USING THE INTERNET WITH A STRUCTURED THINK-ALOUD METHODOLOGY TO ENHANCE COLLEGE STUDENTS' VOCABULARY

by

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Abstract

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Advisor: Professor Linnea Ehri

The present study built upon an earlier study by Ebner and Ehri (in press), which examined the Internet's potential as a learning tool for enhancing college students' vocabularies. The current research sought to extend that study by determining how to make online vocabulary learning more effective. An experiment was conducted to investigate a structured think-aloud methodology that encouraged participants' metacognitive focus on an online vocabulary task. Participants were 70 students from a New York City public university. They were randomly assigned to either a treatment condition to learn about particular terms contained in an online text using a structured think-aloud method, or to a control condition using an unstructured think-aloud method. Analyses of variances revealed that structured think-aloud participants demonstrated significantly greater vocabulary gains, both overall and within specific dimensions of word knowledge, compared to the control group. Both quantitative and qualitative analyses revealed that differences between conditions in vocabulary gains were attributable to structured think-aloud participants' greater metacognitive focus on the task (e.g., greater instances of reminding themselves about the online vocabulary goal; planning and evaluating their online actions in relation to achieving the goal). Correlations and regression analyses also showed that participants showing the best performance in the online vocabulary task had more extensive

vocabularies going into the activity, had some prior familiarity with the terms, and were assigned to the structured think-aloud condition. Results offer strong support for the structured think-aloud methodology as a scaffold for making online vocabulary learning more effective.

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Chapter 1

Introduction

Using the Internet for learning purposes has become commonplace among students and educators, especially with the advent of sophisticated search engines like Google and the constantly growing, seemingly limitless, and almost instantaneously accessible plethora of online multimedia informational resources. As a result, the definition of literacy has expanded to encompass not only reading, writing, and learning from printed forms of text, but also interacting with dynamic forms of hypermedia found within the Internet's World Wide Web (Coiro, 2003). Even though the Internet's unique interactive and dynamic nature can present learners with many cognitive and motivational challenges, it also has the potential to serve as an extremely powerful learning tool. To this end, the Internet not only may be transforming traditional notions of literacy, but also enhancing and facilitating children's acquisition and development of literacy skills (McKenna, Reinking, Labbo, & Kieffer, 1999).

Vocabulary acquisition is one aspect of literacy development for which the Internet offers enormous potential in enhancing student learning. The Internet enables an almost instantaneous assembly of informational sources that offer students multisensory and interactive experiences with words. For example, online readers not only can read a particular term in context, but also often can click on it and be taken to a separate web page that further discusses the meaning of the term. Or readers can plug the term into Google or another Internet search engine and immediately see multiple search results highlighting and discussing the term in different contexts, and sometimes presenting graphic, audio, and/or video information about the term. Readers also can go to websites such as Dictionary.com and hear how the word is pronounced, as well as see how it is defined. This in turn may provide readers with an efficient way to develop a

comprehensive understanding about a word's multiple dimensions, such as its spoken forms, meanings within particular contexts, relationships to other words, and grammatical usages—all of which have been shown to relate to reading comprehension (Nagy & Scott, 2000).

The same Internet attributes, however, may be a significant source of distraction for some users, and thus hinder rather than facilitate achievement of online learning goals such as vocabulary acquisition. According to Leu, Kinzer, Coiro, and Cammack (2004), online reading comprehension can be considered a problem-based inquiry process whereby learners go online to research various problems or questions and seek answers. Researching those problems or questions online is a *self-directed* activity which provides students with considerable autonomy in choosing what information to search for and review, and where and how, and in what order, to search for and review it (Eom & Reiser, 2000). More specifically, the Internet affords users the opportunity to direct and pursue their own learning paths by providing instant access to a multitude of potential sources of information which may or may not be relevant to specific learning goals. Depending upon a succession of user choices and inputs, Internet learners are confronted with layer upon layer of hyperlinks and web pages, countless advertisements and other potential diversions, and sometimes inconsistent, outdated, unsubstantiated, or even erroneous content (Coiro & Dobler, 2007). Thus, unless Internet readers stay focused on their learning goals, they may become lost or disoriented in cyberspace, and risk the possibility of forming incomplete, inaccurate, or even incoherent understandings from a disjointed or random compilation of information sources.

Some researchers (e.g., Greene & Land, 2000; Artino, 2008; Coiro & Dobler, 2007) speculate that individual students' differing degrees of success with Internet learning can be attributed to variability in effectively engaging in self-regulated learning. Self-regulated learning

is defined by Zimmerman "as the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning process" (1986; as cited in Zimmerman, 2008, p. 2). Zimmerman explains that self-regulated learning involves *proactive* processes (as opposed to reactive events).

To investigate researchers' speculations, the present study builds upon an earlier study on *Using the Internet to Enhance College Students' Vocabularies (*Ebner & Ehri, in press). That earlier study revealed that among a sample of 48 New York City college students, using the Internet did result in more comprehensive word knowledge. But the extent of students' word knowledge gains was variable and related to cognitive and motivational factors. Despite the effect of such factors and other challenges posed by online learning, the enormous potential of the Internet to facilitate literacy, especially in vocabulary acquisition, underscored the need for the present study.

The present study sought to assess the effects of a structured, processes-oriented, think-aloud methodology, designed to encourage more effective online learning. A process-oriented think-aloud method, which involves an individual voicing his/her thoughts during performance of a task, has been found to be a beneficial way for gaining insight into processes involved in comprehending printed text (Pressley, 2000), and more recently, for online comprehension as well (Coiro & Dobler, 2007).

The present study's structured, process-oriented think-aloud methodology required students in a treatment group to repeatedly voice their thoughts and feelings during performance of an online task. Participants were instructed to ask themselves specific questions designed to encourage, remind, and enable them to be active and purposeful online learners who stay focused on their learning goal throughout the task. More specifically, the structured think-aloud method

asked treatment group students to repeatedly think aloud about their learning goal, about how engaging in a specific online action (e.g., reading, rereading, skimming, scrolling down, and/or skipping through text; clicking a hyperlink; using a search engine to conduct an online search) would help them achieve their learning goal, and about whether the action that they were engaging in helped them achieve that goal.

The treatment group was compared to a control group that was assigned to the same online learning goal. The control group's participants, however, were not directed to engage in this structured think-aloud method. Instead, they utilized an *unstructured*, process-oriented think-aloud method, in which they were asked to repeatedly think aloud, but without specific questions and prompts to guide their thinking.

It was predicted that the structured think-aloud methodology, in comparison to the unstructured think-aloud methodology, would encourage treatment group participants to engage in more effective self-regulated learning processes. Those processes included continuously predicting, planning ahead, and making deliberate and purposeful choices about online actions, and also evaluating the effectiveness of those choices. It was expected that by supporting students' engagement in critical self-regulated learning processes, use of the structured think-aloud methodology would enable students to gain even more word knowledge than students using an unstructured think-aloud method.

The need for the current research was warranted given Internet's potential to facilitate students' vocabularies, and hence comprehension of a topic. This research was also justified by the fact that most of the prior research on learning within electronic (i.e., computer-based) environments focused on reading comprehension within static hypermedia environments (e.g., encyclopedias on DVDs; library data bases on CD-ROMs), and not the Internet. Unlike the

dynamic and unbounded nature of the Internet, static hypermedia are closed systems that contain a finite amount of information, prepared and assembled in advance by a third party, and usually limited to a single organizational structure. Although existing studies of reading comprehension within static hypermedia structures do help to shed light on factors affecting learning within electronic environments, they do not uncover the complexities of learning within the unique realm of the Internet.

The few studies of online comprehension that have been conducted with the Internet are mostly qualitative in nature (e.g., Coiro & Dobler, 2007). Furthermore, few if any earlier studies, with the exception of Ebner and Ehri's (in press) study, from which the present study emanates, have examined the benefits of the Internet in enhancing students' vocabulary acquisition. The Ebner and Ehri study's promising findings were that to the extent that cognitive and motivational challenges do not interfere, the Internet does have the potential to significantly increase students' word knowledge in relation to a particular topic. Those findings further underscored the need for the present study, which focused on potentially helping students overcome the challenges posed by online learning, so that the benefits of using the Internet to enhance students' word knowledge can be realized.

Chapter 2

Review of Literature

The theories and research discussed below played an instrumental role in informing the present study. In particular, they helped shed light on both the promise and the challenge of using the Internet to enhance vocabulary development in relation to a particular topic. In so do doing, they supported the need for this experimental investigation of whether a structured, process-oriented think-aloud methodology can help students overcome the challenges posed by online learning so that the Internet's benefits for facilitating vocabulary development can be realized.

Theoretical Frameworks

1. The incremental theory of word learning. The incremental theory of word learning provides a particularly useful lens for understanding the complexity of word knowledge, and thus offers valuable insight on how Internet tools and resources can facilitate this development. In particular, according to the incremental theory of word learning, knowing the meaning of a word is not an all-or-nothing phenomenon, but rather a matter of degrees. More specifically, children who encounter a word multiple times gradually move from an incomplete to a comprehensive understanding of the word's meaning (Nagy & Scott, 2000). Some incremental theorists such as Dale (1965) believe that developing a comprehensive understanding of a word's meaning occurs in stages. Dale asserts that there are four stages of word learning, including (i) "never saw it before;" (ii) "heard it, but don't know what it means;" (iii) "recognize it in context as having something to do with . . . ;" and (iv) "know its meaning well." A fifth stage, suggested by Paribakht and Wesche (1997) is "can use the word in a sentence." Although some research casts doubt upon whether such discrete stages of word

learning do in fact exist (see, e.g., Durso & Shore, 1991), it is clear that developing such a comprehensive understanding involves multidimensional knowledge, including a word's spoken form, written form, grammatical behavior, conceptual meaning, associations with other words, and meaning within a particular context (Nagy & Scott).

Because the Internet enables an almost instantaneous assembly of informational sources, which often offer users multisensory and interactive experiences with words, the Internet presents readers with a potentially effective and efficient way to facilitate their multidimensional knowledge about words that they encounter while reading online text. Thus, in accordance with the incremental theory of word learning, an online learner can quickly move from no or limited knowledge about a given term to a comprehensive understanding of a word's spoken forms, meanings within particular contexts, relationships to other words, and grammatical usages—all by utilizing and interacting with Internet tools and resources. In light of this theory, the present study aimed to examine whether and how students, by interacting with hypermedia on the Internet, could efficiently increase the comprehensiveness of their knowledge about particular terms as they relate to a particular topic.

2. Social-cognitive theory of self-regulation. Despite the potential of the Internet to serve as an ideal way for facilitating students' word knowledge, according to the social-cognitive perspective of self-regulated learning, the advantages of online learning cannot be realized unless students effectively engage in self-regulated learning processes throughout their online learning task. Thus, this theory provided a particularly useful framework for understanding why learning on the Internet might be a more meaningful, effective, and enjoyable learning experience for some students than for others. This perspective offered additional theoretical justification for the current research to assess the effects of a structured think-aloud methodology, which was

designed to encourage students to be more active and purposeful online learners who stay focused on their learning goal throughout a task.

The social-cognitive theory of self-regulation suggests that in many ways, effective online learning parallels effective learning in any other platform, because it too involves the continuous interaction of personal, behavioral, and environmental factors. More specifically, this perspective on self-regulation proposes a triadic and interactive model that focuses on the interrelationship among personal processes (i.e., internal factors such as cognitive and affective variables), behavioral processes (i.e., actions), and environmental processes (i.e., external psychical factors), as opposed to purely cognitive factors (e.g., prior knowledge; self-efficacy) (Bandura, 1986). This view of self-regulation stresses the important role of metacognitive processes, self-beliefs, and affective reactions to particular contexts or learning tasks in employing self-regulated learning processes (Zimmerman, 2000).

For example, Zimmerman (2000) explains that this perspective of self-regulated learning requires that an individual possesses behavioral skills and strategies to successfully manage environmental variables within particular contexts, as well as the personal agency to effectively apply these skills and strategies within relevant contexts. Although one might have the self-regulated learning skills needed to succeed at a task, those skills will be of little value unless a person is motivated to employ them. According to this view, knowing how to apply self-regulated learning skills, and proactively wanting to apply them, is critical for effective learning within any learning environment, including the Internet.

According to Zimmerman's (2000) three-phase, cyclical model of self-regulation, cognitive factors (e.g., strategy use; prior knowledge) and motivational variables (e.g., intrinsic motivation and self-efficacy) continuously interact to influence an individual's effective

engagement in self-regulated learning processes. This three-phase, cyclical model includes (i) *forethought* (i.e., setting goals, activating relevant prior knowledge, and allocating time and effort), (ii) *performance or volitional control* (i.e., self-control and self-observation, including monitoring one's actions and related outcomes, as well as attempting to control one's cognitions, motivation, behaviors, and contextual factors during learning), and (iii) *self-reflection* (i.e., self-judgment and self-reaction). During each of these self-regulated learning phases, learners actively combine cognitive strategies with motivational beliefs in pursuit of task-specific goal attainment (Zimmerman; Pintrich, 2000). Thus, the degree to which students will actively engage in self-regulated learning processes depends upon the extent to which they are actively involved in monitoring and sustaining their metacognitions, motivation, and behaviors (Zimmerman).

Effectively engaging in self-regulated learning processes at all three phases of Zimmerman's (2000) model is critical for attaining task-specific goals in any learning environment, including the Internet. The present study's structured think-aloud methodology was designed to support students' engagement in effective self-regulated learning processes at all three phases of Zimmerman's model—ultimately leading to greater word knowledge than control group participants. In particular, (i) at the forethought phase, students were asked to repeatedly think aloud and plan ahead about what online action to perform next to help achieve the learning goal; (ii) during the performance phase, students were reminded to monitor and think aloud about whether what they were doing was helping them meet the learning goal; and (iii) at the self-reflective phase, students were asked to repeatedly self-evaluate the effectiveness of each of their actions in relation to meeting the learning goal, thereby enabling them to make informed

decisions about whether to continue engaging in a particular action, or when to try something else.

3. Constructivist theory of cognitive flexibility. The constructivist theory of cognitive flexibility (Spiro, 2004) further justified the need to assess the potentially beneficial effects of a structured think-aloud methodology for enhancing students' online learning of vocabulary terms in relation to a particular topic. According to this theory, learning in what Spiro and Jehng (1990) refer to as ill-structured domains, such as the Internet, requires a high degree of cognitive flexibility (i.e., knowing how to apply knowledge in flexible ways). This is because Internet learners must draw upon and construct understandings from dynamic, multiple knowledge sources and flexibly apply that knowledge. Coiro and Dobler (2007) explain that "Internet readers are called upon not only to construct meaning from text, but also to construct meaning through flexible and purposeful choices of relevant hyperlinks, icons, and interactive diagrams" (p. 218). This differs from constructing meaning from one informational source, such as a single printed text, which presents material in a static and typically non-interactive manner, thereby making construction of meaning more straightforward but more limited. When reading a printed text, the learner's role is to understand and retain the information presented in that text. In contrast, the interactive nature of online text, which provides the learner with instantaneous access to multiple informational sources about a topic, requires learners to venture beyond merely understanding and retaining information. It also requires sorting, compiling, and reviewing material that is multi-dimensional in nature, such as by utilizing embedded hyperlinks to view multimedia content as well as read plain text. (Spiro, Coulson, Feltovich, & Anderson, 2004).

Because the Internet requires a presumably higher degree of cognitive flexibility than more structured learning environments, researchers such as Greene and Land (2000) assume that effective use of self-regulated learning processes are essential to mediate between emerging constructions of knowledge and the continuously evolving, and seemingly boundless realms of the Internet. In fact, according to Coiro and Dobler (2007), while making predictions about what will happen next is "optional" when reading printed text, it is critical for constructing meaning with reading online material (p. 242). This is because unlike printed text from a book or article, which is unchanging, the Internet is continually expanding and evolving, and Internet resources can be discovered or immediately accessed from multiple pathways.

Thus, in order for Internet learners to effectively construct meaningful representations of online text, they must engage in proactive learning processes such as continuously focusing on their learning goal; predicting, planning ahead, and making deliberate choices about what information is relevant; determining how to most efficiently and effectively locate, access, review, and comprehend that information; and continuously monitoring and evaluating the effectiveness of their online actions in relation to their learning goal. Unless Internet users remain active and purposeful learners throughout the entire task, they might become lost in cyberspace, removed from their learning goal, and left with incoherent understandings of information (Coiro & Dobler, 2007).

For students who become easily distracted, or who lack prior knowledge and/or interest in the learning topic, knowing how to engage in this kind of self-regulated, active, and purposeful learning on the Internet, can pose a formidable challenge (e.g., Coiro & Dobler, 2007; Greene & Land, 2000; Artino, 2008; Eom & Reiser, 2000; Kinzie, 1990; Rakes, 1996). As a result, the present study sought to assess a possible method for helping students remain

proactive, self-regulated learners who could overcome possible cognitive and motivational challenges, and other challenges inherent with learning online. It was believed that students' utilization of a structured think-aloud methodology—an approach that required students to repeatedly focus on their learning goal, and to ask themselves how each of their actions might help them achieve their goal, and whether what they were doing was helping them achieve their goal—would enable them to stay on task. This in turn would help students more effectively and efficiently meet their learning goal, compared to students with the same learning goal, but who were not asked to think aloud using the researcher's structured approach.

Empirical Research

The present study was also informed by previous research on factors affecting comprehension within hypertext environments. Although many of those studies have been conducted within static hypermedia (i.e., non-Internet) environments, and the studies that have been conducted with the Internet have been mostly qualitative in nature, they do suggest that learning within hypertext environments can be beneficial. Thus, they underscore the need for helping students overcome possible challenges of learning within ill-structured hypertext environments.

1. **Studies of reading comprehension within static hypermedia environments**. A series of three studies by Chun and Plass (1996) offers support for the use of hypertext features to enhance vocabulary development. More specifically, Chun and Plass (1996) conducted research with 160 English language learners, who were German university students studying at schools in California. They were using a hypermedia program for reading German texts called *CyberBuch*, which contained a variety of annotations for the meanings of words in the form of text, pictures, and video. The researchers investigated (i) how well vocabulary was learned

incidentally when the goal was comprehension; (ii) the effectiveness of different forms of annotations for acquiring vocabulary knowledge; and (iii) the relationship between look-up behavior and performance on vocabulary tests. The researchers found a higher-than-expected rate of incidental learning of vocabulary on both production and recognition tests, with no substantial differences between scores on immediate and unannounced delayed administrations of those tests (Chun & Plass). In addition, the researchers found significantly higher scores for words that were annotated with pictures and text than for annotations with video and text, or with text only. Finally, the researchers found a correlation between looking up a certain annotation type and using it as a retrieval cue for remembering words (Chun & Plass).

Thus, Chun and Plass's (1996) research offers promising support for using multimedia annotations to support vocabulary acquisition of new words in the context of reading for understanding. Chun and Plass's research, however, was conducted at a time when students' use of the Internet as a learning tool was just beginning and not yet widespread. Because their research involved students using a closed hypermedia program, research was still needed regarding how vocabulary development might be affected by learning from the Internet, whose dynamic, open-ended interactive tools, and virtually limitless resources, can be either a benefit or major distraction. The present study helped meet this need because it extended Ebner and Ehri's (in press) earlier study, which did find initial support for increased word knowledge using Internet tools and resources, even though the extent of students' gains varied as a result of cognitive and motivational factors.

In addition, existing research on reading comprehension within static-hypermedia environments, reveal how learner characteristics (e.g., prior knowledge) might interact with text characteristics (e.g., text structure) to affect comprehension of material that may be presented in

an ill-structured manner, such as on the Internet. This further underscored the need for the current research on helping students overcome possible challenges of learning within ill-structured domains by using a structured methodology designed to promote purposeful learning, so that all students regardless of possible learner differences can realize the benefits of hypertext features for increasing their word knowledge.

An experimental study by Balcytiene (1999) compared college students learning about "How to recognize Gothic style" in hypertext vs. printed text (p. 305). In order to better understand the effects of presenting the material in hypertext vs. printed text, the study analyzed knowledge acquisition through reading. In particular, the researchers were interested in examining whether a student can construct an adequate understanding of information from hypertext and apply that understanding to different complex, problem-solving situations. Balcytiene (1999) also examined the role of individual differences (e.g., prior knowledge) and its effects on making sense of hypertext, as well as patterns of hypertext reading strategies.

The Balcytiene (1999) research found that while all students generally benefitted from both learning activities, the low-prior knowledge students tended to benefit more from working with hypertext than those with high prior knowledge. This difference was not a result of ceiling effects among high prior knowledge students. Although this finding was not statistically significant, Balcytiene indicated that it nevertheless is noteworthy because it questions prior research findings (Charney, 1994; as cited in Balcytiene) that learners with higher prior knowledge about the domain usually benefit more from hypertext features. According to Balcytiene, hypertext programs may help low-prior knowledge students by providing them with tools to recognize main concepts of text and thereby develop a global overview of the topic so that they can begin engaging in meaningful exploratory activities. Furthermore, Balcytiene

suggests that the lack of a statistically significant difference between the treatments may be because information in the hypertext system was highly structured, and thus did not substantially differ from the linear text.

These findings raise the important question explored in the present study about whether the Internet also provides readers with valuable tools to aid vocabulary development, especially among users with low prior knowledge of a subject that they are researching. Unlike the hypertext system used in the Balcytiene study, which was highly structured, the Internet is a complex, dynamic, and ill-structured networked system of information. Insofar as the Balcytiene findings are applicable to the Internet, they do offer some indication that students with low prior knowledge may greatly benefit from reading information in hypertext.

Balcytiene's (1999) research also involved qualitative analyses to categorize students' hypertext reading behaviors. Based upon their reading behaviors, students were grouped into two categories—cue-dependent learners and self-regulated learners. Cue-dependent learners were those who displayed inconsistent reading behaviors and showed a high frequency of random access to information. Interviews revealed that their behaviors were driven by a high concern with learning outcomes, rather than learning for learning's sake. As a result, they lacked motivation, and displayed high test anxiety (Balcytiene). Because these students were so concerned with performance on learning outcomes rather than developing a coherent understanding of the subject, they used author-created, guiding questions as cues for searching the text about what information they should know for later assessment. In a sense, they relied on the author, not themselves, to guide their learning (Balcytiene).

In contrast, the self-regulated readers were concerned with the learning process and building a coherent representation of knowledge (Balcytiene, 1999). They approached the

learning task with a problem-solving framework, and engaged in systematic, rather than random, strategies to access the information. They used metacognitive skills and processes to self-question, self-guide, and self-reflect on the knowledge that they were acquiring to ensure that they were forming coherent understandings of information. Unlike the cue-dependent readers, they took responsibility for the topic, and directed their own their own learning about it. Further, they used author-generated guiding questions not to direct their learning, but instead, to reflect upon specific knowledge after they had already acquired it, and to elaborate on the models of knowledge that they were constructing (Balcytiene).

Based upon these findings, Balcytiene (1999) argues for the need for research to indentify how intentional, self-directed, and problem-solving approaches to learning within hypertext environments can be promoted among students, so that they can avoid possible cognitive and motivational difficulties, as well as challenges inherent to learning within these ill-structured domains. This involves knowing how best to foster metacognitive skills and strategies among students, so that they can be proactive learners who self-construct knowledge by selecting, using, and evaluating different strategies for forming coherent representations of knowledge within hypertext environments. The present study endeavored to address this compelling need. It did so by examining whether a structured think-aloud methodology could help students engage in intentional, self-directed, problem-solving learning so that they could benefit from the Internet's tools and resources to increase their word knowledge despite possible variability in cognitive and motivational factors (e.g., prior knowledge of and interest in a topic).

Along the same lines, a study by Eom and Reiser (2000) investigated how self-reported self-regulated learning strategies among 37 sixth and seventh grade students affected reading comprehension outcomes when learning occurred within a learner-controlled vs. a program-

controlled computer-based instructional program. In this study students were classified as either being high or low self-regulated learners, and then were randomly assigned to learn within either the learner-controlled or the program-controlled version of the computer-based instructional program. Unlike the program-controlled version, the learner-controlled program afforded learners with the autonomy to choose which and how many sources of information to view, and how much time to devote to learning from those materials (Eom & Reiser).

Results revealed higher posttest achievement when learning within the program-controlled environment than the learner-controlled environment (Eom & Reiser, 2000). In addition, those with low self-regulation were found to perform even worse than those with high-self-regulation in the learner controlled environment, although this interaction was not found to be statistically significant (Eom & Reiser). Furthermore, those with low self-regulated learning skills assigned to use the learner-controlled program viewed fewer materials, and spent less time viewing them. The results suggest that when students are afforded the autonomy to self-direct their learning within learner-controlled environments, self-regulatory meaningful learning may be compromised, especially among those with low skills. One possible explanation might be that the autonomy of choosing which and how many materials to view in learner-controlled environments like the Internet, leaves it up to learners to decide "how much is enough." As a result, this may cause learners, especially those who lack self-regulatory skills, to ineffectively self-monitor and self-evaluate their learning, and/or to overestimate the amount that they have effectively learned. Thus, Eom and Reiser's findings also provided justification for examining the effects of a structured think-aloud methodology for promoting critical self-regulated learning skills and strategies, such as self-monitoring and self-evaluating, within the learner-controlled environment of the Internet.

2. Studies on reading comprehension using the Internet. Although most existing studies on reading comprehension in electronic environments have been conducted within static hypermedia environments, there are a small number that do examine factors affecting reading comprehension on the Internet. For example, Dyson and Haselgrove (2000) examined whether comprehension of Internet materials is affected by reading speed and the typical behaviors of rapid scanning or skimming. The study found that reading online text at both normal and fast speeds results in less recall of details than comprehension of more general information, but that faster reading might result in even greater loss of memory for details. The researchers noted, however, that whether or not this speed vs. accuracy trade-off is considered a problem depends upon one's reading objective. For example, if the purpose of rapidly skimming website pages is to decide whether or not they are worth reading, then comprehending details is not so important. The researchers also found, however, that if the reader's objective is only to gain a cursory overview of material by rapidly reading, gaps in general understanding do typically result.

Dyson and Haselgrove's (2000) findings underscore the importance of reading behaviors aligning with reading objectives. Thus, it is not so much the reading behavior in and of itself that will determine effective online learning, but rather, whether a student's online reading behaviors will be effective in light of his/her learning objective. These findings supported use of a structured think-aloud methodology, which aimed to repeatedly remind students to think about their online learning objective, and how engaging in each of their actions would help them achieve that objective.

In addition, a study by Roy, Taylor, and Chi (2003), suggests that there are gender-based differences in the way that students search for information on the Internet, and resultant gender-based differences in the amount of relevant information that students acquire. More specifically,

Roy et al. observed differences between adolescent boys and girls relating to the amount of information learned when searching online about a particular subject vs. searching for information on the subject in library books. The researchers not only found that students learned more information on the topic when searching on the Internet (although that finding was not statistically significant), but also that boys learned more target-specific and target-related information online than the girls. They also found that these gender differences in students' knowledge gains on the Internet were related to gender differences in their online search behaviors. In particular, after ruling out any pre-existing gender differences in experience using the Internet and/or conducting searches on the Internet, Roy et al. observed that the boys had a tendency to scan many more document excerpts than girls, whereas the girls bypassed scanning the documents first, and instead would actually open and browse the entire documents for relevant information.

Roy et al. (2003) believe that this observed gender difference in online searching behaviors resulted in the boys' greater knowledge gains because by quickly scanning document excerpts, they had a greater number of opportunities, in an allotted period of time, to find relevant information, whereas the girls, who took the time to open and browse the contents of entire documents, had fewer opportunities. In addition, the researchers found the content of the document excerpts that the boys scanned contained more target-related and target-specific information than the documents that the girls browsed.

Roy et al.'s (2003) study findings suggest that when reading on the Internet, effective learning does not necessarily depend upon the amount of material read and retained, especially since there are so many informational sources that might be accessed and not relevant to one's learning goal. Instead, being an effective online learner depends in large part on knowing how to

quickly decide if a source is relevant, and how to most effectively and efficiently review that source, which the males in Roy et al.'s study were more likely to do than the girls. Thus, Roy et al.'s study supported the present study's examination of possible gender differences in word knowledge gains, and whether those possible differences were related to any observed gender differences in online learning behaviors. Their study also supported the present study's structured method for helping students, regardless of their gender, to read online materials strategically to meet their learning goal.

Another study, by Coiro and Dobler (2007), also used the Internet to explore differences in reading comprehension strategies used by skilled adolescents searching for and locating information on the Internet vs. those searching for information within a highly structured, but closed hypermedia environment. This qualitative study involved using a think-aloud methodology where participants were asked to think aloud while searching for information about a given topic. The researchers found that the processes and skills used by skilled readers and experienced Internet users to comprehend Internet text are both similar to and more complex than previously identified comprehension strategies used for understanding printed informative text (Coiro & Dobler). They found that this was especially the case for the strategies of using prior knowledge, making inferences, and using self-regulated reading processes.

For example, Coiro and Dobler (2007) found that effective online comprehension not only depends upon prior knowledge of the topic and text structure, as in printed text, but also upon prior knowledge of Web-based search engines, and prior knowledge of informational website structures. In terms of making inferences, Coiro and Dobler believe that while making predictions about what will happen next is "optional" when reading printed text, it is critical for constructing meaning with online material (p. 242). This is because unlike printed text, which is

unchanging, the Internet is continually changing and can be accessed from multiple paths. As a result, unless users make accurate predictions about upcoming text, they may get lost and/or disoriented while constructing their own set of information from the dynamic and virtually infinite sources on the Web (Coiro & Dobler). Unless Internet readers predict and plan ahead about what sites to visit on the Internet, they risk the possibility of forming incoherent understandings from the disjointed compilation of texts (Coiro & Dobler).

Furthermore, Coiro and Dobler (2007) believe that their findings suggest that effective online comprehension involves not only traditional self-regulation strategies for reading, such as planning, predicting, monitoring, and evaluating, but also strategies that involve physical actions unique to the using the Internet. Such actions include typing, clicking, scrolling and rereading, all of which are necessary actions to successfully navigate through the open Internet space (Coiro & Dobler). According to Coiro and Dobler, these additional complexities involved with online comprehension can be explained by the fact that Internet users must engage in self-directed text construction from endless, dynamic, and multi-layered sources, often arrived at in a non-linear manner.

In light of Coiro and Dobler's (2007) findings, being a proactive, purposeful learner who continuously predicts, plans ahead, and monitors one's learning in relation one's goal, is imperative for successful online learning. The present study is in keeping with Coiro and Dobler's findings. It sought to determine whether reminding students to stay focused on their learning goal, and to repeatedly ask themselves whether and how each of their online actions would help them achieve that goal, would ultimately lead to more word knowledge gains by effectively promoting the self-directed, reflective, and purposeful online learning that Coiro and Dobler argue is essential.

Coiro and Dobler's (2007) qualitative study was followed by a quantitative study by Coiro (2011) on predictors of reading comprehension on the Internet. Along with Ebner and Ehri (in press) and the present study, Coiro (2011) is one of the few existing quantitative investigations on the topic of online reading comprehension. Unlike Ebner and Ehri's study and the current investigation, however, Coiro (2011) did not involve an experimental design with random assignment. As a result, Coiro's (2011) research offers a useful first-step toward understanding possible predictors of online reading performance, but unlike the present study, did not investigate cause and effect inferences. This limitation further highlighted the need for the present study's experimental investigation of the possible causal relationship between online word learning success and a structured think-aloud method designed promote more effective online learning.

The purpose of Coiro's (2011) research was to determine whether online reading performance among seventh graders can be uniquely predicted by online reading comprehension when controlling for offline comprehension and topical prior knowledge. Coiro references other qualitative research (e.g., Afflerbach & Cho, 2009; Schmar-Dobler, 2003) suggesting that online and offline reading comprehension skills may differ. For this reason, Coiro conducted a study to see whether online reading performance is predicted by a unique set of skills that are different from offline comprehension skills, and that are independent of prior topical knowledge. Correlational and regression analyses were conducted to see which of the following variables, if any, significantly and uniquely predicted online reading comprehension scores: a parallel measure of online reading comprehension, standardized tests scores of offline reading comprehension, and prior topical knowledge.

Coiro's (2011) results showed online reading performance can be predicted by a combination of offline reading comprehension, prior topical knowledge, and online reading comprehension. Offline reading comprehension explained the biggest unique portion of variance in online reading performance. When offline comprehension was controlled for, along with prior topical knowledge, online comprehension explained 15.4 % of unique variance in online reading performance ($p < .01$). These results are significant in that they show offline and online reading comprehension skills made a unique and unintended contribution to predicting online reading performance. Coiro (2011) suggests that the results imply that offline and online reading comprehension skills are not as dichotomous, as some previously thought. Rather, the significant correlation between these two variables, as well as the unique contributions of each of these variables in explaining variance in online reading performance, suggests that online comprehension skills may be similar to offline skills, but also may be more complex. These results support Coiro and Dobler's (2007) qualitative observations that some offline and online comprehension skills might be the same, whereas other skills such as self-regulation and prior knowledge may be more complex. The findings also offer support for the present study's investigation of whether promoting students' metacognitive engagement can make online word learning more effective. Metacognitive skills are needed for effective learning from printed texts, and may be even more needed for learning within the unique and complex realm of the Internet where distractions are immense.

Coiro (2011) also found that students with low prior knowledge of the topic, but who had more Internet skills, also had higher online reading comprehension scores. That finding supports research by Balcytiene (1999), who also found that low prior knowledge students tend to benefit from hypertext more than high prior knowledge students. Both Coiro's (2011) and Balcytiene's

(1999) results suggest that hypertext, including the Internet, may provide low prior knowledge students with an effective way to quickly locate background information needed for effectively completing an online read task. These findings also support Coiro and Dobler's qualitative findings that two types of prior knowledge are involved when learning online – prior knowledge of the topic and prior knowledge of learning from the Internet. Coiro's findings suggest that even if you have low prior knowledge of a topic, as long as you have high prior knowledge of how to effectively locate information of the Internet, you will still be able to perform well on online reading tasks. In addition Coiro's findings justify the need for the current study's examination of the relationships between prior knowledge of both the topic of religion in ancient Greece, and Internet knowledge and experience, and performance on the online word learning task. In addition, Coiro and Balcytiene's research also highlight the need to investigate whether a structured think-aloud methodology can effectively scaffold students' online word learning regardless of varying levels of prior knowledge of the topic and/or learning from the Internet.

One qualitative study by Greene and Land (2000) did examine the effectiveness of different types of instructional supports for helping college students successfully navigate, sort, and utilize relevant Internet material for researching different project topics. Eighteen students were assigned to research different project topics (e.g., trip planning for third graders; mathematics and investing in the stock market; bird habitats and ecology for third graders), using the Internet as their main resource. The researchers examined the potential benefits of four types of instructional supports: (i) Internet resources offered one possible support by helping students expand and/or refine their project ideas in light of new information gathered on the Web; (ii) a list of guiding questions was another type of instructional support intended to prompt students' reflection on the learning process; (iii) student conversations both within and between groups

was considered another form of scaffolding; and (iv) the effects of instructor-student interactions were also investigated as a possible support for helping students with their projects (Greene & Land).

One of the major findings in Greene and Land's (2000) study was that the benefits of the Internet and other supports depended upon the extent of students' prior knowledge of both the topic and navigating the Internet's resources, so that they could understand how those supports could aide them with their projects (Greene & Land).

As in the Greene and Land's (2000) study, the present study also investigated the potential benefits of Internet resources for scaffolding students' word knowledge on the Web. In addition, the study examined the effects of a structured think-aloud methodology, designed to serve as an additional scaffold for students' online learning, by encouraging them to engage in important self-regulated learning processes. Finally, as in the Greene and Land study, the present study assessed the extent to which the potential benefits of both the Internet and the structured think-aloud methodology depended upon students' prior knowledge of the topic and the Internet.

3. Ebner and Ehri's (in press) study on using the Internet to enhance college students' vocabularies. The foregoing theories and studies not only supported the need for the present research, but also informed the design and conduct of Ebner and Ehri's (in press) study, from which the present study emanates. That study investigated the extent to which students take advantage of the Internet, despite its potential distractions, to develop more comprehensive word knowledge about specific terms presented in an online article regarding a particular topic. The Ebner and Ehri study sought to determine the following: (i) whether participants increased their word knowledge about specific terms as they encountered them in the online text, and how

using Internet tools and resources facilitated their learning of those terms; (ii) whether there is an optimal way to read online text (e.g., in a linear vs. non-linear manner) to gain the most word knowledge about the terms; and (iii) whether participants' prior knowledge and interest in the article topic, online behaviors during the task, and feelings about the task after its completion, related to the extent of word knowledge gained both within each condition and in the two conditions combined.

Method. As in the present research, the online article used in the Ebner and Ehri (in press) study was a Wikipedia article entitled "Religion in ancient Greece." This article was chosen because of the rich terminology associated with that learning topic, and also because of the article's many highlighted/hyperlinked terms, which readers can click to access related Wikipedia articles. Selection of terms was based upon each term's significant role in ancient Greek religion and contextual usage within the article. Each of the terms was highlighted in blue in the article and hyperlinked to other Wikipedia articles that discuss the term in greater detail. The terms were "cult," "epithets," "polytheism," "vices," "mythology," "epic," "hubris," "offal," "libations," and "oracle."

The sample consisted of 48 graduate/undergraduate students from a New York City public university's school of education. There were ten males and 38 females, whose ages ranged from 19 to 50 years, with mean age = 26 years. Students were recruited on the school of education's research participation website. That website allows students to voluntarily sign up to participate in research studies in exchange for research participation credits needed for their school of education courses.

Pairs of students were formed based upon the order in which the students signed up to participate. Within each pair, students were randomly assigned to one of two conditions: (i) a

linear condition, where participants were instructed to learn about each of ten terms in relation to the article topic by reading the online text in the order in which it appeared; and (ii) a non-linear condition, where participants were given the same learning goal, but could read the online text in any manner that they chose. In both conditions, a process-oriented think-aloud methodology was used. The think-aloud methodology required participants to periodically think aloud as they were engaged in the task in order to uncover their thought processes and behaviors.

Each participant met individually with the researcher during a single session. In both conditions, each session began with the participant taking a pretest survey, which consisted of three parts. Part 1 assessed the extent of a participant's prior knowledge about each of the target terms. This part was divided into three sections (A, B, and C), each of which was designed to assess a particular dimension of word knowledge. Section A was designed to assess the degree of a participant's prior knowledge about the semantic meaning(s) of the term. It did so by asking the participant to indicate his or her level of familiarity with each term by checking the appropriate phrases and filling in the blanks where appropriate. The phrases were (i) "Never saw it before," (ii) "Heard it but don't know what it means," (iii) "Know it has something to do with_____," (iv) "Know it well," and (v) "It means_____." This approach was consistent with the incremental view of word learning and is based upon Dale's stage theory described above. Section B of Part 1 was designed to determine each participant's prior knowledge about the syntactical usage(s) of the term by asking each participant to "please try to use the term in a sentence." Section C was designed to assess a participant's prior knowledge of the term's meaning within the specific context of religion in ancient Greece by asking the participant to "please try to explain its role in ancient Greece." Sum scores of participants' overall performance across the ten terms were obtained to assess their prior knowledge of each of these

specific dimensions of word knowledge. In addition, a composite score was calculated of participants' total performance on Part 1 of the pretest. This score served as an index of the overall comprehensiveness of each participant's prior word knowledge about the ten terms.

Part 2 of the pretest survey assessed each participant's prior knowledge about and interest in religion in ancient Greece. In order to assess the participant's prior knowledge, the survey asked each participant to rate on Likert-type scales ranging from 1 to 5 how much he or she knew about religion in ancient Greece (with 1 being "know nothing" and 5 being "know a lot"). The survey also asked how interested the participant was in the subject (with 1 being "no interest" and 5 being "extremely interested"). In addition, the survey asked whether the participant had ever studied ancient Greece in high school or college, and if so in what courses and for how long. Further, the participant was asked whether he or she had ever visited ancient Greek sites, and if so which sites. Finally, the survey asked each participant to write down three facts that he or she knew about religion in ancient Greece.

Part 3 of the pretest survey assessed each participant's level of experience using the Internet, including for research purposes. The first question asked the participant to indicate on an average day how much time he or she spends on the Internet. Participants could choose from three responses: "Less than 1 hour"; "Between 1 to 3 hours"; and "More than 3 hours." The second question asked the participant to indicate how much of the time that he or she spends on the Internet is for school/work-related research. Again, the participants could choose from "Less than 1 hour," "Between 1 to 3 hours," and "More than 3 hours." The next question asked the participant to report on how often he or she visits Wikipedia. The participant could respond by circling "Never," "Occasionally," or "Regularly." The participant also was asked to indicate the

number of social networking sites to which he or she belongs, and to list the three websites (including social networking sites) the he or she visits most frequently when "surfing the Web."

After a participant completed the pretest survey, the researcher explained the goal of the learning task and the think-aloud procedure. In particular, participants were told that they would be reading aloud from a Wikipedia article about religion in ancient Greece with the goal of learning about the contextual meanings of specific terms in the online text. In addition, participants were informed that they would be periodically stopped throughout the task and asked to report exactly what they were thinking, feeling, or doing at that moment, so that the researcher could invoke and record their thoughts and feelings about the task.

Participants in the linear condition were instructed to read the text in the order in which it appeared, beginning at the start of the article and until a point where the researcher would tell them to stop. Participants in this condition also were told that when they read about a term or concept that they would like to know more about, they were free to click on hyperlinks in the article or perform some other Internet search to learn more about that term or concept. They also were instructed that if they did begin reading text from another web page, that text too had to be read aloud and in the order in which it appeared.

Unlike the linear condition, where the participants were instructed to read the text aloud and in order, non-linear condition participants were told that they could read, reread, or skip over the online text in any order that they chose, but that anything they did read had to be read aloud. As in the linear condition, participants in the non-linear condition were free to click on any hyperlinks in the article or conduct some other kind of Internet search to learn more about a term or concept. But if they did begin reading from another web page, that text also had to be read

aloud. All participants were told that they could take as much time as they wanted to complete the learning activity.

After the instructions were given, participants were handed the list of terms that they were asked to learn about in the online article. Participants then moved over to the computer, which was already turned on with the "Religion in ancient Greece" article open, and began the activity. During the learning activity, the researcher both audio-recorded and took detailed notes on what each participant was doing and saying throughout the learning activity. This included the reasons offered by the participant as to why he or she was doing, thinking, or feeling certain things. For example, the researcher noted what sections of the article the participant read and in what order; the hyperlinks that the participant clicked; the terms that the participant searched for both within Wikipedia and in other search engines such as Google; and the websites outside of Wikipedia that the participant visited, and what parts of those websites the participant read. In addition, the researcher noted the reasons offered by the participants, such as why they were searching for more information on particular terms, clicking on certain hyperlinks, scanning, skimming, scrolling through, or skipping sections of text, and any points of confusion.

The researcher also used a data sheet to tally the number of instances each participant was observed to be engaging in the following online learning behaviors: skimming, scanning, or skipping over text (which was also determined by instances in which the reader stopped reading the text aloud); clicking on target words; clicking on non-target words; visiting other Wikipedia articles; visiting other websites outside of Wikipedia; searching for terms in the text; and rereading sections of text. The researcher also noted the amount of time that the participant spent on the activity. Finally, even though the participants were assigned to read the text in one

of two ways, the researcher made sure to note the actual reading style (i.e., linear or non-linear) that each participant engaged in despite his or her assigned condition.

Once the participant indicated that he or she was finished with the learning activity, the researcher handed the participant the posttest assessment. The posttest assessment consisted of four parts. Part 1 of the posttest was the same as the Part 1 of the pretest assessment. This allowed a direct comparison to be made about each participant's word knowledge gains across each of the three dimensions of word knowledge, as well as knowledge of the terms as a whole. Part 2 of the posttest assessment consisted of twelve Likert-type scale questions that were adapted from Ryan's (1982) Intrinsic Motivation Inventory (IMI). These questions were designed to assess participants' post-task subjective feelings about the learning activity and the reading material. For example participants were asked to rate their enjoyment of and interest in the activity and reading material, perceived understanding of the material, and how valuable they saw the activity. Part 3 of the posttest assessment asked participants to respond on Likert-type rating scales about their interest in the topic after reading the article, and how helpful they found the Internet for learning about the target terms. Part 4 of the posttest assessment asked participants to discuss what websites they found most useful among the websites that they visited during the learning activity, and why. After completion of the posttest, the researcher briefly interviewed each participant about his or her thoughts and feelings regarding the advantages and disadvantages of learning from the Internet, both in this study's learning activity and in general.

Results. Ebner and Ehri (in press) reported the results as follows: Analyses of variance revealed that participants did significantly increase their word knowledge both overall and within specific dimensions of word knowledge. Those findings support use of the Internet as an efficient means for developing comprehensive understandings about multiple dimensions of

words, including their definitions, grammatical usages, associations with other words, and meanings and usages within particular contexts.

In addition, Ebner and Ehri (in press) found that there was significant variability in the extent of participants' word knowledge gains. Differences in the extent of participants' word knowledge gains, however, were not found to be the result of condition or how they actually read the text (i.e., in a linear or non-linear manner).

Instead, correlational analyses revealed that variability in participants' gain scores was predicted by the amount of time they spent on the task, their perceived understanding of the material, and their gender, with males learning more than females. In addition, supplemental correlational analyses showed that participants' ratings of how well they believed that they understood the online material after the task was significantly related to their prior knowledge of the topic, their prior interest in the topic, and all but one of the scales assessing participants' self-reported interest in and enjoyment of the activity and online material.

Ebner and Ehri's (in press) results also showed that participants' beliefs about how well they understood the online material was not related to the various online learning behaviors that were observed. The think-aloud method revealed that participants engaged in similar behaviors for different underlying reasons, which may also be tied to cognitive and motivational factors. For example, some participants, who had high prior knowledge of the topic and terms, clicked on hyperlinks because they were interested in learning more, as evidenced by their think-aloud comments. Other participants, who had low prior knowledge, clicked on hyperlinks because, as they explained in their think-alouds, they wanted to clarify their understanding of the topic and/or terms.

The implications of these findings are significant because they suggest that meaningful vocabulary development on the Internet is not simply dependent upon behavioral skills and strategies. Instead, Ebner and Ehri's (in press) results imply that effective online word learning may involve students' utilization of metacognitive strategies for staying focused on the goal of the task, and knowing when and how use of particular online behaviors will be most effective for achieving the learning goal.

Chapter 3

Rationale & Hypotheses

Rationale

The results and implications of Ebner and Ehri's (in press) study played an important role in guiding the present dissertation research. In particular, that study's finding that Internet use significantly increased students' word knowledge, both overall and within specific word knowledge dimensions, supported the need for continuing investigation of this topic. The current research sought to further investigate how college students can increase their multidimensional word knowledge about specific terms contained in the Wikipedia article on "Religion in ancient Greece." As in the Ebner and Ehri study, students' overall word knowledge gains, and gains within specific word knowledge dimensions (e.g., semantic, syntactic, and contextual knowledge), were assessed. The present research also examined one additional aspect of word knowledge —a participant's ability to pronounce each term. Although this ability was not assessed in Ebner and Ehri's study, that study's observations revealed that some participants had difficulty pronouncing several of the terms, thus suggesting the desirability of assessing that skill.

Furthermore, Ebner and Ehri (in press) found that variability in the extent of students' Internet word knowledge gains was not the result of the specific way in which participants were assigned to read the online text (i.e., in a linear vs. a non-linear manner). For this reason, the dissertation research sought to further examine how to make online word learning most effective. The current research, however, differed from Ebner and Ehri's study in several important respects, including the independent variable being manipulated, and the think aloud data being coded.

The present research did not have participants read the online text in either a linear or a non-linear manner, since Ebner and Ehri's (in press) study found that doing so did not influence word knowledge gains. Instead, the present research examined whether using a structured think-aloud methodology served as an effective scaffold for encouraging students to engage in important self-regulated learning processes, so that they could more effectively take advantage of the Internet to enhance their vocabularies. Investigating the effects of this experimental condition built upon, and was consistent with, Ebner and Ehri's findings showing that it is neither the way in which online text is read (i.e., linearly or non-linearly), nor engagement or lack thereof in particular online behaviors, that makes online learning effective. Instead, Ebner and Ehri's results indicated that meaningful online learning may be dependent upon the extent to which a student remains focused on a learning goal, and also upon being aware of how particular online actions will help meet the learning goal. In addition, examining the effects of the structured think-aloud condition aligned with the above-reviewed theories and research regarding the importance of engaging in self-regulated learning processes when learning in loosely structured domains such as the Internet.

As in Ebner and Ehri's (in press) study, participants in both conditions had the same goal, which was to learn about how ten terms contained within a Wikipedia article on Religion in ancient Greece relate to the article topic. It is important to note that the goal of the task was not to learn the terms' meanings for the purpose of comprehending the article. As a result, participants' comprehension of the article was not tested. The goal of learning the terms' meanings, possibly by accessing multiple and interactive informational sources rather than from just the text of the article itself, is in keeping with the constructivist theory of cognitive flexibility. Under that theory, learners construct their understanding of information from

multiple sources rather than from a single source. The structured think-aloud procedure involved explicitly instructing and reminding students (i) to think aloud about their learning goal in order to help them stay focused on that goal throughout the task; (ii) to think aloud about how each of their online actions would help them achieve the learning goal before engaging in an action; and (iii) to think aloud about whether an online action that they performed helped them achieve the goal. The unstructured think-aloud procedure also required students to repeatedly think aloud about what they were thinking, feeling, or doing throughout the task. However, in contrast, it did not involve explicitly instructing or reminding students to focus on their learning goal or the effectiveness of their online actions.

In keeping with the intended objectives of the structured think-aloud methodology, the present research also differed from Ebner and Ehri's (in press) study in the types of online learning behaviors that were tallied during the task. More specifically, the present study assessed the frequency of participants' engagement only in those online learning behaviors that served as possible indicators of participants' focus on, or distraction from, the learning task. The present research assessed five of the eight behaviors assessed in Ebner and Ehri's study: (i) the amount of time that the participant spent on the task; (ii) the number of times that the participant clicked on each target term, and the overall number of target terms clicked; (iii) the number of times that the participant navigated away from the article onto other websites (specifically, directly relevant websites, partially/indirectly relevant websites, and/or websites that were not relevant); (iv) the number of times that the participant returned to the Wikipedia article on Religion in ancient Greece; and (v) the number of times that a participant reread text that contained the target term. These behaviors were selected not only because of previous findings regarding their significance, but also because of their potential to offer important insights about participants' focus on the

learning task, including taking advantage of the Internet's resources for learning about the target terms.

More specifically, Ebner and Ehri's (in press) study revealed that time spent on task was one of the significant predictors of word knowledge gains within the combined conditions. In addition, time spent on the task could indicate both an individual's focus on the task and the effectiveness of his/her learning. For example, spending less time on the task than the average participant would likely indicate not caring about the task, and spending more time on the task than the average participant might likely indicate getting sidetracked.

In addition, like Ebner and Ehri's study, the present study assessed the number of times that a participant clicked on target terms. Both the overall number of times that a participant clicked on target terms, and the number of times that a participant clicked on each target term individually, was recorded. Ebner and Ehri (in press) found that the overall number of times that a participant clicked on target terms was predictive of word knowledge gains, both in the linear condition and in the linear and non-linear conditions combined. Clicking on target terms also could indicate a participant's focus on the goal of the task. This is because clicking on a target term most likely shows a participant's desire to learn more about that term. Further it could indicate that the participant is taking advantage of Internet tools such as hyperlinks to enhance his/her understanding of the target terms. But unlike the Ebner and Ehri's (in press) study, the present study did not assess the number of times that a participant clicked on a non-target word or phrase, since that was not found to be either predictive of word knowledge gains or an indicator of staying on task. Nor did it indicate straying from the task. This was because some participants in Ebner and Ehri's study clicked on non-target words or phrases to help them understand the meaning of a particular target term.

The present research also recorded the number of times that a participant navigated onto other websites (i.e., either websites outside of Wikipedia or other articles or pages within Wikipedia). Although Ebner and Ehri's study did not show that the number of times that a participant visited other websites either within or outside of Wikipedia related to word knowledge gains, this behavior was still important to assess as an indicator of staying focused on, or straying from, the goal of the learning task.

Unlike Ebner and Ehri's (in press) study, the present research did not differentiate between navigating to websites within vs. outside of Wikipedia. This is because such a comparison would not indicate whether a person was distracted vs. was trying to learn more information relevant to the task. Instead, a more sensitive measure was used to record the relevancy of the visited websites to the learning task. More specifically, the researcher recorded the number of times that a participant navigated onto websites that were directly relevant (i.e., any website that explicitly defined or discussed the term's meaning), partially/indirectly relevant (i.e., any website that did not explicitly define or discuss the term's meaning, but provided information that otherwise illustrated, or was useful in understanding, the term's meaning), or not relevant (i.e., any website that was neither directly relevant nor partially/indirectly relevant). In addition, unlike Ebner and Ehri's study, the present study also recorded the number of times that the participant returned to the Wikipedia article on Religion in ancient Greece after navigating away from it (including returning to the article after navigating to a different Wikipedia article or page). This was important to record as a possible indicator of staying focused on the task because if the participant did not return to the article, or only infrequently returned to it, that could be a sign of distraction.

Finally, the number of times that a participant reread text containing the target term was recorded as an indicator of the participant's proactive attempts to understand what a term meant and how it was used in a particular context. Recording this behavior differed slightly from the rereading behavior that was recorded in Ebner and Ehri's (in press) study. That study recorded the number of times that a participant reread *any* text regardless of whether it contained the target term, but that was not found to be predictive of word knowledge gains. Thus, recording the number of times that a participant reread only text that contained the target term provided a more specific indicator of staying on task by trying to learn about the term.

The current study also no longer tallied the number of times that a participant searched for a word in the text, or the number of times that a participant skimmed/scanned/or skipped over text. Neither of those behaviors was found in the earlier study to predict word knowledge gains. Further, neither behavior provided specific enough insight into participants' use of Internet resources to learn more about the target terms and/or their focus on the task. For example, a participant might skim information not because he/she was distracted, but instead, because he/she was first trying to see whether it was related to a target term or the article topic, and thus worth reading more carefully. Or, even though participants might search for a term in the text, this did not mean that they were necessarily learning about the term simply by finding it. Thus, neither of these behaviors alone would have provided enough insight into differences between conditions regarding participants' attempts to learn about the words.

Furthermore, consistent with the intended objectives of the structured think-aloud methodology, the present research tallied differences between conditions relating to participants' engagement in specific self-regulated learning processes. This included possible differences between groups regarding the extent to which participants reminded themselves of the goal of the

task, verbalized the meaning of each term in relation to the article topic, and/or expressed confusion or uncertainty relating to the goal of the task. In addition, the present study examined potential differences between conditions regarding the extent to which participants planed ahead before engaging in an online action, and evaluated the effectiveness of an online action either during or after engaging in that action.

The current research also differed from Ebner and Ehri's (in press) study by focusing upon whether five specific variables explained a significant and possibly unique portion of variance in participants' word knowledge gains, both within each condition and in the conditions combined. These variables included (i) participants' gender; (ii) knowledge of and interest in the learning topic; (iii) knowledge of and experience with searching the Internet; (iv) self-regulated learning skills (as measured by metacognitive awareness); and (v) general vocabulary knowledge. Selection of these potential predictor variables was informed by Ebner and Ehri's findings, published research findings, and related theories.

More specifically, gender was selected as a possible predictor variable of word knowledge gains because of Ebner and Ehri's (in press) findings that gender predicted overall word knowledge gains in both the non-linear condition and the conditions combined, with males outperforming females. Those findings were supported by Roy et al. (2003), who also found gender differences in online learning success. In order to determine whether there were gender differences on task performance both within each condition and in the two conditions combined, the two conditions were equated on gender by forming same-sex pairs of students and randomly assigning students within each pair.

Knowledge of and interest in the learning topic were selected as possible predictors of word knowledge gains because of Ebner and Ehri's (in press) findings showing that those

variables correlated with overall word knowledge on the posttest when the two conditions were combined. Published research (e.g., Balcytiene, 1999) also has found support for the relationship between prior knowledge of and/or interest in a topic and comprehension of material within hypertext environments. Knowledge of and experience with searching the Internet was also thought to be a possible predictor of word knowledge gains. That would be consistent with the Coiro and Dobler (2007) research suggesting that prior knowledge of the Internet for learning may be an additional skill needed for effectively learning online. Research and theory reviewed above (e.g., Eom & Reiser, 2000; Spiro, 2004, Zimmerman, 2000, Coiro & Dobler, 2007) also suggests that self-regulated learning skills, such as being metacognitively aware of one's own thoughts and actions, are essential for effective learning in ill-structured domains like the Internet. This variable was not assessed in Ebner and Ehri's (in press) study. As a result, the present study assessed differences among participants' entry level self-regulated learning skills, in a manner similar to what was done in Eom and Reiser's (2000) study, to determine if they predict performance on the task. Further, unlike the Ebner and Ehri's (in press) study, participants' entry level general vocabulary knowledge was assessed in the current research to investigate whether it predicted participants' performance on the task. It was predicted that students who possessed a more extensive vocabulary would perform better on the learning task, since they would likely be more interested in and better attuned to vocabulary acquisition.

Hypotheses

Based on findings from Ebner and Ehri's (in press) earlier study and the theories and research discussed above, the present study investigated two primary hypotheses, which were confirmatory in nature, and a secondary hypothesis, which was exploratory in nature.

Confirmatory/Primary Hypotheses:

1. Participants assigned to the structured think-aloud condition would display greater word knowledge gains than control participants assigned to the unstructured think-aloud procedure. This would include word knowledge gains on overall composite scores of word knowledge, including the following word knowledge dimensions comprising those composite scores: pronunciation accuracy, declarative knowledge, sentence writing, and relation to the topic.

2. Participants in the structured think-aloud condition would display more behaviors of staying on task than control participants. In particular, it was predicted that compared to the control group, structured think-aloud participants would spend more time on the task. They would also more frequently click on target words and navigate to relevant websites than control participants. In addition, it was predicted that they would more often reread text containing a target term compared to the control group.

It was also predicted that structured think-aloud participants would show more verbal indications of staying on task compared to the control group. In particular, structured think-aloud participants would more often remind themselves about the learning goal. They would explain how an action would help reach the learning goal and whether an action was helping/did help achieve the learning goal. In addition, structured think-aloud participants would show fewer instances of confusion or uncertainty about the learning goal compared to the control group.

Exploratory/Secondary Hypothesis:

The following variables would explain a significant portion of variance in participants' word knowledge gains both within each condition and in the two conditions combined: (i) participant's gender; (ii) knowledge of and interest in the learning topic; (iii) knowledge of and

experience with searching the Internet; (iv) self-regulated learning skills (i.e. metacognitive awareness); and (v) general vocabulary knowledge.

Chapter 4

Method

Participants

The sample of participants was diverse. It consisted of 70 students (seven undergraduate, and 63 graduate students) from a New York City public university's School of Education. Thirty-one of the students were part-time, and 39 were full-time. Participants' ages ranged from 19 to 59, with mean age = 27 years. Forty-two participants were Caucasian, ten were Asian, ten were Hispanic, three were African-American, and five were other ethnicities/races. Fifty-one of the 70 participants reported English as their first language. Thirty-seven of the participants reported speaking one or more language in addition to English. There were 54 female participants, and 16 male participants. Table 1 presents a breakdown of participants' demographic information per condition. The study was advertised to students on the School of Education's research participation website. That website allows students to voluntarily sign up to participate in research studies in exchange for research participation credits needed for their School of Education courses. Prior to participating in the study, each student was asked to provide their written consent (See Appendix A).

Design

The study followed a pretest-posttest experimental design with random assignment to treatment and control groups. The two conditions were also matched on gender by forming same-sex pairs of students, and randomly assigning students within each pair. Pretests were administered before students engaged in the online learning task. They were used to (i) verify that there were no statistically significant, initial between-group differences; (ii) assess the extent of students' prior knowledge about the target terms, and variables that might predict gain scores (e.g., prior knowledge of and interest in learning topic; self-regulated learning skills); and

Table 1

Participants' Demographic Characteristics for Unstructured and Structured Think-Aloud Groups

	STRUCTURED THINK-ALOUD GROUP	UNSTRUCTURED THINK-ALOUD GROUP
Participants (*N*)	35	35
Ages (*M*) (range)	28 (20-59)	26 (19-55)
Gender		
Males (*N*)	8	8
Females (*N*)	27	27
Student Status		
Graduate (*N*)	34	29
Undergraduate (*N)*	1	6
Student Level		
Full-time (*N*)	16	23
Part-time (*N*)	19	12
Native English Speakers		
Yes (*N*)	27	24
No (*N*)	8	11
Number of Additional Languages Spoken (range)	0-3	0-4
Race/Ethnicity		
Caucasian (*N*)	23	18
Asian (*N*)	2	8
Hispanic (*N*)	5	5
African-American (*N*)	1	2
Other (*N*)	4	1

(iii) calculate word knowledge gain scores by subtracting pretest scores from posttest scores. Posttests were administered immediately following the learning task. They were used to assess participants' perceptions about the learning task (e.g., their interest in and enjoyment of the task; their perceived competence in performing the task; their perceptions about the helpfulness of using the Internet to learn about the terms). A survey was also used to assess participants' knowledge of and experience with searching the Internet. This was given as a posttest rather than a pretest so that their thinking about and answers to the questions did not affect their performance on the learning task.

Materials

Technical equipment. The first 33 participants performed the online learning activity on a Dell laptop computer with a 13.3 inch screen running Internet Explorer (v.7.0) as the Web browser. The remainder of the participants performed the activity on a Dell desktop computer, which became available to the researcher midway through the study. The desktop too ran Internet Explorer (v. 7.0) as the Web browser.

A digital voice recorder was used to record each participant's learning activity session. In addition, the researcher initially used Dragon® NaturallySpeaking 11 Premium Mobile software to try to create rough transcripts of participants' digital audio recordings. It soon became apparent, however, that because the Dragon software can recognize only a small number of voices, it could not produce usable transcripts of multiple participants' sessions. As a result, the researcher switched to using the Livescribe Echo™ Smartpen, which syncs written notes with voice recordings. This proved to be a superior tool for recording the participants' comments and activities during the learning task. The researcher not only could upload her handwritten notes into a computer, but also, by pointing to a particular handwritten note

displayed on the computer screen, could hear the actual comments that the participant made at the time that particular note was made.

Online article. The online article used in the present study was a Wikipedia article entitled "Religion in ancient Greece." This article was selected because of the rich terminology included in the text, and also because of the article's many highlighted/hyperlinked terms, which readers can click to access related Wikipedia articles. Although Wikipedia is an online encyclopedia that authorized users can edit, update, or revise at anytime, the researcher ensured that same version of the Religion in ancient Greece article was used with all study participants. This was possible because this version was archived and readily accessible online.

List of target terms. Participants in both conditions were asked to learn about the following ten terms included within the online Wikipedia article entitled "Religion in ancient Greece," and about how each term relates to that article's topic: "cult," "epithets," "polytheism," "vices," "mythology," "epic," "hubris," "offal," "libations," and "symposium" (see Appendix D for list of terms given to treatment group participants). Each of the terms was highlighted in blue in the article and hyperlinked to other Wikipedia articles that discuss the term in greater detail. Selection of these terms was based upon each term's significant role in ancient Greek religion, as well as usage within the article. In addition, although it was expected that some participants might be familiar with some of these terms at the beginning of the study, it was anticipated that they would lack deep knowledge about the terms, including how the terms were related to the topic of religion in ancient Greece. This expectation was based on Ebner and Ehri's (in press) study results, which revealed that all participants showed gains in their overall word knowledge from pretest to posttest (i.e., no ceiling effects were found).

Think-aloud methodologies. To better understand how participants used the Internet to help learn about specific terms and how each term related to the article topic, two types of process-oriented think-aloud methodologies were used—a structured think-aloud methodology in the treatment condition and an unstructured methodology in the control group condition.

A process-oriented think-aloud procedure requires an individual to read text aloud and voice his/her thoughts during performance of a task. It has been found to be a beneficial way for gaining insight into processes involved in comprehending printed text (Pressley, 2000), and more recently, for online comprehension as well (Coiro & Dobler, 2007). Both the structured and unstructured think-aloud methods used in the dissertation research required participants to read aloud everything that they chose to read during the learning task, and to repeatedly voice their thoughts and feelings as they performed the task. Although traditional think-aloud procedures involve specific stopping points for participants to think aloud, Ebner and Ehri's (in press) study revealed that participants showed a tendency to continuously think aloud without the need for specific stopping points. As a result, specific, research- designated stopping points were not used in either procedure. If a participant in either condition had not thought aloud for two minutes, however, the researcher prompted him/her to do so. Two minutes was chosen as the ideal time because less than that would have been be too disruptive, and more than two minutes would not have captured the current thoughts present in the participant's short-term memory.

***Structured think-aloud methodology*.** Participants in the treatment group used a structured think-aloud methodology (see Appendix C for researcher script used with treatment group participants). This procedure required participants not only to voice their thoughts and feelings repeatedly during performance of the online task, but also to remind themselves continuously about the goal of the task.

More specifically, treatment group participants were told that their goal was to learn the meanings of the terms on list provided, and how each term relates to the article topic of Religion in ancient Greece. This goal was also stated on the top of the list of terms provided to treatment group participants (see Appendix D). In addition, treatment group participants were directed, both orally and in writing, to read aloud continuously everything that they chose to read, and to repeatedly think aloud the following:

(a) "Before I act -- How will this help me reach my goal?"

(b) "While or after I act -- Is this helping me, or did that help me, reach my goal?"

These questions were designed to remind participants to be active and purposeful online learners who stayed focused on the learning goal throughout the task. To help treatment group participants remember both the goal of the task and what they should be doing during the task, the directions described above also were provided to participants in written form (see Figure 1). During the task, participants were asked to keep these directions at their side so that they could refer to them when needed.

The researcher prompted the participant to read aloud if he/she was not doing so, and also to think aloud if after two minutes, he/she had not begun or resumed doing so. In addition, if the participant was thinking aloud but did not mention either the goal or the article topic, the researcher reminded the participant to ask himself/herself aloud each of the two questions above.

Unstructured think-aloud methodology. Participants in the control group used an unstructured think-aloud procedure **(**see Appendix E for researcher script used with participants in the unstructured think-aloud methodology**)**. Participants in the control group were handed the same list of terms and given the same learning goal as participants in the treatment group.

Figure 1. Think-Aloud Prompt For Treatment Group Participants

Directions:

Remember the goal: To learn the meaning of each term on the list provided and how each term relates to religion in ancient Greece.

Read text aloud and think aloud:

Before I act: How will this help me reach my goal?

During or after I act: Is this helping me, or did that help me, reach my goal?"

The list of terms provided to control participants, however, did not explicitly state the goal at the top. In addition, participants using the unstructured think-aloud methodology were asked to repeatedly think aloud about what they were thinking, feeling, and doing throughout the learning task, but without specific questions or prompts to guide their thinking (i.e., they were not presented with any directions in writing). This procedure also involved the researcher reminding participants to read aloud if the participants were not doing so, and to repeatedly think aloud, if after two minutes participants had not done so.

Tally Sheet. The researcher used a tally sheet (see Appendix F**)** during the learning activity to code participants' frequency of engagement in particular online learning behaviors, as well as think-aloud responses demonstrating their engagement in self-regulated learning processes. The researcher tallied these behaviors and responses during the participant's engagement in the learning task.

The following online learning behaviors were coded and tallied: (i) the amount of time the participant spent on the task; (ii) the number of times the participant clicked on each target word, and the overall number of times the participant clicked on target terms; (iii) the number of times the participant navigated away from the Wikipedia article onto websites that were directly relevant (i.e., any website that explicitly defined or discussed the term's meaning), partially/indirectly relevant (i.e., any website that did not explicitly define or discuss the term's meaning, but provided information that otherwise illustrated, or was useful in understanding, the term's meaning), or not relevant (i.e., any website that was neither directly relevant nor partially/indirectly relevant); (iv) the number of times that the participant returned to the Wikipedia article after navigating away from it; and (v) the number of times the participant reread a portion text containing the target word. As discussed above in the Rationale section,

these online learning behaviors were selected because Ebner and Ehri's (in press) findings indicated their potential significance in offering important insights about participants' focus on the learning task, including taking advantage of Internet tools and resources, such as other websites and hyperlinked terms, for learning about the target terms. Similarly, think-aloud responses were selected based on their significance in demonstrating the participant's engagement in self-regulated learning processes, such as focusing on the learning goal and proactively planning and evaluating one's online actions in relation the learning goal. The following think-aloud responses were coded and tallied: the number of times the participant (i) explained what he/she was going to do next, but not why, both with prompting and without prompting ; (ii) explained both what he/she was going to do next *and* why (i.e., demonstrated planning), both with prompting and without; (ii) explained whether an action is/did help reach the goal (i.e., demonstrated evaluating), both with prompting and without; (iii); verbalized the meaning of a target term and its relationship to religion in ancient Greece, both with prompting and without; (iv) reminded himself or herself about the learning goal, both with prompting and without; and (v) expressed confusion and/or uncertainty about the goal of the task.

Measures

Table 2 lists the tasks that were used, the general components of each task, and the corresponding attached Appendix in which the complete measure can be found. A more detailed description of each task and the variables that it assessed is discussed below.

1. Target Vocabulary Word Knowledge Survey (see Appendix G for the complete measure)**.** Participants' multidimensional knowledge, and the depth of their knowledge about the target terms, was assessed with a survey that was administered both as a pretest and as a posttest. This allowed for direct comparisons to be made from pretest to posttest about participants' word

knowledge gains both within specific dimensions of word knowledge and overall. The survey consisted of four sections: Pronunciation Accuracy, Declarative Knowledge, Sentence Writing, and Relation to the Topic. These sections are ordered in a way that reflected increasing depth of word knowledge. For example, being able to pronounce a word requires a lesser degree of knowledge than knowing how to use the word in a meaningful context. This is because the latter requires semantic and syntactic knowledge of the word.

Participants received scores for their performance on each section of the survey in order to indicate their knowledge of specific dimensions of the term. They also received composite scores for their total performance on combined parts of the survey in order to reflect their overall deeper knowledge of the term. The researcher scored and coded the Declarative Knowledge, Sentence Writing, and Relation to the Topic sections of the survey using a rubric that she prepared, along with a second rater, who scored and coded using the same rubric for 20% of the surveys (i.e., 14 pretests and posttests). See Appendix H for the Target Vocabulary Word Knowledge Survey scoring rubric. The inter-rater reliability for the items on the three sections of the survey was 76%. The source of disagreement was examined and consensus was reached. Because the second rater did not always apply the rubric fully, resolution of differences did not require rescoring of data.

Pronunciation Accuracy. This section of the survey assessed the accuracy of a participant's pronunciation of each of the ten terms, both prior to and after engaging in the learning activity. When the researcher handed the participant the list of terms for the first time, she asked the participant to pronounce aloud each of the ten written terms. The researcher checked off on a separate sheet which of the terms the participant was able to pronounce

Table 2

Measures

MEASURES	GENERAL COMPONENTS	APPENDIX
Pretest & Posttest:		
Target Vocabulary Word Knowledge Survey	Pronunciation Accuracy	Appendix G
	Declarative Knowledge	
	Sentence Writing	
	Relation to the Topic	
Pretests:		
Survey of Knowledge of & Interest in Learning Topic	Prior Knowledge of Topic	Appendix I
	Prior Interest in Topic	
Metacognitive Awareness Inventory (Schraw, G. & Dennison, R. S.,1994)	Knowledge of Cognition (declarative knowledge, procedural knowledge, and conditional knowledge)	Appendix J
	Regulation of Cognition (planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation)	
Nelson-Denny Reading Test: Vocabulary Subtest (Brown, J. I., Fischo, V. & Hanna, G. S., 1993)	General vocabulary knowledge	

Table 2 (Continued)

Measures

MEASURES	GENERAL COMPONENTS	APPENDIX
Posttests:		
Survey of Knowledge of & Experience with Searching the Internet	Use of Internet for Research	Appendix K
	Knowledge of Internet for Learning	
Survey of Perceptions About the Learning Task	Interest in & Enjoyment of Activity, Online Material, and Learning Topic	Appendix L
	Perceived Competence in Performing Learning Activity & Understanding the Online Material	
	Perceived Helpfulness of Internet for Learning about the Terms	

correctly on his/her own, and which of the terms he/she mispronounced or was unable to pronounce. Participants received 1 point for each term that they accurately pronounced and 0 points for each term that they mispronounced. A total of 10 points could be obtained on this section of the survey. Participants pronunciation accuracy was assessed again as soon they completed the learning task. Each participant's pronunciation accuracy of the terms was compared between pretest and posttest.

Declarative Knowledge. The depth of a participant's semantic knowledge about each term was assessed by asking him/her to indicate his/her level of familiarity with each term's meaning. The participant was asked to check the appropriate phrases and to fill in the blanks with written answers where appropriate. The phrases were (i) "Never saw it before," (ii) "Heard it but don't know what it means," (iii) "Know it has something to do with_____," and (iv) "Know it well. It means ____." This approach, which is consistent with the incremental view of word learning, is based upon Dale's (1965) stage theory.

This section was scored as follows: Participants received a 0 if they checked "Never saw it before" or "Heard it but don't know what it means" (i.e., if they did not provide any definition). Participants also received a 0 if they checked "Know it has something to do with" but did not provide any definition or related definition; or if they checked "Know it well. It means ____" but did not provide any definition or a related definition, or provided an incorrect definition. Participants received a 1 if they checked either "Know it has something to do with" or "Know it well. It means ____" but provided only a partially correct definition or a term and/or concept that was only generally related to the term's definition (e.g., "religion" for "polytheism"; "story" for "epic"). Participants received a 2 if they checked either "Know it has something to do with" or "Know it well. It means ____" and provided a definition that could be

found either in Dictionary.com or Merriam-Webster.com. A sum score for each participant's knowledge about the terms' meanings was then computed by summing up the total number of points that the participant received in this section across the ten terms. A total of 20 points could be obtained.

Sentence Writing. This section assessed not only the participant's declarative knowledge about a term's meaning, but also his/her procedural knowledge about how to use a term in both a semantically and syntactically correct way. It asked the participant provide a written response to the following request: "Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to the term."

This question assessed a greater depth of word knowledge than what is asked of the participant in the declarative knowledge section. Here, the participant was asked to go beyond just being familiar with, or knowing the definition, of a word, by demonstrating his/her understanding of each term's meaning and use within a specific context.

This section was scored as follows: Participants received a 0 if they did not provide any written sentence (i.e., left item blank); or if the provided a sentence that used the term in neither a grammatically correct nor a semantically correct way (e.g., "I polytheism while visiting Athens."). Participants received a 1 if they provided a sentence that used the term, or another syntactic form of the term (e.g., "polytheistic" instead of "polytheism") in a semantically correct way, but not a grammatically correct way, or vice versa (e.g., "Polytheistic is the belief in many gods."). Participants also received 1 point if they provided a sentence that used the term in both a semantically and syntactically correct way, but did not embed the term in a meaningful sentence that also contained words related to that term (e.g., an unrelated word could be substituted for the term in the sentence, thereby making it difficult to infer the term's meaning

simply by reading the sentence (e.g., “I believe in polytheism.”). Participants received 2 points if they provided a sentence that used the term, or another syntactic form of the term such, in both a semantically and syntactically correct way, and that also embedded the term in a meaningful context and contained words related to that term (i.e., the term’s meaning could be inferred by reading the sentence) (e.g., “The Polynesians believed in polytheism, which is the belief in more than one God.”). A sum score for each participant’s performance on this section was obtained by summing up the total number of points each participant received in this section across the ten terms. A total of 20 points could obtained.

***Relation to the Topic*.** This section assessed the greatest depth of a participant’s word knowledge. It required the participant to demonstrate his/her understanding of each term’s meaning and use not just within any context (as in the sentence writing section), but instead, within the specific context of religion in ancient Greece. Participants were asked to provide a written response to the following request: “Please try to use the term in a sentence that explains how it relates to religion in ancient Greece.” An accurate response to this request represented the deepest level of word knowledge. This is because even if a participant was able to demonstrate his/her semantic and syntactic knowledge about a term within a meaningful context, that did not mean the participant could do so within the particular context of religion in ancient Greece. Ebner and Ehri’s study (in press), for example, demonstrated that many participants knew the meaning of the term cult and how it is used within a Westernized context, but lacked prior knowledge about the term’s meaning and use within context of religion in ancient Greece.

This section was scored in the following way: Participants received a 0 if they did not provide any written sentence (i.e., left the item blank); did not provide a semantically or syntactically correct sentence that accurately explained the term’s relation to religion in ancient

Greece (e.g., “I saw polytheistic when I visited Greece last year.”); or if they provided a semantically and/or syntactically correct sentence that explained how the term related to ancient Greece, but not religion in ancient Greece (e.g., “The ancient Greeks attended many symposia where they discussed politics.”). Participants received 1 point if they provided a sentence that used the term (or another syntactic form of the term) in a semantically but not syntactically correct way, or vice versa, and provided a partially correct explanation of how the term related to the article topic (i.e., did not directly explain how it related to the topic, but provided a specific example illustrating its relation to the topic) (e.g. “The Acropolis is a good example of the ancient Greeks’ polytheism.”). Participants received 2 points if they provided a semantically and syntactically correct sentence that accurately explained the term’s relation to religion in ancient Greece (e.g., “The ancient Greeks believed in polytheism, which is the belief in more than one God.”).

Composite Score. In addition to obtaining separate scores for a participant’s performance on each section of the survey, a composite score was calculated of the participant’s overall performance on the entire Target Vocabulary Word Knowledge Survey. This calculation indexed the comprehensiveness of each participant’s multidimensional, overall knowledge about the ten terms. A maximum of 70 points could be obtained. As shown in Table 3, all dimensions of word knowledge significantly and positively correlated with composite word knowledge scores on the posttest, offering support for using composite scores in analyses. Scores on these separate dimensions of word knowledge on the posttest strongly and significantly correlated with posttest composite scores at the $p < .01$ level, with values ranging from $r = .88$ to .93. The exception was pronunciation accuracy which correlated with the composite score at the $p < .05$ level, $r = .31$. The lower correlation resulted from a celing effect. Correlations are reported in

Table 3. These findings indicate that the composite score measured a single construct, and all of the subtests contributed equally to the total score.

Word knowledge gains were obtained by subtracting pretest scores from posttest scores. Although some researchers have debated the reliability of gain scores (e.g., Rachor & Cizek, 1996), many other researchers have found them to be a reliable means for assessing change from one point in time to another (e.g., Zimmerman & William, 1998; Sharma & Gupta, 1985; Rogosa & Willett, 1983). As a result, they were used in the present research. All gains in separate dimensions of word knowledge correlated with overall gain scores at the $p < .01$ level, except for pronunciation gains, which correlated with overall gains at the $p < .05$ level.

2. Survey of Knowledge of & Interest in Learning Topic (see Appendix I for the complete measure)**.** This survey assessed participants' prior knowledge of and interest in the topic religion in ancient Greece. Use of this measure was supported by the Ebner and Ehri's (in press) findings, which showed participants' prior knowledge and interest scores significantly correlated with their overall word knowledge scores on the posttest in the combined conditions. Participants who indicated having more prior knowledge of and interest in the topic prior to performing the learning task displayed more comprehensive word knowledge at the end of the task. The survey contained the same items used in Ebner and Ehri's study to assess participants' prior knowledge of and interest in the topic. Participants were asked to circle their answers and/or to fill in the blanks with written answers where appropriate.

Participants' prior knowledge of the topic was assessed with four items. The first item asked participants to rate on a scale of 1 (know nothing) to 5 (know a lot), "How much do you know about religion in ancient Greece?" This question was scored in accordance with participants' ratings. The next item asked participants to read and answer the following

Table 3

Correlations Between Posttest Composite Word Knowledge Scores and Dimensions of Word Knowledge

	Posttest Word Knowledge Sum Scores			
	Pronunciation accuracy sum score	Semantic knowledge sum score	Sentence writing sum score	Relation to the topic sum score
Pronunciation accuracy sum score				
Sematic knowledge sum score	.20			
Sentence writing sum score	.18	.85**		
Relation to the topic sum score	.23	.71**	.71**	
Composite Score	.31**	.93**	.93**	.88**

questions: “Have you ever studied ancient Greece in high school or college?” (participants were be asked to circle yes or no), and “If so, in what courses and for how long?” Participants received 1 point if they had studied ancient Greece in high school or college, and 0 points if they had not. Next, participants were asked, “Have you ever visited ancient Greek sites?” (participants were asked to circle yes or no), and “If so, which ones?” Participants received 1 point if they had visited ancient Greek sites, and 0 points if they had not. Finally, participants were asked: “In a few words, write down three facts that you know about religion in ancient Greece.” Participants received 3 points if they provided three accurate facts about religion in ancient Greece, 2 points if they provided two correct facts, 1 point if they provided one correct fact, and 0 points if they did not provide any correct facts. A sum score of participants’ prior knowledge about the learning topic was obtained by adding up the total numbers of points on these four items. A maximum of 10 points could be obtained. Chronbach’s alpha for the four knowledge items was .58.

In addition, participants’ prior interest in the topic was assessed by asking them to rate on a Likert-type scale ranging from 1 (no interest) to 5 (very interested), “How interested are you in the topic of religion in ancient Greece?” This item was examined both separately, and along with the prior knowledge survey items because there was a modest correlation between participants’ prior knowledge and prior interest ($r = .36$, $p < .01$). Cronbach’s alpha for the four prior knowledge items together with the prior interest item was .60.

Participants’ prior knowledge and interest ratings were compared to their word knowledge gain scores, and their overall word knowledge scores on the posttest. In addition, participants’ prior interest ratings were compared to their post-task interest ratings.

3. Metacognitive Awareness Inventory (Schraw, G. & Dennison, R. S., 1994) (see Appendix J for the complete measure)**.** This self-report inventory was administered as a pretest assessment of participants' entry-level self-regulated learning skills. It was important to assess this variable at the beginning of the study in light of researchers' findings (e.g., Eom & Reiser's, 2000) that differences among students' self-regulated learning skills may predict their degree of learning within hypermedia environments.

This measure of self-regulated learning skills pertains to adults' metacognitive awareness about their cognitions and their ability to monitor or regulate their own cognitions when performing a task. Participants were asked to provide written responses to 52 Likert-type rating scale items ranging from 1 (not at all true) to 7 (very true). Items assess two underlying factors: Knowledge of Cognition and Regulation of Cognition. The Knowledge of Cognition factor consists of three dimensions: declarative knowledge, procedural knowledge, and conditional knowledge. Examples of items include: "I understand my intellectual strengths and weaknesses" (declarative knowledge); "I try to use strategies that have worked in the past" (procedural knowledge); and "I learn best when I know something about the topic" (conditional knowledge).

The Regulation of Cognition factor consists of five dimensions: planning; information management strategies; comprehension monitoring; debugging strategies; and evaluation. Examples include: "I think about what I really need to learn before I begin a task" (planning); "I slow down when I encounter important information" (information management strategies); "I periodically review to help me understand important relationships" (comprehension monitoring); "I reevaluate my assumptions when I get confused" (debugging strategies); and "I use different learning strategies depending on the situation" (evaluation).

Schraw and Dennison (1994) found that the two underlying factors were reliable ($\alpha = .90$) and inter-correlated ($r = .54$). In the present study, the two underlying factors were also found to reliable with the study's sample. Chronbach's alphas for Knowledge of Cognition and Regulation of Cognition were .74 and .87 respectively. In addition, the two underlying factors were inter-correlated ($r = .60$, $p < .01$).

4. Nelson-Denny Reading Test: Vocabulary Subtest (Form G) (Brown, J. I., Fischo, V. & Hanna, G. S., 1993) This standardized assessment of high school students' and adults' general vocabulary knowledge is one of two subtests on the Nelson-Denny reading test (the other subtest is reading comprehension). The vocabulary subtest is a timed, 15-minute, 80-item multiple choice test of adults' general vocabulary knowledge. The words have been drawn from high school and college textbooks, and vary in difficulty. This test has been used to predict students' academic success (Brown, J. A., Fischo, V. V., and Hanna, G., 1993). The internal consistency of the items ranges from 0.88 to 0.95 (Brown et al. 1993). This test was administered as a pretest assessment of participants' general vocabulary knowledge in order to determine if it was predictive of participants' performance on the task.

5. Survey of Knowledge of & Experience with Searching the Internet (see Appendix K for the complete measure)**.** This self-report posttest assessment examined participants current use of the Internet for research purposes, as well as their knowledge of using the Internet for learning purposes, including about vocabulary. Participants' current use of the Internet for research purposes was assessed with the following two questions: (i) "On an average day, how much time do you spend visiting sites on the Internet?" and (ii) "How much of the time that you spend on the Internet is to conduct research for school-related or work-related purposes?" Participants could choose from three responses: "less than 1 hour," "between 1 to 3 hours," and

"more than 3 hours." For both questions, participants received 1 point if they circled "less than 1 hour," 2 points if they circled "between 1 and 3 hours," and 3 points if they circled "more than 3 hours."

Participants' knowledge of using the Internet for learning purposes, including for vocabulary acquisition, was assessed by asking participants as follows: (i) "Please list as many Internet search engines that you can think of." (participants revived 1 point for every different and valid search engine that they provided); (ii) "Please name as many websites as you can that may provide you with information about a word or a phrase that you want to know more about." (participants received 1 point for every website that they listed); and (iii) "What types of information can you gain about a word from the websites that you listed above?" (participants received 1 point for every correct type of information that they provided).

Participants' use of the Internet for research scores were added to their knowledge of the Internet for learning scores to create an overall composite score for this measure. All items but one significantly correlated with the composite score of these five items (all correlations were significant at the $p < .01$ level). The item "How much of the time that you spend on the Internet is to conduct research for school-related or work-related purposes" was not significantly correlated with the sum score of the five items ($p > .05$). When that item was removed, the internal consistency of the four other items was approaching moderate ($\alpha = .47$). The average score of the four items among the study sample was 12.70, and $SD = 3.80$.

In addition to the numerically scored items, the survey also contained a couple of items that were not numerically scored. These items included asking participants: (i) if they owned a computer or another device that allowed them to search the Internet, and if so what kind of

device they owned; (ii) where they normally search the Internet from; and (iii) and the Internet search engines they use the most often.

6. Survey of Perceptions About the Learning Task (see Appendix L for the complete measure)**.** This self-report survey of Likert-type rating scale questions was designed to assess participants' perceptions about the learning task. Some of the items were created by the researcher, whereas others were adapted from Ryan's Intrinsic Motivation Inventory (IMI; 1982). The complete IMI contains 45 items assessing seven general factors: Interest/Enjoyment; Perceived Competence; Effort/Importance; Pressure/Tension; Perceived Choice; Value/Usefulness; and Relatedness in Relation To Performing a Laboratory Task. IMI items ask participants to respond to various statements on Likert-type rating scales ranging from 1 (not at all true) to 7 (very true). IMI items can be easily modified to fit specific activities.

The present survey was organized into three sections, each of which was scored separately: (i) interest in and enjoyment of the learning activity, online material, and learning topic; (ii) perceived competence in performing the learning activity and understanding the online material; and (iii) perceptions about the helpfulness of using the Internet to learn about the terms. Each section and its items are detailed below.

Interest in & Enjoyment of the Activity, Online Material, and Learning Topic. Participants' interest/enjoyment regarding both the learning activity and the online material was assessed with the following adapted items from the Interest/Enjoyment Scale of the IMI: "I enjoyed doing this activity very much"; "I think this was a very interesting activity"; "I enjoyed reading the material very much"; "The material I was reading was fun to read"; and "I would describe the material I was reading as very interesting." Responses to these questions were scored in accordance with participants' ratings of these items. Ebner and Ehri's (in press) study

findings supported the inclusion of these particular items. In particular, Ebner and Ehri's study found that the interest/enjoyment items positively predicted participants' post-test overall word knowledge scores.

This part of the survey also included a question asking participants to rate on a Likert-type scale ranging from 1 (no interest) to 5 (very interested) how interested they were in the learning topic after completing the task. Responses to this question were also scored in accordance with participants' ratings of this item. This item was then compared to each participant's rating of his/her interest in the learning topic prior to participating in the learning task in order to see if participating in the task changed participants' levels of interest. The internal consistency of these interest/enjoyment items was high ($\alpha = .88$).

Perceived Competence in Performing Learning Activity & Understanding the Online Material. The present study also adapted items from the IMI's Perceived Competence Scale to assess participants' perceived competence in performing the activity and in understanding the online material. The following items were included: "I think I did pretty well at this activity, compared to other students"; "I am satisfied with my performance on this activity"; "I felt pretty skilled at this task"; and "I think that I understood the material I was reading very well." Participants were asked to rate their responses on Likert-type rating scales ranging from 1 (not at all true) to 7 (very true). Responses to these questions were scored in accordance with participants' ratings of the items. Support for the inclusion of these items also came from Ebner and Ehri's (in press) study, which found that participants' perceptions about how well they understood the online material explained a significant portion of variance in both their word knowledge gain scores, and their posttest overall word knowledge scores. The internal consistency of these items was also high ($\alpha = .82$).

***Perceived Helpfulness of the Internet for Learning about the Terms*.** Participants were also asked to indicate on a Likert-type scale of 1 to 5 (with 1 being "not at all helpful" and 5 being "extremely helpful") how helpful they found using the Internet to understand the terms and concepts presented in the article. Responses to this question were scored in accordance with participants' ratings of the item. In addition, participants were asked to list the websites, from among those that they visited during the activity, that they found to be most informative in learning about the terms and concepts in the Wikipedia article, and to explain why those sites were particularly helpful.

Procedure

Pairs of same-sex participants were formed based upon the order in which they signed up to participate in the study on the School of Education's research participation website. Within each same-sex pair, participants were randomly assigned to one of the two conditions: (i) a *structured*, process-oriented think-aloud methodology condition, or (ii) an *unstructured*, process-oriented think-aloud methodology condition.

In both conditions, each participant met individually with the researcher. Before the researcher introduced the study, she asked the participant to first fill out the Demographics Survey (see Appendix B). The researcher then briefly introduced the learning activity and explained its purpose. She then administered the following pretest assessments to the participant in the following order: (i) the Nelson-Denny Reading Test : Vocabulary Subtest; (ii) the Metacognitive Awareness Inventory (see Appendix I); (iii) the Target Vocabulary Word Knowledge Survey (see Appendix G) (with the exception of the Pronunciation Accuracy part of the test, which was given when the participant was handed the list of terns); and (iv) the Survey of Knowledge of & Interest in Learning Topic (see Appendix I).

Once the participant had completed the pretest assessments, the researcher explained in greater detail the learning goal, and depending upon the condition to which the participant had been assigned, the specific think-aloud procedure that would be used (see Appendixes C and E for researcher scripts used with participants in each condition).

The researcher then provided each participant (in both conditions) with the same terms to be learned during the activity. Each participant was asked to pronounce each term on the list, and the researcher checked off whether or not the participant correctly pronounced each term. After the participant pronounced each of the terms, he/she was asked to move to the computer, which was open to the Wikipedia article.

During the learning activity, the researcher audio-recorded each participant's think-aloud responses, with both a digital audio recorder and the Livescribe Echo™ Smartpen. The researcher also used the Smartpen to take detailed notes about the participant's behaviors and comments. Later, both the digital audio recordings and the synchronized notes were uploaded onto the researcher's computer to capture and memorialize in detail what was occurring during the learning activity for each participant. The researcher also used a tally sheet (see Appendix F) to record the amount of time that the participant spent on the task, the frequency of the participant's engagement in specific online behaviors, and particular think-aloud responses. When appropriate, the researcher prompted the participant under the guidelines described earlier.

Participants in both conditions were given as much time as they wished to complete the learning task. Once a participant indicated that he or /she was finished, the researcher administered the posttest assessments. The researcher first asked the participant to pronounce each term on the list, and checked off on a separate sheet whether or not the participant was able to correctly pronounce each term on his or her own. Then the researcher requested the

participant to complete (i) the remaining sections of the Target Vocabulary Word Knowledge Survey (i.e., the Declarative Knowledge, Sentence Writing, and Relation to the Topic sections) (see Appendix G); (ii) the Survey of Knowledge of and Experience with Searching the Internet (see Appendix K); and (iii) the Survey of Perceptions About the Learning Task (see Appendix L).

Chapter 5

Results

Both quantitative and qualitative analyses were conducted. The results of each are discussed below.

Quantitative Results

Comparison of conditions on demographic and pretest variables. One-way ANOVAs confirmed that the two conditions did not significantly differ on the demographic variables presented in Table 1 of the Methods Section (all *p*s > .05). In addition, a series of one-way ANOVAs showed that the two groups did not significantly differ on any of the pretest variables (see Table 4). As reflected in Table 4, participants in both conditions entered the task with a moderate degree of declarative knowledge about the terms and how they can be used in sentences. In addition, prior to the task participants in both conditions showed relatively high pronunciation accuracy for the ten terms. Thus, participants had little room for gains on this dimension. In contrast, as displayed in Table 4, participants in both conditions lacked prior knowledge about how the ten terms related to the topic of religion in ancient Greece. As a result, that dimension of word knowledge afforded the most room for gains. Participants' varying amounts of prior knowledge on these different dimensions of word knowledge underscore the importance of assessing multiple dimensions of word knowledge rather than conceptualizing it as one dimensional. As shown, assessing multiple dimensions of word knowledge highlights the sensitivity of the present study's Word Knowledge Survey measure as a tool for identifying the specific areas of word knowledge that participants had the most or least potential for gains.

Table 4

Comparison of Conditions On Pretest Measures

PRETEST MEASURE	CONDITION	MEAN	STD. DEV.	*F*-Stat
Target Vocabulary Word Knowledge Survey				
Pronunciation Accuracy (max. 10)	Structured	8.86	.85	.16 ns
	Unstructured	8.77	.97	
Declarative Knowledge (max. 20)	Structured	7.40	3.64	.14 ns
	Unstructured	7.06	4.10	
Sentence Writing (max. 20)	Structured	8.71	4.27	.29 ns
	Unstructured	8.14	4.54	
Relation to the Topic (max. 20)	Structured	2.11	2.11	.78 ns
	Unstructured	2.66	2.19	
Composite (max. 70)	Structured	27.09	9.37	.04 ns
	Unstructured	26.63	10.63	
Survey of Knowledge of & Interest in the Learning Topic				
Prior Knowledge of the Topic (max. 10)	Structured	4.89	1.76	.38 ns
	Unstructured	4.60	2.10	
Prior Interest in the Topic (max. 5)	Structured	3.26	1.17	1.39 ns
	Unstructured	2.94	1.06	
Prior Knowledge of & Interest in the Topic Combined (max. 15)	Structured	8.14	2.32	.96 ns
	Unstructured	7.54	2.78	
Meta-Cognitive Awareness Inventory				
Knowledge of Cognition (max. 119)	Structured	87.48	9.63	.07 ns
	Unstructured	88.09	9.51	
Regulation of Cognition (max. 245)	Structured	164.86	24.75	3.11 ns
	Unstructured	173.77	16.78	
Composite Score (max. 364)	Structured	257.17	31.73	1.93 ns
	Unstructured	266.86	26.39	

Table 4 (Continued)

Comparison of Conditions On Pretest Measures

PRETEST MEASURE	CONDITION	MEAN	STD. DEV.	F-Stat
Nelson-Denny Vocabulary Test (max. 80)				
	Structured	61.91	13.00	.44 ns
	Unstructured	59.91	12.28	
Survey of Knowledge of & Experience with Searching the Internet (no max.)†				
	Structured	14.00	3.30	1.70 ns
	Unstructured	15.21	4.26	

Note. There were a total of 70 participants, 35 in each condition. *$p < .05$; **$p < .01$; ns = not statistically significant.

† Although this measure was administered at timed of posttest, it was still considered a pretest.

Table 4 also shows that participants in both conditions embarked upon the task with moderate amounts of prior knowledge about the topic, but a relatively low degree of prior interest in the topic. Participants in both conditions also showed moderately high self-reported self-regulatory skills and general vocabulary knowledge coming into the task.

Distribution of participants' word knowledge gain scores. Table 5 presents the distribution of participants' gain scores with the two conditions combined, and within each of the two conditions, on each word knowledge dimension, and overall. As indicated in Table 5, and displayed in Figure 2, there was considerable variability in participants' overall word knowledge gain scores within the two conditions combined (M = 17.4, SD = 10.85, Range = -8 to 38). In addition, as displayed in Table 5 in the column reporting minimum scores across the individual measures of word knowledge, several participants showed negative gains from pretest to posttest. The majority of those participants were from the unstructured think-aloud condition. Inspection of written responses revealed that many of those participants left the majority of posttest items blank hence lowering posttest scores. One explanation is reduced motivation in this condition. In addition, there was also considerable variability in participants' overall word knowledge gains within each condition. As displayed Figure 3, the box and whisker plot shows that there was less spread in overall gain scores among participants in the structured think-aloud condition compared to the unstructured think-aloud condition. There were also more scores towards the higher end of the gain score distribution in the structured think-aloud condition compared to the unstructured think-aloud condition (Structured: M = 22.80, SD = 8.00; Range = 4 to 38; Unstructured: M = 13.60, SD = 9.83 , Range = -3 to 38). The same distribution patterns were also shown for gains on each of the word knowledge dimensions.

Table 5

Distribution of Participants' Word Knowledge Gain Scores Within the Two Conditions Combined

		Descriptive Statistics			
Conditions Combined	N	Minimum	Maximum	Mean	Std. Deviation
Definition Gain (max. 20)	70	-3	14	6.16	3.977
Sentence Gain (max. 20)	70	-8	14	4.87	4.324
Greece Gain (max. 20)	70	-4	20	6.23	4.703
Pronunciation Gain (max. 10)	70	-8	3	.14	1.195
Overall Gain (max. 40)	70	-8	38	17.40	10.850
Structured Think-Aloud Condition	N	Minimum	Maximum	Mean	Std. Deviation
Definition Gain (max. 20)	35	0	14	7.34	3.17
Sentence Gain (max. 20)	35	-5	11	6.29	3.54
Greece Gain (max .20)	35	0	20	8.86	4.05
Pronunciation Gain (max. 10)	35	-1	3	.31	1.52
Overall Gain (max. 40)	35	4	38	22.80	8.00
Unstructured Think-Aloud Condition	N	Minimum	Maximum	Mean	Std. Deviation
Definition Gain (max. 20)	35	-3	14	5.31	4.16
Sentence Gain (max. 20)	35	-2	14	4.20	3.66
Greece Gain (max. 20)	35	-6	11	4.11	3.74
Pronunciation Gain (max. 10)	35	-8	2	-.03	1.52
Overall Gain (max. 40)	35	-3	38	13.60	9.83

Figure 2. Distribution Of Students' Gain Scores On the Target Vocabulary Word Knowledge Survey From Pretest To Posttest

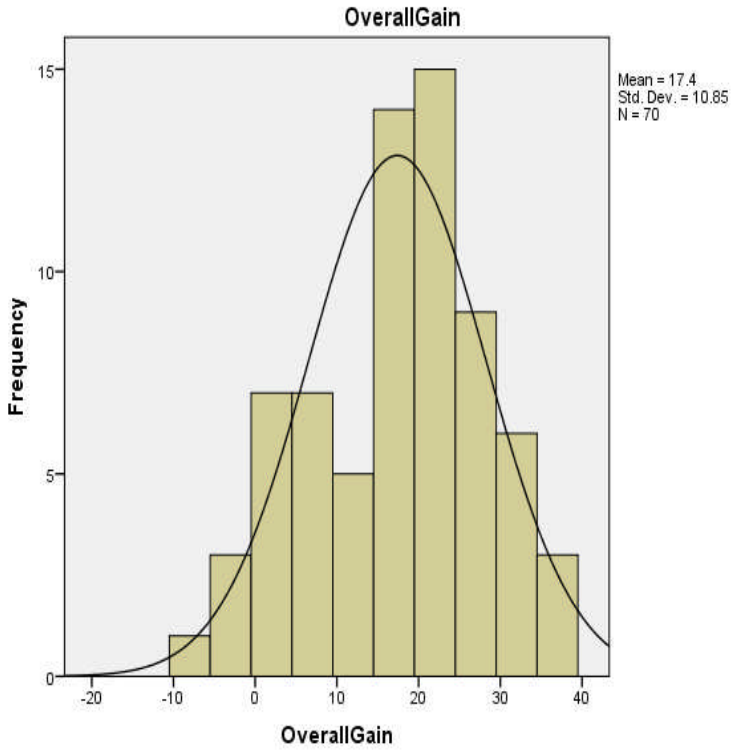
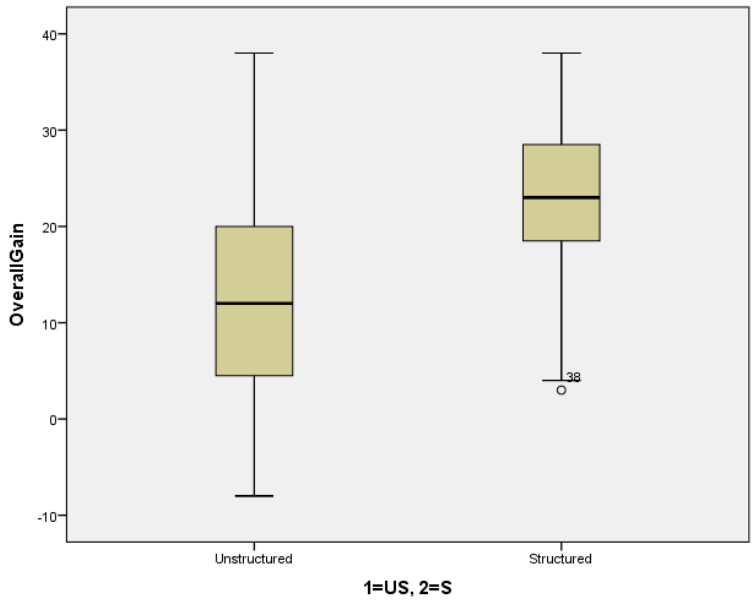


Figure 3. Distribution of Participants' Overall Word Knowledge Gains By Condition



Examination of confirmatory/primary hypotheses.

Comparison of conditions on Target Vocabulary Word Knowledge Survey scores from pretest to posttest. A series of repeated measures ANOVAs were conducted to examine the first study hypothesis. That hypothesis predicted that participants assigned to the structured think-aloud condition would display significantly greater word knowledge scores from pretest to posttest, both overall and within the specific dimensions of word knowledge, compared to control group participants. The independent variables were treatment and time of test. Table 6 presents the results of these analyses.

As displayed in Table 6, ANOVAs revealed significant effects of time. Posttests scores were significantly higher than pretest scores indicating that participants' knowledge of the words improved. ANOVAs also indicated significant interaction effects between time and the treatment condition on overall word knowledge scores, as well as on the declarative knowledge, sentence writing, and relation to the topic dimensions. The significant effects of time showed that participants in both conditions gained more word knowledge, both overall and within the specific dimensions of word knowledge from pretest to posttest (with the exception of pronunciation accuracy, which was not statistically significant) . These effects were significant at the $p < .01$ level. The significant interaction effects revealed that participants in the structured think-aloud group gained significantly more word knowledge from pretest to posttest than control participants, both overall and on all but one dimension of word knowledge (pronunciation accuracy, which was not statistically significant). The interaction effects were significant at the $p < .01$ level for word knowledge composite scores, sentence writing scores, and relation to the topic scores. Interaction effects on declarative knowledge scores were significant at the $p < .05$ level.

Table 6

Comparison of Conditions On Word Knowledge Survey Scores From Pretest To Posttest Per Condition

	CONDITION	PRETEST		POSTTEST		*F* –STAT (*df* = 1, 68)	PARTIAL ETA SQ.
		Mean	Std. Dev.	Mean	Std. Dev.		
Composite (max. 70)	Structured	27.09	9.37	49.89	12.72	Test Point: 288.31**	.81
	Unstructured	26.63	10.63	40.20	13.87	Test Point x Condition: 18.56**	.21
Pronunciation Accuracy (max. 10)	Structured	8.86	.85	9.17	.81	Test Point: 1.00 ns	.02
	Unstructured	8.77	.97	8.74	1.65	Test Point x Condition: 1.45 ns	.02
Declarative Knowledge (max. 20)	Structured	7.40	3.64	14.74	3.92	Test Point: 205.12**	.75
	Unstructured	7.06	4.09	12.37	5.17	Test Point x Condition: 5.27*	.07
Sentence Writing (max. 20)	Structured	8.71	4.27	15.00	4.89	Test Point: 148.22**	.69
	Unstructured	8.14	4.54	12.34	5.62	Test Point x Condition: 5.86**	.08
Relation to Topic (max. 20)	Structured	2.11	2.11	10.97	4.92	Test Point: 190.76**	.74
	Unstructured	2.66	2.97	6.74	3.95	Test Point x Condition: 25.93**	.28

Note. There were a total of 70 participants, 35 in each condition. *$p < .05$; **$p < .01$; ns = not statistically significant.

Overall, the results of these analyses offer support for the hypothesis that participants in the structured think-aloud group would display significantly more word knowledge than those in the unstructured think-aloud group, both overall and within specific dimensions of word knowledge. The only exception was for pronunciation accuracy, where effects, though in the expected direction, were not statistically significant. One likely reason is that pronunciation accuracy in both conditions was high on the pretest, thus leaving little room for improvement.

Effects of conditions across each term. Treatment effects were also found to generalize across each of the ten terms. As shown in Table 7, the structured think-aloud group showed superior word knowledge gains on each of the ten terms compared to the control group. Thus, not only did the effects of the structured think-aloud condition generalize across subjects, but also across all of the terms. Table 7 lists the terms in order of greatest effect of the structured think-aloud condition to the smallest effect.

Comparison of conditions on behavioral and verbal indications of staying on task. ANOVAs were next conducted to determine whether support could be obtained for the second confirmatory hypothesis. That hypothesis predicted that structured think-aloud participants would display more behavioral and verbal indicators of staying focused on the task during the learning activity than control group participants. As displayed in Table 8, however, there were no statistically significant differences between conditions on the tallied behavioral indicators that were hypothesized to indicate participants' focus on, or distraction from, the task (all *p*s > .05) These non-significant results were surprising. They may suggest that the particular online behaviors tallied during the task were not valid or sensitive indicators of participants' focus on the task. Or they may mean that online behaviors in general are not a valid indicator of a participant's focus on, or distraction from, an online task. The latter explanation is consistent

Table 7

Effect of Conditions On Each Term

Terms	Structured Think-Aloud Condition Mean Gain	Unstructured Think-Aloud Condition Mean Gain	Effects (Structured Mean Gain - Unstructured Mean Gain)
Epithets	3.11	1.49	1.62
Offal	4.37	2.91	1.46
Epic	1.11	-.23	1.34
Mythology	1.51	.43	1.08
Hubris	2.06	1.06	1.00
Polytheism	2.00	1.17	.83
Libations	2.94	2.37	.57
Symposium	2.83	2.49	.34
Cult	.86	.54	.32
Vices	1.51	1.40	.11

Note. Terms are ordered from largest effect of the structured think-aloud condition to the smallest effect.

Table 8

Comparison of Conditions on Behavioral Indicators of Staying Focused On, Or Straying From, the Task

BEHAVIORAL INDICATORS	CONDITION	MEAN	STD. DEV.	*F*-STAT
Time spent on task	Structured	25.37	11.97	1.77 ns
	Unstructured	21.63	11.60	
Clicks on target words (total times)	Structured	6.34	3.51	.07 ns
	Unstructured	6.09	4.51	
Navigates to a directly relevant web page	Structured	9.00	3.48	.45 ns
	Unstructured	9.600	4.01	
Navigates to an indirectly/marginally related web page	Structured	1.23	2.07	.12 ns
	Unstructured	1.09	1.38	
Navigates to a not relevant web page	Structured	.80	1.05	1.26 ns
	Unstructured	1.31	2.49	
Returns to article after navigating away from it	Structured	6.86	3.00	.05 ns
	Unstructured	6.66	4.46	
Rereads text containing a target term	Structured	3.26	3.05	2.44 ns
	Unstructured	2.14	2.91	

Note. There were a total of 70 participants, 35 in each condition. *$p < .05$; **$p < .01$; ns = not statistically significant.

with findings from Ebner and Ehri's earlier study (in press), which also found that online word learning success was not determined merely by engagement in, or lack of engagement in, specific online behaviors.

For example, participants in the structured think-aloud group did not, on average, spend significantly more time on the online task than the control group. This lack of significant difference suggests that the requirement for treatment participants to think aloud in detail about their online learning goal, and about their actions in relation to achieving that goal, did not lengthen the time spent on the task. In addition, there were no significant differences in the average number of times participants in both groups clicked on target terms. This lack of significant difference suggests that clicking on target terms in and of itself does not necessarily reflect focus on, or distraction from, the task. The same finding was evidenced in Ebner and Ehri's (in press) study, whereby participants in that study clicked on, or did not click on, target terms for varying reasons.

The same can be said about the lack of significant differences between conditions on the number of relevant, marginally relevant, and not-relevant websites that participants navigated to during the task. For example, it was originally expected that participants in the structured think-aloud group would navigate more often to relevant websites, and less frequently to marginally relevant or not-relevant websites, than the control group, thereby indicating a greater focus on the task. The lack of significant differences, however, shows that merely navigating to relevant websites does not necessarily result in obtaining and/or retaining pertinent information from that website. Along the same lines, it cannot be assumed that navigating to an irrelevant website indicates that a participant lost focus on the learning goal, especially if that website was visited

by accident and then quickly exited. Similarly, returning to the article after navigating away from it, or rereading text containing a target term, does not necessarily indicate lack of focus on, or distraction from, the goal of the online vocabulary task. Instead, as suggested by Ebner and Ehri (in press), it is important to consider the reasons underlying engagement in particular behaviors vs. just considering engagement in behaviors alone. The present study also supports this conclusion.

Although there were no statistically significant differences between conditions on behavioral indicators of staying focused on the task, structured think-aloud participants did display some verbal indicators of staying focused on the task. The majority of control participants, however, did not display those same indicators, which are as follows: (i) explaining, both with and without prompting, both what they were going to do next *and* why (e.g., demonstrating; planning); and (ii) explaining, both with and without prompting, whether an action was helping /did help in reaching the goal (e.g., demonstrating; evaluating); and (iii) reminding himself or herself, with prompting, about the goal of the learning task. The fact that the majority of participants in the control condition did not engage in these verbalizations is not surprising. This is because unlike participants in the structured think-aloud condition, participants in the unstructured think-aloud condition were not required or instructed to think aloud about their goal, or plan and evaluate their actions. Thus, the majority of participants in each condition did not deviate from what they were required, or not required, to do.

These results show that treatment was effective in encouraging participants to think-aloud about what they were going to do to help them achieve their goal, and whether what they were doing would/did help them achieve their goal. While it is not surprising that structured think-aloud participants did think aloud about their actions in relation to their online learning goal

when prompted, it is significant that they similarly thought aloud about their actions in relation to their online goal even when not prompted. This shows that even merely providing specific think-aloud directions at the beginning of an online learning task can encourage participants to be more actively involved in their own online-learning (e.g., staying self-focused and cognitively aware of their actions towards attaining that goal). As displayed in Table 9, the vast majority of participants in both conditions did not explain what they were going to do next, but not why. This is not surprising since neither condition was instructed to do so. Similarly, almost no participants in either condition verbalized, with prompting, the meaning of a term and its relationship to ancient Greece. Again, neither condition was directed to do so. This shows that participants in both conditions were adhering to the directions given to them. Finally, more than half of the participants in each condition did not express confusion or uncertainty about the goal of the learning task. Thus, participants in both conditions understood the directions, and what they were supposed to do during the learning task. Performance differences between the two groups, therefore, were not because the control group was more confused about the goal of the task, or because directions were less clear for that group. Rather, findings suggest that the structured think-aloud group's superior performance resulted from their greater metacognitive focus on the task. Thus, findings suggest that differences between conditions on online word knowledge gains did not depend upon differences between conditions on specific behaviors engaged in, or not engaged in, during the task. Instead, differences were better explained by the extent to which participants were metacognitively aware of how their online actions would or would not help them achieve their goal.

Table 9

Comparison of Conditions On Verbal Indicators of Staying Focused On, Or Straying From, the Task

VERBAL INDICATORS	CONDITION	% 0 Scores	MEAN	STD. DEV.	*F*- STAT
Explains *what* he/she would do next, but not why (without prompting)	Structured	2.9	9.17	5.36	8.45**
	Unstructured	17.1	5.49	5.26	
Explains *what* he/she would do next, but not why (with prompting)	Structured	82.9	.56	2.41	.87 ns
	Unstructured	85.7	.17	.45	
Explains both what he/she is going to do next *and* why (i.e., demonstrates planning) (without prompting)	Structured	2.9	13.40	7.57	67.74**
	Unstructured	37.1	2.26	2.63	
Explains both what he/she is going to do next *and* why (i.e., demonstrates planning) (with prompting)	Structured	11.4	2.34	1.88	39.18 **
	Unstructured	91.4	.20	.78	
Explains whether an action is/did help in reaching the goal (i.e., demonstrates evaluating) (without prompting)	Structured	8.6	9.94	5.75	85.17**
	Unstructured	65.7	.74	1.31	
Explains whether an action is/did help in reaching the goal (i.e., demonstrates evaluating) (with prompting)	Structured	2.9	4.31	3.04	69.508**
	Unstructured	97.1	.03	.17	
Verbalizes the meaning of a target term and its relationship to religion in ancient Greece (without prompting)	Structured	25.7	3.66	4.56	1.65 ns
	Unstructured	42.9	2.40	3.69	

Table 9 (Continued)

Comparison of Conditions On Verbal Indicators of Staying Focused On, Or Straying From, the Task

VERBAL INDICATORS:	CONDITION	% 0 Scores	MEAN	STD. DEV.	*F*-STAT
Verbalizes the meaning of a target term and its relationship to religion in ancient Greece (with prompting)	Structured	91.4	.31	1.53	1.21 ns
	Unstructured	97.1	.03	.17	
Expresses confusion and/or uncertainty about the goal of the task	Structured	68.6	.60	1.14	.43 ns
	Unstructured	57.1	.77	1.03	
Reminds himself or herself about the goal of the learning task (without prompting)	Structured	68.6	.66	1.63	4.57*
	Unstructured	97.1	.06	.34	
Reminds himself or herself about the goal of the learning task (with prompting)	Structured	28.6	1.89	2.32	6.79**
	Unstructured	54.3	.77	1.00	

Note. There were a total of 70 participants, 35 in each condition. *$p < .05$; **$p < .01$; ns = not statistically significant.

Comparison of conditions on post-task self-reported perceptions about the learning task. A series of one-way ANOVAs did not find any significant differences between conditions in participants' perceived interest/enjoyment of the learning task, material, and topic, or their perceived competence for performing the task and understanding the online material (all *ps* > .05). These lack of significant differences show that in addition to the structured think-aloud method being more effective in increasing participants' performance on the online word learning task, it did not do so at the expense of participants' interest and enjoyment of the task, or their perceived competence for performing the task.

Examination of exploratory/secondary hypothesis:

Correlational Analyses. In addition to the two confirmatory hypotheses, it was also hypothesized that particular variables would predict and explain a significant portion of variance in participants' composite measure of word knowledge gains, both within each condition and in the two conditions combined. These variables included: (i) participant's gender; (ii) knowledge of and interest in the learning topic; (iii) knowledge of and experience with searching the Internet; (iv) self-regulated learning skills (i.e. metacognitive awareness); and (v) general vocabulary knowledge. Correlational analyses were conducted to investigate this exploratory/secondary hypothesis. Within the combined conditions, only Nelson-Denny vocabulary test scores predicted participants' overall word knowledge gain scores ($r = .28$, $p < .05$) (see Table 10). Within the structured think-aloud condition, Nelson-Denny vocabulary test scores also predicted participants overall word knowledge gains scores ($r = .40$, $p < .01$) (see Table 11). Thus, within both the combined conditions and the structured think-aloud condition,

Table 10

Correlations Between Variables Within the Combined Conditions

Variable	Word Knowledge Composite Score Gains	Gender	Prior Knowledge of the Topic	Prior Interest in the Topic	Knowledge and Experience with Searching the Internet	Self-regulation	Vocabulary
Word Knowledge Composite Score Gains							
Gender	-.11						
Prior Knowledge of the Topic	-.01	.09					
Prior Interest in the Topic	.10	.04	.36**				
Knowledge and Experience with Searching the Internet	.15	-.05	.14	.00			
Self-regulation	.03	.01	-.04	.16	.04		
Vocabulary	.28*	-.08	.43**	.09	.31**	-.07	

Note. *$p < .05$ (one-tailed); **$p < .01$ (one-tailed)

Table 11

Correlations Between Variables In the Structured Think-Aloud Group

Variable	Word Knowledge Composite Score Gains	Gender	Prior Knowledge of the Topic	Prior Interest in the Topic	Knowledge and Experience with Searching the Internet	Self-regulation	Vocabulary
Word Knowledge Composite Score Gains							
Gender	-.14						
Prior Knowledge of the Topic	-.16	-.00					
Prior Interest in the Topic	-.08	-.12	.21				
Knowledge and Experience with Searching the Internet	.38*	.11	.24	.10			
Self-regulation	-.04	.12	.03	.18	.10		
Vocabulary	.40**	-.02	.28	-.13	.54**	.00	

Note. *$p < .05$ (one-tailed); **$p < .01$ (one-tailed)

participants who had more extensive vocabularies also gained more overall word knowledge. Perhaps this was because those participants were more attuned to and interested in word learning. Nelson-Denny vocabulary test scores, however, did not predict participants' word knowledge gains within the unstructured think-aloud condition ($r = .17$, $p > .05$) (see Table 12). This suggests that having an extensive vocabulary will not alone predict whether a student will gain more word knowledge when reading online. Instead, the dissertation research results suggest that online readers need to have a structured method to avoid the Internet's distractions and to stay focused on their learning task in order to gain online word knowledge.

Within the structured think-aloud condition, participants' knowledge of and experience with searching the Internet also significantly predicted their word knowledge gain scores ($r = .38$, $p < .05$), but not in the unstructured think-aloud condition ($r = .17$, $p > .05$) (see Table 12), or in the combined conditions ($r = .15$, $p > .05$) (see Table 10). As with vocabulary knowledge, having more knowledge and experience with searching the Internet may only benefit readers who also have a structured method to remain metacognitively engaged in their online word learning task. The results suggest that even if a student has prior knowledge of and experience with researching and learning on the Internet, he/she will not necessarily gain more online word knowledge, unless he/she also has a method for remaining focused on both the goal of the task and how online behaviors can help him/her achieve the learning goal.

In fact, the only variable within the unstructured think-aloud condition that significantly predicted overall word knowledge gain scores was participants' self-reported self-regulation scores, which assessed both their knowledge of cognition and regulation of cognition ($r = .29$, $p < .05$). Participants' with higher self-regulation scores in the unstructured condition were more successful at gaining word knowledge than those participants with lower self-regulation scores

within that condition. This is not surprising. The structured think-aloud groups' greater word knowledge gains demonstrated that encouraging metacognitive awareness caused greater word knowledge gains. Further, the fact that self-regulation scores were not predictive of overall word knowledge gains within the structured think-aloud condition demonstrates that the structured think-aloud methodology benefited participants regardless of their self-regulation skills. Thus, the structured think-aloud condition compensated for any weak self-regulation skills among participants in that group.

In sum, correlational analyses showed that participants' gender did not significantly correlate with their composite word knowledge gain scores either within the combined conditions, or within each of the treatment conditions. This was contrary to expectations in view of Ebner and Ehri's (in press) earlier findings that males showed superior online word learning performance compared to females. Participants' prior knowledge and prior interest in the learning topic also did not significantly correlate with word knowledge composite gain scores within either of the two conditions, or within the two conditions combined. This too was surprising given previous research findings showing significant correlations between prior knowledge and interest in a learning topic and comprehension of material within hypertext environments. Greater vocabulary knowledge, and knowledge and experience with searching the Internet, however, did significantly predict word knowledge composite gains within the structured think-aloud condition, but not in the unstructured think-aloud condition or the combined conditions. Such findings show that even if students have extensive vocabularies and/or are knowledgeable about how to navigate the Internet, they still need a structured method to remain metacognitively engaged in their online word learning task to succeed. The need for a structured method to compensate for weak self-regulation skills is supported by the significant

Table 12

Correlations Between Variables In the Unstructured Think-Aloud Group

Variable	Word Knowledge Composite Score Gains	Gender	Prior Knowledge of the Topic	Prior Interest in the Topic	Knowledge and Experience with Searching the Internet	Self-regulation	Vocabulary
Word Knowledge Composite Score Gains							
Gender	-.10						
Prior Knowledge of the Topic	.03	.17					
Prior Interest in the Topic	.15	.23	.49**				
Knowledge and Experience with Searching the Internet	.17	-.18	.09	-.03			
Self-regulation	.29*	-.12	-.08	.18	-.07		
Vocabulary	.17	-.13	.57**	.33*	.15	-.14	

Note. *$p < .05$ (one-tailed); **$p < .01$ (one-tailed)

positive correlation between word knowledge composite gains and self-regulation skills in the unstructured think-aloud group.

Regression analyses. In order to see which variables explained a significant portion of variance in participants' posttest word knowledge scores, a linear regression analysis was performed. The variables were entered into the analysis using a forward selection stepwise method. This procedure sequentially enters variables that satisfy the criterion for entry into the analysis. The variables are entered from those with the strongest to those with the weakest correlations with the dependent variable. Table 13 presents the results of this regression analysis, which resulted in the three models (all significant at the $p < .01$ level).

As shown in Table 13, participants' vocabulary scores, treatment condition, and pretest composite word knowledge scores each explained significant portion of variance in participants' posttest word knowledge composite scores. Participants' vocabulary scores had the strongest correlation with the participants' posttest word knowledge composite scores, followed by participants' treatment condition, and then participants' pretest word knowledge composite scores. The other predictor variables did not meet the criteria for inclusion, which was *F* –to-enter $p \leq .05$, because they did not explain any significant portion of variance any of the three models. Model 3 explained the biggest portion of variance in participants' posttest word knowledge scores. In that Model, participants' posttest word knowledge composite scores could best be explained by their general vocabulary knowledge, their treatment condition, and their pretest word knowledge composite scores. Those with the best performance on the online word learning task had more extensive vocabularies going into the activity, were in the structured think-aloud condition, and had higher pretest word knowledge scores. These results support expectations that overall word knowledge posttest scores would be dependent upon prior

Table 13

Regression Analysis (Forward Selection Stepwise Method) For Variables Predicting Posttest Word Knowledge Composite Scores

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Vocabulary	.83	.09	.75**	.81	.08	.73**	.52	.12	.47**
Condition (Structured vs. Unstructured)				7.92	2.10	.28**	8.46	2.00	.30**
Pretest Word Knowledge Composite Score							.47	.16	.33**
R^2		.56			.64			.68	
F-Stat		82.12**			56.60**			45.27**	

Note. *$p < .05$; **$p < .01$

vocabulary knowledge (both in general, and for the specific target terms in the activity), as well as having a structured method to remain focused on the goal of the learning task.

Conclusions drawn from quantitative results. Quantitative results showed that participants in the structured think-aloud group gained more overall word knowledge, both overall and within specific dimensions of word knowledge (with the exception of pronunciation accuracy where there was not a statistically significant difference). These treatment effects generalized across each of the ten terms. In addition, results support use of the structured think-aloud method as an effective scaffold for encouraging participants to stay metacognitively aware of their on their online word learning goals and actions.

Further, results showed a lack of significant difference between conditions in specific behaviors that were expected to indicate differences between groups in participants' focus on, or distraction from, the online word learning task. These results are in keeping with Ebner and Ehri's (in press) results, which also suggested that online word learning success is not determined merely by engagement, or lack of engagement, in specific online behaviors. Rather, online word learning success depends upon whether or not participants are metacognitively aware of their behaviors and how those behaviors will or will not help them achieve their goal. The structured think-aloud method offered participants a way to remain metacognitively aware of their online actions and goal. This was accomplished by reminding participants to think continuously about their goal, plan how each action will help them achieve their goal, and evaluate whether or not an action was helping them achieve their goal. In addition, although there were no significant differences between the two conditions in the number of unrelated or partially related websites that participants in the two groups visited, the structured think-aloud

method helped participants refocus on their goal, even when visiting a website that was not directly relevant to the learning goal.

Finally, correlational and regression analyses revealed that participants with more extensive general vocabularies showed the greatest online word learning performance. This was especially true if those participants with more extensive general vocabularies also had a structured method to help them remain metacognitively engaged in the online word learning task, and if they also had some prior familiarity with the terms. Further, the only significant correlation between word knowledge gains within the unstructured think-aloud condition was self-regulation scores. This finding is significant because it suggests that without a structured method to promote metacognitive awareness, students needed to possess stronger self-regulatory skills to benefit the most in gaining word knowledge online. Thus, the structured think-aloud method helped participants stay focused on the task. As result, participants within that condition were able to take advantage of Internet tools and resources to increase their word knowledge, regardless of the extent of their self-regulatory skills prior to engaging in the task.

Qualitative Results

A qualitative analysis was conducted to seek additional support for quantitative findings. The qualitative analysis was based on researcher observations, notes, and audio recordings. Inductive and deductive analyses of the data were performed to identify and describe common themes, behaviors, and comments offered by participants during the online learning task.

Key approaches to the learning task. Researcher observations revealed certain patterns in the way that participants in both conditions approached the online word learning task. Among the 70 participants observed, only four of them, each from the unstructured group, read all, or almost all, of the online article word for word in a linear manner. Instead, the vast majority of

participants in both conditions approached the online word learning task by utilizing one of three main approaches (a) locating terms in the article and researching their meanings (the " locate-in-article" approach); (b) spending minimal-to-no time on the article web page itself (the "minimal-time-with-article" approach); and (c) using no systematic method at all (the "no-systematic-method" approach).

Table 14 lists the frequency of participants per condition utilizing each of these three key approaches. As displayed in the table, more than half of the total number of participants utilized the locate-in-article approach. Between the remaining approaches, the minimal-time-with-article approach and the no-systematic-method approach, there was an almost equal split. Further, utilization of the three approaches was fairly evenly divided between the structured and unstructured think-aloud groups. The fact that there was not much of an observed difference between the two conditions in the frequency of participants' engagement in the different key approaches is in keeping with quantitative findings which showed that the two conditions did not significantly differ in their online behaviors tallied during the task. As discussed below, the difference in word knowledge gain scores is instead attributable to participants' ability to stay metacognitively focused on the learning task.

The locate-in-article approach: Locating terms in the article and researching their meanings. This was the most common approach. It involved participants trying to find the terms in the online article in the order in which they appeared on the list that the researcher handed to them. Participants utilized this approach in one of two ways. Some participants manually scanned the article looking for the terms. Others would type the terms into the Internet Explorer "Find on this Page" box, which can be accessed either on the "Edit" drop down menu on the Menu Bar, or through the Ctrl+F shortcut. Once a term was found, participants simply read the

Table 14

Frequency Of Participants Per Condition Utilizing Each Of the Different Key Approaches To the Learning Task

Approach:	Structured Think-Aloud Group (N)	Unstructured Think-Aloud Group (N)	Total (N)
Locate-in-article[a]	22	17	39
Minimal-time-with article[b]	6	7	13
No-systematic-method[c]	7	7	14
Total			66

Note: Four participants all in the unstructured group read all, or almost all, of the online article word for word in a linear manner.

[a] Locating terms in article and researching their meaning
[b] Spending minimal-to-no time on the article web page
[c] Using no systematic method

online article text surrounding the term. If they wanted to learn more, they would click on the hyperlink for that term, or in some cases would conduct an Internet search to look up the meaning of the term in an online dictionary or on another website. While researching the meaning of a term, some participants would then return to the article and reread the text containing the term. Others would move on to the next term. After participants reached the end of the list of terms, most would indicate they were finished. Some, however, would look back to the list of terms, and quiz themselves on the meaning of each term. For any term that they could not remember, those participants would go back and research that term again.

The locate-in-article approach seemed to be very effective, especially for the structured think-aloud participants. In fact, the four participants with the highest composite posttest word knowledge scores, all of whom were from the structured think-aloud condition, used this approach. This approach also was used by the four participants who had the three highest overall word knowledge gain scores. All but one of those four participants were from the structured think-aloud condition. In addition, results of a one-way ANOVA showed that participants using this approach gained significantly more knowledge about how the terms related to the topic (M = 8.35, SD = 4.02) compared to participants using the minimal-to-no-time-with-article approach (M = 4.67, SD = 3.68) or the no-systematic-method approach (M = 3.64, SD = 4.78). Differences between the locate-in-article approach and the other two approaches on this dimension of word knowledge were significant at the $p < .05$ level.

Although both the structured and unstructured think-aloud participants were observed using the locate-in-article approach, there was a fundamental difference. Unlike most of the structured think-aloud participants, many of the unstructured think-aloud participants using this approach would find each term in the text, research its meaning, but then would forget to relate

the meaning of the term to the specific context of religion in ancient Greece. In contrast, the structured think-aloud participants, who were asked to continuously think-aloud about their learning goal, remembered not only to learn the meaning of each term, but also how each term related to religion in ancient Greece. In some cases, structured think-aloud participants would look for references to religion in ancient Greece in the separate, hyperlinked Wikipedia article about the term, or would conduct an Internet search for the term and its relation to religion in ancient Greece. In other instances, structured think-aloud participants would research the meaning of the term, and then go back to the Wikipedia article to read about the term again in the context of the article.

This difference in remembering the goal of the task was supported by quantitative findings, which showed that participants in the structured think-aloud group more often reminded themselves about the goal of the task both with and without prompting (i.e., without prompting M = .66, SD = 1.36 for structured think-aloud group ; M = .06, SD = .34 for unstructured think-aloud group; $p < .05$). Quantitative findings also showed that among the individual dimensions of word knowledge, structured think-aloud participants gained the most word knowledge in comparison to unstructured participants in relating the term to the topic of religion in ancient Greece (M = 8.86, SD = 4.05 for structured think-aloud group; M = 4.11, SD = 3.74 for the unstructured group; $p < .01$). The performance difference between the two groups, although statistically significant, was not as great on the measure of declarative knowledge gains (M = 7.34, SD = 3.17 for structured think-aloud group; M = 5.31, SD = 4.16 for the unstructured group; $p < .05$). Thus, while this approach seemed to be effective in helping both unstructured and structured think-aloud participants gain declarative knowledge about the terms, this approach was more effective in helping structured think-aloud participants obtain

their goal of not merely knowing the meaning of the terms, but how each term related to the specific context of religion in ancient Greece.

Minimal-to-no-time-with-article approach: Spending minimal-to-no time on the article web page. Another approach observed among participants was to spend minimal or no time on the article web page itself. Many of those participants plugged each term into the Wikipedia "Search" box, or into an Internet search engine (e.g., Google; Bing), read the meaning of the term, and then moved on to the next term. Those participants rarely if ever returned to the Religion in ancient Greece article itself. Some participants who did return to the article apparently did so unintentionally, and left as soon as they realized they were back on the article web page. For example, several participants researched a term in Google, and then clicked on a Google search result which took them back to the main Wikipedia article, apparently without first realizing that was what they were doing. Once those participants realized that they had returned to the article, they left the article almost immediately.

Some participants who used this approach seemed to have forgotten that their goal was to learn not only the meanings of the terms, but also how each term related to religion in ancient Greece. Other participants using this approach, who seemed to remember that they had to learn how each term related to religion in ancient Greece, would simply speculate how the terms related to that topic, but would not check to see if their inferences or guesses were accurate. Those participants were seemingly to uninterested or impatient to finish the task.

Further, a couple of unstructured think-aloud participants spent minimal-to- no time on the article web page. They seemed to get so sidetracked while researching a term, they forgot about the main article. For example, one participant started out reading the Religion in ancient Greece article, but did not take long to become disoriented after clicking on the Etruscan Cult

hyperlink in the first section of the article. After clicking on Etruscan Cult, she spent the entire remainder of the learning task clicking on unrelated hyperlinked terms that appeared on the Etruscan Cult page, and then on hyperlinked terms on those unrelated terms' own web pages. Not surprisingly, that distracted participant gained minimal-to-no word knowledge, both overall and in the specific dimensions of word knowledge. She even showed a 1 point negative gain in declarative knowledge.

Another unstructured think-aloud participant started out reading the Religion in ancient Greece article, but after clicking on the hyperlink for epithet, never returned to the article web page. Instead, that participant tried to find the different target terms on the epithet Wikipedia page, seemingly forgetting that that was not the main article. Not surprisingly, that participant too was not successful in learning about the terms, and showed no overall word knowledge gains.

Both of these participants exemplify how easy it can be to become disoriented or distracted in cyberspace by not having a structured way of remaining metacognitively focused on an online learning goal, and aware of the succession of online actions being taken in pursuit of that goal.

No-systematic-method approach: Using no apparent systematic method. Finally, other participants in both conditions appeared not to use any systematic way for approaching the learning task. For example, some participants would use a combination of techniques, such as reading parts of the Religion in ancient Greece article in a linear way, searching other parts of the article for terms, and/or conducting Internet searches for other terms. Those participants seemed to be trying out different methods for learning about the terms. Some participants who did not appear to use a systematic method performed better than others who did not use a systematic

method. The key difference again seemed to be how metacognitively aware participants were of their different actions, and how those actions would help them achieve their learning goal. More specifically, there were some participants using this approach, especially in the unstructured think-aloud group, who would not provide reasons regarding which terms they were clicking on, or what portions of text they were choosing to read or not read. Those participants seemed to be approaching the task in what appeared to be a random way. Although those participants were thinking aloud, they were not saying *why* they were doing what they were doing. Although it is possible that they knew, inside their heads, what they were doing and why, that was not apparent to the researcher.

On the other hand, those structured think-aloud group participants who apparently were not following a systematic approach were asked and reminded by the researcher to be metacognitively aware of what actions they were taking and why. Thus, many would explain why for some terms like "polytheism," they were intentionally not clicking on the hyperlink for that term (e.g., because they already knew its meaning well), and why for other terms such as cult,, they were spending more time reading the text carefully in a linear way to try to understand the term's meaning in the article context. This observation is supported by quantitative findings showing that participants in the structured think-aloud group thought aloud more than unstructured think-aloud participants both about what they were going to do next *and* why, even when not prompted (M = 13.40, SD = 7.57 for structured think-aloud group; M = 2.26, SD = 2.63 for unstructured think-aloud group; $p < .01$).

Oral and behavioral indicators of staying on, or straying from, the learning task. In addition to the online approaches tallied by the researcher during the learning task, think-aloud data and researcher notes revealed other indicators of participants' active involvement in, or

distraction from, the task. As discussed below, some of the self-directed behaviors participants engaged in seemed effective in helping them learn and remember the terms. On the other hand, some of the same or similar behaviors served as sources of distraction for other participants, and were not helpful to them in achieving their learning goal. One of the primary differences noticed between the structured and unstructured groups was that the structured group seemed to have an easier time refocusing on their goal after being sidetracked.

Self-checking their memory for the terms. One meta-memory technique, engaged in by participants, involved repeatedly quizzing themselves on the meanings of the terms that they had researched. Those participants then often would revisit the definitions of any terms that they had forgotten. By self-checking their memory for those already-researched terms' meanings, participants were able to identify any gaps in their knowledge. This behavior appeared helpful for enabling participants to learn and remember the meanings of the terms. It did not always guarantee, however, that participants were learning how the terms could be used in a sentence, and/or how the terms were related to the specific context of religion in ancient Greece. Some participants would quiz themselves on the meanings of the terms by saying aloud just one word to remind themselves of the meaning. For example, they would say "drink" for libations or "poem" for epic. Thus, while these participants were remembering generally what the term had to do with, they were not always learning and remembering the syntactic use of the term, and how the term related to religion in ancient Greece. Quantitative findings suggest that unstructured think-aloud participants had the tendency to more often remember the general meaning of term, rather than its meaning within the context of ancient Greek religion. These observations again underscore the importance of the preset study's assessment of participants'

multidimensional knowledge about the terms as opposed to just their semantic understanding of the term's meaning.

Connecting the definitions of the terms to their own personal experiences. Another metacognitive strategy that many participants in both conditions displayed involved making connections between the meanings of an unfamiliar term and how it related to their own personal experiences. For example, one participant discussed how he understood the meaning of "libations" (i.e., the ritual pouring of liquid) because as a child, he observed his own father pouring out a bit of his alcohol before drinking it in honor of the deceased. As another example, several participants, after reading the definition of "epic" when used as a noun vs. an adjective, said that definition made sense to them because they remembered reading in high school Homer's *Iliad*, which they know is a narrative poem. Another participant after reading about "offal" said he would remember that term because it describes what he once ate in a food competition while in college. Although this technique was effective in making the definition of a term more personally meaningful, some participants became so involved in thinking about how the term related to their own personal experiences, they seemed to forget that their goal was to learn how the term related to religion in ancient Greece.

Searching for specific references to religion in ancient Greece on other websites about the terms. One indication of participants' focus on the goal of their learning task was when they would search for specific references to religion in ancient Greece on separate, hyperlinked Wikipedia articles about the terms. When those participants did not see specific references to religion in ancient Greece on the web page that they were reading, many who were actively engaged in the task would leave Wikipedia and search for the term and its relation to religion in ancient Greece on another Internet search engine like Google. Some participants, however, who

were seemingly uninterested in the task, would very quickly scroll through the separate Wikipedia article about a term to see if a reference to the religion in ancient Greece topic was included. If such a reference did not appear upon first glance, the participant either simply would guess how the term related to the topic, or would just move on and say "I could not find out how it relates."

Some participants also got sidetracked using this technique. This happened when they would search on a term's hyperlinked Wikipedia page just for a reference to Greece, or to ancient Greece, or to religion, but not for a reference to religion in ancient Greece. For example, the "offal" Wikipedia article discusses offal in the context of Greece, but does not discuss it in the context of religion in ancient Greece. As a result, some participants would scroll down to the part of the article that discusses offal in the context of Greece (i.e., different types of organ meats eaten by Greeks), and then move on without learning how it related to religion in ancient Greece.

***Clicking on unfamiliar non-target terms*.** Some participants also had the tendency to click on unfamiliar, non-target terms that they encountered as they were reading and trying to understand the text. These terms were often unrelated to the terms they were supposed to be learning about. Some participants would click on these unfamiliar hyperlinked terms because they thought it would help them understand the religion in ancient Greek text. Others clicked on non-target terms because they were merely interested in learning about them. Since those terms were often unrelated to the terms they were supposed to be learning about, they would get sidetracked by learning about non-relevant information. Although this happened at times among both structured and unstructured think-aloud participants, the structured think-aloud participants who most often were continuously thinking aloud about their goal and their online actions

seemed to have a much easier time getting back on track after realizing that they had gotten sidetracked.

On the other hand, the unstructured think-aloud participants seemed to have much more difficulty getting back on track, and in some instances never got back on track. For example, several unstructured think-aloud participants not only would click on unrelated hyperlinked terms on the original article page, but also then would begin clicking on hyperlinked terms on the non-related term's web page. As a result, they became completely disoriented and confused about what they were supposed to be learning. These participants were *not* metacognitively focused on the goal of the task, and their online learning behaviors were being driven by a succession of unrelated hyperlinks. Unlike the structured think-aloud participants, they lacked a method to help them get back on track when disoriented or distracted for their learning goal.

These observations are supported by quantitative findings. Even though there were no statistically significant differences found between treatment conditions on the number of irrelevant, partially relevant, or directly relevant websites that participants in the two groups visited, structured think-aloud participants still performed better on the task. This suggests that it is not about the number of times that a participant visited a website that may or may not have been relevant. Instead, a better measure of online learning success is how quickly a participant is able to get back on task after going astray. The number of times participants' reminded themselves about the goal of the task provided some indication of participants' attempts to refocus on the goal.

Knowing how to manipulate tools on the Internet. Some participants seemed less knowledgeable than others about how to effectively and efficiently to manipulate Internet tools. This in turn may have also served as a distraction from the task. For example, a few participants

knew that they had to learn about the meanings of the different terms and how they related to religion in ancient Greece, but they did not know how to search within a website for specific terms. For example, they did not know how to use the Internet Explorer "Find on this Page" tool. Another difficulty and source of frustration that a couple of participants experienced was when they confused the "Find on this Page" tool with the Wikipedia "Search" box. The latter searches all of Wikipedia, not just the page being viewed, for the entered term or phrase. In fact, quantitative findings showed that within the structured think-aloud condition, participants with less Internet knowledge and experience also displayed less word knowledge gains than those with more Internet knowledge and experience. Thus, while having a structured think-aloud method can help an individual stay focused on an online learning goal, he/she still needs to know how to search the Internet and use online tools to fulfill a learning goal.

Conclusions drawn from qualitative analysis. Overall, qualitative findings support and illuminate quantitative findings. More specifically, participants in the structured think-aloud group were more focused on the goal of the task, which was to learn not only the meanings the terms, but also their meanings within the context of ancient Greek religion. This was true regardless of the particular approach participants chose to take. Qualitative and quantitative findings both demonstrated that differences between the two conditions in word knowledge gains were not the result of how participants in each group chose to approach the task, or the online actions they employed. Rather, differences can be best attributed to the extent to which participants remained focused on their online goal, and were metacognitively aware of how particular actions were or were not helping them achieve their goal. For example, even though researcher observations revealed that there were times when participants in both conditions got sidetracked from the learning goal (e.g., visiting irrelevant or only partially relevant websites;

clicking on unfamiliar or non-target terms), both qualitative and quantitative findings showed that those in the structured think-aloud group had an easier time refocusing on the learning goal after going astray. Thus, the structured think-aloud method provided participants with an effective scaffold for remaining metacognitively aware of their online word learning goal, as well as aware of the effectiveness of their online actions for achieving that goal.

Chapter 6

Discussion

The present study investigated the Internet's potential as a learning tool for enhancing college students' vocabularies. It followed an earlier study by Ebner and Ehri (in press). That study showed that the Internet can significantly increase students' multidimensional knowledge about particular terms contained within an online article. Findings also suggested that cognitive and motivational factors may facilitate students' online word learning success.

The present research involved an experimental investigation of a structured think-aloud methodology designed to encourage participants ' metacognitive focus on an online word-learning task. The structured think-aloud methodology instructed participants to think aloud continuously about their learning goal, and how their online actions would help them achieve that goal. It was predicted that students using this structured think-aloud method would be more self-directed and purposeful learners. More specifically, it was predicted that participants using the structured think-aloud method could better avoid the Internet's myriad distractions and gain more word knowledge than those using an unstructured think-aloud method.

Both quantitative and qualitative results offer strong support for the use of a structured think-aloud methodology as an effective scaffold for promoting self-regulatory skills and processes when engaged in an online word learning task. Quantitative results revealed that those utilizing the structured think-aloud methodology gained significantly more word knowledge, both overall and within specific word knowledge dimensions, than those participants using an unstructured think-aloud method. In addition, the effects of the structured think-aloud methodology were found to generalize across each of the ten terms.

Results showed that differences in word knowledge gains between the two conditions were primarily attributable to structured think-aloud participants' metacognitive focus on the task in comparison to unstructured think-aloud participants. In particular, compared to the unstructured think-aloud group, structured think-aloud participants more often reminded themselves about the goal of the learning task, planned ahead about how particular actions would help them achieve the goal, and evaluated the effectiveness of those actions. It is highly significant that structured think-aloud participants engaged in these metacognitive acts even when the researcher did not specifically prompt them to do so. This shows that merely providing participants with directions to engage in self-regulatory processes at the beginning of an online word learning task can help them remain focused on the task. It was shown in turn that staying focused on the task enables them to acquire more comprehensive online word knowledge.

In addition, researcher observations and quantitative analysis both showed that differences between the two conditions in online word knowledge gains were not determined by differences in participants' engagement in specific online behaviors or approaches to the online word learning task. This finding is in keeping with the Ebner and Ehri (in press) study results. That earlier study showed that it is not participants' engagement in specific online behaviors, or the manner in which they read online text, which determines word knowledge gains. Instead, the present study demonstrates that word knowledge gains are determined by participants' metacognitive awareness of how engaging in particular online actions will, or will not, help them achieve their online word learning goal.

In fact, researcher observations revealed that there were times when even structured think-aloud participants would get sidetracked from their task, just like unstructured think-aloud participants. For example, even structured think-aloud participants at times would click on

unrelated target terms, or visit irrelevant or only indirectly relevant websites. The primary difference, however, was that unlike the unstructured think-aloud participants, those in the structured think-aloud group more quickly got themselves back on track, rather than getting derailed from the learning task, after going astray. This is because by continuously thinking aloud about their online word learning goal, the structured think-aloud participants were more cognitively aware of when they went off task.

Finally, results also showed that specific variables predicted word knowledge gains within each of the two conditions and within the two conditions combined. For example, within both the combined conditions and the structured think-aloud condition, participants who had more extensive general vocabularies also gained more overall word knowledge. In contrast, prior general vocabulary knowledge did not predict participants' word knowledge gains within the unstructured think-aloud condition. This suggests that having an extensive vocabulary alone will not predict word knowledge gains if an online reader also does not have a structured method to avoid Internet distractions and stay focused on their online word learning task.

In fact, results showed that the only variable that predicted word knowledge gains within the unstructured think-aloud condition was participants' prior self-reported metacognitive skills. That finding further supports use of the structured think-aloud method, which can help participants remain actively focused on the learning task, regardless of their prior metacognitive skills. Without a structured method to help stay focused on the task, participants who lack important self-regulated learning skills will not be as effective in increasing their vocabularies on the Internet.

In addition, regression analysis showed that participants' performance on the online word learning task could best be explained by being assigned to the structured think-aloud condition,

having more extensive general vocabularies, and by having had some familiarity with the target terms prior to the task.

Comparison of present study with prior research.

While the present study did result in some findings comparable to Ebner and Ehri's (in press) previous research, as well as previous studies on online reading comprehension, unique findings were also revealed. In particular, as in Ebner and Ehri's previous study, online vocabulary was found to be facilitated on the Internet. These findings support use of the Internet as an effective tool for facilitating vocabulary acquisition by providing online users with accelerated and multifaceted experiences with words. In addition, as in Ebner and Ehri's earlier research, participants' engagement in specific online behaviors or approaches to the online word learning task did not determine differences among participants in word knowledge gains. In particular, Ebner and Ehri found that randomly assigning participants to read online text in a linear manner or a non-linear manner did not explain variability in participants' word knowledge gain scores. Instead, the present study's different procedure of randomly assigning participants to a structured think-aloud condition or an unstructured think-aloud condition did result in significant differences in word knowledge gain scores both overall and within specific dimensions of word knowledge.

Thus, the present study demonstrates that it is participants' metacognitive focus on the online word learning task which determines effective performance. This finding supports and extends past research (e.g., Coiro & Dobler, 2007; Greene & Land, 2000; Artino, 2008; Eom & Reiser, 2000; Kinzie, 1990; Rakes, 1996), which demonstrated that participants' varying degrees of success with online learning relates to effective engagement in self-regulatory learning processes. But unlike prior research, the preset study involved an experimental design and

thereby enables conclusions to be drawn about cause and effect relationships between self-regulation and online learning performance.

In addition, results of the present study support Coiro and Dobler's (2007) observations that different types of prior knowledge can affect online learning success. In particular, although the present study did not find that prior knowledge of the topic related to online word learning performance, results did show that other types of prior knowledge, including prior knowledge of the terms, general vocabulary, and how to navigate the Internet, did relate to online word learning performance.

Finally, unlike Ebner and Ehri's study, however, and research by Roy et al. (2003), participants' gender was not found to predict online learning performance. This finding is of significance because it shows that gender does not predict performance on an online word learning task. Rather it is participants' metacognitive focus on the task which affects online word learning, regardless of gender.

Strengths, possible limitations, and areas for future research.

One of the greatest strengths of the present research is that unlike prior research regarding online reading comprehension, it involved an experimental design. As a result, the present study offers strong support for causal inferences to be made about the need to be metacognitively focused when learning online. Another key strength of the present research is that it assessed participants' multidimensional vocabulary knowledge as opposed to just one dimension of word knowledge (e.g., only declarative knowledge). The present study demonstrated that even if participants may have some general familiarity about the semantic meanings of particular terms, they may not have a comprehensive understanding of the terms' multiple meanings and uses within specific contexts. This finding is in keeping with the incremental theory of word learning,

which suggests acquiring comprehensive vocabulary knowledge involves developing multidimensional knowledge about words. The present study showed that the Internet can facilitate this process by enabling students to gain multidimensional knowledge about words as opposed to just partial knowledge.

Even though the present study offers strong support for using the Internet with a structured think-aloud methodology to enhance multidimensional word knowledge, there are some possible study limitations that future research needs to address.

First, because there was only one researcher implementing the study, she was unable to blindly test, code, and score the data. The second rater, however, served as somewhat of a check for this limitation. She scored 20% of the pretest and posttest word knowledge surveys and was blind to the participants' assigned conditions. Future research should address this limitation by having one researcher implement the study, and another researcher score and code the data. Along the same lines, although the researcher used a systematic method for tallying specific online behaviors in which participants were observed to engage, it would be useful to have more than one researcher present during the learning task. The second researcher too could tally participants' engagement in particular behaviors to help ensure that none are missed.

Further, although inter-rater reliability was determined with a second rater who scored 20% of the word knowledge surveys using a rubric developed by the researcher, she was not as familiar as the researcher with the terms and how they relate to religion in ancient Greece. As a result of implementing the study, the researcher became an expert in understanding the terms' different meanings, uses, and relation to ancient Greek religion. In contrast, the second rater, like the study participants, may have been learning this information for the first time. This may have accounted for some inconsistencies between the second rater's and the researcher's ratings.

Future research could address this issue by ensuring that the second rater is also in expert on the meanings of the terms and how they relate to the online learning topic.

In addition, having participants read the text aloud also might have influenced the results by limiting the extent of word learning. This is because many participants indicated that they were not used to reading aloud, had trouble concentrating on the meaning of the text when reading it aloud, and/or were observed to have difficulty fluidly reading the text aloud. However, because participants were assigned randomly to the treatments, this is unlikely to explain superior performance by the structured think-aloud group. Future research needs to address this possibility. For example, a future study might compare participants' performance on the task while reading the text aloud to that of reading the text silently. Alternatively, participants may need to be pre-screened on their fluency and reading comprehension abilities in order to separate good from poor readers to see how this might affect the results.

Along the same lines, the sample included students whose second language was English. As a result, some students' mispronunciations of the vocabulary words might have been a result of their foreign accents. Although it was not possible for the researcher to determine if this was the case, pronunciation accuracy was relatively high for all participants, and as a result, this did not pose much of a problem.

Research observations also showed that some participants had trouble manipulating Internet tools and resources. In fact, correlational analyses showed within the structured think-aloud condition that participants' prior knowledge of and experience with Internet learning predicted word knowledge gains. Those results suggest that even if participants are focused on their goal, and know what they want to do to obtain that goal, they need to know how to manipulate Internet tools. Lack of such skills could compromise online word learning

performance, even when using a structured method to avoid Internet distractions. Future research could address this confound by eliminating those participants with low Internet skills and experience.

Many participants also indicated that if they were doing the task on their own, they would be taking notes on the terms, instead of trying to remember their meanings. For this reason, it is possible that not allowing participants to take notes during the task may have compromised their memory of the terms. On the other hand, one could argue a deeper form of learning was encouraged by not allowing participants to take notes during the task. That is because in order to remember the terms without writing down their definitions, participants had to internalize the terms' meanings and make those definitions personally meaningful (e.g., by relating the terms' meanings to their own personal experiences). A future study could investigate the effects of allowing participants in each condition to take notes during the task vs. not allowing them to take notes.

Future research also needs to investigate the generalizability of the structured think-aloud methodology for students who most likely would not be thinking aloud when engaged in Internet learning on their own. In particular, the structured think-aloud methodology was found to be effective in encouraging students to remain more metacognitively focused on the online word learning task, and in turn gain more word knowledge. It is unclear, however, if the same effects would be found if participants were not required to think-aloud, but instead were asked to think internally about their online goal and actions. This raises the question of whether part of the effectiveness of the structured think-aloud methodology is the act of thinking aloud itself. Future research needs to investigate this question. This might involve a study which compares

participants asked to continuously think-aloud about their goal and actions vs. participants who are instructed to think the same things to themselves.

Future research should also investigate the long-term effects of participants practicing with the structured think-aloud method. In particular, research should investigate the degree to which successful use of the structured think-aloud method requires continual prompting by a researcher and/or instructor. In other words, how much practice with explicit instructions and prompting is required before students can consistently utilize and internalize this self-regulation method on their own? Research of this kind would also be important for informing the design of effective instructional scaffolds or supports within hypermedia environments. Such scaffolds or supports could assume the role of the researcher or the investigator for guiding students' engagement with the structured think-aloud method. For example, computer software could be designed to prompt students to think about their online goal and actions when engaged in specific online tasks, such as online vocabulary learning. In addition, the study sample consisted of all education school students, the majority of whom were female graduate students. This raises the question of whether study results can be generalized to other populations, including students with different majors and of different ages. For example, future research should investigate the effectiveness of the structured think-aloud methodology for online word learning with younger students, who may have even more difficulty avoiding Internet distractions and engaging in metacognitive processes. Further, unlike previous research that found gender differences in the extent of online learning, the present research did not find any such differences as had been predicted. This may have been because there were not enough males in the study, even though the two groups had been equated on this variable. Future research not only should replicate this study with students of different ages, and with different majors, but also should

ensure that there is more of an even split between males and females in the study to determine whether there are in fact significant gender differences.

Finally, future research should investigate whether the effects of the structured think-aloud methodology not only generalize across different student populations, but also whether effects generalize across learning different kinds of words. In particular, the present study involved students learning about terms that were all nouns. Future research also should investigate whether the structured think-aloud methodology would be effective in helping students gain more knowledge about other classes of vocabulary words, including verbs, adjectives, and adverbs.

Educational implications.

As the present study demonstrates, the Internet has the potential to serve as an extremely powerful word learning tool. No other learning platform offers virtually unlimited multimedia resources that can be accessed instantaneously to increase students' multidimensional word knowledge. As a result, the Internet provides students with multiple and varied experiences with words almost instantaneously, and for this reason, serves as one of the most optimal platforms for efficiently facilitating diverse learners' vocabularies. Students who are more visual learners can be directed to access graphics or videos relating to a term or concept, while students who learn best by hearing information can be directed to access online audio or audio-visual information about a term or concept.

At the same time, however, as the current study shows, the Internet's great potential for rapidly increasing students' vocabulary will be compromised unless students are able to remain metacognitively engaged in their online word learning task and overcome the Internet's many distractions. In the same way that educators should not assume that merely providing students

with a book will guarantee meaningful learning, teachers should not assume that simply providing students with access to the Internet and its many tools and resources will guarantee that effective word learning will occur. Further, it is not enough to simply teach students how to engage in certain online word learning behaviors or approaches to online word learning tasks, (e.g., clicking or not clicking on certain hyperlinks; visiting certain websites more frequently than other websites; reading or not reading certain text; conducting Internet searches). As study results showed, it is not utilization of particular online word learning behaviors or approaches that guarantee online word learning. Instead, it is students' metacognitive engagement that facilitates online word learning success.

Educators can play a critical role in guiding students' metacognitive processes during online word learning tasks in a similar way that they play an essential role in helping students acquire metacognitive strategies for learning from printed text. In keeping with study results, instructing students to think aloud with a structured method can encourage them to engage in important metacognitive processes so that they can most effectively and efficiently learn vocabulary on the Internet. These processes include continuously thinking about their online word goal, how an action will help them achieve that goal, and whether that action helped them achieve that goal. Thus, by instructing and showing students how to utilize a structured think-aloud method, students can learn how to stay on task, and also how to quickly get back on task when becoming aware that they have gone astray.

Helping students acquire and utilize this structured method can be achieved in the same way many reading comprehension strategies are shown and taught to students. That involves a combination of explicit teaching, modeling, and students' practice employing the structured think-aloud method technique. Eventually, the goal should be for students to be able to

internalize the structured think-aloud method so that they can automatically employ it on their own, and use it to guide their online word learning.

In sum, the Internet offers students with an optimal platform for increasing the comprehensiveness of their vocabularies. Educators and students not only need to be aware of the Internet's power for facilitating vocabulary acquisition, but also need to know how to best take advantage of the Internet for online word learning to be most effective. Instructing students to utilize the structured think-aloud approach can be one powerful way. The present study demonstrated that this method serves an effective scaffold for helping students acquire the most online word knowledge by encouraging them to engage in essential metacognitive processes on the Internet.

Appendix A: Consent Form

CONSENT FORM

My name is Rachel Ebner. I am a student in the Educational Psychology Ph.D. Program at The Graduate Center of the City University of New York (CUNY), and Principal Investigator of this project, entitled "Using the Internet to Enhance Word Knowledge." This is a research study about how people use the Internet for learning purposes.

You must be 18 years or older to participate in this study. I would like your permission to observe and ask you about your online reading behaviors during a learning activity. In addition, I would like you to fill out pretest and a posttest surveys. At the very end, I would also like to briefly interview you about your thoughts regarding the learning activity.

The pretest and posttest surveys each will take approximately 30 minutes. You are free to spend as much time as you would like on the learning activity. The brief interview at the end will last for about 5-10 minutes. At any time you can end your participation in the study. You may or may not receive research credit in return for your participation. With your permission, I would like to audio-record both your engagement in the learning activity and the interview at the end, so that I can record the details accurately. The audio recordings will only be used by me and my advisor. All information gathered, including your name, will be kept confidential, and only I and my advisor will have access.

The risks from participating in this study are no more than encountered in everyday life. The benefits are that you will be contributing to research on how the Internet can best be used to increase learning.

There will be approximately 50 participants taking part in this study.

I may publish results of the study, but names of participants, or any individual identifying characteristics, will not be used in any of the publications. If you would like a copy of the study, please provide me with your email address and I will send you a copy in the future.

If you have any questions about this research, you can contact me at (202) 288-7581 or email me at REbner@gc.cuny.edu, or contact my advisor, Dr. Linnea Ehri, at (212) 817-8294 or at LEhri@gc.cuny.edu. If you have questions about your rights as a participant in this study, you can contact Kay Powell, Institutional Review Board (IRB) Administrator, The Graduate Center, City University of New York at (212) 817-7525 or KPowell@gc.cuny.edu.

Thank you for your participation in the study. I will give you a copy of this form to take with you.

I agree to participate in the study described above [circle one]:

Yes No

_____ _____ _____ _____

Participant's signature Date Investigator's signature Date

Appendix B: Demographics Survey

Your name (please print): _____

Your age (please print): _____

Your gender (please circle): Male / Female

Your race/ethnicity (please print):_____

Please circle whether you are an:

Undergraduate student / Graduate student

Part-time student / Full-time student

Is English your first language? (please circle) Yes / No

If not, your first language is: _____

Please list any additional language(s) that you can speak and read fluently:

Appendix C: Researcher Script for Structured Think-Aloud Group

I. <u>Demographics Survey directions</u>:

A. ***Say to the participant:*** "Before we start, I would like for you to please complete this survey. It asks you to answer some general questions about yourself."

B. ***Instructions for the researcher:*** *Hand the participant the Demographic Survey. When the participant has completed the survey, collect it.*

II. <u>Introduction of the study</u>:

A. ***Say to the participant:*** **"**In this study I will ask you to read an online text. Before we begin, there are several tasks that I would like you to do. First, I am going to have you complete a vocabulary assessment. Then I would like for you to please complete some additional surveys."

B. ***Instructions for researcher:*** *Hand the participant the Nelson-Denny Reading Test Vocabulary Subtest (Form G) test booklet, and corresponding answer sheet. Also hand the participant a number 2 pencil.*

III. <u>Nelson-Denny Reading Test: Vocabulary Subtest (Form G) directions</u>:

A. ***Say to the participant:*** "Please listen carefully to the following directions."

B. ***Instructions for the researcher:*** *Read the directions exactly as they appear in the Directions for Administration Forms G& H booklet. Once the directions have been read, and the participant has completed the three practice items, ask the participant to begin the test. Note: As explained in the Directions for Administration booklet, the participant has 15 minutes to complete the test. When 15 minutes are up, collect the test.*

IV. <u>Directions for the pretest surveys</u>:

A. ***Say to the participant*:** "Now I would like for you to please complete these surveys. If you would like to change any of your responses, please do not erase. Just cross out and write next to your initial response."

B. ***Instructions for researcher:*** *Hand the participant the battery of pretest surveys. They should be ordered as follows: The Metacognitive Awareness Inventory, the Target Vocabulary Word Knowledge Survey (except for the Pronunciation Accuracy part of the test, which will be given when the list of terms are handed to the participant), and the Survey of Knowledge of & Interest in Learning Topic. After the participant has completed the surveys, collect them.*

V. <u>Learning activity directions</u>:

A. ***Say to the participant: "***Thank you for completing these surveys. Next I will be giving you an online article . Your goal in this learning activity will be to learn about specific terms that appear in this online article, and how each term relates to the article topic. I will be giving you a list of those terms and then later asking you more about them. Before I show you the article and provide you with the list of terms, I would like to explain a little more about the research that you are assisting me with."

B. ***Explain the structured think-aloud procedure and learning activity*:**

1. ***Say to the participant:*** "I am studying how students use the Internet to help them understand online text. When people read text, various thoughts run through their minds as they focus on comprehending what the text is about.

Because these thoughts occur inside the reader's head, studying comprehension processes can be challenging. One method that researchers use to uncover a reader's thoughts is to have them perform a "think aloud." This is what I want you to do. Please read the text out loud to me, and as you do this, tell me everything that comes to mind -- what you are thinking or feeling in the process of understanding what the text is about."

2. ***Say to the participant*:** The title of the text is "Religion in ancient Greece." This text appears on Wikipedia. You do not need to be concerned about whether it contains any incorrect information. The text will include these ten terms. [*Present the list of ten terms.*] Please pronounce each of these ten terms.

Instructions to the researcher: *On a separate sheet that lists the terms, check of all the terms that the participant correctly pronounces on his or her own.*

3. ***Say to the participant:*** "Your goal will be to learn about the meanings of these terms and how each one relates to the topic of the online article. You are free to read, reread, or skip over, any part of the article, and in any order that you wish. You also can click on hyperlinks in the article, conduct Internet searches, or visit other websites, to attain your goal of learning about the ten terms. But again, whatever you do choose to read needs to be read out loud."

4. ***Present the written directions to the participant.*** "When you think aloud, you need to keep in mind the goal of the task. It is to learn the meanings of the vocabulary words and how they are related to the topic of religion in ancient Greece. All of the actions that you take as you read the text need to be directed to this goal. You need to tell me why or how each of your actions is directed to the

goal. As you read the text aloud, you may consider rereading the text, or clicking on a hyperlink. You may consider skimming or scanning or skipping over text, or scrolling through text, or searching within the text, or conducting an Internet search, or visiting other websites to learn about the terms, among other actions.

Now **before** you begin each action, you need to explain how you think this action will help you achieve your goal. For example, you might say that you are going to click on a hyperlink because you feel that you need to learn more about the term on a different website and how it relates to the article topic on religion in ancient Greece. Or you might say that you are going to scroll through the text to find one of the terms because you have not yet encountered the term in the part of the text that you have read, and you want to read about the term in the context of the article topic.

Then **during or after** you perform an action, you need to explain whether the action is helping or helped you achieve your goal. If you think that what you are currently doing is not helping you achieve your goal, and you want to do something else to achieve your, goal, I would like for you -- before doing it -- to then think aloud 'Will that action help me achieve my goal?'

It can be easy to get distracted on the Internet. So you should keep these written directions by your side throughout the learning task so that you can easily remind yourself about your learning goal and the two questions that you should be continuously thinking about and aloud.

You may take as long as you like to complete this task. I will be recording what you say and taking detailed notes. If you forget to read aloud, or forget to think aloud, I will remind you.

C. ***Instructions to the researcher:*** *Open to the Wikipedia article on Religion in ancient Greece. Be sure that the tape recorder is turned on, and that the diagram with the learning goal and two think-aloud questions is by the participant's side.*

Throughout the learning activity, make a record of the participant's behaviors and think-aloud responses using the tally sheet provided.

Note to researcher: *If the participant is not reading aloud, you* ***should*** *gently remind the participant to do so. In addition, if the participant has not been thinking aloud, then after two minutes, say to the participant* **"You must think aloud about your goal and actions."** ***(Point to the directions.)***

You should ***not*** *make any suggestions about what it is that the participant should be doing, or whether what they are doing is helpful. For example do not suggest a particular term or concept to research, or link to click on, or website to visit, or search mode (e.g., Keyword Search; Advanced Search vs. Browse Resources) to use. Instead, allow the participant to make those choices.*

VI. Directions for the posttest surveys:

A. ***Instructions to the researcher:*** *At the completion of the learning activity, close the Wikipedia article and any other open websites and have the participant complete the posttest assessments.*

B. ***Say to the participant*****: "**Now that you have read the online article and learned about the terms on the list and how they relate to the article topic, I would like for you to please pronounce each term on the list for me again.

C. ***Instructions to the researcher.*** *Ask the participant to pronounce each of the ten terms on the list and check off on a separate sheet that lists the terms whether or not the participant was able to initially pronounce each term on his or her own.*

D. ***Say to the participant:*** "I would like for you now to please complete some additional surveys. You can take as much time as you like to complete the questions."

E. ***Instructions to the researcher:*** *Have the participant complete the three remaining sections of the Target Vocabulary Word Knowledge Survey, the Survey of Knowledge of and Experience with Searching the Internet, and the Survey of Perceptions About the Learning Task.*

VII. **<u>Conclusion:</u>**

A. ***Instructions to the researcher:*** *Collect the posttest surveys.*

B. ***Say to the participant*****: "**Thank you for participating in my study. Please feel free to get in touch with me if you have any future questions."

Appendix D: List of Terms for Treatment Group

List of terms

Goal: To learn about each term on the list below and how each one relates to **religion in ancient Greece**

Cult

Epithets

Polytheism

Vices

Mythology

Epic

Hubris

Offal

Libations

Symposium

Appendix E: Researcher Script for Unstructured Think-Aloud Group

I. <u>Demographics Survey directions</u>:

A. ***Say to the participant:*** "Before we start, I would like for you to please complete this survey that asks you to answer some general questions about yourself."

B. ***Instructions for the researcher:*** *Hand the participant the Demographic Survey. When the participant has completed the survey, collect it.*

II. <u>Introduction of the study</u>:

A. ***Say to participant*:** "In this study I will ask you to read an online text on this computer. Before we begin, there are several tasks I would like for you to do. First, I am going to have you complete a vocabulary assessment, and then I would like for you to please complete some additional surveys."

B. ***Instructions for researcher:*** *Hand the participant the Nelson-Denny Reading Test Vocabulary Subtest (Form G) test booklet, and corresponding answer sheet. Also hand the participant a number 2 pencil.*

III. <u>Nelson-Denny Reading Test: Vocabulary Subtest (Form G) directions</u>:

A. ***Say to the participant:*** "Please listen carefully to the following directions."

B. ***Instructions for the researcher:*** *Read the directions exactly as they appear in the Directions for Administration Forms G& H booklet. Once the directions have been read, and the participant has completed the three practice items, ask the participant to begin the test. Note: As explained in the Directions for Administration booklet, the participant has 15 minutes to complete the test. When 15 minutes are up, collect the test.*

IV. Directions for pretest surveys:

A. ***Say to the participant*:** "Now, I would like for you to please complete these surveys. If you would like to change any of your responses, please do not erase. Just cross out and write next to your initial response."

B. ***Instructions for researcher:*** *Hand the participant the battery of pretest surveys. They should be ordered as follows: The Metacognitive Awareness Inventory , the Target Vocabulary Word Knowledge Survey (except for the Pronunciation Accuracy part of the test, which will be given when the list of terms are handed to the participant), and the Survey of Knowledge of & Interest in Learning Topic. After the participant has completed the surveys, collect them.*

V. Learning activity directions:

A. ***Say to the participant:*** **"**Thank you for completing these surveys. Next I will be giving you an online article. Your goal in this learning activity will be to learn about specific terms that appear in this online article, and how each term relates to the article topic. I will be giving you a list of those terms and then later asking you more about them. Before I show you the article and provide you with the list of terms, I would like to explain a little more about the research that you are assisting me with."

B. ***Explain the unstructured think-aloud procedure and learning activity*:**

1. "I am studying how students use the Internet to help them understand online text. When people read text, various thoughts run through their minds as they focus on comprehending what the text is about. Because these thoughts occur inside the reader's head, studying comprehension processes can be

challenging. One method that researchers use to uncover a reader's thoughts is to have them perform a "think aloud." This is what I want you to do. Please read the text out loud to me, and as you do that, tell me everything that comes to mind -- what you are thinking or feeling in the process of understanding what the text is about."

2. "The title of the text is "Religion in ancient Greece." This text appears in Wikipedia. You do not need to be concerned about whether it contains any incorrect information. The text will include these ten terms. [*Present the list of ten terms.*] Please pronounce each of these ten terms.

C. ***Instructions to the researcher:*** *On a separate sheet that lists the terms check of all the terms that the participant correctly pronounced on his or her own.*

D. ***Say to the participant: "Your goal will be to learn about the*** meanings of these terms and how each one relates to the topic of the text. You are free to read, reread, or skip over, any part of the article, and in any order that you wish. You also can click on hyperlinks in the article, conduct Internet searches, or visit other websites, to attain your goal. But again, whatever you do choose to read needs to be read out loud." You also need to remember to continuously <u>think aloud</u> to me everything that you are thinking, feeling, and doing, as you are learning how each term on the list relates to the article topic. It is very important that you express to me in as much detail as you can what you are thinking, feeling, and doing throughout the entire learning task.

You may take as long as you wish to complete this task. I will be recording what you say and taking notes. If you forget to read aloud or to think aloud, I will remind you."

E. ***Instructions to the researcher:*** *Open to the Wikipedia article on Religion in ancient Greece. Be sure that the tape recorder is turned on. Throughout the learning activity, record the participant's behaviors and think-aloud responses.*

Note to researcher: *If the participant is not reading aloud, you* ***should*** *gently remind the participant to do so. In addition, if the participant has not been thinking aloud, then after two minutes, say to the participant* ***"remember to think aloud ."*** *You should* ***not*** *make any suggestions about what it is that they should be doing, or why, or whether what they are doing is helpful. For example do not suggest a particular term or concept to research, or link to click on, or website to visit, or search mode (e.g., Keyword Search; Advanced Search vs. Browse Resources) to use. Instead, allow the participant to make those choices.*

VI. Directions for posttest surveys:

A. ***Instructions to the researcher:*** *At the completion of the learning activity, close the article and any other open websites and have the participant complete the posttest assessments.*

B. ***Say to the participant*****: "**Now that you have read the online article and learned about the terms on the list and how they relate to the article topic, I would like for you to please pronounce each term on the list for me again."

C. ***Instructions to the researcher.*** *Ask the participant to pronounce each of the ten terms on the list and check off on a separate sheet that lists the terms whether or not the participant was able to initially pronounce each term on his or her own.*

D. ***Say to the participant:*** "I would like for you now to please complete the following surveys. You can take as much time as you like to complete the questions."

E. ***Instructions to the researcher:*** *Have the participant complete the three remaining sections of the Target Vocabulary Word Knowledge Survey, the Survey of Knowledge of and Experience with Searching the Internet*; *and (iii) the Survey of Perceptions About the Learning Task.*

VII. <u>Conclusion:</u>

A. ***Instructions to the researcher:*** *Collect the posttest surveys.*

B. ***Say to the participant*****: "**Thank you for participating in my study. Please feel free to get in touch with me if you have any future questions."

Appendix F: Tally Sheet of Participant's Think-Aloud Data

Tally Sheet of Participant's TA Data

Participant's Name: **Condition:**
Start time: **End time:**
Number of times:

explains *what* he/she would do next, but not why	w/out prompting
	w/prompting
explains both what he/she is going to do next *and* why (i.e., demonstrates planning)	w/out prompting
	w/prompting
explains whether an action is/did help in reaching the goal (i.e., demonstrates evaluating)	w/out prompting
	w/prompting
clicks on a target word	Cult
	Epithets
	Polytheism
	Vices
	Mythology
	Epic
	Hubris
	Offal
	Libations
	Symposium
navigates to a directly relevant web page	
navigates to an indirectly/marginally relevant web page	
navigates to a not relevant web page	
returns to article after navigating away	

rereads text containing the target term	
verbalizes the meaning of a target term and its relationship to religion in ancient Greece	w/out prompting
	w/prompting
expresses confusion and/or uncertainty about the goal of the task	
reminds himself or herself about the goal of the learning task	w/out prompting
	w/prompting

Appendix G: Target Vocabulary Word Knowledge Survey

Participant's Name:

Directions for the researcher: *Please have the participant pronounce each term on the list below. Write a check next to each term that the participant correctly pronounces.*

Cult

Epithets

Polytheism

Vices

Mythology

Epic

Hubris

Offal

Libations

Symposium

Your Name (please print):_____

For each term listed below please follow the directions and complete Parts A, B, and C.

1. Polytheism

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

    b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

    c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

2. Cult

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

3. Epithets

a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

_____Never saw it before

_____Heard it but don't know what it means

_____Know it has something to do with: _____

_____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

4. Vices

a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

_____Never saw it before

_____Heard it but don't know what it means

_____Know it has something to do with: _____

_____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

5. Symposium

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

    b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

    c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

6. Hubris

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

7. Offal

a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

_____Never saw it before

_____Heard it but don't know what it means

_____Know it has something to do with: _____

_____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

8. Mythology

   a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

   _____Never saw it before

   _____Heard it but don't know what it means

   _____Know it has something to do with: _____

   _____Know it well. It means: _____

   b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

   c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

9. Libations

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

    b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

    c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

10. Epic

    a. Please indicate your familiarity with the term by checking the appropriate phrase and/or filling in the blanks where appropriate.

    _____Never saw it before

    _____Heard it but don't know what it means

    _____Know it has something to do with: _____

    _____Know it well. It means: _____

b. Please try to use the term in a sentence that embeds the term in a meaningful context and that contains words related to that term:

c. Please try to use the term in a sentence that explains how the term relates to religion in ancient Greece:

Appendix H: Word Knowledge Survey Scoring Rubric

	0 points	1 point	2 points
Section a.	1. Checks either "Never saw it before" or "Heard it but don't know what it means" (i.e., does not provide any definition) 2. Checks "Know it has something to do with" but does not provide any definition or related definition; or checks "Know it well. It means..." but does not provide any definition or a related definition, or provides an incorrect definition	Checks either "Know it has something to do with" or "Know it well. It means..." but provides only a partially correct definition or a term and/or concept that is only generally related to the term's definition (e.g., religion for polytheism; story for epic)	Checks either "Know it has something to do with" or "Know it well. It means…." and provides any definition that can be found either in Dictionary.com, Merriam-Webster.com
	0 points	**1 point**	**2 points**
Section b.	1. Does not provide any written sentence (i.e., leaves it blank) 2. Provides a sentence that uses the term in neither a grammatically correct nor a semantically correct way (e.g., "I polytheism while visiting	1. Provides a sentence that uses the term (or another syntactic form of the term such as "polytheistic" instead of "polytheism") in a semantically correct way, but not a grammatically correct way, or vice versa (e.g.,	Provides a sentence that uses the term (or another syntactic form of the term such as polytheistic instead of polytheism) in both a semantically and syntactically correct way, and that also embeds the term in a meaningful context and contains words related to that term (i.e., can infer the term's meaning by reading the sentence) (e.g., "The Polynesians, believed in

	Athens")	"Polytheistic is the belief in many gods."; "Polytheism is the belief in one God." 2. Provides a sentence that uses the term in both a semantically and syntactically correct way, but does not embed the term in a meaningful sentence that also contains words related to that term (i.e. cannot infer the term's meaning by reading the sentence, for example, can substitute an unrelated word for the term) (e.g., "I believe in polytheism.")	polytheism, which is the belief in more than one God").
	0 points	**1 point**	**2 points**
Section c.	1. Does not provide any written sentence (i.e., leaves the item blank) 2. Does not provide a semantically or syntactically correct sentence that accurately explains the term's relation to religion in ancient Greece (e.g., "I saw polytheistic when I visited Greece last year."). 3. Provides a semantically and/or	Provides a sentence that uses the term (or another syntactic form of the term such "polytheistic" instead of "polytheism") in a semantically correct way, but not a syntactically correct way, or vice versa, and provides a partially correct explanation of how the term relates to the article topic (i.e., does not directly explain how it relates to the topic, but provides a specific example illustrating its relation to the topic) (e.g. "The acropolis is a good example of the	Provides a semantically and syntactically correct sentence that accurately explains the term's relation to religion in ancient Greece (e.g., "The ancient Greeks believed in polytheism, or the belief in many Gods.")

	syntactically correct sentence that explains how the term relates to ancient Greece, but not religion in ancient Greece (e.g., the ancient Greeks attended many symposiums where they discussed politics).	ancient Greeks polytheism.")	

Appendix I: Survey of Knowledge of & Interest in Learning Topic

Your Name (please print):_____

Please read the following two questions and circle your answers.

1. On a scale of 1 (know nothing) to 5 (know a lot), how much do you know about religion in ancient Greece?

1 2 3 4 5

2. On scale of 1 (no interest) to 5 (extremely interested), how interested are you in the subject of religion in ancient Greece?

1 2 3 4 5

Please read and answer the following questions:

3. Did you ever study ancient Greece while you were in high school or college? (Please circle yes or no below.)

Yes No

If yes, in what course(s), and for how many days or weeks?

4. Have you ever visited ancient sites in Greece? (Please circle yes or no below.)

Yes No

If yes, which sites did you see and how recently did you visit them?

5. In a few words, write down three facts that you know about religion in ancient Greece.

   (a)

   (b)

   (c)

Appendix J: Metacognitive Awareness Inventory
(Schraw, G. & Dennison, R. S., 1994)

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I ask myself periodically if I am meeting my goals.
2. I consider several alternatives to a problem before I answer.
3. I try to use strategies that have worked in the past.
4. **I often do not pace myself when taking a test I know is timed.**
5. I understand my intellectual strengths and weaknesses.
6. I think about what I really need to learn before I begin a task
7. I know how well I did once I finish a test.
8. I set specific goals before I begin a task.
9. **I often do not slow down even when I encounter important information.**
10. I know what kind of information is most important to learn.
11. I ask myself if I have considered all options when solving a problem.
12. I am good at organizing information.
13. I consciously focus my attention on important information.
14. **I learn spontaneously and do not typically apply specific strategies.**
15. I learn best when I know something about the topic.
16. I know what the teacher expects me to learn.
17. I am good at remembering information.
18. I use different learning strategies depending on the situation.
19. I ask myself if there was an easier way to do things after I finish a task.

20. **I feel I do not have control over how well I learn.**
21. I periodically review to help me understand important relationships.
22. I ask myself questions about the material before I begin.
23. I think of several ways to solve a problem and choose the best one.
24. I summarize what I've learned after I finish.
25. I ask others for help when I don't understand something.
26. **I often cannot motivate myself to learn when I need to.**
27. I am aware of what strategies I use when I study.
28. I find myself analyzing the usefulness of strategies while I study.
29. I use my intellectual strengths to compensate for my weaknesses.
30. I focus on the meaning and significance of new information.
31. I create my own examples to make information more meaningful.
32. **I am not a very good judge of how well I understand something.**
33. I find myself using helpful learning strategies automatically.
34. I find myself pausing regularly to check my comprehension.
35. I know when each strategy I use will be most effective.
36. I ask myself how well I accomplish my goals once I'm finished.
37. I draw pictures or diagrams to help me understand while learning.
38. I ask myself if I have considered all options after I solve a problem.
39. I try to translate new information into my own words.
40. I change strategies when I fail to understand.
41. I use the organizational structure of the text to help me learn.
42. **I tend not to read instructions carefully before I begin a task.**

43. I ask myself if what I'm reading is related to what I already know.
44. I reevaluate my assumptions when I get confused.
45. I organize my time to best accomplish my goals.
46. I learn more when I am interested in the topic.
47. I try to break studying down into smaller steps.
48. I focus on overall meaning rather than specifics.
49. I ask myself questions about how well I am doing while I am learning something new.
50. I ask myself if I learned as much as I could have once I finish a task.
51. I stop and go back over new information that is not clear.
52. I stop and reread when I get confused.

Components and Corresponding Scales & Items

Note: Bolded item numbers are reversed coded

1. Knowledge About Cognition
    a. Declarative Knowledge: 5, 10, 12, 16, 17, **20**, **32**, 46
    b. Procedural Knowledge: 3, **14**, 27, 33
    c. Conditional Knowledge: 15, 18, **26,** 29, 35
2. Regulation of Cognition
    a. Planning: **4**, 6, 8, 22, 23, **42**, 45
    b. Information Management Strategies: **9**, 13, 30, 31, 37, 39, 41, 43, 47, 48
    c. Comprehension Monitoring: 1, 2, 11, 21, 28, 34, 49
    d. Debugging Strategies: 25, 40, 44, 51, 52
    e. Evaluation: 7, 18, 24, 36, 38, 49

Appendix K: Survey of Knowledge of and Experience with Searching the Internet

Your name (please print): _____

Please read the following questions. Circle your answers and/or fill in the blanks.

1. On an average day, how much time do you spend visiting sites on the Internet?

   Less than 1 hour Between 1 - 3 hours More than 3 hours

2. How much of the time that you spend on the Internet is to conduct research for school-related or work-related purposes?

   Less than 1 hour Between 1 - 3 hours More than 3 hours

3. Do you own a computer or other devise that enables you to search the Internet?

   Y / N

   If yes, please circle all that you own:

   Desktop Laptop/Notebook Tablet Smart Phone Other_____

4. Which of the following do you use to search the Internet?

   Desktop Laptop/Notebook Tablet Smart Phone Other_____

5. Where do you search the Internet from :

   Home Work School/Library Other_____

6. Please list as many Internet search engines as you can think of.

7. Of the Internet search engines that you listed above, name the three that you use most often.

    a. _____

    b. _____

    c. _____

8. Please name as many websites as you can that would provide you with information about a word or a phrase that you wanted to know more about.

9. What types of information can you gain about a word from the websites that you listed above?

Appendix L: Survey of Perceptions About the Learning Task

Your Name (please print):_____

Please read the following statements and indicate on the scale below how true it is for you.

1. I enjoyed doing this activity very much.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

2. I think that this was a very interesting activity.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

3. I think I did pretty well at this activity, compared to other students

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

4. I am satisfied with my performance on this activity.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

5. I felt pretty skilled at this activity.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

6. I think I understood the material I was reading very well.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

7. I would describe the material I was reading as very interesting.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

8. I enjoyed the material I was reading very much.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

9. The material I was reading was fun to read.

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

Please read the following questions and circle your answers.

1. On scale of 1 (no interest) to 5 (extremely interested), how interested are you in the subject of religion in ancient Greece after having done this learning activity?

1 2 3 4 5

2. On scale of 1 (not at all likely) to 5 (extremely likely), how likely are you to read more about this topic in the future?

1 2 3 4 5

3. On a scale of 1 (not at all helpful) to 5 (extremely helpful), how helpful did you find using the Internet for understanding the terms and concepts in this article?

1 2 3 4 5

Among the websites that you visited during this learning activity, which did you find most informative in helping you understand the terms and concepts in the article? Explain why.

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