, the presence of notes did not significantly improve essay scores in comparison to the absence of notes. Second, learners did benefit from using the Internet for 1 hour in comparison to their peers who were not exposed to the Internet, regardless of level of domain knowledge. Third, high levels of motivation did not affect essay performance. A discussion of why time may have compensated for low domain knowledge while notes and motivation did not is included. In addition, methods that may compensate for low domain knowledge when time is restricted are suggested.
Acknowledgements

Many people contributed to the completion of this thesis, and for that I am grateful. First, I would like to thank my advisor Dr. Teena Willoughby. Her guidance, knowledge and support were extremely valuable throughout this entire process. I have learned so much, not only regarding the topic of my thesis, but also about myself and my capabilities. My gratitude also extends to my committee members for their contributions. Dr. Linda Rose-Krasnor and Dr. John McNamara provided suggestions that greatly improved the quality of my thesis. Second, I would like to acknowledge those who had a role in the development of the methodology. Dr. Paul Hamilton in the Department of Political Science, and Dr. Anna Lathrop in the Department of Physical Education and Kinesiology, took the time to create the essay topics that were assigned to the participants in the current study. Without their cooperation this project would not have been possible. I am also appreciative of the amount of time and energy Kelly Sanderson, Yaroslav Diduch and Catherine Fawcett spent scoring the essays and labeling the explanations. Finally, I want express thanks to Travis Stark, my parents Robert and Elsie, and my friends for their tremendous support, love and encouragement during this process.
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Introduction

The Internet is a widely used resource for finding and retrieving information, particularly for high school and university students (Dryburgh, 2001; Jones, 2002). In a survey of 25,090 Canadians, 90% of adolescents between the ages of 15 and 19 years reported using the Internet during the year 2000 (Dryburgh, 2001). Similarly, almost three-quarters of American adolescents between the ages of 12 and 17 years reported using the Internet in 2000 (Rainie & Packel, 2001), and of the 86% of American post-secondary students who went online in 2002, almost half reported using the Internet prior to arriving at college (Jones, 2002). In fact, over a third of youth in Grades 4 through 11 across Canada rely on the Internet as an information source and have used this source at least once a week to complete homework (Environics Research Group, 2001). Indeed, the Internet tends to be the first source for information that they turn to when doing school work (Environics Research Group, 2001). This pattern is also true of the United States, where a majority of American adolescents aged 12 to 17 reported accessing the Internet to complete school-related research (Lenhart et al., 2001).

Prevalence of Internet use, however, does not mean that the Internet is an effective learning tool. That is, just having information available does not translate into learners being able to retrieve or use information effectively. In fact, the Internet may create unique challenges for learning as a result of its nonlinear and dynamic structure. One significant constraint on its effectiveness may be when learners search for information in domains for which they have low background knowledge. In fact, Willoughby, Anderson, Wood, Mueller and Ross (2006) found that students who completed an essay after searching for information on the Internet performed the same as
students without Internet exposure when they had low domain knowledge. Similarly, comparing pre- and post-test measures of domain knowledge, Lawless, Schrader and Mayall (2006) found that undergraduate students with relatively little knowledge for the assigned domain did not exhibit knowledge gains after searching a website. Although this research suggests that having low domain knowledge is a significant challenge when using the Internet for learning tasks, there may be methods to compensate for low domain knowledge. For example, less knowledgeable learners may be able to learn from the Internet if they are provided with plenty of time to search for information, are able to refer to their notes taken during their Internet search when completing the assigned task, or are highly motivated to use the Internet. This thesis specifically examined these potential compensating factors.

There is a lack of empirical research, however, that examines why existing domain knowledge is an important factor when using the Internet. Instead, researchers typically have investigated learners’ interaction with closed hypermedia. Unlike open-ended hypermedia such as the Internet, closed hypermedia is comprised of a fixed amount of reliable information, usually available in the form of educational computer software (e.g., Encarta) or electronic databases (e.g., PsycInfo or online library catalogs). Although it is not clear whether the results from closed hypermedia research extend to the Internet, this area of research may provide valuable insight into why a rich knowledge base is important when learning from the Internet. The following literature review, therefore, will include a discussion of the advantages associated with domain knowledge in general and more specifically using the Internet by drawing from findings in the closed
hypermedia research area. A discussion of how one might compensate for low domain knowledge when using the Internet will also be included.

Existing Domain Knowledge Facilitates Learning

Researchers have consistently demonstrated that high domain knowledge (total information learners possess related to a particular field of study) enhances performance on memory tasks (Chi, 1978; Fincher-Kiefer, Post, Greene & Voss, 1988; Schneider, Korkel & Weinert, 1989; Spilich, Vesonder, Chejese & Voss, 1979). Domain knowledge not only facilitates how much learners remember but also what information they recall (Marchionini, 1995; Schneider, Korkel & Weinert, 1990; Spilich et al., 1979). For example, third grade soccer experts (in terms of their domain knowledge) recalled significantly more novel information related to soccer than novices in their own grade and even older novice children in grades five and seven (Schneider et al., 1989). Similarly, adults with a rich knowledge base for baseball not only recalled more information from textual passages detailing a baseball game but also recalled more relevant information in comparison to their less knowledgeable peers (Spilich et al., 1979). The positive effect of existing domain knowledge, however, does not extend beyond the specific domain being studied (Bjorklund & Schneider, 1996; Chi, 1978). For example, although child chess experts were able to more accurately recall chess configurations than adult novices, the children’s capability to recall digit spans was inferior compared to the adults (Chi, 1978). Therefore, there is not an overall increase in the capacity of working memory as domain knowledge increases, but rather information processing is thought to be more efficient when the assigned task corresponds to a high knowledge domain (Bjorklund & Schneider, 1996; Chi, 1978).
According to cognitive schema theory, learners' knowledge about concepts is stored within interrelated networks of more general information in long-term memory, called schemas (Anderson & Pearson, 1984). These networks are formed through interconnections (i.e., synapses) between nodes (i.e., neurons) mentally representing individual concepts (Rumelhart, Hinton & McClelland, 1986). Nodes become active when they receive input from the environment (McClelland, 1988). Activation of a node then spreads to its connecting nodes, which in turn activates their connections (Wills, 2005). Learners only become conscious of the information that the node encodes, however, when activation exceeds the level of threshold (i.e., the connection is strong enough); otherwise the learner remains unaware of this information (Rumelhart et al., 1986).

As knowledge increases, connections between concepts or nodes are created and strengthened (Bjorklund & Schneider, 1996; Chi, 1978). When knowledgeable learners encounter novel domain-related information, they often create meaningful associations in order to connect the material to an existing knowledge base (Stein, Morris & Bransford, 1978). As a result, there is a good probability that activation of the node will exceed the level of threshold, facilitating retrieval at a later time (Rumelhart et al., 1986). This elaborate processing of information is often automatic.

Moreover, individuals with higher domain knowledge typically have more effective search strategies to find and extract information from text (Symons, MacLatchy-Gaudet, Stone, & Reynolds, 2001; Symons & Pressley, 1993) or closed archival information systems (e.g., PsycINFO; Downing, Moore, & Brown, 2005). If the knowledge base is high enough, however, knowledge can override the need for strategies
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altogether (Muir-Broaddus & Bjorklund, 1990; Schneider, 2000; Schneider et al., 1990). Indeed, Moos and Azevedo (2006) demonstrated that when exposed to information in a closed hypermedia program (e.g., Encarta) undergraduate students used less learning strategies as existing knowledge for the domain increased.

Automatic processing and lack of required strategy use reduce cognitive load. This is valuable since working memory has a fixed limited capacity (Baddeley & Hitch, 1974; Miller, 1956). Most adults can only hold between five and nine units of information in working memory at any one time, and information held does not remain long in working memory if it is not actively manipulated (Miller, 1956). In addition to holding information in working memory, cognitive resources may also be allocated to interpreting the information at hand, integrating novel information with existing knowledge and employing learning strategies such as repetition or elaboration. When one of these aspects does not need to be carried out or can be carried out automatically, cognitive resources may be reallocated to working memory’s remaining functions (Case, 1985; Pressley & Schneider, 1997). Therefore, the cognitive demands associated with the learning task will be unlikely to exceed working memory capacity for highly knowledgeable learners.

In contrast, novices experience greater challenges allocating working memory resources. When domain knowledge is low, schemas are typically insufficiently developed and thus the process of creating connections is more challenging, less efficient and less automatic (Fincher-Kiefer et al., 1988; Willoughby et al., 2006). Not only do individuals tend to interpret content inaccurately or less extensively when they have less knowledge related to the domain (Fincher-Kiefer et al., 1988), but they also tend to
expend a great deal of mental effort to interpreting and integrating the information (Mayer, 2001). Consequently, there is a shortage of cognitive resources available for the sophisticated processing of novel material. Ultimately, less knowledgeable learners may be overwhelmed when faced with a challenging task. Interacting with the Internet may be an example of a challenging task.

The Role of Existing Domain Knowledge When Searching for Information on the Internet

As a type of hypermedia, the Internet is a computerized presentation of text, illustrations, video and/or audio files. Typically, hypermedia is viewed as offering advantages to the learner compared to traditional learning contexts. For example, learners can select the content to read, select the order in which they wish to read it, and control the pace of their learning (Curry, Haderlie, Ku, Lawless, Lemon & Wood, 1999; Eveland & Dunwoody, 2002; Large, 1996). Moreover, learners are able to access an infinite amount of information on a wide variety of topics at any time and from almost anywhere (Eveland & Dunwoody, 2000). Despite these advantages, however, learners with low domain knowledge may experience challenges when conducting their searches, identifying relevant information, integrating information within and across individual websites, and when exposed to poorly designed websites. These, in turn, may negatively impact learning outcomes.

Challenges When Searching for Information. Information on the Internet can be accessed in a variety of ways. For example, three methods of retrieving information include clicking on a topic presented in an index (i.e., browsing), going directly to the desired website by entering its URL or web address (e.g., http://www.msn.com), or clicking on a link within the website which takes learners either to a page within the
current website or to a different website entirely (Kuiper, Volman & Terwel, 2005). The majority of Internet users, however, frequently rely on one of the many search engines available, such as Google or Yahoo, to retrieve information corresponding to the topic (Lorenzen, 2001). Learners input keywords related to their search topic into the search engine and are provided with a list of websites containing the specified term(s), also known as hits, which may or may not be relevant to the desired topic. This list typically contains hundreds of thousands or even millions of websites, which not only vary depending upon the search engine used, but also may change daily when using the same search engine due to the constant changes, deletions, or additions of websites.

Existing domain knowledge may facilitate the use of superior search strategies. For example, highly knowledgeable learners may have a greater awareness of major concepts and vocabulary within their domain in comparison to less knowledgeable learners (Marchionini, 1995). Therefore, they may be able to generate more appropriate keywords, resulting in a greater amount of relevant information. In addition, Marchionini (1995) suggested that highly knowledgeable learners become experienced searching for information in their domain. They become familiar with solving typical problems and with searching for answers within various resources devoted to their domain. Consequently, when using the Internet, highly knowledgeable learners may be aware of where to find the desired information and be able to quickly identify high quality websites from the hits list.

Allen (1991), for example, attempted to investigate the relation between the quality of search terms and existing domain knowledge when using an online library database. University students’ level of existing factual knowledge for the solar system
and planetary exploration was determined by scores on a multiple choice pre-test. Using a median split, half the students were classified as high knowledge and the other half as low knowledge. After reading an article on Voyager 2’s encounter with Neptune and completing an interpolation task, participants were instructed to search an online library catalog. Their task was to create a list of books that they would want to use to write a detailed article on Voyager 2’s encounter with Neptune. Students entered a search expression in the online library database and were either provided with a list of books or a system-generated list of alternate terms that when selected provided a list of citations.

The quality of students’ searches was assessed by how many citations on their list matched the 50 books that two expert reference librarians would request if they completed the task. Surprisingly, there was no relation between the number of relevant books students listed and existing domain knowledge. In fact, novices were just as likely as experts to generate search expressions that resulted in a list of relevant citations as well as expressions that provided a list of alternate terms. Allen (1991) suggested that less knowledgeable learners conducted searches in an online library catalog that were as effective as highly knowledgeable students. However, this conclusion is based on the outcome rather than the actual quality of the search terms used. Therefore, the relation between domain knowledge and search term quality was not directly investigated.

According to Allen (1991), another limitation of this study was that the task may have been too easy. Simply by inputting the expression “Project Voyager” in the search engine, or choosing this expression from the search term alternatives, over half of the books on the librarians’ list were produced. Although Allen did not indicate which participants accessed citations via this expression, one may question whether or not
students with low domain knowledge would have entered this search expression if they were not exposed to information directly related to the topic immediately prior to their searches. In fact, using specific and technical language to formulate queries has been characteristic of more knowledgeable learners when using closed hypermedia (Marchionini et al., 1991; Marchionini, Dwiggins, Katz & Lin, 1993). When searching for a less familiar topic, on the other hand, learners often have difficulty generating synonyms to further their searches (Marchionini et al., 1993).

To investigate the relation between domain knowledge and search quality when using the Internet, Willoughby and colleagues (2006) recorded learners’ searches for information on the Internet pertaining to two experimenter-assigned essay topics. One topic was directly related to individuals’ major or discipline and the other was unrelated to their discipline. Willoughby and colleagues compared the quality of the essays between learners who were exposed to the Internet and a control group who completed the essays based solely on their existing domain knowledge. Learners did not demonstrate any major differences in the search strategies they used to retrieve information, or any differences in the relevancy of the websites that they accessed, as a function of domain knowledge. In other words, students used similar search strategies whether they were searching for information corresponding to the high or the low knowledge topic. In addition, they accessed the same number of relevant websites for both essays. As expected, students generated better essays when they wrote on topics for which they had high domain knowledge and poorer essays in areas for which domain knowledge was low. Interestingly, when domain knowledge was low, having access to the Internet to search for relevant material yielded no better essays than having no
exposure to the Internet. Willoughby et al. (2006) suggested that modern search engines generate a relevant array of sites from which to search, and therefore, even learners with low domain knowledge may be able to conduct valuable searches on the Internet. Despite this, however, less knowledgeable learners still are faced with the challenge of identifying and understanding relevant information.

*Challenges When Identifying Relevant Information.* There is a lack of empirical research investigating learners’ ability to identify relevant information when using the Internet specifically. However, students’ interaction with more traditional learning environments such as closed information systems (e.g., CD-ROM programs, online databases) or paper-based materials provide insight into the role of domain knowledge for judging relevancy. For example, college students majoring in Biology or Business searched for articles in a closed archival information system (e.g., PsycInfo) that corresponded to two Biology-related topics, and two Business-related topics (Downing et al., 2005). Therefore, the students conducted queries corresponding to a domain in which they had high knowledge as well as a domain in which they had low knowledge. For each of the four questions, participants were provided with five minutes to search for, retrieve and print off articles they believed would contain relevant information to answer the question. Not surprisingly, learners with high domain knowledge took less time to retrieve the first relevant article and printed off more relevant articles in total compared to less knowledgeable learners (Downing et al., 2005). In a similar study, Hirsch (1997) examined the number of relevant books fifth grade children indicated they would use to complete a hypothetical science assignment in relation to domain knowledge. Students
who had higher marks in science and presumably, higher domain knowledge, identified more relevant books than learners with lower grades.

Although less knowledgeable learners may be able to identify sources that likely contain relevant information, conclusions cannot be drawn from Downing et al. (2005), Hirsch’s (1997), and Willoughby et al.’s (2006) studies regarding novice’s ability to distinguish between relevant and irrelevant information. There is no doubt that learners are capable of making accurate relevancy judgments while searching full-text databases when domain knowledge is high (Marchionini et al., 1993), but it is of more interest whether less knowledgeable learners are able to make successful judgments. Spilich and colleagues (1979), for example, directly examined the proportion of relevant and irrelevant information recalled from a paper-based description of a baseball game. Learners who had low domain knowledge often recalled more irrelevant information after reading the passage in comparison to their more knowledgeable peers. Similarly, Symons and Pressley (1993) also instructed novices and experts to search paper-based materials for relevant information. Learners with high domain knowledge identified the target information more often than individuals lacking domain knowledge, even though the less knowledgeable learners scanned the pages that contained the relevant information.

Not only do less knowledgeable learners have difficulty identifying relevant information, but they also tend to use inferior techniques when trying to do so. Although Marchionini et al. (1993) only examined the search strategies of eight participants using an online database, the researchers did find that less knowledgeable adults had a tendency to judge 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. In contrast, learners with high domain knowledge used more appropriate strategies such as judging whether or not the information addressed the question at hand (Marchionini et al., 1993). Therefore, the lack of learning when using the Internet that Willoughby and colleagues (2006) observed likely is not a result of an inability to retrieve relevant material but rather may be attributable to a deficiency for distinguishing between relevant and irrelevant information. Empirical support that directly examines the relation between domain knowledge and relevancy judgments when using the Internet, rather than closed hypermedia, is necessary to support this claim.

Another challenge that learners must contend with, however, is understanding or successfully synthesizing the information they access.

_Challenges When Synthesizing Information._ When using the Internet, learners decide the order in which they wish to access information. Closed hypermedia researchers have compared performance on recall tasks between less knowledgeable learners who were forced to adhere to the presentation order as set by the programmer (i.e., program-controlled) and their peers who were able to decide for themselves what information they would view as well as the presentation sequence (i.e., learner-controlled). Program-controlled presentations often only provide learners with the options of moving forward or backward within the hypermedia. In contrast, in a learner-controlled setting the constant presence of links connecting students to any section within the presentation permits students to jump from section to section, skipping sections of information entirely.

Gay (1986) identified that undergraduate students with little conceptual understanding for an assigned topic performed poorer on retention and recall tests after
studying from a learner-controlled multimedia presentation in comparison to a program-controlled version. However, students with high conceptual understanding performed equally well regardless of whether or not they could direct their own learning session (Gay, 1986). Shin, Schaller and Savence (1994) examined whether this pattern was consistent for the learning of children. Second-grade students with computer experience were randomly assigned to one of the two following conditions. Learners either navigated through the material in the closed hypermedia freely or they had to adhere to a predetermined sequence by simply clicking “next page” to view the information. Consistent with Gay (1986), learner control significantly hindered less knowledgeable learners’ comprehension of the material, whereas this format did not affect learning for their more knowledgeable peers. Therefore, having to decide what information to access and in which order negatively affected learning when existing domain knowledge was low for students of all ages (see also Alexander, Kulikowich & Jetton, 1994; Dillon & Gabbard, 1998; Fry, 1972; Gall & Hannafin, 1994).

Researchers claim that learners with high domain knowledge are more capable of directing their own learning. For example, according to Shyu and Brown (1995) and Fry (1972), domain knowledge not only promotes understanding, but also enables learners to make decisions about their learning progress and whether additional instruction is needed. In addition, Lawless and Brown (1997) suggested that learners are able to identify what information is necessary to be successful and can seek out such information in a nonlinear presentation. Therefore, when learners are not provided with directions to efficiently navigate through the presentation, they are left to their own resources to figure out the relations among the information they access, both within and across individual
websites. To determine the impact that this lack of organization and structure has on learning for less knowledgeable learners, closed hypermedia researchers have compared learning outcomes in cases where learners are exposed to nonlinear presentations either with or without an overview of the content.

For example, McDonald and Stevenson (1998) examined whether the inclusion of a spatial map would facilitate the recall of information for learners with little domain knowledge. The spatial map was classified as a navigational aid such that it provided learners with an overview of the structure of the content and thus illustrated the relation among the information within the closed hypermedia. University students who were majoring either in the related discipline (i.e., high knowledge) or another discipline (i.e., low knowledge) were exposed to the closed hypermedia either with or without a spatial map. Individuals searched through the nonlinear computerized document to answer ten questions. The inclusion of the spatial map acted as an enhancer for less knowledgeable learners, such that these learners performed just as well as their highly knowledgeable peers when provided with an overview (McDonald & Stevenson, 1998). Therefore, the spatial map may have clarified the relation among the information, and in turn facilitated a deeper understanding. McDonald and Stevenson (1998) suggested that when the hypermedia excluded navigational aids, less knowledgeable learners were not aware of what information was available or what information they needed to access. Structure and organization, therefore, may be important aspects to facilitate learning when the material corresponds to a low knowledge domain.

The structure and organization placed on the information, however, may need to match the learners' intentions in order for it to be beneficial. In other words, if the
material is organized according to one theme, but the learner wants to identify commonalities across a different theme, then learning may still suffer. In fact, Shapiro (1999) investigated just this hypothesis. Undergraduate students with little ecology knowledge were presented with one of two versions of a closed hypermedia program containing information on the biology and ecology of fictitious animals. Half the students received a version that categorized the information by animal family (i.e., birds, herders, reptiles or rodents) and included an interactive overview that clearly identified the animals belonging to each family. The remaining participants studied from another version which organized the information by ecosystem (i.e., forest, desert or mountains) and included an interactive overview that clearly identified the animals that belonged to each ecosystem. All learners were instructed to study the relation among animals in each ecosystem for as long as they desired. Shapiro (1999) compared learning for the two-groups by using a short-answer post-test. In comparison to the ecosystem overview group, students provided with the animal family overview were less able to identify commonalities and differences across ecosystems even though they studied the information with this goal in mind. Although the animal family closed hypermedia version was organized very well, the structure did not match the learning goals of the students. Therefore, although structure and organization may facilitate learning, the information must be organized and structured in a way that is consistent with students' learning goals to be effective.

The Internet, unfortunately, rarely structures or hierarchically organizes information (i.e., from most critical to least critical or from general to specific points; Willoughby et al., 2006). Even when information is organized there is little chance the
organization will be consistent with students’ learning goals. As a result, individuals with low domain knowledge may learn very little when interacting with the Internet. Researchers, however, have not explicitly examined the interaction between existing knowledge and organization when using the Internet specifically.

The challenges faced by learners with differing levels of domain knowledge do not end here. Learners must not only attempt to manage cognitive demands associated with the Internet as a whole, but also each individual website. Since anyone may post information on the Internet, there are no set formats for presenting the material. This is of concern since presenting information in certain ways increases the cognitive load associated with learning the presented information.

Poorly Designed Websites Hinder Learning for Less Knowledgeable Students

The Internet is comprised of a large amount of web pages that vary in their combination of text, illustrations, animation and narration, and as such may be considered a collection of multimedia presentations. Mayer and colleagues have identified that some types of multimedia presentation formats (e.g., inclusion of redundant or extraneous information) increase the cognitive load required to learn the material contained within the presentation (e.g., Mayer & Anderson, 1991; Mayer, Heiser, & Lonn, 2001; Moreno & Mayer, 2002; Moreno & Mayer, 1999). The multimedia presentations used in studies conducted by Mayer and colleagues were typically short in duration (e.g., 30 or 180 seconds) and program-controlled; thus, they did not provide learners with the opportunity to read the information at their own pace or to review self-selected information (e.g., Mayer, Mathias & Wetzell, 2002; Moreno & Mayer, 1999). This poses a problem when generalizing the findings to naturalistic learning situations, including when learners use
the Internet. Being able to control one’s learning is characteristic of the Internet. Therefore, Mayer et al.’s (2002, 1999) conclusions that learners may experience cognitive overload when reading information on a web page once may not be true when learning from the Internet, as learners can review the material multiple times.

In support of Mayer et al.’s conclusions, however, Lawless Brown, Mills and Mayall (2003) observed that students with limited domain knowledge rarely reread sections of text when interacting with a closed hypermedia environment. Therefore, learners may interact with individual web pages in the same way that they interact with single multimedia presentations, reading the pages only once and becoming overwhelmed with the cognitive demands. In addition, the multimedia presentations Mayer and colleagues used were not learner controlled. Since learner control is a disadvantage for less knowledgeable learners (Shin et al., 1994), these learners would probably perform more poorly when interacting with the Internet in comparison to Mayer and colleagues’ multimedia presentations. For these reasons, factors that affect learning with multimedia (i.e., redundancy, extraneous material and the placement of information) may also influence learning when using the Internet. Since researchers have not investigated the relation among domain knowledge and these design issues when learners use the Internet, however, it is uncertain whether the negative impact does generalize to the Internet.

**Redundant Information.** It has been suggested that presenting the same information in two modalities (e.g., narration and animation) increases learners’ exposure to the material and therefore, enhances learning. Moreover, learners can decide to attend to only a single modality, one which matches their learning style (e.g., Jonassen & Grabowski, 1993). On the other hand, Mayer et al. (2001) suggested that the inclusion of
redundant information increases cognitive load. Mayer and colleagues (2001) investigated whether the performance of college students with low domain knowledge would be negatively affected when presentations contained redundant information. Less knowledgeable learners were exposed to one of two 140-second multimedia presentations. One group of students were shown how lightning works by using animation and narration only, whereas the remaining participants viewed the same presentation but with the inclusion of on-screen text, a duplication of the narration. Performance on both recall and problem-solving transfer tests were superior when the on-screen text was not included (Mayer et al., 2001). This same pattern of results was found when the presentation’s length was increased twofold (Moreno & Mayer, 2002).

As knowledge increases, however, performance differences due to formatting tend to disappear (Kalyuga, Chandler & Sweller, 2000). Specifically, knowledgeable trade apprentices performed well on recognition tests regardless of whether they were exposed to the material using illustration-text-and-narration, illustration-and-text, illustration-and-narration, or illustration only (Kalyuga et al., 2000). When knowledge becomes high, however, experts had a tendency to do better when provided with the illustration-only presentation in comparison to the illustration-and-narration. Kalyuga and colleagues (2000) claimed that for experts the narration provided the same information as the illustration and thus was considered to be redundant information. In effect, the narration, if attended to, increased the cognitive load for these learners.

Mayer et al. (2001) suggested that the negative effects associated with redundant information is attributable to the allocation of cognitive resources to processing the narration as well as the on-screen text as separate sections of information. For less
knowledgeable learners, processing both narration and text may require more cognitive resources than what is available and thus, they may quickly experience cognitive overload. In contrast, although the presence of redundant information may also increase the cognitive load for high knowledgeable learners, it is unlikely that the cognitive demands associated with processing the information would exceed their cognitive capacity. Moreover, high knowledgeable learners may be able to quickly recognize repetitive information. Therefore, processing information becomes less demanding if they ignore one of the modalities (Mayer et al., 2001). Therefore, although the inclusion of redundant information may impact learning for high knowledgeable learners, they are still able to effectively process novel information.

*Extraneous Information.* The inclusion of extraneous material has also presented problems for less knowledgeable students when using closed hypermedia. Although extraneous material is related to but irrelevant for understanding the multimedia presentation topic, it is often included in an attempt to increase learners’ interest and therefore, their performance on learning measures (Mayer et al., 2001). Mayer and colleagues (2001) presented college students who lacked knowledge for meteorology with a multimedia presentation detailing how lightning works, which either did or did not incorporate unnecessary video clips of lightning storms. Both presentations contained identical relevant animations and narrations. Results indicated that the extraneous material hindered the learners’ ability to transfer relevant information to novel problem-solving situations. These researchers found the same effect when video clips were substituted for verbalizations of interesting but irrelevant facts associated with lightning storms (Mayer et al., 2001). Mayer and colleagues (2001) suggested that less
knowledgeable learners focused on relating the extraneous material to the relevant information in the multimedia, and as a result, they were unable to form a deep understanding for the material.

Learners, however, may avoid exposure to extraneous material if provided with the opportunity. Typically, as children get older their ability to ignore distractions or irrelevant responses increases (Dempster, 1981). Lawless and colleagues (2003) examined the relation between the amount of time that learners spent with extraneous material in a closed hypermedia environment and their level of domain knowledge. College students were instructed to navigate through a nonlinear and non-hierarchical hypermedia program to learn as much as they could about the topic. Although the program presented information primarily by using text, participants were given the option of accessing narration, animation and video – some of which were extraneous. Not only did less knowledgeable students spend more time with extraneous material in comparison to their highly knowledgeable peers, they often viewed the irrelevant video clips multiple times (Lawless et al., 2003). Therefore, when learners have low domain knowledge they may not be able to distinguish between relevant and irrelevant information, in turn, creating challenges for allocating cognitive resources.

*Temporal and Spatial Separation.* Challenges associated with processing information not only arise because of what information is included in the multimedia, but also the way in which the information is organized. For example, Mayer and Anderson (1991) exposed college students to either a 45-second successive (animation then narration) or 30-second simultaneous multimedia of the same animation and narration. Learners who had low domain knowledge were able to create a greater proportion of
solutions on the problem-solving transfer task when the information was presented at the same time rather than viewing the entire animation and then listening to the narration. The superior test performance associated with simultaneous presentation of material persisted even when learners viewed the successive presentation a total of three times (Mayer & Anderson, 1992).

Learners’ understanding of the material may be affected by the proximity between textual descriptions and their respective illustrations or animations. For example, Moreno and Mayer (1999) tested whether proximity between text and animation was critical. College students with low domain knowledge were presented with animation and corresponding textual descriptions. Individuals who were exposed to descriptions physically close to the animation provided more accurate solutions on the problem-solving transfer test than their peers who were presented with descriptions far away on-screen from the animation. Therefore, the separation of information either by order of presentation or physical proximity impacts the formation of deeper understanding. Mayer and colleagues suggested that the learners were required to hold information they extracted from the animation in working memory, while either listening to the succeeding narration or searching for the corresponding textual description (Mayer & Anderson, 1991; Mayer & Anderson, 1992; Moreno & Mayer, 1999). Holding information in working memory requires cognitive resources and therefore, in such instances less knowledgeable learners may no longer have sufficient resources to effectively process the material resulting in inferior learning (Mayer & Anderson, 1991; Mayer & Anderson, 1992; Moreno & Mayer, 1999).
Although highly knowledgeable learners may be able to use their knowledge to compensate for a poorly designed multimedia presentation (Mayer, 2001), it is clear that less knowledgeable learners are challenged by poor presentations. Recall that these findings are based on research conducted in closed hypermedia environments. The Internet presents additional challenges that may exacerbate the challenges faced by less knowledgeable learners. For example, learners with limited domain knowledge may experience difficulty when using the Internet in selecting quality information from the vast amount of information available, or in identifying relevant information (Symons & Pressley, 1993). Consequently, researchers have started to investigate the learning outcomes of less knowledgeable learners after searching for and retrieving information from the Internet in particular.

The Role of Existing Domain Knowledge When Learning from the Internet

Researchers have investigated the role of existing domain knowledge when learning from the Internet by examining students’ interaction with either a single website or the entire World Wide Web. For example, Lawless and colleagues (2006) restricted students to a single website that consisted of 100 pages of information, which collectively comprised 11 topic areas both relevant and irrelevant to the topic students were instructed to study. Undergraduate and graduate students completed a pre-test measure of existing knowledge, searched the website for 30 minutes, and then completed an immediate post-test of topic knowledge identical to the pre-test. Half of the participants, however, read a 500-word paper-based article that globally outlined the major topics in human genetics, the assigned subject matter, prior to their Internet navigation. The other half of the participants did not receive exposure to pre-reading material.
The groups did not differ in their level of existing domain knowledge, which was relatively low (approximately 45% correct on the pre-test). Even after statistically accounting for the pre-test scores, results indicated that pre-reading facilitated students learning, such that their post-test knowledge scores were greater than the scores of learners who were not exposed to the pre-reading material. In fact, there was no change from pre- to post-test scores for the control group. Lawless and colleagues (2006) suggested that the pre-reading material provided students with "an overall schema for the domain into which new knowledge could be integrated" (p. 13), and therefore, facilitated the integration of information across individual pages in the website. More importantly, without this scaffolding university students were unable to create coherent mental models of the accessed information, and thus increases in knowledge did not occur.

One major limitation in Lawless and colleagues (2006) research was that they did not include a control group who were exposed only to the pre-reading material. Without comparing the learning gains of the pre-reading group to such a control group, we cannot determine how much learning can be credited to the Internet exposure over and above the pre-reading content. A second limitation is the use of a pre-test to measure domain knowledge. A pre-test would have encouraged students with higher domain knowledge to access their existing knowledge prior to interacting with the material. Consequently, this experimental manipulation may have resulted in a larger gain in knowledge for the more knowledgeable learners in comparison to a natural setting which would lack such priming.

Willoughby and colleagues (2006) also explored how domain knowledge interacts with performance, although they examined learning outcomes after learners searched for
and retrieved information from the Internet as a whole. Undergraduate students majoring in Environmental Studies or Biology were randomly assigned to either an Internet or control condition, such that each condition was comprised of half Environmental Studies students and half Biology students. Each participant completed the same two essays, one corresponding to an Environmental Studies topic and the other to a Biology topic. Therefore, one topic represented an area for which they had high domain knowledge and the other topic represented an area for which they had low domain knowledge. Students in the Internet condition were asked to search for and retrieve information corresponding to the essay topic for 30 minutes prior to writing the essay. The control group, on the other hand, relied purely on their existing knowledge to answer each question, permitting researchers to determine the relative contribution of existing knowledge.

Essay performance was represented by the frequency of correct facts. As expected, students had superior performance on the essay corresponding to their area of expertise than to the unfamiliar topic, regardless of condition. However, most importantly, learners who searched the Internet for information corresponding to the topic in which they lacked existing knowledge wrote essays similar in quality to the control group (Willoughby et al., 2006). In contrast, when learners had high domain knowledge, being able to search the Internet resulted in superior performance in comparison to the control group. For example, the Environmental Studies students received higher scores on the Environmental Studies essay when they conducted Internet searches than their peers in the control condition. In contrast, Environmental Studies students who conducted Internet searches for the Biology essay did not differ from their peers who did not use the Internet. The results were reverse for the Biology students. The researchers concluded
that studying from the Internet may benefit only learners with existing knowledge, and
that simply having access to information does not automatically translate to acquiring
more knowledge. The Internet, therefore, may only be a valuable resource when learners
have a rich knowledge base in the topic area (Willoughby et al., 2006).

*Methods to Compensate for Low Domain Knowledge When Using the Internet*

Existing domain knowledge has been shown to be essential to learn from the
Internet. However, this does not necessarily mean that less knowledgeable learners
should not use the Internet, but rather that they may only be successful under certain
conditions. Factors such as sufficient search time, the capability to refer to notes recorded
during searches when writing the essay, and high levels of motivation to use the Internet
may enhance learning for less knowledgeable students when using the Internet.

*Available Time to Use the Internet.* Researchers have compared the length of time
individuals took to complete an assigned task when they were unfamiliar with the topic in
comparison to a familiar topic. For example, Patel, Drury and Shalin (1998) provided
experts and novices for a word processing program with an instructional closed
hypermedia environment detailing the program's features and functions. Pretending to be
program consultants, their task was to provide detailed procedural solutions to 18
hypothetical problems that individuals encountered when using the word processing
program. The students in the study were able to refer to the instructional hypermedia to
obtain the correct answers. In comparison to experts, novices spent more time on each
page in the program as well as more time to complete the task (Patel et al., 1998).

Similarly, Ford and Chen (2000) found that knowledgeable graduate students who were
required to browse a closed hypermedia environment to learn how to construct a webpage
spent less time learning the material than students who possessed little knowledge for this area. Moreover, in interviews, eighth graders explicitly indicated that they typically require more time to search the Internet when they are less knowledgeable about the research question (Watson, 1998). On the other hand, when they had an idea of the information they needed to search for to meet their information needs they did not require additional time (Watson, 1998). These results collectively indicate that learners require more time with the Internet when they lack knowledge for the domain. However, it is unknown how much more time is actually needed.

Willoughby and colleagues (2006) as well as Lawless and colleagues (2006) provided a maximum of 30 minutes for participants to search for information on the Internet or an individual website, respectively, corresponding to a particular topic. They both found that learners who lacked domain knowledge were unable to learn from information on the Internet during this time. In these cases, 30 minutes may be insufficient for less knowledgeable learners when completing these challenging tasks. By providing learners with more time to search for and retrieve information from the Internet, learners may be able to compare information across various websites to discover commonalities in information, and recognize important and major concepts that may improve subsequent searches. Less knowledgeable learners also would have more time to review their notes, enabling learners to formulate connections between novel information and existing knowledge and as such facilitate comprehension.

Researchers have shown that being able to review notes is beneficial for learning. For example, Kiewra and colleagues (1991) investigated whether the amount of information undergraduate students could recall depended on whether or not they were
able to review their notes. Participants recorded notes while watching a video-recorded lecture. Students who were permitted to review their notes were given 22 minutes to do so and then completed the recall tests. Students who were not permitted to review their notes completed the recall tests immediately following the lecture. Students who reviewed their notes recalled significantly more correct facts than participants who did not have time to reread their notes. Consistent with this finding, in a review of research, Kiewra (1985) identified that 17 out of 22 studies demonstrated that allowing learners to review their notes prior to a recall test leads to better performance in comparison to no review. In fact, none of the studies found that reviewing notes was debilitating for learning. Therefore, if learners had more time before writing the essay in Willoughby et al.’s (2006) study, learners may have had sufficient time to review their notes. Learners then may be capable of efficiently synthesizing novel information and existing knowledge, in effect, leading to a deeper understanding of the material.

Taking into account the poorly developed schemas of less knowledgeable learners, however, time may not be enough to enhance learning. When using the Internet, less knowledgeable learners would still need to identify the relation among sections of information both within and between websites. This may be too challenging for less knowledgeable learners. One method to reduce cognitive load, however, is to allow learners to refer their study notes when writing the essay.

*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 take notes while searching. In this case, the measure of learning resembled a test situation. However, allowing
students to use their notes when writing an essay may not only more closely resemble their typical actions when studying new information in a natural study, but may also make the task less cognitively demanding. For example, it seems likely that for academic tasks requiring students to recall information, such as exams, learners would memorize information from their textbooks and lecture notes rather than from the Internet. In contrast, the Internet may be used when searching for information to complete a written assignment such as an essay, term paper or research proposal - a situation where learners are able to rely on their notes rather than their memory.

Researchers, in fact, have acknowledged students’ use of the Internet as a resource for seeking information to complete homework but not when studying for exams (Jones, 2002; Ren, 2000; Seamans, 2002; Shenton & Dixon, 2003). According to Shenton and Dixon (2003), elementary and high school students report an increase in use of the Internet with age due to the nature of their assignments. Specifically, older students were more likely to indicate that their assignments focused on more specialized topics and therefore required more detailed information that they felt could be better retrieved from the Internet in comparison to CD-ROM programs. On the other hand, these students did not indicate using the Internet as a resource when studying for exams (Shenton & Dixon, 2003). Moreover, university students have reported that they conduct research via the Internet (Jones, 2002; Seamans, 2002). For example, in a survey of 1032 American postsecondary students, 73% reported using the Internet to do research more often than the library (Jones, 2002). In fact, when they searched for information corresponding to academic-related tasks, students reported using commercial search engines on the Internet rather than university or library websites (Jones, 2002). Therefore, it is likely that
the Internet is more commonly used when completing written assignments than for studying for exams (the typical dependent variable in studies examining students’ use of the Internet).

In addition, the ability to refer to notes while completing the assigned task eliminates the need to memorize information (Kiewra et al., 1991). If learners are not required to integrate the novel information with existing schemas, the creation of a weak connection between the selected novel information and existing knowledge is no longer of concern. According to Kiewra and colleagues (1991), learners who are able to refer to their notes while completing the assigned task are not only able to record material from the resource they are studying, but also can then transfer that information into their essay (Kiewra et al., 1991). Moreover, Kellogg (1988) claimed that referring to notes reduces memory load and thereby frees up cognitive resources. As a result, less knowledgeable learners 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) compared the length and cohesiveness of essays between undergraduate students who were and were not able to use notes they recorded during a lecture while completing an assigned essay. All participants recorded notes while watching a videotaped lecture. Half the learners completed the assigned essay without using their notes, however, while the remaining learners completed the essay with their notes present. Essays were coded for the number of words included, the number of idea units included that were expressed in the lecture, and for the combined total number of contrasting and comparison idea units that addressed the assigned question (i.e., cohesion). For these three dependent variables, the
learners who were able to refer to their notes obtained superior scores in comparison to learners required to write the essay from recall. Since the groups did not differ in the length of notes recorded, Benton et al. (1993) suggested that all learners attended to the same amount of information. The enhanced performance, therefore, was attributed to the presence of notes during the essay. According to Benton and colleagues (1993), the presence of notes provided learners with more access to the information in comparison to learners who recorded notes but were not permitted to refer to them when writing the essay.

Motivation. Although having little domain-specific knowledge may make searching the Internet a difficult endeavor, an increased level of motivation may result in persistence to learn and in turn increase performance for the task at hand. Research, in fact, has indicated that students tend to be more motivated to learn from computerized learning environments compared to print sources (Small & Ferreira, 1994; Shuell & Farber, 2001; Wishart, 2000). 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, librarians and teachers have commented that multimedia presentations increased motivation among their students for learning the material (Wishart, 2000). In empirical examinations of student motivation, moreover, 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).
A higher level of motivation to complete the task has typically resulted in superior performance on school-related tasks for students compared to the outcomes of learners who were less motivated (Gaston-Gayles, 2004; Pintrich & De Groot, 1990). For instance, college students' motivation towards academic-related tasks (unspecified) was a significant predictor of GPA, even after controlling for individual differences such as sex, race and parental level of education (Gaston-Gayles, 2004). Likewise, Pintrich and De Groot (1990) found that students who were highly motivated to complete academic-related tasks (i.e., in-class seat work, quizzes or tests, and essays or reports) outperformed their lower motivated peers. Therefore, students who are highly motivated because they are able to use the Internet may outperform less motivated students. Students then who have little domain-specific knowledge but are highly motivated to use the Internet may have superior performance in comparison to learners lacking both domain-specific knowledge and motivation. In other words, motivation to use the Internet may also compensate for a lack of domain-specific knowledge when learning from the Internet.
Thesis Study

Researchers who have investigated the learning outcomes of students after using the Internet have commonly provided learners with 30 minutes or less to search for and study information in preparation for an immediate recall task (e.g., Lawless et al., 2006; Willoughby et al., 2006). Under these conditions, learners with little domain knowledge demonstrated no benefits from their time with the Internet. The purpose of the current study was to determine whether three factors in particular would compensate for low domain knowledge. Specifically, I investigated whether allowing for more time (1 hour) to use the Internet, the presence of notes while writing the assigned essays, and high levels of motivation would benefit less knowledgeable learners when using the Internet.

Hypotheses

In the current study, participants were randomly assigned to one of the following three conditions: (a) Internet search followed by completing an essay with notes present, (b) Internet search followed by completing an essay without notes present, or (c) no Internet search prior to writing an essay. Each participant wrote two essays, one corresponding to a high knowledge domain and another related to a low knowledge domain. Based on the notes and Internet exposure manipulations, the current study tested the following five hypotheses.

Hypothesis 1. It was hypothesized that students would perform better on the essay corresponding to a high knowledge domain than to a low knowledge domain.

Hypothesis 2. It was hypothesized that the presence of notes when writing the essay would facilitate learning from the Internet when domain knowledge was low. Less knowledgeable learners were expected to have higher essay scores when they were able
to use their notes recorded during their Internet search when writing the essay in comparison to their peers who completed the essay from recall. No significant differences in performance were expected, however, when domain knowledge was high.

*Hypothesis 3.* It was hypothesized that providing plenty of time (i.e., 1 hour) to search the Internet prior to writing the essays may compensate for low domain knowledge. Learners who searched the Internet were expected to outscore their peers who did not search the Internet prior to writing the essays, when domain knowledge was low and high. It was not expected, however, that under these improved conditions less knowledgeable learners would perform at the same level as learners with high domain knowledge.

*Hypothesis 4.* It was hypothesized that a high level of motivation for using the Internet to search for and retrieve information when completing an essay rather than using print sources such as books or journal articles would enhance students’ learning when using the Internet, particularly when domain knowledge was low. Therefore, students who had low domain knowledge but were highly motivated were expected to have superior performance in comparison to their peers who lacked both domain knowledge and motivation. Motivation was not expected to affect performance when domain knowledge was high.

*Hypothesis 5.* It was hypothesized that learners who had notes present when writing an essay would indicate that this procedure was more similar to the method they used to complete essays for their university courses in comparison to learners who did not have notes present.
Method

Participants and Design

The participants were 60 undergraduate students (n = 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) 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 completed a first-year Physical Education and Kinesiology course and did not complete, nor were currently completing, any courses within Political Science or History disciplines. Participants were recruited through announcements made in class or posters displayed around the university. Interested students emailed the researcher to set up an appointment to participate.

The students in each discipline were randomly assigned to one of the following three conditions: (a) 1 hour Internet search followed by completing an essay with notes present (i.e., Internet-notes; $n = 20$), (b) 1 hour Internet search followed by completing an essay without notes present (i.e., Internet-no-notes; $n = 20$), or (c) no Internet search prior to writing an essay (i.e., control; $n = 20$). Participants were informed of which condition they were assigned to when they arrived to complete the study. An equal proportion of males and females were assigned to each condition. Figure 1 shows a summary of the design.
## Table

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<th>Discipline</th>
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<td>Internet notes</td>
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**Figure 1.** Experiment design.
Each participant wrote the same 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). 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. The essays were typed in Microsoft Word, with 1.25 inch margins, and were double-spaced. Participants in the Internet conditions received $50 for their participation and the control group participants received $20. Monetary compensation was based on the time participants spent in the study.

Undergraduate students were carefully chosen as the sampling population in this study due to the study’s knowledge level requirements for completing the assigned task. The specialization of students’ knowledge within a specific domain is most evident when completing postsecondary education (Horn & Masunaga, 2000). In other words, when completing a degree in a chosen domain, undergraduates complete the vast majority of their courses within that specific domain. Furthermore, while there is some variability of choice for courses within their major area of study, there is a substantial variety of courses outside their area of study that students may choose from to fulfill the degree’s elective component. As a result, there is a large diversity in the combination of undergraduates’ course completions, increasing the probability that Political Science students did not complete any courses in Kinesiology or related subjects, and vice versa. In contrast, elementary and secondary school students are required to complete a number of the same courses and may have few options for electives, therefore, limiting the
options for essay topics and also the number of participants that would meet the stringent criteria. Thus, there is a greater probability that a sufficient sample of participants would have met the required combination of high and low knowledge levels corresponding to the predetermined domains by targeting undergraduates.

Materials

The paper-based materials consisted of a consent form (see Appendix A and B), a Demographics and Internet Background questionnaire (see Appendix C) and a Task Reflection questionnaire (see Appendix D and E). The Demographics and Internet questionnaire asked participants to indicate their age, sex, undergraduate major, number of completed credits in their major, and year in university major. Using a 5-point Likert scale, participants also rated the following: (a) their level of comfort and knowledge when searching for information from the Internet (0 = very low, 4 = very high); (b) how often they used the Internet when completing actual university essays as well as when studying for tests (0 = never or almost never, 4 = always or almost always); and (c) 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). Participants also provided explanations for their motivation rating.

The questions on the Task Reflection Questionnaire varied depending upon condition. Both the Internet and control conditions rated their level of motivation for completing each of the essays (0 = very low, 4 = very high). The Internet groups, however, also rated the level of difficulty to search for and retrieve information from the Internet for each essay topic (0 = very low, 4 = very high), and the level of similarity
between the procedure they used (e.g., types of sites visited on the Internet, method of note-taking, use of notes when writing the essay) to complete the essay assigned in this experiment compared to completing actual essays in their university courses (0 = very different, 4 = very similar). Participants were also required to provide explanations for the difficulty and similarity ratings they provided.

Participants searched the Internet and typed their essays on a Compaq Presario R3000 notebook. All Internet participants began their searches at the Microsoft network home page (http://www.msn.com). A stopwatch was used to time the Internet searches and essay completion.

Defining the Internet. A concern that rose from research examining students’ learning from the Internet was that researchers did not define “using the Internet.” Therefore, it is unknown whether library websites and their online databases were included in researchers’ references to the Internet. For example, the Environics Research Group (2001) indicated that Canadian youth use the Internet to complete homework. Similarly, Lenhart, Rainie and Lewis (2001) found that the Internet was accessed to complete school-related research among American adolescents. In addition, Jones (2002) found that almost three-quarters of surveyed university students would go online rather than to the physical library. Given that researchers did not indicate whether or not reference to the Internet excluded electronic library databases, it cannot be concluded with certainty that the students did not access materials from the library website. Since Jones, however, did make a distinction between commercial and library search engines, it may be presumed that Jones’ definition of the Internet did exclude the library website.
The reason a distinction between the actual Internet and the library websites is important is because the latter is simply an online version of the library, including card catalogs and journal article databases which permit students to search for information. All information contained in such databases has undergone some form of quality control, and thus is distinctly different from information presented on the Internet. In addition, the library websites often do not provide individuals with the actual information, as a website would, but rather provides a list of resources that may be applicable, whether they must be retrieved from the physical library or are available for downloading. Taking this into account, within the current study, the Internet referred to websites on the World Wide Web (e.g., www.stcatharinesstandard.ca), and excluded email programs (e.g., hotmail, yahoo, etc.), chat rooms (e.g., MSN Messenger), library databases, journal article databases (e.g., PsycInfo), and WebCT.

Procedure

Instructions and procedures differed whether participants were randomly assigned to one of the Internet groups or the control group.

Internet groups. The duration of the study session for the Internet condition was approximately 3 hours and was divided into two phases. In phase one, participants first completed the consent form as well as the Demographics and Internet Background questionnaire. Participants were then assigned their first essay topic and given 1 hour to search the Internet for corresponding information.

For the sports essay, students in the Internet-notes condition were provided with the following instructions, “During this session, you will be given 1 hour to search the Internet to learn about 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. I have provided you with paper and a pen to take notes, which you may use to write your essay. I will stop your search for information after 1 hour and any windows containing information from the Internet will be closed. You will be given 20 minutes to write an essay (maximum 2 pages) using Microsoft Word. I will be available during your entire session if you have any questions regarding the expectations of the assignment or the programs. However, I am not able to answer questions corresponding to the content of your searches." For the political topic, Internet-notes participants received the same directions but instead they were instructed to search the Internet to learn about how the role and powers of the American President are different from the Canadian Prime Minister.

In contrast, students assigned to complete the sports essay without reference to their notes (i.e., Internet-no-notes participants) were provided with the following instructions: "During this session, you will be given 1 hour to search the Internet to learn about 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. I have provided you with paper and a pen to take notes. However, you will NOT be able to refer to your notes when writing your essay. I will stop your search for information after 1 hour and any windows containing information from the Internet will be closed. You will then be given 20 minutes to write an essay (maximum 2 pages) using Microsoft Word. I will be available at all times if you have any questions regarding the expectations of the assignment or the programs. However, I am not able to answer questions corresponding to the content of your searches." For the political topic, Internet-no-notes
participants received the same directions but instead they were instructed to search the
Internet to learn about how the roles and powers of the American President are different
from the Canadian Prime Minister.

At the end of the first phase, participants completed a portion of the Task
Reflection questionnaire, which required them to indicate the difficulty level to complete
the first essay and the reasons for their rating, as well as rate their motivation for
completing the essay.

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,
participants searched the Internet for 1 hour and then completed an essay corresponding
to the topic they did not complete in the first phase. Participants received the instructions
related to the second essay topic as detailed above. After submitting the completed essay,
participants then completed the remainder of the Task Reflection questionnaire. They
indicated the difficulty level to complete the second essay and the reasons for their rating,
as well as rate their motivation for completing the essay. In addition, they also rated the
level of similarity between the processes they used to complete the assigned task in this
study compared to actual essays in their university courses as well as provided an
explanation for their rating. Participants received a Thank You Letter (see Appendix F)
before leaving.

Control group. The control group attended a single session lasting approximately
1 hour. Participants completed the consent form, Demographics and Internet Background
questionnaire and two essays (one for each level of domain knowledge) without any
exposure to the Internet. When completing the sports essay, participants were provided with the following instructions: “You will be given up to 20 minutes to write an essay (maximum 2 pages) about 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. You will complete this essay using Microsoft Word. I will be available at all times if you have any questions regarding the expectations of the assignment or the program.” For the political topic, participants received the same directions but instead they were instructed to write an essay about how the roles and powers of the American President are different from the Canadian Prime Minister. After completing their first essay, participants were offered a break before beginning the next essay. Participants then were given up to 20 minutes to complete the second essay corresponding to the alternate topic. At the outset of the session, participants completed the appropriate version of the Task Reflection questionnaire, which asked them to rate their level of motivation for completing each essay. Participants received a Thank You Letter (see Appendix F) before leaving.

Scoring of Essays

Using Moreno and Mayer’s (2002) scoring method, essay quality was computed for each participant by counting the number of answers that directly addressed the assigned question. For example, an acceptable answer for the political question included that the President was the Commander-in-Chief whereas in Canada the Prime Minister did not fulfill this role. An example of an acceptable answer for the sports essay included that both Ancient Roman and contemporary spectators are exposed to violence in sports for entertainment. Participants were given 1 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. One rater was a graduate student in Political Science and was recommended by the Political Science department as having high knowledge in Political Science. The researcher served as the second rater. Similarly, two raters scored approximately 30% of the sports essays. Again, one of the raters (4th year undergraduate student in Kinesiology) was highly knowledgeable in Kinesiology as indicated by a Physical Education & Kinesiology professor, and the other rater was the researcher. The researcher scored all of the remaining essays. The raters were unaware of the treatment conditions and the individuals’ existing domain knowledge. For the political essay, raters achieved 80% reliability and for the sports essays rater agreement achieved 82%. Discrepancies were resolved through discussion.

Coding of Explanations for Motivation, Similarity and Difficulty Ratings

All participants provided explanations for their motivation rating, and learners in the Internet group provided explanations for their similarity and difficulty ratings. Using the content analysis approach described by Gibson and Oberg (2004) common themes in the explanations were identified. First, segments of information (phrases or sentences) discussing a similar idea were identified and labeled inductively according to theme. Related labels were combined, resulting in the development of categorical themes. The number of participants that were combined together for each categorical theme was calculated. For the motivation explanations, each labeled segment also was classified as positive or negative.
Two raters indicated the themes for 25% of the motivation explanations, 25% of the similarity explanations and 25% of the difficulty explanations to determine inter-rater reliability. One of these raters coded all of the remaining explanations. Raters achieved 90% reliability corresponding to the motivation explanations, 80% reliability corresponding to the similarity explanations and 90% reliability corresponding to difficulty explanations. Discrepancies were resolved through discussion.

Data Analysis

Preliminary analyses were conducted first to make certain that the groups did not differ in their level of motivation to complete the essays as well as to ensure that the Internet groups did not differ in the number of days between completing the two phases of the experiment. In addition, preliminary analyses were conducted to ensure that essay performance did not differ according to sex and the order of essays (i.e., high knowledge essay completed first or second). The main analyses examined whether the presence of notes, time to use the Internet, and high motivation levels compensated for low domain knowledge. In addition, to determine whether the presence of notes made the task more representative of actual tasks, similarity ratings for the procedure participants used to complete the essay assigned in the study in comparison to completing essays for their university courses were compared between the notes and no-notes conditions. Explanations for similarity ratings also were explored for patterns. Finally, secondary data analyses were conducted to investigate whether participants used the Internet more often for completing academic essays in comparison to preparing for exams, and to investigate participants' ratings for the difficulty to complete each essay. Explanations for difficulty level were also examined for patterns.
Results

Preliminary Analyses

See Table 1 for the overall means, standard deviations, ranges, kurtosis and skewness for the following questionnaire data: level of 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, level of difficulty to search for information on the Internet pertaining to the sports and political essays, level of similarity between the experimental procedure and the procedure used when completing essays in university courses, and how often learners used the Internet when completing essays and when studying for exams in their university courses. Table 2 presents the first-order correlations between these variables.

Motivation for Completing the Essays. To make certain that the groups did not differ in their motivation to complete each of the essays, two one-way Analyses of Variance (ANOVAs) were conducted. Bonferonni correction was used to control for the number of comparisons, and therefore, alpha level was set at .025. Learners’ motivation to complete the sports essay did not differ significantly between the Internet-notes ($M = 2.72$, $SD = 0.56$), Internet-no-notes ($M = 2.55$, $SD = 0.51$) and the control ($M = 2.60$, $SD = 1.14$) groups, $F(2, 57) = 0.23$, $p > .025$. Similarly, learners’ motivation to complete the political essay did not differ significantly between the Internet-notes ($M = 2.65$, $SD = 0.75$), Internet-no-notes ($M = 2.65$, $SD = 0.93$) and the control ($M = 2.10$, $SD = 1.33$) groups, $F(2, 57) = 1.88$, $p > .025$. 
Table 1

Descriptive Statistics for the Questionnaire Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>Kurtosis</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>2.00 (1.16)</td>
<td>4</td>
<td>-1.43</td>
<td>-0.68</td>
</tr>
<tr>
<td>Difficulty (sports topic)</td>
<td>1.45 (0.88)</td>
<td>3</td>
<td>-0.84</td>
<td>-0.22</td>
</tr>
<tr>
<td>Difficulty (political topic)</td>
<td>1.43 (0.98)</td>
<td>4</td>
<td>-0.03</td>
<td>1.50</td>
</tr>
<tr>
<td>Similarity</td>
<td>2.16 (0.83)</td>
<td>4</td>
<td>0.18</td>
<td>-0.83</td>
</tr>
<tr>
<td>Internet use for essays</td>
<td>2.28 (1.22)</td>
<td>4</td>
<td>-1.56</td>
<td>-0.91</td>
</tr>
<tr>
<td>Internet use for exams</td>
<td>1.30 (0.96)</td>
<td>4</td>
<td>-0.27</td>
<td>1.35</td>
</tr>
</tbody>
</table>
Table 2

*Correlations Between Questionnaire Data*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Motivation</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Difficulty (sports topic)</td>
<td>.04</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Difficulty (political topic)</td>
<td>-.08</td>
<td>.01</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Similarity</td>
<td>.35*</td>
<td>-.22</td>
<td>-.08</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Internet use for essays</td>
<td>.74**</td>
<td>.19</td>
<td>.01</td>
<td>.14</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>6. Internet use for exams</td>
<td>.44*</td>
<td>.01</td>
<td>-.09</td>
<td>.00</td>
<td>.36**</td>
<td>--</td>
</tr>
</tbody>
</table>

*Note.** *p < .01, * p < .05.*
**Number of Days Between Phases.** To ensure that the Internet-notes and no-notes groups did not differ in the number of days that occurred between phases of the study, an independent t-test was conducted. The delay between phases did not differ significantly between the Internet-notes \((M = 3.60, SD = 2.42)\) and Internet-no-notes \((M = 4.10, SD = 3.57)\) groups, \(t(38) = 0.52, p > .05\). To examine whether the number of days between phases predicted essay scores or predicted essay scores differentially across Internet conditions, a hierarchical multiple regression analysis was conducted with essay scores as the dependent variable and number of days and Internet condition as the predictors. Number of days between phases and Internet condition (notes and no-notes) were entered in the first step, and the interaction between number of days and condition was entered in the second step. Both steps were not significant, \(\Delta F(2, 37) = 0.73, p > .05\), and \(\Delta F(1, 36) = 0.36, p > .05\), indicating that number of days between phases did not significantly predict essay scores.

**Order and Sex Effects.** To ensure that the order of essay completion and sex did not impact essay quality, a 2 (order of presentation) X 2 (discipline) X 3 (condition) X 2 (sex) X 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 presentation (less knowledgeable essay completed first and second) were the between-subjects factors, and essay topic (politics and sports) was the within-subjects factor. All main effects and interactions 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, $F(2, 37) = 6.03, p < .05$. Given these significant effects, order of presentation and sex were included as covariates in all further analyses.

**Main Analyses**

**Hypothesis 1: Domain Knowledge Enhances Performance.** To directly test this hypothesis, a mixed measures ANCOVA was conducted with essay scores as the dependent variable, discipline (Political science and Kinesiology) as the between-subjects variable, essay topic (politics and sports) as the within-subjects variable, and order and sex as covariates. The essay topic by discipline interaction was the only significant effect, $F(1, 56) = 41.25, p < .05, \eta^2 = .42$. See Table 3 for means and standard errors. Political Science students performed significantly better on the political essay in comparison to the sports essay, $t(29) = 3.66, p < .05$. In contrast, Kinesiology students obtained significantly higher scores on the sports essay than on the political essay, $t(29) = 5.66, p < .05$. Therefore, these data are consistent with Hypothesis 1, indicating that students performed significantly better when the essay topic corresponded to a high knowledge domain.

**Hypothesis 2: The Presence of Notes Supports Learning.** To directly test this hypothesis, a mixed measures ANCOVA was conducted to investigate 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, both for high knowledge and low knowledge domains. 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. Again, 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
Table 3

*Mean Adjusted Essay Scores for All Participants as a Function of Discipline and Essay Topic*

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Political Essay Mean (SE)</th>
<th>Sports Essay Mean (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science</td>
<td>2.98 (0.30)</td>
<td>1.78 (0.25)</td>
</tr>
<tr>
<td>Kinesiology</td>
<td>1.44 (0.30)</td>
<td>3.26 (0.25)</td>
</tr>
</tbody>
</table>

*Note.* Means were adjusted based on the inclusion of the covariates.
significantly better when the essay topic corresponded to a high knowledge domain. See Table 4 for means and standard errors. Political Science students performed significantly better on the political essay in comparison to the sports essay, t(19) = 4.02, p < .05. In contrast, Kinesiology students obtained significantly higher scores on the sports essay than on the political essay, t(19) = 3.80, p < .05. Therefore, notes did not aid essay quality when learners had high or low domain knowledge in comparison to an absence of notes.

_Hypothesis 3: Plenty of Time to Search the Internet Supports Learning._ Because learners in the Internet-notes and Internet-no-notes condition did not differ significantly in essay quality for the two topics, these conditions were collapsed into a single Internet group in all subsequent analyses. To directly test Hypothesis 3, a mixed measures ANCOVA was conducted with discipline (Political Science and Kinesiology) and condition (Internet and control) as the between-subjects factors, essay topic (politics and sports) as the within-subjects variable, and order and sex as covariates. Both the main effect of condition and the two-way 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 ($M = 2.87, SE = 0.16$) significantly outperformed the control group ($M = 1.35, SE = 0.23$), and learners performed significantly better when the essay topic corresponded to a high knowledge domain. Table 5 shows the mean essay scores and standard errors. These results support the hypothesis that providing plenty of time to search the Internet prior to writing the essays may compensate for low domain knowledge. Learners who searched the Internet outperformed their peers who did not search the Internet regardless of level of domain knowledge.
Table 4

Mean Adjusted Essay Scores for the Internet Groups as a Function of Discipline and Essay Topic

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Political Essay Mean (SE)</th>
<th>Sports Essay Mean (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science</td>
<td>3.70 (0.35)</td>
<td>2.03 (0.32)</td>
</tr>
<tr>
<td>Kinesiology</td>
<td>2.00 (0.35)</td>
<td>3.77 (0.32)</td>
</tr>
</tbody>
</table>

Note. Table includes data for the Internet condition only. Means were adjusted based on the inclusion of the covariates.
Table 5

Mean Adjusted Essay Scores for All Participants as a Function of Discipline and Essay Topic with the Inclusion of Condition in the Analyses

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Political Essay Mean (SE)</th>
<th>Sports Essay Mean (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science</td>
<td>2.62 (0.27)</td>
<td>1.66 (0.25)</td>
</tr>
<tr>
<td>Kinesiology</td>
<td>1.15 (0.27)</td>
<td>3.00 (0.25)</td>
</tr>
</tbody>
</table>

Note. The Internet-notes and Internet-no-notes conditions were collapsed into one condition. Means were adjusted based on the inclusion of the covariates.
Hypothesis 4: High Level of Motivation Supports Learning. To test this hypothesis, two hierarchical multiple regression analyses were conducted, one for each essay topic with only the Internet group. One participant was excluded from the analyses because they misinterpreted the question, as indicated by their explanation provided for their motivation rating. 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 entered as 0 and Kinesiology was entered 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. Tables 6 and 7 show the regression analyses. Thus, motivation did not significantly predict essay performance regardless of domain knowledge.

Motivation Explanations. Learners provided explanations for their level of motivation to use the Internet, which were labeled according to categorical theme. Two participants provided explanations for their motivation rating that indicated they did not interpret the question correctly and therefore were excluded from all analyses involving the motivation explanations. Because some participants provided more than one attribute in their explanations, the total frequency of participants across categorical themes exceeds the total number in the study included in the analyses \( n = 58 \).

The mean motivation rating across all participants was 1.97 \( (SD = 1.20) \), indicating that learners in the current study were moderately motivated to use the Internet rather than print sources to retrieve information. Figure 2 shows the distribution of
Table 6

*Regression of Motivation on Sports Essay Quality*

<table>
<thead>
<tr>
<th>Step</th>
<th>B</th>
<th>β</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Order</td>
<td>-.64</td>
<td>-.19</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
<td>.53</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discipline</td>
<td>1.78**</td>
<td>.53**</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td>Motivation</td>
<td>.06</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discipline X Motivation</td>
<td>.05</td>
<td></td>
<td>2.55</td>
</tr>
</tbody>
</table>

*Note.* Coefficients are from the second step. ** p < .01.

Overall R² = .34
### Table 7

*Regression of Motivation on Political Essay Quality*

<table>
<thead>
<tr>
<th>Step</th>
<th>B</th>
<th>β</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order</td>
<td>-.88</td>
<td>-.26</td>
<td>.03</td>
<td>.65</td>
</tr>
<tr>
<td>Sex</td>
<td>-.47</td>
<td>-.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discipline</td>
<td>-1.73**</td>
<td>-.51**</td>
<td>.25</td>
<td>5.91**</td>
</tr>
<tr>
<td>Motivation</td>
<td>-.25</td>
<td>-.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>.00</td>
<td>.08</td>
</tr>
</tbody>
</table>

**Note.** Coefficients are from the second step. **p < .01.

Overall $R^2 = .28$
attribute type by motivation rating. The 20 participants who rated their motivation as very low or low provided only negative attributes of the Internet. In contrast, 20 of the 23 participants with high or very high motivation discussed only positive attributes of the Internet. The remaining three participants discussed both positive and negative attributes. The 15 learners whose motivation was rated as moderate provided negative and positive attributes of the Internet.

The attribute of the Internet that was most commonly praised was that the Internet was more efficient to use than print sources ($n = 27$ participants). Researching the Internet took less time and could be accessed anytime and anywhere. The only other positive attribute mentioned was that the Internet was a good source for information, such that there is an abundance of information and up-to-date information ($n = 6$). In contrast, 31 learners indicated that the Internet is a poor source for information, mainly due to its unreliability. Other reasons that negatively affected motivation was that the Internet was time consuming ($n = 1$) or that learners were not comfortable using the Internet ($n = 5$).

**Hypothesis 5: Internet-notes Group Rates Procedure Similar to the Method They Use to Complete Academic Essays.** Students in the Internet condition rated the level of similarity between the procedure they used to complete the essays assigned to them in the experiment compared to completing actual essays in their university courses. Three participants misunderstood the question (i.e., provided reasons why the procedure used was similar or different between the sports and political questions they completed in the current study) and therefore were excluded from the analyses involving similarity ratings. An independent t-test was conducted with Internet condition (notes and no-notes) as the between-groups factor and similarity ratings as the dependent variable. The similarity
Figure 2. Distribution of ratings for motivation to use the Internet depending on attribute type.
rating provided by the Internet notes group ($M = 2.06, SD = 0.80$) did not differ significantly from the Internet-no-notes group ($M = 2.26, SD = 0.87$), $t(35) = 0.75, p > .05$. Therefore, both groups indicated that the procedure they used to complete the experimenter-assigned essays was somewhat similar to the procedure they use to complete actual essays for their university courses.

Table 8 presents a complete listing of reasons (according to categorical theme) participants provided for why completing the experiment-assigned essays and academic-related essays were similar and different from each other. Some learners indicated more than one difference ($n = 8$), multiple similarities ($n = 1$), or a combination of differences and similarities ($n = 11$). Also, because some learners provided more than one unit of information, the total frequency of participants indicated in the tables exceeds the actual number of participants in the study.

Across both Internet groups, 14 learners listed similarities between the essays in the current study and academic essays. Learners indicated that their search for information (e.g., use same search engines and access the same type of websites; $n = 11$) and the recording of notes ($n = 5$) in the current study was representative of what they did while completing academic essays. In contrast, 30 students across the Internet-notes and Internet-no-notes conditions indicated differences between the completion of the task in current study and the completion of academic essays. The most common explanations for differences discussed by students in both conditions included using different sources for information (e.g., books, journal articles, academic-oriented websites; $n = 27$) and a different note-taking procedure while searching for information (e.g., bookmark websites,
Table 8

*The Number of Participants across Explanations for Their Similarity Rating as a Function of Internet Condition*

<table>
<thead>
<tr>
<th>Explanations for Similarity Rating</th>
<th>Internet Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Notes</td>
</tr>
<tr>
<td>Differences</td>
<td></td>
</tr>
<tr>
<td>Use different source for information</td>
<td>11</td>
</tr>
<tr>
<td>Use different note-taking method</td>
<td>1</td>
</tr>
<tr>
<td>Spend more or less time researching</td>
<td>2</td>
</tr>
<tr>
<td>Notes are present when writing essays</td>
<td>0</td>
</tr>
<tr>
<td>Include references</td>
<td>1</td>
</tr>
<tr>
<td>Include quotations</td>
<td>1</td>
</tr>
<tr>
<td>Conduct more in depth research</td>
<td>0</td>
</tr>
<tr>
<td>Similarities</td>
<td></td>
</tr>
<tr>
<td>Similar search process</td>
<td>4</td>
</tr>
<tr>
<td>Record notes</td>
<td>3</td>
</tr>
</tbody>
</table>
copy-and-paste; \( n = 5 \). Four students in the Internet-no-notes group indicated that they would have normally used their notes when writing the essay.

**Secondary Analyses**

*Typical Internet Use for Academic Tasks.* Students provided ratings for both how often they used the Internet when writing essays and when studying for exams. These mean ratings were compared to identify whether students used the Internet more often when completing essays or when studying for exams. A paired t-test revealed that students used the Internet more often when writing essays (\( M = 2.28, SD = 1.22 \)) than when studying for an exam (\( M = 1.30, SD = 0.96 \)), \( t(59) = 6.07, p < .05 \).

*Difficulty of the Essay Topics.* Students in the Internet group rated the level of difficulty to search for and retrieve information on the Internet on a five-point likert scale (0 = very low to 4 = very high) for each essay topic. Figure 3 presents the distribution of participants’ difficulty ratings by domain knowledge. A 2 (discipline) X 2 (essay topic) mixed model ANOVA was conducted to investigate whether learners rated the essay corresponding to their less knowledgeable domain as more difficult to search for when using the Internet in comparison to their high knowledge topic. Discipline served as the between-subjects measure and essay topic was the within-subjects factor. The difficulty ratings to search for and retrieve information on the Internet for each essay were the dependent variables. The main effect for difficulty, \( F(1, 40) < 1, p > .05 \), and discipline, \( F(1, 40) < 1, p > .05 \), did not reach significance. However, there was a significant two-way interaction, \( F(1, 40) = 13.35, p < .05 \).

Two paired-sample t-tests were conducted to examine the interaction. Learners found it more difficult to search for information when their domain knowledge was low.
Figure 3. Distribution of ratings for the level of difficulty to search for and retrieve information from the Internet depending on domain knowledge.
in comparison to when their domain knowledge was high. Political Science students rated the sports essay \((M = 1.05, SD = 0.95)\) as significantly more difficult than the political essay \((M = 1.70, SD = 0.87)\), \(t(19) = 2.94, p < .025\). There was a trend that the Kinesiology students rated the sports essay \((M = 1.20, SD = 0.83)\) less difficult than the political essay \((M = 1.80, SD = 0.89)\), \(t(19) = 2.04, p = .06\).

Two multiple regression analyses were conducted to determine whether learners’ difficulty ratings would account for variance over and above the variance accounted for by domain knowledge. Therefore, the partial correlation between difficulty and essay performance was of interest. Discipline was dummy-coded such that the Political Science domain was coded as 0 and Kinesiology was coded as 1. For the first regression, performance for the political essay was the dependent variable. Discipline and the difficulty ratings to search for and retrieve information from the Internet for the political topic were entered in one step. For both the politics and sports topics, the regression was significant, \(F(2, 37) = 6.30, p < .05, F(2, 37) = 7.55, p < .05\), respectively, and discipline was the only significant variable. Tables 9 and 10 show the results for the regression analyses. Thus, difficulty did not significantly predict essay performance regardless of domain knowledge.

*Difficulty Explanations.* Participants provided reasons for their ratings of the difficulty levels for each essay topic, which were labeled according to categorical theme. Some participants’ explanations contained more than one categorical theme, and therefore, the frequencies discussed below exceed the total number of participants. For the essay corresponding to participants’ high knowledge domain, learners indicated that their search for information was easy because of the following: (a) they had high
Table 9

Regression of Difficulty Rating on Political Essay Quality

<table>
<thead>
<tr>
<th>Step</th>
<th>B</th>
<th>(\beta)</th>
<th>(R^2)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>.25</td>
<td>6.30**</td>
</tr>
<tr>
<td></td>
<td>Discipline</td>
<td>-1.42*</td>
<td>-.41*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difficulty Rating</td>
<td>-.31</td>
<td>-.18</td>
<td></td>
</tr>
</tbody>
</table>

Note. ** p < .01, * p < .05.
Table 10

Regression of Difficulty Rating on Sports Essay Quality

<table>
<thead>
<tr>
<th>Step</th>
<th>B</th>
<th>β</th>
<th>$R^2$</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>.29</td>
<td>7.55**</td>
</tr>
<tr>
<td>Discipline</td>
<td>1.74**</td>
<td>.49**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty Rating</td>
<td>-.12</td>
<td>.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. ** p < .01.
domain knowledge \((n = 10\) participants), (b) there was plenty of information \((n = 15)\), (c) little effort was required to find information \((n = 8)\), and (d) they were able to find reliable resources \((n = 1)\). In contrast, some participants indicated that their search for information was relatively difficult because much effort was required to find information \((n = 6)\) or that the Internet contained low quality resources \((n = 6)\). The less common reasons provided were that the Internet contained too much information \((n = 1)\), and presented redundant information \((n = 1)\).

For the essay corresponding to the low knowledge domain, participants specified that the Internet lacked information \((n = 14)\) and that much effort was required to find information \((n = 8)\), which made the Internet relatively difficult to use. Less common explanations for why they found it difficult to find information on the Internet included their low domain knowledge \((n = 3)\), and that the Internet either contained redundant \((n = 2)\), inconsistent \((n = 2)\) or too much information \((n = 1)\). In contrast, the three reasons provided for why they found it relatively easy to find information when domain knowledge was low was because there was plenty of information \((n = 13)\), little effort was required to find information \((n = 7)\), or they were able to distinguish reliable sources \((n = 2)\).
Discussion

Previous research has revealed that students do not learn from the Internet when domain knowledge is low (Lawless et al., 2006; Willoughby et al., 2006). The purpose of the current study was to investigate methods that could compensate for low domain knowledge when using the Internet. Three supports that were examined included the presence of notes while writing essays, plenty of time provided to search the Internet (i.e., 1 hour), and having high levels of motivation to use the Internet. Under these conditions, learning from the Internet was hypothesized to be less challenging. Results for each of these supports will be discussed below.

The Presence of Notes

By having notes present when completing essays in the present study, learners were able to use information that they recorded during their Internet searches in their essay, in the event they could not remember. Access to notes was expected to be beneficial for less knowledgeable learners since their schemas are typically insufficiently developed, and thus the process of integrating novel information with existing knowledge is more challenging and less efficient (Fincher-Kiefer et al., 1988; Willoughby et al., 2006). As a result, novel information may not be retrieved from memory during subsequent recall. However, being able to refer to notes while completing the essays in the current study did not facilitate learning when domain knowledge was low in comparison to not having notes present.

The presence of notes may not have compensated for low domain knowledge when using the Internet because learners were informed beforehand as to whether or not their notes would be present during the essay writing stage. This information may have
influenced learners’ performance. For example, Benton and colleagues (1993) did not inform undergraduate students beforehand whether or not they would have had access to their notes while writing an assigned essay. Learners attended a lecture during which they were permitted to record notes, and then immediately completed an essay question related to the content of that lecture. At the onset of the essay, half the participants were informed that they could refer to their notes, whereas the remaining participants were instructed to complete the essay from recall. Since the groups did not differ in the number of idea units included in their notes, Benton et al. (1993) concluded that the inferior performance of the group who did not have notes present was a result of forgetting the information they recorded during the lecture. When notes were present, however, learners were capable of referring to their notes to obtain information they did not remember.

In contrast, Slotte and Lonka (1999) did inform students at the beginning of the study whether or not their notes would be present when completing an essay. High school graduates were given 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 had their notes present during the essay writing stage whereas the remaining students did not have their notes present. Essay quality, however, did not differ whether learners were required to write the essay from memory or could refer to their notes. Therefore, the successful recall of information may have been influenced by learners’ awareness of the task requirements.
When learners are presented with a task, self-regulated learning theorists such as Winne and Hadwin (1998) claim that learners define the task and what it will entail, including but not limited to time constraints, requirements and resources available. Based on this information, learners enact strategies they believe will lead to successful completion of the task. This hypothesis is based on the concept that learners have some knowledge and awareness of their own memory and anything that pertains to information storage and retrieval (Harris, 1982). These metacognitive beliefs impact strategies learners use to memorize information (Simons, 1996). For example, Hadwin, Winne, Stockley, Nesbit and Woszczyna (2001) found that the strategies undergraduate students used varied according to context (i.e., reading for learning, preparing to write a paper or studying for a midterm exam). Most interestingly, learners appeared not only to use tactics related to memorization (i.e., rehearsal) more often than other tactics when studying for an exam, but seemed to use such strategies more often for this task than the other tasks.

Interestingly, Braten and Samuelsteun (2004) found that the learning strategies undergraduate students used corresponded to the demands of the task. Undergraduate students were presented with an article and randomly instructed to read the article in preparation for either an exam or a discussion. After studying the article for an allotted amount of time, participants then completed questionnaires regarding the strategies they used while studying the information. Learners who prepared for a discussion reported using memorization strategies as often as those preparing for an exam. Therefore, having to recall information, regardless of the task, may promote strategy use aimed at increasing recall and therefore, facilitate performance on recall tasks. In the current study,
then, learners who were informed that they would not be able to use their notes when writing the essay could have used learning strategies they normally use to enhance recall. Therefore, having to memorize information may not have been a challenging task.

It is not surprising, on the other hand, that the Internet-notes group did not outperform the Internet-no-notes group when the essay corresponded to participants’ high knowledge domain. As domain knowledge increases, the complexity and validity of related schemas also increases (Bjorklund & Schneider, 1996). Consequently, when knowledgeable learners encounter novel domain-related information, they are able to create meaningful connections with their existing knowledge base with little cognitive effort (Stein et al., 1978). During recall, these schemas associated with the domain are activated. Therefore, requiring learners with high domain knowledge in the current study to memorize information was not a challenging task, and students in the no-notes condition performed just as well as learners not required to memorize novel domain-related information.

Writing an essay from recall also may not have resulted in poorer essay performance for high as well as low knowledge domains because this was not recognized as an unfamiliar course of action. Learners in the Internet-no-notes condition indicated that the procedure they used to complete the essays assigned in the current study was somewhat similar to the procedure they used to complete essays assigned in their university courses. Indeed, only four learners in the Internet-no-notes group indicated that they used their notes when completing an academic essay. Moreover, this similarity rating was not significantly different from the similarity rating provided by the Internet-notes group. Learners without notes may have associated the task with completing an
essay rather than completing an exam. This might explain why there were no
performance differences between the Internet groups.

*Plenty of Time to Use the Internet*

In interviews, students have reported that they require more time to search the
Internet when the domain is unfamiliar (Watson, 1998). Taking this into account, learners
in the present study were provided with 1 hour to search for information on the Internet
prior to writing the essays. In contrast to Willoughby et al. (2006) and Lawless et al.
(2006) who provided learners with less time to search the Internet, learners in the current
study benefited from Internet exposure when domain knowledge was both high and low,
in comparison to a control group. Therefore, plenty of time to search the Internet may
compensate for low domain knowledge.

Students with low domain knowledge in the current study, on average, indicated a
moderate level of difficulty to retrieve domain-related information on the Internet. Some
learners reported that the Internet contained plenty of information or that conducting
keyword searches required little effort, facilitating the search for information. This is not
surprising, since search engines today are fairly good at generating relevant sources.
Indeed, Willoughby and colleagues (2006) found that less knowledgeable learners
accessed relevant websites as often as their more knowledgeable peers. Therefore, less
knowledgeable learners in the current study may have been able to access relevant
information with little difficulty. However, learners did indicate that searching for and
retrieving information from the Internet was slightly more difficult when the essay
corresponded to a low knowledge domain in comparison to a high knowledge domain.
Therefore, although knowledge may not be necessary when using the Internet, knowledge may still make the Internet less challenging.

By providing learners in the present study with plenty of time, however, they had the opportunity to review individual websites as well as access more websites. Therefore, learners may have had repeated exposure to information and likely important concepts. Researchers have identified that repetitive reading is an effective study strategy and facilitates comprehension. For example, Haenggi and Perfetti (1992) compared the learning outcomes of undergraduate students who rewrote notes, reviewed notes or reread the text. During the first session, participants read an 8-page document and were instructed to either record notes or not to record notes. Participants returned one day later for a second session when they restudied the material. Of the learners who recorded notes, half were instructed to reread their notes whereas the remaining note-takers rewrote their notes. Learners who did not record notes the previous session were instructed to reread the document. After controlling for domain knowledge, learners’ comprehension did not differ significantly across the three study strategies. Therefore, Haenggi and Perfetti (1992) concluded that repetitive reading was an efficient reprocessing strategy.

Similarly, Barnett and Seefeldt (1989) also found that repeated reading facilitated retention of factual information. Howe and Singer (1975) found that students who reread unfamiliar text outperformed learners who summarized or copied texts verbatim on immediate and delayed recall tests. Rereading information on the Internet, therefore, may have facilitated learning for less knowledgeable learners in the current study.
By increasing learners' time with the Internet, the cognitive load also may have been decreased. Cognitive resources are typically divided among holding information in working memory, interpreting information, integrating information with existing knowledge and employing learning strategies. Since learners were able to record notes, little cognitive resources may have been allocated to holding information in working memory as well as employing learning strategies such as repetition. Note-taking has also been found to facilitate integration of information. For example, Shrager and Mayer (1989) found that less knowledgeable learners performed better on recall and transfer tests when they were instructed to record notes during a multimedia presentation in comparison to learners who were instructed to simply watch the presentation closely. Shrager and Mayer concluded that note-taking facilitated the integration of novel information with learners' existing schemata. Therefore, the combination of decreased cognitive load and sufficient time may have provided learners in the present study with the opportunity to think about and effectively process the novel information.

In the current study, highly knowledgeable learners also benefited when using the Internet. This is not surprising, however, since learners with high domain knowledge are capable of creating meaningful associations between novel information and existing knowledge with little mental effort (Stein et al., 1978). Such learners are also able to successfully identify relevant information (Symons & Pressley, 1993) and perform just as well when information is presented in a nonlinear format (Gay, 1986). In the current study, the most common reasons that students provided for why their search for information pertaining to their high knowledge domain was not difficult focused on the abundance of information and their high domain knowledge. Most interestingly, 10
learners indicated that their high domain knowledge facilitated their search. For example, one student wrote the following, "a familiar topic, knew what searching for and how to find it." In addition to supporting Winne and Hadwin's (1998) theory of self-regulated learning, this statement illustrates Marchionini's (1995) claim that highly knowledgeable learners are experienced searching within various resources for information in their domain. Consequently, when given a domain-related problem learners are aware of where to find the desired information.

Motivation

Individuals' motivation to search for and retrieve information from the Internet in comparison to print sources was also examined as a potential compensating factor for low domain knowledge. However, high levels of motivation did not increase performance on the essays when learners had high or low levels of domain knowledge. Small and Ferreira (1994) as well as Shuell and Farber (2001) found that students were more motivated to learn when the information was presented in a computerized environment in comparison to paper-based materials. Although motivation typically has been shown to have a positive effect on learning outcomes, researchers did not take into account domain knowledge (Gaston-Gayles, 2004; Pintrich & De Groot, 1990).

In contrast, Lawless and colleagues (2003) examined the relation among domain knowledge and situational interest when undergraduate students searched for information from closed hypermedia. Situational interest, a form of intrinsic motivation, pertains to interest learners have for characteristics of the current situation (Hidi, 1990; Schiefele, 1991). In Lawless and colleagues' (2003) study, situational interest referred to learners' interest in features of the computerized environment. Learners with various levels of
domain knowledge completed measures of domain knowledge and individual interest (higher scores indicated greater interest) and then searched the hypermedia to learn as much information regarding the domain as possible. While domain knowledge significantly predicted the amount of information learners recalled, situational interest did not predict performance. This is consistent with the results in the current study. Therefore, domain knowledge rather than motivation appears to play a critical role when learning from the Internet.

Secondary Analyses

It was hypothesized that the presence of notes when writing an essay would be regarded as a more appropriate task in comparison to the absence of notes. Although learners indicated that the essays in the current study were similar to academic essays, both Internet groups discussed differences more often than similarities when instructed to explain their similarity rating. Learners, however, may have been more inclined to identify the differences if they thought the similarities were common sense. For example, the similarities that were indicated by participants included using the same sources and recording notes. More interestingly, the main difference between completing the essays in the current study and university courses identified by learners in both Internet groups was that they would have used alternate sources of information to complete academic tasks. For example, journal articles, books, or alternate websites would have been accessed if the essays had been assigned in a university course. However, learners indicated that they do sometimes use the Internet when writing academic essays. Therefore, learners may use the Internet when completing academic tasks; however, they do not typically use this as a primary source for information.
Limitations

There are two main limitations in the current study. First, because the current study recruited only undergraduate students within two disciplines results may not extend to other disciplines or populations, such as children, adolescents or non-student adults. Second, the current study only used one method to measure learning, which was an immediate test of knowledge. Because participants did not complete maintenance or transfer measures, conclusions cannot be made as to whether or not the learners actually gained a deeper understanding of the information when using the Internet. Therefore, conclusions cannot be made regarding whether such positive results would be maintained over time or even be achieved on transfer exams.

Alternate Methods to Compensate for Low Domain Knowledge When Using the Internet

The current study found that plenty of time may compensate for low domain knowledge. However, taking into account the benefits associated with high domain knowledge, it may be more beneficial to provide less knowledgeable learners with some form of scaffolding (either prior to or while searching the Internet). First, learners may benefit from domain-related instruction prior to Internet use. Mayer, Mathias and Wetzell (2002) as well as Lawless, Schrader and Mayall (2006), for example, demonstrated that learning could be enhanced if students developed an overview schema of the information prior to interacting with closed hypermedia. Mayer and colleagues (2002) provided half the undergraduate students with a diagram of a braking system with the components labeled prior to observing a multimedia presentation detailing how brakes operate. The remaining participants studied the multimedia without viewing the pre-training material. All participants indicated that they had little knowledge corresponding to automobile
mechanics. In comparison to learners who were not exposed to the pre-training, individuals performed significantly better on the post-test measures of learning. Mayer et al. (2002) suggested that the pre-training decreased the cognitive load associated with processing information in the multimedia and thus allowed learners to obtain a deeper understanding of the material.

Similarly, Lawless et al. (2006) assigned a group of undergraduate students with relatively low levels of domain knowledge to read a paper-based passage outlining the major topics in human genetics immediately before studying related information from a single website. The remaining participants were not provided with this prior scaffolding. As a result, learning outcomes were greatest for learners who were exposed to the pre-training material before navigating the website. Lawless and colleagues (2006) claimed that the passage increased learners’ knowledge about how the domain-related content on the Internet was related. Therefore, learners were more capable of managing the complexity of the environment. Exposure to quality material, even at a basic level, prior to using the Internet may facilitate learning when domain knowledge is low.

It is not feasible, however, for educators to determine learners’ level of domain knowledge prior to each assignment, especially for undergraduate students. Therefore, researchers have examined the impact of electronic and human assistance while learners navigate the Internet. For example, less knowledgeable learners also may demonstrate learning benefits if they work with peers while interacting with the Internet. Lazonder (2005) discovered that college students who searched for and retrieved information from the Internet were able to answer a greater number of the assigned questions successfully as well correct wrong answers more often when they completed the searches with a
partner rather than alone. According to Lazender (2005), when working in pairs, students had to come to a consensus regarding the relevance of the material found on the Internet for answering the question at hand. It might be expected that less knowledgeable learners would exhibit the best results when they have the assistance of more knowledgeable peers to find the correct answer on the Internet. Lazender (2005), however, did not explicitly test this hypothesis.

In contrast, Winters, Azevedo and Levin (2004) investigated the learning gains of heterogeneous ability pairs. High school students with little domain knowledge were partnered with more knowledgeable peers to solve three science problems by retrieving information from a closed hypermedia program. Identical pre- and post-test measures of knowledge were compared for learning gains. As a result, more knowledgeable students did not experience any differences in their level of knowledge following the task. Less knowledgeable students, however, did exhibit significant improved scores on the post-test. By primarily questioning their partner about the material, the novice learners were able to increase their understanding (Winters et al., 2004). Such results are not surprising considering that scaffolding has lead to knowledge acquisition after navigating closed hypermedia for students of all ages with little domain knowledge (Azevedo, Cromley & Siebert, 2004; Azevedo, Cromley, Thomas, Seibert & Tron, 2003; Azevedo et al., 2004). Therefore, peer collaboration may compensate for low domain knowledge when initially using the Internet, and thus is another research area in need of empirical support.

Assistance during the learning process not only can be provided through human interaction, but also may be supported with computer software. The software program, gStudy, is currently being examined for its potential to enhance learners’ strategy use and
self-monitoring when interacting with multimedia (Nesbit & Winne, in press). However, this software application includes features which may be especially useful when using the Internet to research a topic corresponding to a low knowledge domain. gStudy provides learners with the ability to efficiently organize information they retrieved from various hypermedia, including the Internet. For example, students first search the Internet for information pertaining to the topic at-hand, and information they believe addresses the topic can be downloaded into gStudy. Students are able to highlight segments of information they regard as important or relevant, and then provide each segment with a label such as principle or key experiment (Nesbit & Winne, in press). An index, one of gStudy’s many features, arranges the segments according to their labels. Therefore, students are able to review all of the notes pertaining to a single label, such as key experiments, with a single click of the mouse. Learners, however, are also able to organize their own notes by using one of the many note-taking templates offered or by creating one of their own templates. For example, the debate template enables learners to input the issue and positions A and B and then organize their highlighted segments according to the evidence for A, evidence for B, and their own position (Nesbit & Winne, in press). The index and note-taking templates store related information together which may decrease cognitive load and facilitate the integration of information, in turn, leading to a deeper understanding of the topic at-hand. Moreover, if students are having difficulties understanding the information, they may use gStudy’s chat tool to communicate with their peers – including individuals who are more knowledgeable – to seek clarification.
One limitation with software applications such as gStudy is that students are still forced to make decisions regarding the relevancy of the information on the Internet. While the software may promote effective strategy use and self-monitoring as well as decrease the cognitive load associated with integrating information, students with little domain knowledge may still either download irrelevant information into the program or highlight irrelevant segments. However, if learners recognize such difficulties they could ask their peers for help by using the chat feature. gStudy, therefore, shows great potential to facilitate learning when students, with little domain knowledge, use the Internet.

**Future Research**

The results from the current study give rise to four main areas for future research. First, it is important to examine the cognitive processes involved when less knowledgeable learners use the Internet for various amounts of time. Such research would provide insight into why more time may compensate for low domain knowledge. In addition, researchers would be able to pinpoint the challenges learners face when given less time and thereby develop more effective scaffolding to successfully enhance learning when using the Internet when under time restraints. Second, other methods for compensating low domain knowledge need to be investigated. For example, less knowledgeable learners may benefit from using the Internet if they are provided with domain-related instruction before their searches, collaborate with more knowledgeable peers during their Internet searches, or use computer programs aimed at reducing cognitive load while using the Internet. Finally, we need to identify whether such advantages of domain knowledge generalize to a younger population. Taking into account that adults are able to manage cognitive demands more efficiently than younger
children (Baddeley & Hitch, 1974; Chi, 1978; Dempster, 1978; Schneider et al., 1989), it is unknown whether the Internet is a valuable resource for elementary school students regardless of domain knowledge.

Conclusion

Compared to traditional learning sources, the Internet is typically viewed as offering advantages to the learner. For example, learners can control their own learning and access an infinite amount of information at any time and from almost anywhere. Because of such reasons the Internet has become a prevalent resource for information among high school and undergraduate students. The current study found that under certain conditions, Internet exposure is beneficial for highly knowledgeable and less knowledgeable learners. Specifically, when learners were provided with more time to use the Internet than in typical studies, they demonstrated learning in comparison to their peers who were not exposed to the Internet, regardless of domain knowledge. However, using notes and motivation did not compensate for low domain knowledge. Therefore, when learners do not have a rich knowledge base and are put in control of their own learning, they may need plenty of time to be successful. To be able to maximize learning from the Internet, however, we need to know how cognitive processes of less knowledgeable learners facilitate the retrieval and retention of relevant information when they have plenty of time to use the Internet.
References


Appendix A: Informed Consent Form for the Internet Groups

(2005)

Title of Study: Can low domain knowledge be compensated for when learning from the Internet?

Principal Investigator: Malinda Desjarlais, MA Candidate
Department of Psychology, Brock University

Faculty Supervisor: Dr. Teena Willoughby, Faculty
Department of Child & Youth Studies, Brock University

Name of Participant (please print): _______________________________________

- I understand that this study involves research, and that I am being invited to participate. I understand that the purpose of this study is to investigate students' learning outcomes when using the Internet.
- I understand that the expected duration of my participation in this study is approximately 3.5 hours across 2 sessions, which I will complete individually.
- I understand the procedures to be followed include completing a Demographics/Internet Background Questionnaire, searching for information using the Internet, writing 2 essays, and a Task Reflection Questionnaire.
- I understand that I am not obligated to answer any questions on the questionnaires that I do not feel comfortable answering.
- I understand that my data will be kept anonymous and confidential. I understand that my contact information obtained from the pre-interview has been recorded in case session 1 had to be rescheduled.
- I understand that my questionnaires and essays will be labeled with a participant number. I understand that the Principal Investigator will document this participant number along with my first name and last initial and my email address on a separate sheet of paper (i.e., contact information from pre-interview). I understand that this information is recorded only for the purpose that information collected is kept organized and to contact myself in case session 2 needs to be rescheduled. I understand that this information will be kept confidential such that no one other than the Principal Investigator will have access to this information during participation. I understand that this information will be destroyed upon my completion of the study.
- I understand that to ensure that my questionnaires and essays remain anonymous, any information provided in session 1 will not be examined until my contact information linking me to my information has been destroyed.
- I understand that the anticipated risk associated with this study may involve feeling embarrassed or experience some degree of stress as I search the Internet or try to write the essays. I understand that I am not obligated to answer either of the essay questions.
- I understand that the anticipated benefit may involve gaining knowledge in a novel domain and/or becoming motivated to search for information on either topic after completing the study.
- I understand that I will receive $50 cash for my participation. I understand that participation is voluntary; refusal to participate will not affect my grades in any of my courses.
- I understand that if I decide I do not want my data to be included in the final report or further studies, I may contact the Principal Investigator by December 15, 2005 and request my data be excluded. I understand that my data will then be destroyed.

This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board (file # 05-046).
I understand my consent form will be stored separately from my questionnaires and essays. I understand that I shall not put any identifying marks on the questionnaires and essays.

I understand that during my participation, only the Principal Investigator will have access to my data. I understand that after completion of session 2, only the Principal Investigator & the Faculty Supervisor will have access to my data. I understand that all information (excluding destroyed contact information) will be stored securely in locked file cabinets until May 2010, when all data will be destroyed.

I understand that it is recommended that I retain a copy of a signed consent form for my records.

I understand that the group results of this study may be published. Currently there is no planned analysis of individual data, however, in the case that there is, reference to this data will be made using a random participant number. You may contact the Principal Investigator or Faculty Supervisor by April 30, 2006 if you would like to be informed of the results of this research and its publication.

I understand that if I have any pertinent questions about my rights as a research participant, I can contact the Brock University Research Ethics Officer (905 688-5550 ext. 3035, reb@brocku.ca).

I, ________________________________
1. Have read and understood the relevant information regarding this research project
2. Understand that I may ask questions in the future
3. Indicate free consent to research participation by signing this research consent form

Participant's Signature: ________________________________

I have explained this study to the participant.

Researcher's Signature: ________________________________

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This study has been reviewed and received ethics clearance through Brock University’s Research Ethics Board (file # 05-046).
Appendix B: Informed Consent Form for the Control Group

(2005)

Title of Study: Can low domain knowledge be compensated for when learning from the Internet?

Principal Investigator: Malinda Desjarlais, MA Candidate  
Department of Psychology, Brock University

Faculty Supervisor: Dr. Teena Willoughby, Faculty  
Department of Child & Youth Studies, Brock University

Name of Participant (please print): ____________________________

- I understand that this study involves research, and that I am being invited to participate. I understand that the purpose of this study is to investigate students' learning outcomes when using the Internet.
- I understand that the expected duration of my participation in this study is approximately 1 hour occurring in 1 session, which I will complete individually.
- I understand the procedures to be followed include completing a Demographics/Internet Background Questionnaire, writing 2 essays, and a Task Reflection Questionnaire.
- I understand that I am not obligated to answer any questions on the questionnaires I do not feel comfortable answering.
- I understand that my data will be kept anonymous and confidential. I understand that my contact information obtained from the pre-interview has been recorded in case the appointment had to be rescheduled. I understand that this information will be destroyed immediately following completion of the session and will not be attached to any of my data. I understand that only the Principal Researcher had access to this information.
- I understand that to ensure that my questionnaires and essays remain anonymous, any information provided in session 1 will not be looked at until my contact information linking me to my information is destroyed. I understand this information will be destroyed upon completion of the study.
- I understand that the anticipated risk associated with this study involve feeling embarrassed or experience some degree of stress as I try to write the essays. I understand that I am not obligated to answer either of the essay questions.
- I understand that the anticipated benefit may involve becoming motivated to search for information on either topic after the study.
- I understand that I will receive $20 cash for my participation. I understand that participation is voluntary; refusal to participate will not affect my grades in any of my courses.
- I understand that if I decide I do not want my data to be included in the final report or further studies, I may contact the Principal Investigator by July 15, 2006 and request my data be excluded. I understand that my data will then be destroyed.
- I understand my consent form will be stored separately from my questionnaires and essays. I understand that I shall not put any identifying marks on the questionnaires and essays.
- I understand that only the Principal Investigator & the Faculty Supervisor will have access to my data. I understand that only the Principal Investigator, however, will have access to my contact information.

This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board (file # 05-046).
prior to its destruction. I understand that all information (excluding destroyed contact information) will be stored securely in locked file cabinets until May 2010, when all data will be destroyed.

- I understand that it is recommended that I retain a copy of a signed consent form for my records.
- I understand that the group results of this study may be published. Currently there is no planned analysis of individual data, however, in the case that there is, reference to this data will be made using a random participant number. You may contact the Principal Investigator or Faculty Supervisor by September 30, 2006 if you would like to be informed of the results of this research and its publication.

- I understand that if I have any pertinent questions about my rights as a research participant, I can contact the Brock University Research Ethics Officer (905 688-5550 ext. 3035, reb@brocku.ca).

I, ______________________________________________________________________________________
1. Have read and understood the relevant information regarding this research project
2. Understand that I may ask questions in the future
3. Indicate free consent to research participation by signing this research consent form

Participant's Signature: ____________________________________________

I have explained this study to the participant.

Researcher's Signature: ____________________________________________

Malinda Desjarlais
MA Candidate, Principal Investigator
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This study has been reviewed and received ethics clearance through Brock University’s Research Ethics Board (file # 05-046).
Appendix C: Demographics and Internet Background Questionnaire

**DEMOGRAPHICS**

Age: ________
Sex: O Male  O Female

Undergraduate Major (select one):  O Political Science  
O Policing & Criminal Justice  
O History  
O Physical Education & Kinesiology

Number of undergraduate credits completed in your major: ________

Year in University major: O 2nd  O 3rd  O 4th

**INTERNET BACKGROUND**

For the following questions, the Internet refers to websites on the World Wide Web (e.g., www.stcatharinesstandard.ca), excluding all of the following: email programs (e.g., hotmail, yahoo), chat rooms (e.g., MSN Messenger), library databases, electronic journal article databases (e.g., Psyclnfo, Academic Search Premier, Sport Discus), and WebCT. Please choose the best answer from the options provided.

In general, how would you rate the level of comfort you feel when searching for information from the Internet (as defined above)?

O Very High  O High  O Moderate  O Low  O Very Low

In general, how would you rate your level of knowledge for searching for information from the Internet (as defined above)?

O Very High  O High  O Moderate  O Low  O Very Low

How often have you used the Internet (as defined above) when completing actual essays assigned to you in your university courses?

O Always or almost always  O Often  O Sometimes  O Rarely  O Never or almost never

How often have you used the Internet (as defined above) when studying for tests in your university courses?

O Always or almost always  O Often  O Sometimes  O Rarely  O Never or almost never
In general, how would you rate your level of motivation for using the Internet (as defined above) to search for and retrieve information to complete an essay rather than using print sources such as books or journal articles?

- O Very High
- O High
- O Moderate
- O Low
- O Very Low

Please provide an explanation for your motivation rating in the previous question:
Appendix D: Task Reflection Questionnaire for the Internet Groups

<table>
<thead>
<tr>
<th>Task Reflection</th>
</tr>
</thead>
</table>

For the following questions, the Internet refers to websites on the World Wide Web (e.g., www.stcatharinesstandard.ca), excluding all of the following: email programs (e.g., hotmail, yahoo, etc.), chat rooms (e.g., MSN Messenger), library databases, electronic journal article databases (e.g., PsycInfo, Academic Search Premier, Sport Discus), and WebCT. Please choose the best answer from the options provided.

1. The following questions pertain to the essay corresponding to how the Ancient Greece model of athleticism and the Ancient Roman model of sport spectatorship are different from contemporary models for sport and physical activity in the 21st century.

   How would you rate the level of difficulty to search for and retrieve information from the Internet for this essay topic?

   | Very High | High | Moderate | Low | Very Low |

   Please provide an explanation for your rating:

   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

   How would you rate your level of motivation for completing this essay?

   | Very High | High | Moderate | Low | Very Low |

2. The following questions pertain to the essay corresponding to how the role and powers of the American President are different from the Canadian Prime Minister.

   How would you rate the level of difficulty to search for and retrieve information from the Internet for this essay topic?

   | Very High | High | Moderate | Low | Very Low |

   Please provide an explanation for your rating:

   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

   How would you rate your level of motivation for completing this essay?

   | Very High | High | Moderate | Low | Very Low |
For the following question, recall your use of the Internet when completing actual essays assigned to you in your university courses:

How would you rate the level of similarity between the procedure you used (e.g., types of sites visited on the Internet, method of note-taking, use of notes when writing the essay) to complete the essay assigned in this experiment compared to completing actual essays in your university courses.

- Very similar
- Mostly similar
- Somewhat similar
- Mostly different
- Very different

Please provide an explanation for your rating:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Appendix E: Task Reflection Questionnaire for the Control Group

<table>
<thead>
<tr>
<th>Task Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please choose the best answer from the options provided.</td>
</tr>
<tr>
<td>How would you rate your level of motivation for completing the essay corresponding to how the Ancient Greece model of athleticism and the Ancient Roman model of sport spectatorship are different from contemporary models for sport and physical activity in the 21st century?</td>
</tr>
<tr>
<td>O Very High O High O Moderate O Low O Very Low</td>
</tr>
<tr>
<td>How would you rate your level of motivation for completing your essay corresponding to how the role and powers of the American President are different from the Canadian Prime Minister?</td>
</tr>
<tr>
<td>O Very High O High O Moderate O Low O Very Low</td>
</tr>
</tbody>
</table>

Dear Participant,

Thank you for your participation in the study entitled “Can low domain knowledge be compensated for when using the Internet?” The purpose of this study is to investigate students’ learning outcomes when using the Internet. If you would like to be informed of the results of this research and its publication, you may contact either the Principal Investigator or Faculty Supervisor by April 30, 2006.

Any contact information you provided me with during the study will be immediately destroyed and therefore cannot be attached to any of your questionnaires and essays. I can ensure that your data was and will remain anonymous and confidential.

This study has been reviewed and received ethics clearance through Brock University’s Research Ethics Board (file # 05-046). If you have any pertinent questions about your rights as a research participant, you can contact the Brock University Research Ethics Officer (905 688-5550 ext. 3035, reb@brocku.ca).

Thank you,

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Department of Psychology  
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DATE: October 4, 2005

FROM: Brian Roy, Acting Chair
Research Ethics Board (REB)

TO: Teena Willoughby, Social Sciences
Malinda DESJARLAIS

FILE: 05-046 DESJARLAIS

TITLE: Can low domain knowledge be compensated for when learning from the Internet?

The Brock University Research Ethics Board has reviewed the above research proposal.

DECISION: Accepted as clarified.

This project has received ethics clearance for the period of October 4, 2005 to April 30, 2006 subject to full REB ratification at the Research Ethics Board's next scheduled meeting. The clearance period may be extended upon request. The study may now proceed.

Please note that the Research Ethics Board (REB) requires that you adhere to the protocol as last reviewed and cleared by the REB. During the course of research no deviations from, or changes to, the protocol, recruitment, or consent form may be initiated without prior written clearance from the REB. The Board must provide clearance for any modifications before they can be implemented. If you wish to modify your research project, please refer to http://www.brocku.ca/researchservices/forms to complete the appropriate form Revision or Modification to an Ongoing Application.

Adverse or unexpected events must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Principal Investigator, the safety of the participants and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-Council. Policy Statement requires that ongoing research be monitored. A Final Report is required for all projects upon completion of the project. Researchers with projects lasting more than one year are required to submit a Continuing Review Report annually. The Office of Research Services will contact you when this form Continuing Review/Final Report is required.
Please quote your REB file number on all future correspondence.

BR/bb

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