5-10-2013

The Internet and Adolescent Readers: Exploring Relationships Between Online Reading Comprehension, Prior Knowledge, Critical Evaluation, and Dispositions.

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The purpose of this mixed methods study was to investigate the role that background knowledge, critical evaluation of information, and a reader’s dispositions play in predicting online reading comprehension performance, during comprehension tasks that take place in either less restricted or more restricted information spaces.

Sequential regression models demonstrated that, after controlling for verbal intelligence, critical evaluation and prior knowledge were significant in both the less restricted information space and the more restricted information space. Scores on a disposition measure were only significant in the more restricted model.

Qualitative analysis, using verbal protocol methods, found that were key overall differences in how skilled online readers navigate and monitor meaning during Internet inquiry tasks. Skilled readers engage in strategic text assembly. However all participants were not successful at evaluating or communicating online information.

The results of this study contribute to both research and practice. For research, the results inform richer and more complex models of online reading comprehension. For practice, the results inform teachers charged with teaching literacy in a constantly evolving world, one in which the Internet is increasingly important to both reading and learning.
The Internet and Adolescent Readers: Exploring Relationships Between Online Reading Comprehension, Prior Knowledge, Critical Evaluation, and Dispositions.

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A Dissertation
Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy at the University of Connecticut 2013
The Internet and Adolescent Readers: Exploring Relationships Between Online Reading Comprehension, Prior Knowledge, Critical Evaluation, and Dispositions.

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2013
ACKNOWLEDGEMENTS

Many hands helped write this dissertation. First to my loving wife who put up with countless hours of sleepless nights, groggy mornings, and occasional tense one way negotiations with technology. You have always been my driving force.

To my children, who provided my center, we wrote this for you. It is fitting that on the day my second son was born my father drove me from the hospital to a school for data collection, and a week before I defended we welcomed our third son into this world. As a family we came full cycle and all the while, John, my namesake, you were always there to sneak into my office to help me work.

I am eternally grateful to my friend, colleague, and advisor Don. You taught me innumerable lessons about research, teaching, and most importantly writing. I owe you a debt of gratitude for the countless hours of revisions and support.

A special thanks to Ian who started and finished this journey with me. We have spent countless hours discussing vital issues that face our field, our fatherhood, and our future. I thank you for being there in class and helping me when the endgame seemed insurmountable.

I also owe a special thanks to Sue. You kept me grounded in what is truly important in education. I want to offer my heartfelt gratitude for the countless hours you spent editing my work.

I would also like to thank the members of my dissertation committee. Doug Kaufman, you were an invaluable support when times were tough and it seemed the decks were stacked against me. Doug Hartman I have always looked to you as a source of intellectual guidance. Rand you have always guided my thinking about thinking. Michael your insight into adolescent literacy was a valued asset.

Finally thanks to the many friends and family members who stood by me during this process. You have helped guide me in more ways than I can list here. I look forward to thanking and celebrating with every one of you.
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CHAPTER I

OVERVIEW OF THE STUDY

Introduction

The Internet is quickly becoming an important new context for reading. No tool for literacy has spread quicker and faster than the Internet (Coiro, Knobel, Lankshear, & Leu, 2008). With over two billion users online (Miniwatts Marketing Group, 2012) and a growth rate that is exponential, the Internet is shifting the social practices of literacy and learning (Lankshear & Knobel, 2006). Thus, understanding how students read and comprehend information online is crucial for teaching and learning.

After all, evidence is emerging that the Internet is the text of choice for adolescent readers. For example, adolescents now spend more time reading online than offline (Kaiser Family Foundation, 2005). Furthermore, in a 2001 survey 90% of students with Internet access reported using the Internet for homework. 70% of these students responded that the Internet was their primary source of information (Lenhart, Horrigan, & Fallows, 2004). These fundamental shifts in the access, use, and dissemination of information have led researchers to call for richer theoretical models of reading comprehension that account for the additional complexity of online environments (Alexander, 2010).

The purpose of this mixed methods study was to investigate the role that background knowledge, critical evaluation of information, and a reader’s dispositions play in predicting online reading comprehension performance, during comprehension tasks that take place in either less restricted or more restricted information spaces. The results of this study contribute to both research and practice. For research, the results inform richer and more complex models of online reading comprehension. For practice, the results inform teachers charged with teaching literacy in
a constantly evolving world, one in which the Internet is increasingly important to both reading and learning (Snow, 2002). This mixed method study explored the following research questions:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?

These questions were investigated in three phases. In phase one the instruments necessary for the study were created. In phase two, regression analysis was used in an attempt to understand factors that explained variance in scores of an online reading comprehension measure. In phase three verbal protocol methods (Afflerbach, 2010) were used to explore strategy use among participants who varied in their online reading comprehension proficiency.
Background of the Study

The largest review of comprehension research has concluded that the demands of online reading comprehension require novel skills beyond those necessary to understand printed text (Snow, 2002). A body of evidence (Coiro, 2011; Coiro & Dobler, 2007; Henry, 2006; Kuiper, Volman, & Terwel, 2005) is growing to support this claim. However, these nascent models of online reading comprehension need to be enriched if we are to better understand the diverse nature of reading that takes place online.

Simultaneously, as the Internet has become the informational text of choice for many students, schools across the nation have struggled to provide adolescents with successful literacy classrooms (Snow & Biancarosa, 2003). Thus, scholars have called for an agenda to “systematically link instruction to the growing knowledge base on literacy and inform it with up-to-date data relating to outcomes and best practices.” (Carnegie Council on Advancing Adolescent Literacy [CCAAL], 2010, p. 10).

Yet these recent calls to action pay little attention to the changing nature of reading comprehension. In fact, the report “A Time to Act” (CCAAL, 2010) noted that adolescents must understand longer more complicated texts with specialized vocabulary and complex graphical representations. However this review of research on adolescent literacy did not describe how these challenges are further complicated when reading online (Snow, 2002). Efforts to improve adolescent literacy must begin to include online reading comprehension if we wish to prepare students for the reading demands of the 21st century.

Previous work in online reading comprehension has often assumed a limited definition of online reading. Little work has evaluated online reading comprehension from a more complex perspective – one that includes variations in the extent of the information space, background knowledge, the critical evaluation of information, or a reader’s dispositions. Research (Coiro, 2011)
Kuiper & Volman, 2005; Metzger, 2007) suggests that each of these elements may be important to understand if we expect to better understand the complex nature of online reading comprehension.

More Restricted and Less Restricted Information Spaces

The Internet is not a unidimensional context for reading; it is a complex multifaceted informational space. In order to enrich our understanding and develop new theoretical models of online reading, researchers must investigate how the demands of reading change in different types of reading contexts (Hartman et al., 2010). Previous research has not always evaluated online reading comprehension within multiple contexts such as when the reading tasks occur in more restricted or less restricted information spaces.

One of the greatest demands placed on the reader is dealing with a shifting information space; when reading online, the size of the information field constantly shifts based on the task of the reader (Leu, 2000). More restricted information spaces use a smaller field of information. Less restricted information spaces have a larger field of information.

For example reading an article on a newspaper website takes place within a more restricted information space when compared to an Internet inquiry on the search for the Lochness Monster. Having a reader look for a specific website, such as the New York Times, also uses a more restricted information search task. On the other hand, having readers locate any useful website on a given topic requires a less restricted information space than locating a specific website. Students who have to sift through many more search results and keyword searches may not automatically identify a useful source. Clearly there are fundamental differences in the reading demands of more or less restricted information spaces.

Most studies of online reading comprehension have focused on either a more restricted information space (Coiro & Dobler, 2007) or a less restricted information space (Deschryver & Spiro, 2010) without recognizing the possible alterations this might make to reading performance. For example Coiro & Dobler (2007) used a more restricted environment by having students locate a
specific tiger website as part of a verbal protocol analysis. On the other hand Deschryver and Spiro (2010) used a less restricted information space by having students conduct an open-ended search on climate change. To date no study has examined how a reader’s performance changes by varying the restricted nature of information in online spaces. It is important for both researchers and educators to understand how the reading demands of online reading comprehension shift based on the nature of the information space.

**Prior Knowledge**

It is also important to investigate how prior knowledge affects student performance on tasks that take place in both more restricted and less restricted information spaces. Prior knowledge was operationalized as background knowledge in this study as only domain specific knowledge about the American Revolution was measured. Other prior knowledge such as knowledge of the Internet was not measured.

The strong effect that background knowledge has on reading comprehension is one of the most stable findings in all of cognitive psychology (Paris & Stahl, 2005). Even early reading researchers from Gates (1931), Huey (1908), and Gray (1939) noted the relationship between background knowledge and reading. Therefore background knowledge was included in the analysis because it has historically been such a strong predictor in models of offline reading comprehension (Alexander & Jetton, 2004; Pearson, 1982).

While the role of background knowledge in the comprehension of offline text is well established, the reading community has only begun to investigate role of background knowledge during online reading comprehension. Hill and Hannifin (1997) found that prior knowledge of both the topic and Internet systems are required for successful online reading. Coiro and Dobler (2007), from their think alouds with skilled 6th grade online readers, identified four types of prior knowledge involved during online reading comprehension: topic, informational text structures, website structure, and search engines. Coiro (2011 used hierarchical linear regression and found
background knowledge to predict a significant amount of variance in each hierarchical regression model of both offline and online reading comprehension.

**Critical Evaluation of Texts**

In addition, it is important to investigate how the critical evaluation of online information affects student performance on tasks that take place in more restricted and less restricted information spaces. One of the more essential elements to successful online reading comprehension is the ability to critically evaluate information (Kiili, 2008). In an era when publishing has become the province of a participatory culture, traditional markers of relevancy and credibility are not readily available to readers (Metzger, Flanagan, & Zwarun, 2003). Furthermore, studies investigating the critical evaluation of websites suggest that many students struggle with this important aspect of online reading comprehension. College age participants (Tillotson, 2002) and middle school students (Coiro & Dobler, 2007) often rely on superficial content to reach their decision when judging websites. Clearly, readers must approach the Internet with a critical eye. Yet we do not fully understand the role that the evaluation of information plays during online reading comprehension.

While evidence is emerging that critical evaluation is central to successful online reading comprehension, researchers do not know how this role shifts with a changing information landscape. One of the fundamental challenges students face when reading online is the vast amount of information (Tate & Alexander, 1998) available during self-directed text construction (Coiro & Dobler, 2007). Thus, as the information space becomes larger and less restricted, readers may have to rely more heavily on their ability to judge the relevancy and credibility of websites. For these reasons, critical evaluation will be included in this study because, as a skill, it encapsulates many of the challenges students face when reading online.

**Dispositions**

Finally, it is important to investigate how dispositions of online reading comprehension affect student performance on tasks that take place in both more restricted and less restricted
information spaces. Reading is always a situated, affective activity (Brown, Collins, & Duguid, 1989). This requires any adequate attempt at modeling online reading comprehension to include variables, beyond knowledge and skills (Carr & Claxton, 2002), such as dispositions. According to Katz (1993) dispositions are a “tendency to exhibit frequently, consciously, and voluntarily, a pattern of behavior that is directed toward a broad goal.”

As online readers engage in self-directed text construction (Coiro & Dobler, 2007) dispositions may become even more critical for comprehension for several reasons. First the Internet is a much more complex information space (Katz & Rice, 2002; Norris, 2001) and it is unlimited in nature (Alvermann, 2004; Gross, 2004). These fundamental changes to texts, and the challenges they present to readers, suggest that online reading comprehension requires emerging habits of mind (DeSchryver & Spiro, 2010). Furthermore since learners with positive dispositions often seek out challenging texts (Guthrie, Wigfield, & Percenevich, 2004) readers with positive dispositions towards online reading comprehension may be able to complete tasks that require increased topical knowledge. Finally students with a positive disposition towards online reading may exhibit greater use of cognitive strategies in online environments (Coiro, 2007). As a result, a measure of reader dispositions is included in the analysis because traditional studies in reading have established the importance of including affective variables (Guthrie & Wigfield, 1997) in reading comprehension models.

In short, this study seeks to examine some of the complexities that appear to be a part of online reading comprehension: the relative contributions of background knowledge, critical evaluation, and dispositions of the reader during tasks that take place within more restricted and less restricted information spaces.

**Verbal Intelligence**

One of the fundamental differences of online reading comprehension is that these tasks are driven by their problem solving nature (Leu, O’Byrne, Zawilinski, McVerry, Everett-Cacopardo,
Students, engaged in online reading comprehension tasks also have to undertake self-directed text construction (Coiro & Dobler, 2007) using websites with varying degrees of readability. This presents a unique challenge to studying models of online reading comprehension, as students will have varying cognitive abilities to create these multiple source texts.

It is common in the field of cognitive science to control for verbal intelligence on searching and information retrieval tasks to control for these differences in cognitive abilities (Allen, 1992). Verbal intelligence has been shown, using factor analysis, to be significantly related to measures of concept attainment and information processing (Lemke, Elmer, Klausmeier, & Harris, 1967). Therefore in order to understand the contribution that background knowledge, critical evaluation skills, and dispositions make to models of online reading comprehension verbal intelligence will be controlled.

**Research Questions**

This study uses a mixed method design (Creswell, 1994) with both quantitative and qualitative analyses. Collins, Onwuegbuzie, and Sutton (2006) suggest that before mixed methods questions can be developed the goals of the study must be identified. The goal of this study was both predictive and descriptive in nature.

Onwuegbuzie and Leech (2006) define prediction as “using pre-existing knowledge or theory to forecast what will occur at a later point in time.” Therefore this study will draw on both the theoretical perspectives in which it is framed and prior research to investigate the contributions that background knowledge, critical evaluation of websites, and dispositions make to online reading comprehension in both less restricted and more restricted information spaces.

Describing the differences in the processes students use during online reading comprehension tasks is also a goal of this study. Verbal protocols (Pressley & Afflerbach, 1995), or think-alouds, are often used to describe the cognitive processes used during comprehension activities (Campbell, 2005). These data can reveal important processes used to complete the
assessment (Ericsson & Simon, 1993) and can be adapted to also help illuminate the role of background knowledge (Palinscar, Magnusson, Pesko, & Hamlin, 2005) during online reading comprehension tasks. Consequentially this study utilized verbal protocol analysis to identify patterns of comprehension processes used during an online reading comprehension assessment.

Four research questions guided this study:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information spaces?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?

**Methods**

**Settings and Participants**

This study was conducted with a convenience sample of 131 7th grade students. This sample was selected from three schools. The schools were chosen from districts that were...
economically privileged, economically average, and economically challenged. One school was chosen from each SES group as determined from the Connecticut District Reference Groups [DRG] (Connecticut Department of Education, 2009). A district’s DRG is determined using a variety of economic indicators including, parental median income, median home value, free or reduced lunch ratio, parental education level, and other related factors (Connecticut Department of Education, 2009).

**Quantitative participants.** The participants in this study involved 131 seventh graders. According to Tabachink & Field (2007) a sample of 131 participants exceeds their guidelines for regression analysis of $100 + m$, where $m$ equals the number of predictors. This sample size is also adequate for a regression model with one dependent variable and three independent variables with an $\alpha=.05$, a desired power size of 0.8, and an anticipated effect size of 0.15 (Sloper, 2010). This anticipated Cohen’s $f^2$ is a medium effect. The estimate of power size was chosen to ensure an adequate effect (Sloper, 2010).

**Qualitative participants.** Twelve students, four from each participating school, were selected for the qualitative portion of the study. Performance on the first administration of the online reading comprehension assessment was used to determine participants in the think aloud activity. They were selected as follows.

1. First all students in their class were ranked based on scores on the first administration of the ORCA. Students were divided into two groups: the top 10% of scores and the bottom 10% of scores.
2. These groups were then reviewed by the teacher to allow for the selection of students who would be comfortable working with an adult on a verbal protocol task.
3. Then four students from each participating school were randomly selected from the list: two students who scored in the 10% of their class and two students who scored in the bottom 10% of their class.
Then, for the qualitative analysis, the twelve selected students were divided into three achievement-level groups (high average, low) based on ORCA scores, independent of school. Ten students were included in the final analysis since two students had to be removed from the study due to errors in data collection.

**Materials**

Assessments used in this study, except verbal intelligence, were created and validated by the researcher. They include two measures of online reading comprehension: one within a less restricted context and the other within a more restricted context. Each assessment consisted of two Internet inquiry tasks on the America Revolution. There were 12 score points in each task for a total of 24 score points per assessment.

Background knowledge was estimated using a three-item topical knowledge questionnaire. The questionnaire was delivered using a computer-based survey. Participants were asked to respond to a prompt asking them to list all the facts or details they knew about the American Revolution. These methods were adapted from Coiro (2011) who adapted Leslie and Caldwell's (1995) Concept Question Task and Wolfe and Goldman's (2005) measure of topic-specific background knowledge.

Critical Evaluation of websites was measured using a fourteen-item, multiple-choice test, Critical Online Information Literacies (COIL). The COIL focused on four constructs: author expertise, publisher, evidence, and bias.

The Dispositions of Online Reading Comprehension instrument (DORC) (O'Byrne & McVerry, 2008) was used to measure the dispositions of online reading comprehension among participants. The DORC was a composite score of five scales: reflective thinking, collaboration, flexibility, critical stance, and persistence.

Verbal intelligence was measured using a previously validated assessment, the verbal comprehension vocabulary test of the Kit of Factor Referenced Cognitive Test (Ekstrom, French,
Harman & Derman, 1976). This test consisted of a series of vocabulary multiple-choice questions. The measure was chosen because of its established reliability and use by researchers studying informational retrieval and learning from multiple sources. Reliability estimates for the test when working with 7th graders have ranged from .73-.86. The assessment has been used by researchers studying a number of contexts: search patterns in hypertext within CD-ROMs (Allen, 1992); the learning of science content with Web based texts (Wallen, Plass, Brunken, 2005); and comparisons of note taking strategies while reading (Tuckman, 1993).

**Procedures**

First, participants were asked to complete the measure of background knowledge. Then students completed the dispositions of online reading comprehension assessment and the COIL assessment. Next, the students completed a less restricted and a more restricted ORCA task. This was the first half of both the less restricted online reading comprehension assessment and the more restricted online reading comprehension assessments. Then the first two ORCA tasks were scored. Next participants for the think-alouds were identified based on performance on the first half of the ORCA. Finally all students were administered the second ORCA assessment.

After the first administration of the ORCA, participants for the think-alouds were identified. Students then completed a structurally prompted think aloud activity, during the second administration of both the less restricted and the more restricted ORCA. Students were prompted at fixed structural locations to think aloud by the experimenters (Afflerbach, 2002) while reading online. The students were asked, "What were you thinking?" at key decision points such as clicking on a link, leaving a website, or entering keywords.

**Analysis**

To answer the two quantitative questions, sequential (hierarchical) regression analysis (Tabachink & Field, 2007) was used to estimate the best fit models between the independent variable of online reading comprehension scores and the dependent variables after controlling for
verbal intelligence. This was done for both the less restricted and the more restricted online reading tasks.

To answer my qualitative questions abductive (Onwuegbuzie & Leech, 2006) methods and constant-comparative (Bogdan & Biklen, 2003; Merriam, 1988) methods were. This dual approach was designed to identify patterns in cognitive processing while also allowing for the codebook to unfold as the data were examined.

Abductive coding methods (Onwuegbuzie & Leech, 2006) employ both inductive and deductive coding procedures. Initial coding schemes were informed by previous work (Leu et al., 2004; Leu et al., 2009). The qualitative data was coded using HyperRESEARCH, a software-packaging tool that allows for the coding of video data. Each video case was loaded into the program. The videos were then broken into separate frames. A unit of analysis began with student action or talk. All related talk and repetitive actions were included in a unit. The unit ended when talk or action clearly changed, such as clicking on “Go/Search/Enter” or leaving a website.

**Significance of the Study**

This study contributes to both literacy research and literacy practice. For research this study investigated the changes in the reader by focusing on one of the greatest challenges the Internet presents to readers: the size of the information space. By investigating background knowledge, critical evaluation, and dispositions of the reader while having students read in both more restricted and less restricted information spaces this study seeks to enrich models of online reading comprehension.

Results of this study can also offer directions to teachers. By examining the differences in reading processes used by students who score high on a measure of online reading comprehension and those who score low this study will identify successful strategies used by good online readers. This data can be used by classroom teachers would want to model and teach the processes used by good readers.
CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this mixed methods study was to investigate the role that background knowledge, critical evaluation of information, and a reader’s dispositions play in predicting online reading comprehension performance after controlling for verbal intelligence. These variables were investigated in two different models. The comprehension tasks took place in either a less restricted or a more restricted information space. This chapter defines the relevant theoretical perspectives and explains how the principles of each theoretical perspective might shape the predictions of the variables in each model. Finally I explore the literature on defining and measuring each variable included in the statistical models.

Theoretical Perspectives

This study is framed within a multiple realities perspective (Labbo & Reinking, 1999). This perspective suggests that research benefits when we frame our work within multiple theoretical frameworks so that we might capture more of the complexity and richness that surrounds issues of literacy and technology. Accordingly, this study embraces two different theoretical frameworks: cognitive flexibility theory (Spiro, 2004) and new literacies of online reading comprehension (Leu et al., 2004).

Both perspectives have helped identify elements hypothesized to be essential to reading in online spaces. Specifically, Cognitive Flexibility Theory has suggested the role of background knowledge and dispositions are central for students to develop “advanced web skills and open mindsets.” (DeSchryver and Spiro, 2010). A new literacies of online reading comprehension perspective has suggested that critical evaluation of online information and dispositions would also be central to online reading comprehension. In this section I explore the literature around each of
the theoretical perspectives. I then explore how these theories influence the dependent and independent variables selected for this study.

**Cognitive Flexibility Theory**

Cognitive flexibility theory (Spiro, Feltovich, Jacobson, & Coulson, 1991) is a constructivist-learning framework, which builds on previous schema theories (i.e. Campione, Shapiro, Brown, 1995; Paris, Wasik, Turner, 1991). Cognitive flexibility theory has shaped the prediction, in this study, of how background knowledge and dispositions would be expected to function within more and less restricted information spaces.

Cognitive flexibility theory suggests that learning on the web, especially when moving beyond fact finding, requires advanced skills and open mindsets (DeSchryver & Spiro, 2010). In other words, tasks that take place in more restricted information spaces such as finding a train schedule would place different cognitive demands on the reader than an online inquiry around the Middle East peace process, which takes place in a less restricted information space. The review of cognitive flexibility theory informed the variables of interest selected for this study: online reading comprehension, background knowledge, critical evaluation, and dispositions.

**Cognitive flexibility theory and online reading comprehension.** It has been argued that Cognitive flexibility theory is a well-suited perspective for nonlinear learning involving random access technology such as the Internet (Spiro & Jehng, 1990). Based on the principles of Cognitive flexibility theory, online reading comprehension may be defined as taking place in an ill-structured context. Ill-structured domains, such as the Internet, require flexible learning because they are not guided by generalizable rules (Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987). In other words there is no one way to navigate online texts. Instead of following linear pages students build the texts they read by choosing hyperlinks (Eagleton & Dobler, 2006). Thus, online texts require readers to actively construct meaning with novel skills and strategies that do not apply to traditional text, in more structured domains (Snow, 2002).
Cognitive flexibility theorists have suggested these new skills are part of a domain of “advanced web exploration” (Deschryver & Spiro, 2010) that need to move beyond simply search for answers. These wide ranging searches unfold using “learner-initiated, complex, reciprocally adaptive (LICRA) techniques” (p. 4). These advanced techniques, found in those adept at online reading comprehension, can be used for deep learning in a space of unfettered information and access (Deschryver & Spiro, 2010).

**Cognitive flexibility theory and background knowledge.** Cognitive Flexibility Theory explores the flexible use of background knowledge. In fact cognitive flexibility theorists define background knowledge as something that is constructed based on the situation rather than retrieved (Spiro, Feltovich, Jacobson, Coulson, 1992). When online, the reader is situated in an environment where those with advanced skills can access unlimited knowledge.

Cognitive Flexibility Theory would suggest that in ill-structured domains such as online reading comprehension activation of background knowledge becomes more problematic as textual features change on a case-by-case nature as students read online (Spiro & DeSchryver, 2010). Readers may no longer rely on their templates of what websites or arguments look like. In fact an overreliance on background knowledge may lead to greater difficulty.

The access to unlimited amounts of non-linear information, according to the principles of cognitive flexibility theory, also has implications for background knowledge use while reading online. Spiro and Deschryver (2010) argue that the no one knows the role background knowledge will play in a world with so much external memory storage.

Thus, students who have advanced skills for reading online may be able to use the Internet to overcome a lack of background knowledge. Conversely, students with high background knowledge, but low online reading comprehension skills may not be able to actively construct background knowledge during Internet inquiry tasks. Finally, students who overly rely on their
background knowledge of texts in online environments may make mistakes as these templates do not always transfer to non-linear spaces (Spiro & Jehng, 1990).

Therefore, in order to enrich our understanding of models of online reading comprehension it is important to study the role of background knowledge. Furthermore, cognitive flexibility theory would suggest that background knowledge will behave differently in models of online reading comprehension depending upon how restricted the information space is for any task. In tasks with less restricted information spaces students may have to rely more on their “advanced web skills” rather than topical background knowledge. In more restricted information spaces, topical background knowledge may be more important than “advanced web skills.” Thus background knowledge, while significant in both models, would predict more of the variance in the more restricted model as students will need to rely on topical knowledge rather than “advanced web skills.”

Cognitive flexibility theory and critical evaluation. The ill-structured nature of online texts is a major source of the challenges involved in the critical evaluation of websites. Reih and Belkin (1998) noted the lack of quality control leads to the ineffectiveness of traditional strategies to evaluate an online text. Furthermore, Flannigan and Metzger (2000) commented that editors do not vet websites, leading to new challenges. Finally, Coiro (2003) described the inconsistency of text features and described the texts on the Internet as intertwined with hidden economic, social, personal, and political agendas. The sum of these challenges indicates that many of the strategies readers are taught to comprehend traditional texts may not rigidly transfer to the ill-structured nature of online texts.

Second when learners try to apply a set of rigid strategies to an ill-structured domain, errors of oversimplification often occur (Spiro et al., 1988). Oversimplification of knowledge may lead to errors when evaluating websites. For example students may judge a website using superficial content (Coiro, 2011). This may be because rigid strategy instruction taught for printed
materials may lead to errors of oversimplification when reading online. Furthermore, cognitive flexibility theory would assert that a stable taxonomy of skills would not guarantee the transfer of skills in new domains because of errors in oversimplification. This may explain why a recent review of critical evaluation research (Metzger, 2007) found no evidence that checklists, a common intervention to teach critical evaluation, improved judgments.

Bias in a mental representation can also lead to a lack of transfer of skills between ill-structured domains on the Internet. Therefore what a person believes about a topic may influence how they judge sources. For example, Damico and Baildon (1998), using think–aloud procedures during an Internet Inquiry unit of Mexican-American migration, found that beliefs about a domain or subject influenced the evaluation of claims and evidence.

Thus, cognitive flexibility theory would suggest that critical evaluation scores will be significant predictors in both the less restricted and the more restricted models. Students who score well on both of the ORCA assessments and the measure of critical evaluation skills may have “advanced web skills.” Conversely, students who score low on the critical evaluation measure may be making errors of oversimplification or have bias in their mental representation.

**Cognitive flexibility theory and dispositions.** According to Cognitive Flexibility Theory dispositions of the learner may also be important elements to include in a model of online reading comprehension. In fact theorists have suggested an “open mind set” is required for online reading comprehension (Spiro, 2004). After all, according to cognitive flexibility theorists, learners cannot be taught to simply apply rigid views of knowledge to multiple situations. They must understand the complex nature of knowledge and be able to use novel ways to learn. Furthermore cognitive flexibility theorists have noted bias in mental representation can lead to a lack of transfer of skills between ill-structured domains (Spiro et al., 1992). In other words if readers do not have an open epistemological belief about knowledge construction they may not succeed in an ill-structured
space such as the Internet. These principles suggest dispositions are critical to online reading comprehension.

Therefore, cognitive flexibility theory would suggest that other factors affect performance beyond background knowledge and comprehension skills. In fact certain learners may have habits of thoughts (Spiro, 2004) or dispositions that allow for more flexible learning (Leu, Kinzer, Coiro, & Cammack, 2004). This construct of “open mindsets” is very similar to the five scales measured in the disposition instrument: reflective thinking, flexibility, persistence, critical stance, and collaboration. Thus, students with positive dispositions towards reading online may have greater success in both less restricted and more restricted information spaces. However, according to cognitive flexibility theory having positive dispositions toward online reading comprehension would explain a greater amount of variance in less restricted information spaces than it would in more restricted information spaces. This is because a less restricted information space would require more flexible learning, persistence, and a greater critical stance in order to sift through the unfettered information and unstructured searches of the open Internet. (Schryver & Spiro, 2008).

New Literacies

This study is framed within a broad perspective of an upper-case theory of New Literacies (Coiro et al., 2008) as well as a more specific, lower-case theory of the new literacies of online reading comprehension. An upper-case New Literacies theory is used to capture commonalities among diverse areas of inquiry in this area including work in social practices (Street, 2003), Discourses (Gee & Green, 2007), comprehension (Castek, 2008), and other areas. Four common principles currently appear to define an upper-case theory of New Literacies (Coiro et al, 2008):

- ICTs require us to bring new potentials to their effective use.
- New literacies are central to full civic, economic, and personal participation in a globalized community.
- New literacies are deictic and change regularly.
• New literacies are multiple, multimodal, and multifaceted.

Within this broadly conceived notion of New Literacies, many are actively pursuing more specific areas of research, informed by separate lower-case theories of new literacies (Leu, Kinzer, Coiro, Castek, & Henry, in press).

**New literacies of online reading comprehension.** The new literacies of online reading comprehension (Leu et al., 2009), are one such lower-case theory (Coiro et al., 2008). This perspective defines online reading comprehension as a problem-based learning process, which includes the skills, strategies, and dispositions required to locate, evaluate, synthesize, and communicate online information. This perspective suggests that the shifting nature of how texts are constructed, evaluated, and accessed requires us to alter traditional models of reading comprehension (Leu et al., 2004). The theory of new literacies of online reading comprehension informed the inclusion of the independent variables of background knowledge, critical evaluation, and dispositions.

**New literacies of online reading comprehension and background knowledge.** There is no consistent body of evidence explaining the role of background knowledge during online reading comprehension. While empirical studies of online reading comprehension have included background knowledge as a variable in models of online reading comprehension researchers have just begun to explore the theoretical implications. Overall some argue that background knowledge will play a diminished role (Coiro, 2011). Others (Hartman, Morsnik, & Zheng, 2010) argue that new forms of background knowledge will be reprioritized.

Coiro (2011) suggested that researchers must rethink the role that background knowledge plays during online reading comprehension. She found that “while topic-specific background knowledge usually plays a significant role in most offline reading tasks, it appeared to play a relatively minor role in a series of three online reading tasks,” included in her study (Coiro, 2007 p. 262). Coiro suggested the importance of background knowledge may change based on the
information space. Specifically, Coiro argued that the possibility exists that “background knowledge is indeed a function of the specificity of online tasks or the non-linear nature of online task” (Coiro, 2007 p. 246). These results suggest that in less restricted tasks students may find it more difficult to rely on topical background knowledge and become more dependent on “advanced web skills.”

Hartman et al. (2010) suggest new forms of knowledge are required for cognitive models of online reading comprehension. This new knowledge adds new complexities rather than supplants traditional views of knowledge that included: declarative, procedural and conditional knowledge (Paris, Wasik, and Turner, 1990).

Hartman et al. (2010) argue that online reading comprehension requires goal knowledge, location knowledge, and identity knowledge. Goal knowledge, or knowing why, provides students with a continued sense of purpose during online reading comprehension tasks. Location knowledge, or knowing where, refers to knowing the location of search engine features and the basics of Internet searching. Identity knowledge, or knowing who, is knowledge of the basics of how authors construct and represent online identities.

Therefore a theory of new literacies of online reading comprehension would suggest that prior topical knowledge may not contribute the same amount of variance to models of online reading comprehension as they have in the past. Instead, as stated by Coiro (2011) prior topical knowledge, may have a reduced role or, as stated by Hartman et al. (2010) new forms of background knowledge will become more important. Based on these theories prior topical knowledge will play a stronger role in more restricted environments as students will need increased background knowledge to make more finite judgments.

**New literacies of online reading comprehension and critical evaluation.** While a new literacies of online reading comprehension perspective suggests that questioning, locating, evaluating, synthesizing, and communication are all central constructs for investigation, only critical evaluation of online information was chosen for this study. There were several reasons for
this decision. First, due to the self-directed text construction (Coiro & Dobler, 2007) the judging of the relevance of sources (Braasch et al., 2009) is fundamental when reading online. As readers select texts to read they must constantly judge the relevancy and credibility of sources. Thus, critical evaluation becomes especially important during online reading. In addition, while some work is beginning in this area (Damico & Baildon, 2007; Kiili et al., 2008; Quintana, Zhang, & Krajcik, 2005) we know little about the role of critical evaluation during online reading comprehension.

The principles of new literacies of online reading comprehension would suggest that a measure of critical evaluation skills would explain a significant amount of the variance in both restricted and less restricted information spaces. However, less restricted information spaces require greater self-directed text construction which makes the critical evaluation of texts more important. In a less restricted information space the participants have to build the text with no guidance and have to consider the relevancy and reliability of the sources. In the more restricted task the participants know the source they are trying to locate. Therefore readers with greater critical evaluation skills may have higher success in less restricted spaces and readers with less proficient skills will perform worse. Thus, even though a theory of online reading comprehension predicts that critical evaluation skills will be a significant predictor in both models, the scores on the critical evaluation measure may have more predictive value within less restricted information spaces.

**New literacies of online reading comprehension and dispositions.** A new literacies of online reading comprehension perspective would also suggest that dispositions may be central to reading in both less restricted and more restricted online information spaces. O’Byrne and McVerry (2008) identified five learning dispositions that are central to online reading comprehension: reflective thinking, taking a critical stance, persistence, flexibility, and collaboration. While these
dispositions may be important for all learning tasks the ill-defined nature of the Internet may make these dispositions, or habits of mind (Spiro, 2004), more central to online reading comprehension.

According to the principles of online reading comprehension reader dispositions would predict significant variance in both less restricted and more restricted information spaces. Research is emerging that demonstrates affective variables are positively related to strategy use within online reading tasks (Dwyer, 2010; Tsai, 2004; Tsai & Lin, 2004; Hofman, Wu, Krajcik, and Soloway, 2003). In fact Leu et al. (2004) suggest that new dispositions are central to meaning making in online environments. Therefore scores on a self report measure of dispositions of online reading comprehension are expected to make a significant prediction in models using both less restricted and more restricted information spaces.

This prediction differs from that of cognitive flexibility theory. Based on the theories of cognitive flexibility theory dispositions would be a significant predictor in both models, but a better predictor in the less restricted model. Based on the new literacies of online reading comprehension dispositions would be a significant and strong predictor in both models. This difference is attributed to the greater emphasis new literacies of online reading comprehension places on dispositions in all theoretical definitions.

**Summary of theoretical perspectives.** Two theoretical perspectives were used to guide this study: cognitive flexibility theory and new literacies of online reading comprehension. These perspectives helped to guide the selection of variables of interest. Furthermore they were used to make predictions about how the variables of interest will behave in models of online reading comprehension that use both a less restricted information space and a more restricted information space.

In this study predictions from the two theoretical perspectives are closely aligned. The two theoretical perspectives Cognitive Flexibility Theory and new literacies of online reading comprehension theory have been used to explore recent shifts in our literacy practices. The most
important alignments, in terms of this study, are a significant but reduced role for background knowledge and the increased importance of critical evaluation. The one area of disagreement was in the area of dispositions. Based on the principles of cognitive flexibility theory, dispositions would not play as significant a role in the more restricted information space as the structured nature of the task would limit the potential for deep learning on the Web. Conversely, a theory of new literacies of online reading comprehension, would suggest that dispositions are just as critical in the more restricted spaces as they are in the less restricted spaces.

Cognitive flexibility theory led to a number of predictions: (a) background knowledge, while significant in both models, would not be the strongest predictor in either model; (b) scores on a measure of critical evaluation would be significant in both models, but predict more of the variance in the less restricted model; and (c) scores on a self-report of dispositions measure would explain a significant amount of variance in both models, but would be a better predictor in the less restricted model.

In this study, a new literacies of online reading comprehension theory led to a number of predictions: (a) background knowledge will be significant, but not be as a strong of a predictor as in offline comprehension research; (b) critical evaluation skills will be significant in both models, but explain greater variance in the less restricted model; and (c) scores on a self-report of dispositions measure would explain a significant amount of variance in both models.

**Prior Research**

In addition to these theoretical perspectives, several areas of research also informed the design of this study: (a) online reading comprehension, (b) background knowledge, (c) critical evaluation, (d) dispositions, and (e) verbal intelligence. Each will be explored below.

**Research In Online Reading Comprehension**

Research suggests that online reading comprehension is different, and may be more complex, than traditional reading comprehension (Coiro & Dobler, 2007; Hartman et al., 2010; Leu
et al., 2009). These studies have found several common results: scores on measures of online reading comprehension are not isomorphic with offline reading comprehension measures (Coiro, 2011, Leu et al., 2005); new strategies are required in online spaces (Chen, 2011; Schmar-Dobler, 2003); new knowledge and attitudes are required for online reading comprehension (Bilal, 2001; 2002; Deschryver & Spiro, 2010); the nature of the information space may affect the nature of online reading comprehension; and assessments of online reading comprehension have a history of being valid and reliable.

**Scores on measures of online reading comprehension are not isomorphic with offline reading comprehension measures.** Leu et al. (2005) suggest that reading comprehension and online reading comprehension are not isomorphic. They found no significant statistical correlation among the Degrees of Reading Power (Touchstone Applied Science Associates, 2004) test and a validated measure of online reading comprehension administered to 89 seventh grade students. The online reading comprehension measure (ORCA-Blog) required students to locate, evaluate, synthesize, and communicate information. The Degrees of Reading Power (DRP) test, is a criterion-referenced measure used widely as a measure of reading comprehension.

Coiro (2011) found that knowing a student’s online reading comprehension ability predicted a significant amount of variance over and above offline reading comprehension and background knowledge, but an additional 16% of independent variance was contributed by knowing students’ online reading comprehension ability. Participants included 118 seventh-grade students from Connecticut. Students were administered two different versions of the ORCA, one used as a dependent variable and the other as an independent variable. Participants also completed a background knowledge measure. Scores on the Connecticut Mastery Test (State of Connecticut, 2010) were used as a measure of reading comprehension. The data suggest that additional skills are required for online reading comprehension, beyond those required for offline reading.
comprehension. These studies suggest that there may not be a high correlation between offline and online reading comprehension.

**New strategies are required in online spaces.** Research has also found that online reading comprehension may require new skills and strategies. Schmar-Dobler (2003) investigated strategy use among fifth graders as they searched for both explicit and implicit information on the Internet. Data sources included observations, think-aloud protocols, and post-reading interviews. Schmar-Dobler concluded students used many of the same strategies used during traditional online reading activities. However, she noted that new navigational strategies were required to read in online spaces. This study suggests that online reading comprehension requires new strategies.

Another study, using qualitative think aloud methods with 12 proficient sixth grade students, concluded that online reading comprehension and offline reading comprehension are similar, but online reading comprehension was also more complex (Coiro & Dobler, 2007). In this study students completed two separate online reading comprehension tasks. The first task had students read within a website. The second task had students answer very specific questions using a search engine. Data sources included think-aloud protocols, field observations, and semi-structured interviews. The authors concluded that online reading comprehension required a process of self-directed text construction that adds additional complexities to traditional comprehension.

Deschryver (2010) conducted a think aloud procedure with advanced web learners, skilled college age students and compared these results with studies investigating school age children. Deschryver concluded that differences exist among expert users of the Internet. Specifically, advanced learners can synthesize new learning that moves beyond what is already known about a topic.

Chen (2010) using qualitative methods compared the online reading comprehension strategies of upper elementary students with and with out learning disabilities. Data sources
included: surveys, structured metacognitive interviews, observations, reading comprehension activities, and online search tasks that were administered to 119 students in the fifth and sixth grades. Chen concluded that the lack of navigational strategies to deal with non-linear reading impeded comprehension.

**New knowledge and attitudes are required for online reading comprehension.** Research has also demonstrated that new knowledge and attitudes may be required for online reading comprehension. Bilal (2000; 2001) worked with approximately 25 seventh graders to explore the cognitive, affective, and psychomotor domains of learning as participants searched the Internet using Yahooligans. Bilal created a Web Traversal Measure to quantify search behaviors. Other data sources included: screen shot recordings, teacher assessments of student attributes and student exit interviews. Bilal concluded that ability to recover from “breakdowns,” navigational style, and one's focus on task were key to successful online reading. This indicates that online reading performance may go beyond skills and require learner dispositions.

In summary these studies present a growing corpus of work that reading comprehension is fundamentally different and more complex in online spaces. Specifically new skills, knowledge, and dispositions are needed. Across all of the studies there was an increased note of the role navigation plays during reading comprehension. Many of the studies noted the importance of goal knowledge (Bilal, 2000; 2001; Schmar-Dobler, 2003) through self directed text construction (Coiro & Dobler, 2003).

**The nature of the information space may affect the nature of online reading comprehension.** Several studies have used various levels of a restricted information space during online reading without controlling for the potential consequences (Chen, 2010; Coiro & Dobler, 2007; Deschryver, 2010; Leu et al., 2005; Schmar-Dobler, 2003). To date no study has examined the differences in performance based on the restricted nature of the information spaces.
The majority of studies used a more restricted information space to measure online reading comprehension. Schmar-Dobler (2003) used a more restricted information space by limiting the task to questions from class. Coiro and Dobler (2007) used a restricted space of just a single website and directed questions. Leu et al. (2005) used a more restricted space by having students look for specific answers to focused Internet queries. The assessments in these studies had students answer specific questions and evaluate specific pages rather than conduct searches for topical information.

Few studies utilized less restricted information spaces. Deschryver (2010) used a less restricted information space by having students conduct an open-ended search. Chen (2010) used a more restricted space for think aloud activities and a less restricted space for his quantitative measures.

While previous studies have used a variety of types of information space in their research, there are no studies on the role that more or less restricted information space plays during online reading comprehension tasks. This study seeks to explore student performance in both less restricted and more restricted spaces. The restricted nature of the Internet inquiry task may influence the skills, strategies, and dispositions of the reader.

Assessments of online reading comprehension have a history of being valid and reliable. Valid and reliable assessments of online reading comprehension have been used in previous work that attempted to capture the nature of reading online through performance based assessment tasks. The purpose of each ORCA measure that has been previously used was to capture “real-time” online reading products and processes during reading on the open Internet, a dynamic and unbounded digital information environment. These assessments included ORCA-Instant Message (ORCA-IM), ORCA-Blog, ORCA-Scenarios I and II, ORCA-Iditarod, and ORCA-Iditarod Revised. Each of these assessments has been shown to be valid and reliable as shown in Table 2.1.
Table 2.1

*Descriptive, Validity, and Reliability of Scores on ORCA-Open assessments*

<table>
<thead>
<tr>
<th>Instrument/ # Items</th>
<th>Score Ranges</th>
<th>N</th>
<th>Validity*</th>
<th>Reliability**</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-IM (12)</td>
<td>3-36 of 38</td>
<td>12</td>
<td>66.5%</td>
<td>.85-.95</td>
</tr>
<tr>
<td>ORCA-Blog (10)</td>
<td>0-30 of 32</td>
<td>89</td>
<td>59.2%</td>
<td>.84</td>
</tr>
<tr>
<td>ORCA Scenario I (20)</td>
<td>0-56 of 60</td>
<td>120</td>
<td>51.7%</td>
<td>.92</td>
</tr>
<tr>
<td>ORCA Scenario II (20)</td>
<td>0-56 of 60</td>
<td>120</td>
<td>44.1%</td>
<td>.91</td>
</tr>
<tr>
<td>ORCA Iditarod (17)</td>
<td>0-33 of 42</td>
<td>220</td>
<td>53.1%</td>
<td>.88</td>
</tr>
<tr>
<td>ORCA Iditarod Revised (13)</td>
<td>0-20 of 30</td>
<td>373</td>
<td>41.6%</td>
<td>.73</td>
</tr>
</tbody>
</table>

* % of variance explained by a composite score, a measure of construct validity.
** Cronbach’s alpha reliability coefficient, a measure of reliability.

The first attempt to create a valid and reliable measure was the *ORCA-IM* (Leu et al., 2005). To complete the *ORCA-IM* students worked individually on four Internet reading tasks. An online researcher introduced the activity over instant message. A second researcher sat with the student and collected field notes. While *ORCA-IM*, resulted in a successful protocol for data collection the amount of resources it required, two researchers per administration, made the *ORCA-IM* very labor intensive.

The next assessment developed was the *ORCA-Blog* (Leu et al., 2005). The goal of *ORCA-Blog* was to repeat the design of *ORCA-IM* but with procedures that allowed scaling up through simultaneous administration. Students who completed the *ORCA-Blog* had to answer three information requests posted on a blog site by fictitious teachers requesting online resources for human body systems. The *ORCA-Blog*, captured a range of achievement levels in online reading comprehension. However it did not account for the multiple dimensions of critical evaluation or the synthesis of multiple sources. The *ORCA-Blog* had students evaluate a single website on overall reliability. Furthermore students were not required to integrate multiple sources in their synthesis tasks. These are key skills that need to be measured during online reading comprehension assessments.
The next iteration of assessments, *ORCA-Scenario I & II*, was developed by Coiro (2007; 2011). The instrument involved two parallel measures of online reading comprehension. Each instrument included 20 open-ended items constructed to measure the students’ reading ability during the location, evaluation, synthesis, and communication of online information. The assessment was delivered over a private quiz interface that required individual user sign on. The *ORCA-Scenario I & II* were both valid and reliable but utilized a very restricted information space in order to ensure a parallel item format. The test took place in a quiz interface and students were given very targeted searches to complete or were provided websites to evaluate.

Two *ORCA-Iditarod* measures were developed as part of an IES supported research grant project (*Teaching Internet Comprehension to Adolescents [TICA Project]*, Leu & Reinking, 2005). The instruments required students to use an online assessment tool, *Survey Monkey*. The tasks asked students to locate, evaluate, synthesize, and communicate information. The information requested was very restricted in nature. For example students were asked to find single facts such as, “Who holds the *Iditarod* record?” Also the critical evaluation task was restricted to a single website.

**Summary of research in online reading comprehension.** To date, research in online reading comprehension is advancing. Yet unique challenges remain. First we do not know how the restricted nature of the information space may affect online reading comprehension scores. Furthermore efforts to capture the collaborative nature of communication during online reading comprehension, such as on *ORCA-Blog* create difficulties for assessment including ecological validity and cumbersome scoring. Efforts were tried to utilize instant messaging and blogging. Yet it was impossible to recreate the collaborative nature of these communication tools. The scoring for online reading comprehension assessments, involved the coding of video screencasts. This meant each assessment would take fifty minutes to score. Finally the shifting nature of online websites
threatens the stability of the assessments. In many of these assessments, secondary replication studies can not be completed as websites that were used in the assessments are no longer available.

The assessments designed for the present study tried to account from the lessons learned in past development. First and foremost two different models will be tested to account for shifting information spaces. One model will use a less restricted space. The second model will use a more restricted space.

Another improvement is to require the reading of multiple sources. In many previous versions of the ORCA students did not have to utilize multiple sources. This does not reflect true online reading comprehension. In this study both the less restricted and more restricted tasks required the reading of multiple online sources.

In addition, multiple elements of sourcing skills were included in the critical evaluation items. In previous studies, critical evaluation skills were limited to examining just the author. This study also includes the evaluation of the evidence used by an author.

Finally efforts were made to draw on the collaborative nature of online communication. In previous ORCA versions communication tasks were limited to blogs or instant messaging. Both assessment versions in the present study required students to reply to previous posts on a discussion board. Specifically students have to use the information they learn to respond to another post.

**Research on prior knowledge**

The role that prior knowledge plays in traditional, offline reading comprehension is well known, stable, and significant (Chiesi, Spilich, & Voss, 1979; Spilich, Vesonder, Chiesi, & Voss, 1979). However the results from recent studies investigating background knowledge and online reading comprehension have shown a somewhat mixed pattern of results. This includes studies of Internet inquiry (Bilal 2000; 2001; Hill & Hannafin, 1997), non-linear hypertext reading (Tabati & Shore,
These studies do not provide conclusive evidence that background knowledge plays a strong role in online reading comprehension.

Hill and Hannafin (1997) used a case study method with four college students to investigate strategy use. They concluded that students’ background knowledge affected metacognitive strategy use. This background knowledge included both topic and systems knowledge. Hill and Hannafin (1997) asked participants to locate materials on a subject of their choosing. They reported that previous experience with the Internet predicted performance on the task. In the study prior tool expertise, as measured using a self-report frequency of use measure, was more predictive than domain knowledge. In online reading comprehension assessment, familiarity with available Web-based tools may better predict success than prior domain knowledge and experience.

The results of both of Bilal’s studies (2000; 2001) found that background knowledge did not influence success. Results suggested neither domain knowledge nor topic knowledge influenced the success (Bilal 2000; 2001) of students at Internet inquiry. In the 2001 study, four students with a higher mean score of measures of topic knowledge were unsuccessful in their searches while nine students who scored lower on a measure of topic knowledge were successful. This indicates that background knowledge may not be as critical during online reading comprehension.

Other studies, however, have found that background knowledge played a significant role. Tabati and Shore (2005) conducted a study comparing the searching behaviors of experts and novices. Participants included 10 novices, 9 intermediates, and 10 experts. Using verbal protocol and survival analysis, a method for analyzing data based on the occurrence of an event, (Allison, 2010), they concluded that most significant differences in patterns of search between novices and experts were found in the cognitive, metacognitive, and background knowledge strategies. The researchers found a significant correlation between metacognitive strategies and background knowledge ($r = 0.54, p = 0.003$). Specifically they found significant correlations between reflection
and domain knowledge ($r = 0.45, p = 0.01$), reflection and system knowledge ($r = 0.41, p = 0.03$), and monitoring and domain knowledge ($r = 0.45, p = 0.01$).

Finally some studies have found that the role background knowledge plays in online reading comprehension may be determined by a student’s online reading comprehension ability. Coiro (2011) found that background knowledge explained a significant amount of variance when entered into a regression model predicting online reading comprehension assessment. However Coiro also found an interaction effect between background knowledge and online reading comprehension ability. Coiro concluded that the interaction may suggest that topic-specific background knowledge affects students with high and average online reading ability less than those with low online reading ability.

The five studies of online reading comprehension that investigated background knowledge, either with qualitative analysis (Bilal 2000; 2001; Hill & Hannifin; 1997) or statistical testing (Ciro, 2011; Tabati & Shore, 2005) have found somewhat competing results as to the role of background knowledge. This is in such stark contrast to studies of traditional reading comprehension. Some research found a strong role for background knowledge (Hill & Hannafin, 1997; Tabati & Shore 2005) while other work found a diminished role for background knowledge (Bilal, 2000; 2001; Coiro, 2011). This has led some researchers to speculate that the expertise of the user, including their ability to use the Internet (Ciro, 2011; Hill & Hannifin, 1997), may influence the role of background knowledge.

**Measures of prior knowledge in online reading comprehension studies.** There have been two major methods for measuring prior knowledge in studies that examined prior knowledge and online reading comprehension: self-report surveys and prior knowledge questionnaires. The types of prior knowledge measured included domain, or topic knowledge, and system knowledge, in other words task knowledge.
Hall and Hannifin (1997) used a questionnaire to judge both topic knowledge and system knowledge. Four questions were related to participants’ prior subject knowledge. Participants were asked to explain their search task and asked to rate themselves on a scale of novice to expert. System knowledge was rated using a self-report frequency measure on common search tools. The scale was along a continuum of never used to daily use.

Bilal (2000; 2001) used a teacher survey of students’ background knowledge. The survey consisted of questions about topic knowledge (alligators). The survey also asked about domain knowledge. Finally teachers also rated students’ reading ability.

Tabati and Shore (2005) also used self—reports of self-efficacy to serve as a score for system knowledge. Participants were asked to rate themselves in three areas of computer literacy: information-seeking knowledge, computer knowledge, and knowledge of the Web. A five point Likert scale on a dimension of poor to excellent was used. No topic background knowledge measure was used.

Coiro (2011) used a prior knowledge measure that moved beyond self-report scores. A six-item questionnaire was used. Four of the questions asked students about topic-specific knowledge. Two of the questions asked about task knowledge, specifically animation and website reliability. Item scoring procedures were informed by Leslie and Caldwell’s (1995) Concept Question Task and Wolfe and Goldman’s (2005) measure of topic-specific prior knowledge. The questionnaire was administered orally on a one-to-one basis.

**Summary of research on prior knowledge in both offline and online reading comprehension.** Prior knowledge plays an important role in offline reading comprehension. Its role in online reading comprehension is less clear. The diversity in the results exploring the role of prior knowledge during online reading may have as much to do with the types of measures used to measure prior knowledge as they do with online reading comprehension. Thus it was decided to
operationalize prior knowledge as background knowledge for this study. This refers to only domain specific knowledge about the American Revolution.

Across the studies the majority measured prior knowledge using self-report measures. This may be problematic as these items are open to bias. Studies that come from library and information science favor system knowledge. Studies from a reading perspective favor topic knowledge. Given the focus of this study, the methods employed by Coiro (2011) seem most promising. However the one-on-one administration format was not practical. Therefore the background knowledge measure in this study drew on the methods used by Coiro but utilized an online form for systematic data collection.

**Research on Critical Evaluation**

**Foundational Overview.** A variety of fields have explored the critical evaluation of information. Before beginning a systematic review of research of the critical evaluation of websites, it is useful to have a broad sense of the several fields that have provided the foundation for this research. These include: information processing, information retrieval, design theory, critical thinking, and document representation.

**Information processing.** The emergence of the computer in the 1950’s led cognitive science to metaphors of thinking that compared the mind and the computer (Wilson & Myers, 2000). Thus computer oriented information processing models provided new ways to think about thinking (Johnson-Laird, 1988). Information processing theories believe information is received from external stimuli (websites), it receives attention, the information is stored in short term or long term memory where it is combined with previously stored information, and finally a response (judgment) is generated. Much of the early research on the critical evaluation or credibility of websites draws on information processing models (Tate & Alexander, 1996). Specifically, frameworks of information retrieval and design theory were situated in information processing perspectives.
**Information retrieval.** Information retrieval (IR) frameworks encompass cognitive processes involved in the searching, organizing, and accessing of information. Much of the literature from library science adopts an IR framework and explores critical evaluation as a credibility judgment that involves information quality and cognitive authority.

The IR literature on the evaluation of websites draws on five principles of information quality identified from literature on the evaluation of print texts: accuracy, authority, objectivity, currency, and coverage (Tate & Alexander, 1996). These five elements of credibility have been quite stable over the last decade. For example, in a recent review of the literature Metzger (2007) found the most consistent elements of information quality were found to be: believability, accuracy, trustworthiness, bias, and completeness of information. These five principles, similar to the characteristics outlined by Tate and Alexander, were drawn from Taylor’s (1986) value added model of judging information quality.

Taylor defined quality as “a user criterion, which has to do with excellence or in some cases truthfulness in labeling” (p. 62). Taylor posited that information systems and information had specific values some were tangible and could be seen, while others such as reliability were intangible. There were specific values that could be built up over time. Taylor identified five of these values that have consistently been found in the literature that takes an IR perspective: accuracy, or the degree to which the information is true; comprehensiveness, or the completeness of coverage; currency, or how recent the information is reliability, or the trust someone puts in the information; and validity, or how useful the information is to the task.

Another element common to research in library science that takes an IR framework is cognitive authority. Cognitive authority as defined by Wilson (1983) influences many of the theoretical articles (Tate & Alexander, 1996) or studies (Fritch & Cromwell, 2001, Reih, 2002; Reih & Belkin, 1998) investigating the critical evaluation of websites through recognition that information from different sources has varying reliability. Reih and Belkin (1998) summarized
Wilson’s external tests for cognitive authority of texts as involving: personal authority in recognition of the author; institutional authority in recognition of the publisher; textual type authority in placing value in the type of text; and intrinsic plausibility authority in placing authority in the content.

**Design theory.** Some of the earliest empirical work on the critical evaluation of websites developed from researchers investigating what makes people believe some websites over others (Fogg et al., 2001; Fogg et al., 2003; Fox, 2006; Fox & Raihne, 2002). Design theory aligns closely with the theoretical framework found in IR such as Wilson's (1983) cognitive authority and the values of information quality identified by Taylor (1986). The major theoretical difference is in the audience. IR research focused on improvements in systems and users. Design theory looks to increase the perceived credibility of texts in order to increase market value.

**Critical thinking.** Research in science has often used a critical thinking framework to investigate how readers evaluate science arguments online (Brem, Russell, Weems, 2001; Graesser et al., 2007; Sanchez, Wiley, & Goldman, 2007). Brem et al. define argumentation as the employment of critical thinking skills in the evaluation of specific claims but also framed their research in situated cognition. According to Graesser et al. critical thinking, "requires learners to evaluate the truth and relevance of information, to think about the quality of information sources, to trace the likely implications of evidence and claims, and to ask how the information is linked to the learner’s goals and larger conceptual frameworks” (p. 3). They then suggest that critical thinking requires a critical stance that requires readers to be suspect of all information they encounter.

**Document representation.** Theories of document representation build off of earlier work in the reader’s construction of document models with single texts (Kintsch, 1998; Kintsch, & Van Dijk, 1978) but try to account for the multiple sources read when conducting Internet inquiries. Theories of document representation suggest that readers construct a document model. It defers from earlier document models that suggested a two-phase construction – integration (Kintsch, 1998) that
involves the text base, or internal meaning, and the situational model, which combines the information in the text with background knowledge, by adding on an additional layer the intertext model (Britt, Perfetti, Sandak, & Rouet, 2007). The intertext model includes information about how the texts are related and information about characteristics of the sources (Braten, Strømsø, & Britt, 2010. It is the intertext model, and more specifically the skill of sourcing, that aligns with other operationalized definitions of critical evaluation. Sourcing “is the skill of gathering information about a source and using it to form conclusions about a document, especially conclusions regarding credibility” (Britt & Gabrys, 2002 p. 171).

**Defining the critical evaluation of websites.** There are multiple definitions of critical evaluation (Coiro, 2007) that draw on many different theoretical perspectives. Constructs used to measure these processes and judgments vary across different research fields and include: evaluation, judgment, and criticality. I will use the term critical evaluation to explore similarities and differences in how various constructs were operationalized. Overall studies and theoretical articles agree that the construct of evaluation draws heavily on cognitive work investigating the evaluation process and credibility judgments.

**Evaluation.** In defining evaluation Fitzgerald (1999) draws on Bloom’s taxonomy (Bloom, Engelhart, Furst, Hill, Krathwohl, 1956), which defined evaluation as a judgment involved in the evaluation of criteria, values, and standards. Krathwohl (2002) expanded on these ideas created a two-dimension taxonomy that separates knowledge (factual, procedural, conditional, and metacognitive) and cognitive processes (understand, apply, analyze, evaluate, and create). The revised taxonomy also defines the cognitive process of evaluation as the making of judgments based on standards and criteria that involve the cognitive processes of checking and critiquing.

Most research has defined the process of evaluation as involving judgments (Flanagin, Metzger, & Miriam, 2000; Fogg et al., 2001; Reih, 2002; Reih & Belkin, 1998; Zhang & Duke, 2007) or as a decision involving the processes of evaluation (Flanigan, 1999). Even those researchers who
took a new literacies perspective, which adapted a more sociological perspective, still accounted for a judgment of claims and evidence (Damicco & Baildon, 1998; Damicco & Baildon, 2006) or developed taxonomies grounded in the credibility judgment literature (Coiro, 2007; Coiro & Dobler, 2006, Zawilinski et al., 2007).

**Judgment.** The work done in the field of judgment, decision-making, and choice (Hogarth, 1987; Goldstein & Hogarth, 1997, Rachlin, 1989) influences the definitions of judgment used by researchers investigating the critical evaluation of websites. According to Rachlin (1989), “…a judgment is always a guide for making a decision, which leads to a choice, which then produces an outcome” (p. 43). Hogarth (1987) identified two types of judgment: predictive judgments and evaluative judgments. Researchers have often adapted these two types of judgments in their explanations of critical evaluation (Reih, 2002).

The predictive judgment, or predictive inference (Coiro, 2007; Coiro & Dobler, 2007) involves the judging of the relevance of a link. The reader is deciding if that link will be useful, makes a predictive judgment and follows with a choice by clicking on a link. At that point the reader would then make an evaluative judgment.

As stated earlier, researchers who adopt an IR and/or a library science perspective look to this evaluative judgment as using both information quality and cognitive authority (Fritch & Cromwell, 2001, Reih, 2002; Reih & Belkin, 1998) as criteria. The criteria used by researchers to operationalize information quality and cognitive authority share many common elements.

**Criticality.** Critical, in terms of critical evaluation can mean many things to many different people. In terms of the definitions collected for this study, critical refers to three separate entities in terms of educational research: critical thinking, critical reading, and critical literacy.

As noted by Fitzgerald (1999), many writers equate critical thinking with evaluation while the majority of researchers view evaluation as one of a subset of higher order skills involved in critical thinking. In terms of judging text, critical thinking is “analytical thinking for the process of
evaluating sources” (Hickey, 1990 p. 175). It involves analyzing facts, generating and organizing of ideas defending opinions, comparisons, drawing inferences, evaluating fact/opinion, problem solving, set of dispositions to draw on those skills (Brem et al., 2001; Coiro, 2008; Fitzgerald, 1999). Coiro (2008) uses a critical thinking lens to draw on her definition of critical evaluation as “readers applying their critical thinking abilities to: (a) question, analyze, and compare the resources they located; (b) judge the quality of information on various characteristics; and (c) defend their opinions with evidence from multiple sources and their background knowledge” (p. 47).

In his work, Spache (1964) wrote that critical reading is a set of skills that extends beyond both functional literacy skills and higher comprehension. These skills include investigating sources, recognizing an author’s purpose, distinguishing fact from opinion, drawing inferences, judgments, and detecting propaganda. There are many parallels evident between definitions of critical thinking and critical reading found in much of the literature (c.f. Coiro 2003, 2008; Robinson, 1964, Russell, 1963).

In fact many literacy researchers in the field of critical reading have long held that critical reading can not be separated from critical thinking (Ennis, 1962; Wolf, King & Huck, 1968). This is evident in research on critical evaluation rooted in library information sciences, information retrieval, and more socio-cognitive views of new literacies. Many of the critical reading skills are evident in the checklists that are commonly used to teach critical evaluation of websites. Cervetti, Pardales, and Damico (2001) argue that this connection is rooted in liberal-humanist traditions that are at odds with the traditions of critical literacy.

Unlike critical reading, critical literacy is rooted more in socio-cultural views of reading that view response to the text as less a personal extractions of author’s intent and more rooted in social, historical, and cultural practices (Freebody & Luke, 1990; Lankshear & Knobel, 1998; Luke, 2000; Mellor & Patterson, 2004). Influences on critical literacy emerged from a variety of traditions. Critical social theories of New Criticism schools of thought, focused on using language resources to
create a more just society (Cevetti et al., 2001). Postcolonial and Marxist views rest on the assumption that we live in a world of unequal power and texts are used to either reinforce or challenge these power structures (Friere, 1970).

Recently views of critical literacy have drawn of ideas of post-structuralism that examine the relationship between power, discourses, and culture (Mellor & Patterson, 2004). How meaning is constructed, is then connected to power relationships within specific communities of practice (Cevetti et al., 2001). Lankshear and Knobel (1998) argue that definitions of literacy must then consider three elements: the operational, the critical, and the cultural.

While critical literacy draws on a variety of historical schools of thought it is united in the idea that literacy is a social practice and not a set of neutral psychological skills. To this end Luke and Freebody (1990) created the four-resources model to create critical literacy pedagogy. They suggest that there are four necessary, but insufficient, roles readers must take in a post-modern world: code-breaker, meaning maker, text user, and text critic. Coiro (2008), while rooting her work in critical reading, gives a passing nod to critical literacy by suggesting it will be necessary for students to comprehend the increasingly image-driven websites. Murray and McPherson (2006) suggest that the understanding of online texts and websites will require greater critical literacy skills. Stone (2007) suggests that we must think of critical reading of websites as involving more than evaluation of truth but also look to see how students use popular websites in their everyday lives.

**Summary: Drawing on multiple perspectives and definitions to define the critical evaluation of websites.** It is clear that the critical evaluation of texts, whether the definition is rooted in critical thinking, critical reading, or critical literacy involves a judgment. However, assuming that authority and credibility are inherent features of texts ignores certain contextual elements to reading. The purpose, culture, and practices of readers will influence what judgments and decisions they make.
I define critical evaluation of websites as a contextual process of examining, adopting, and changing perspectives in order to judge the relevancy and reliability of a website. First, critical evaluation is contextual because it may require specific content knowledge or may be influenced by students’ epistemic belief (Damico & Baildon, 2007; Brem et al., 2001).

Second, critical evaluation is a recursive process. The criteria and judgments involved in critical evaluation have to be continuous throughout Internet inquiry. It is not a specific stage or step in a simple taxonomy. Critical evaluation takes repeated questioning, goal setting, and a variety of metacognitive skills (Graesser et al., 2008; Zhang & Duke, 2007).

Third, critical evaluation involves the examining, adopting, and changing of perspectives because all texts are socially, historically, and culturally situated (Lankshear & Knobel, 1998). Focusing critical evaluation as simply identifying an author’s message, intent and bias “privileges the factual and objective” (Fabos, 2008 p. 843). Encouraging students to understand the different perspectives that shape “truth” will allow them to judge relevancy and reliability and may avoid errors of oversimplification such as rejecting a source because it is biased.

Finally, the critical evaluation of websites involves the judgment of relevancy and reliability over the judgment of credibility and authority simply because texts are not neutral entities. The reliability and relevancy of a source may change based on content, context and purpose.

This definition was applied to the design of the Critical Online Information Literacies measure of website evaluation used in this study. The original assessment included scales to measure both relevancy and credibility judgments. Furthermore it included items that looked at the author, publisher, credibility of evidence, and bias.

**Methods for identifying critical evaluation skills and strategies.** The methodologies used to study the critical evaluation of websites continuously evolve. The major focus of studies has been to identify the skills and strategies used to evaluate websites. Three basic methods have been used:
1) self-report surveys and questionnaires to understand the frequency and type of skills students use in critical evaluation;

2) verbal protocol analysis [VPA] and interviews to identify the skills and strategies used by students; and

3) case studies to explore socio-cultural factors of critical evaluation.

**Self-report surveys and questionnaires.** The earliest studies investigating the critical evaluation of websites involved self-report surveys and frequency questionnaires (Flanagin & Metzger, 2000; Fogg et al, 2001; Fox & Raihne, n.d. Fox & Raihne, 2002, Metzger, Flanagin, Zwarum, n.d.; Princeton Survey Associates, 2005). The goals of these measures were to understand: (a) What makes a website credible? (b) What were the perceived levels of trust in different types of media? and (c) What was the frequency of skills used? The majority of skills surveyed in these studies shared many similarities, from lists of skills used for print based media (i.e. Tate & Alexander, 1996) which included accuracy, authority, objectivity, currency, and coverage.

Across the self-report studies a variety of methods were used. Surveys were created and validated (Fogg et al, 2001) using exploratory factor analysis. Other surveys relied on descriptive statistics from large samples to draw conclusions (Fox, 2006; Fox & Raihne, 2002; Princeton Review Board, 2002; 2005) while others used descriptive statistics as dependent variables for further study (Flannigan & Metzger, 2000). Since the Internet is a rather young phenomenon it is understandable that some of the earliest studies would rely on self-report surveys to identify trends and factors that influence the critical evaluation of websites.

Early research into website credibility, using surveys, had the goal of making commercial websites more credible. For example, Fogg et al. (2001) created and administered a survey to 1,441 participants ranking 51 elements of credibility on a Likert scale. The creation of the 51 items that may influence credibility went through four rigorous stages of content validation. The survey was
then administered to participants who ranked the items on a seven-point scale from less believable to more believable. The researchers, using varimax rotation, and Eigenvalues greater than 1.73 found that five factors increased website credibility: real-world feel, ease of use, expertise, trustworthiness, and tailoring. In contrast two factors hurt perceived credibility: commercialism and amateurism. From these findings the researchers concluded with a set of design principles that could be used to increase the perceived credibility of websites. It must be noted, however, that researchers only explained 15.1% of the variance in their model, which could indicate that the predicted factor loadings do not adequately explain the variance in the population.

Another purpose of surveys was to compare website credibility with other media types (Princeton Survey Research Associates, 2002; 2005; Flanigan & Metzger, 2000). The Princeton Survey Associates (2002) conducted a survey of 1,051 adults in order to identify areas that could improve website credibility. The results showed that only 29% of respondents trusted websites that sold products. In the study, 33% of respondents trusted websites that reviewed products and services. These scores were drastically lower than other media types and private entities.

Flanigan and Metzger (2000) also conducted a survey to compare perceived credibility of websites with other media and also to understand the verification strategies used by people based on demographics, type of media, and Internet experience. Using a repeated measure ANOVA the results showed newspapers were perceived to have a significant higher level of credibility than other media ($F = 114.12, df = 4, 2428, p < .001, \eta^2 = .1$).

In the survey conducted by Princeton Survey Research Associates (2002) 80% of respondents stated that trust was very important, 80% stated that ease of navigation was important, and 80% stated that being able to identify the source of the information was very important. Only 32% of respondents said it was important to know the author of a website. Finally, 65% responded that knowing that the website was updated frequently is very important. In the follow up study (Princeton Survey Research Associates, 2005) the credibility of websites seemed to
decline with only 21% of respondents trusting websites that sold products. There was also an
increase in the elements of websites important to trust. There was a statistically significant increase
in the number of respondents saying it was important to identify the source of information, the
frequency of updates, and knowing who owns a website.

Studies investigating how people trust health information online have also been conducted. In 2002,
500 “health seekers” were asked about their search habits in phone interviews (Fox, 2006). Over 50% of
respondents reported checking the source or date of the information they read online websites for medical advice “only sometimes,” “hardly ever,” or “never.” One quarter seemed to judge the credibility “most of the time” and another 25% “all of the time.” 49% of respondents who look for information on multiple sites responded that verifying information gave them a lot more confidence, and 38% said that it gave them a little more confidence. In the 2006 survey seventy-five percent of respondents reported evaluating information sometimes, hardly, and never (Fox, 2006). This represents a 25% increase over the 50% of adults who reported not being vigilant or concerned from the 2002 survey. The authors speculate that this fall in the self-reports of evaluation could be caused by the increase in eighteen and plus users (Fox, 2006) who grew up with the Internet and who place more trust in website credibility.

Studies were also done, using self-report questionnaires, to understand the criteria students use to evaluate websites in academic settings. Tillotson (2002) collected 499 questionnaires from college undergraduate students in order to investigate if they recognized a need to evaluate websites, the extent to which they evaluated websites, and the type of criteria used to evaluate websites. The results showed that students have a nascent approach to evaluating websites. He found that 38% of students responded they have never found misleading information online; the average student reported using fewer than two criteria to evaluate a website. The results show that the majority of students who reported using criteria used source reliability. Only twenty-five of the
students reported using the URL or web address to make a judgment. Furthermore, over half the students who used content to evaluate a website used it as the only criteria.

The studies using self-report methodologies are in general agreement of the types of skills needed or used by students to evaluate online information and the lack of these skills in Internet users regardless of age. These skills do not differ greatly from evaluation skills identified using print media. Skills common across all the self-report studies include: (a) identifying the author or sponsor; (b) examining the URL; (c) using format or appearance of the website; (d) checking the currency of information; (e) checking the accuracy using a secondary source; (f) examining bias; and (g) using content to judge a website. It must be noted, however, that many of these skills, because these were self-report measures were not directly observed. The studies therefore are subject to errors in both over and under-reporting. Furthermore, across the studies participants rarely used more than one skill to judge a website. Finally, the skills reported with the greatest frequencies included identifying the author and using superficial elements such as the appearance of a website or the content.

The results of research studies using self-report methods also provide insight into how readers critically evaluate websites. These studies are in general agreement that readers do not evaluate websites with great frequency. Across the studies that investigated the criteria to judge websites, evaluating the source was consistently mentioned as the most frequent skill used by participants. However across all the surveys very few readers used multiple criteria. For example, Flanigan and Metzger (2000) used mean verification scores to analyze credibility verification strategies. Across all the strategies respondents reported using skills between “never” to “sometimes.” with most scores falling between “never” to “rarely.” This indicates that participants did not evaluate the sources they read.

The self-report studies also show differences in the responses based on age. Younger participants often reported greater frequency of Internet use, but also placed greater trust in
Internet sources. This could indicate an easing of fears with increased use; however, this finding may also indicate that while students are so-called “digital natives” they are not information savvy (Bennet, Maton, & Kervin, 2008). In other words students may be able to download MP3’s or create a mash-up for YouTube, but that does not mean they are skilled in using the Internet during problem based inquiry tasks.

Also, the research shows different results in trends overtime. The studies conducted by the Princeton Survey Research Associates (2002, 2005) show an increase in the distrust of websites. On the other hand, the Pew Internet and American Life Surveys (Fox & Rainie, 2002; Fox, 2006) show an uptick in the number of respondents who “never” or “rarely” evaluate websites. This may be explained by differences in the reading task. The Princeton Survey focused primarily on websites that provided products or services for purchase. The Pew studies were concerned with health. This could indicate that the critical evaluation skills used by students are task and domain specific. Yet the studies indicate that as the Internet matures the critical evaluation skills exhibited be people are also evolving.

Finally, the majority of studies using self-report data focused on adult populations. The studies may not provide insight into the cognitive processes of younger readers. Compounding this issue is the lack of research in academic settings. Only a few studies collected for his review dealt with student populations, and of those studies all used undergraduate students. A greater effort needs to be made to understand the reading habits of younger learners.

**Interviews, case studies, verbal protocol analysis.** A variety of qualitative methods have been used to identify the skills and strategies readers use to critically evaluate websites. These methods vary based on the positioning and epistemological stances of the researcher, but overall seek to understand the process of judging a website, identifying the cognitive skills used in website evaluation, and identifying external social factors that affect how people judge websites.
Across the studies collected for this review three qualitative methods were used: interviews (Reih, 2002; Reih & Belkin, 1998), case studies (Damico & Baildon, 2006), and verbal protocol analysis (Coiro, 2007; Damico & Baildon, 2007; Reih & Belkin, 1998, Zawilinski et al., 2007). Research using semi-structured interview data asked participants to indicate which skills they use while reading online (Merriam, 1998). Case Studies (Yin, 2003) used examples from larger samples to explore the relationship between individual dispositions and critical evaluation skills. Finally verbal protocol analysis (Afflerbach & Pressley, 1995) had participants think aloud and explain their decisions, as they read online (Zawilinski et al., 2007).

Two major procedures were common across the qualitative studies: website rankings or giving students a task and having them complete an Internet inquiry. In website ranking tasks (Brem, Russell, & Weems, 2003; Fogg et al., 2003) students were given a list of websites to rank on a scale. Students took notes, which were later analyzed. Participants discussed these rankings in interviews or during verbal protocol analysis, or they wrote explanations of their rankings.

Assigning Internet inquiry tasks to participants was also a procedure used in qualitative studies. These tasks were then recorded, often with screen capture software, and used in analysis with verbal protocol analysis (Reih, 2002; Zawilinski et al., 2007), semi-structured interviews (Reih & Belkin, 1998), or case studies (Damico & Baildon, 1998, 2007). The tasks varied on the restricted nature of the Internet. Some researchers had students evaluate a single website (Zawilinski et al., 2007); others used a listed if pre-selected websites (Agosto, 2002; Sanchez et al., 2006) while some studies gave students open access to the full web (Coiro & Dobler, 2007; Damico & Baildon, 1998, 2007; Reih 2002, Reih & Belkin, 1998, Zawilinski et al., 2007). The Internet is an unbounded space, by restricting students to a single website the results of these studies may be limited.

The procedures and methods used to investigate critical evaluation varied but across the individual projects some important commonalities emerge. First there is a common agreement that new skills, strategies and dispositions are needed above those required for linear print reading.
Second the critical evaluation of websites may require a more flexible worldview. Third social factors may play a more dominant role than cognitive factors in the evaluation of websites. Finally, new screen capture software will serve as an important methodological tool in the studies on critical evaluation. The results of these studies help to inform what critical evaluation skills should be initially measured. Based on the literature review it was decided to examine two scales of evaluation: credibility and relevancy.

Assessment of critical evaluation skills and strategy use. Measuring critical evaluation is a challenge for researchers. Only a few studies attempted to measure students’ judgments of online texts. Four formats were commonly used to assess critical evaluation skills: website ranking, written statements, and online reading comprehension assessments [ORCA].

The most popular assessment tool was the ranking of websites (Graesser et al., 2006; Sanchez et al., 2006; Zhang & Duke, 2007). Basically students are given a list of websites and then have to rank them from least reliable to most reliable. These are then scored against a predetermined list of rankings. Graesser et al. (2007) and Sanchez et al. (2006) created a mock Google page with seven websites: three reliable sites, three unreliable sites, and one ambiguous site. The goal was to create a naturalistic environment but limit the number of Webpages participants could read. After a fifty-minute inquiry students were asked to rank the sites 1-7 and rate the information on the websites on a six-point scale. Zhang & Duke (2007) gave students a list of four websites and had them rank websites from one to four. They also had students decide if the information on a single website was trustworthy.

Written statements were also a common measurement tool. They were often used in conjunction with website rankings (Zhang & Duke, 2007) or as measurements of learning gains (Graesser et al., 2007 & Sanchez et al., 2006). Zhang and Duke had participants write a paragraph explaining their highest ranking and an additional paragraph explaining their lowest ranking.
Sanchez et al. had students also justify their rankings. Furthermore there was no difference in the judgment scores of students on the single website, but the reasoning score on the Sanchez et al., (nd) found that students trained in the SEEK method were more likely to justify their rankings using evidence in the web site and information about the source whereas participants in the control simply used content.

Graesser et al., (nd), testing a web tutor based on the SEEK method, had students write an essay on the topic of inquiry. These essays were analyzed to evaluate students' use of a critical stance. There was a significant effect on treatment even though there were no significant differences in the ranking of websites between treatment and control. In other words students could not correctly rank websites but there was significant improvement in their justification of their rankings. This would suggest students were more cognizant of the skills they should apply but applied the skills incorrectly.

Researchers have also developed online reading comprehension assessments that embed critical evaluation scales into full Internet inquiry tasks. Leu et al., (2005) embedded critical evaluation items into a larger assessment of online reading comprehension. This assessment had students: locate two websites when they were given a partial description of the website or URL, evaluate the two sites and choose the best source, and explain their reasoning. The second task asked students to locate a website with a graphic of the respiratory system that met specific criteria, and communicate how someone should check for accuracy.

Coiro (2011) also included critical evaluation in her ORCA assessments. Factor analysis for both ORCAS revealed that a one-factor solution was most appropriate which might suggest that the processes of online reading comprehension may not be independent of each other.

The ORCA-Iditarod (Coiro, Castek, Henry, & Malloy, 20007) had students read about and then take a stand on the Iditarod. To measure critical evaluation skills were given one source and
had to answer a series of questions. Unlike Coiro (2011) the scores on this ORCA did not load on one-scale using principal component analysis. (McVerry, O'Byrne, & Roberts, 2009).

A summary of critical evaluation assessments. Initial work in the assessment of critical evaluation skills needs to continue. Website ranking has been the most popular method to assess critical evaluation. However no psychometric properties of these assessments were reported in the artifacts collected for this review. Therefore it was decided not to use website ranking as a method for measuring critical evaluation skills.

The fact that researchers find statistical differences, after interventions in written statements but not in concurrent website ranking is also interesting (Zhang & Duke, 2007). This could indicate students are making errors of oversimplification. They know what responses about strategy use to give and parrot these responses back without actually applying the strategies to websites. Therefore it was decided not to use written justification of website evaluation in the measure of critical evaluation skills.

Furthermore indications that online reading comprehension skills may not be independent of each other will make measuring critical evaluation skills challenging. Independence of items is an assumption on almost all reading comprehension tests. Of note were the factor loadings on the ORCA-Iditarod. Relevancy judgments loaded with locating items and credibility judgments loaded with evaluation items. If reading online does involve a set of multidimensional skills then developing assessments will be a unique challenge.

Research on Dispositions

Current models of reading comprehension (Alexander & Jetton, 2002; Snow, 2002) have noted the importance of both affective and cognitive variables (Baker & Wigfield, 1999; Guthrie & Wigfield, 1997). These dispositions and open mind sets (Deschreyver & Spiro, 2010) are central to online reading comprehension (Leu et al., 2004).
According to Claxton (1999), the process of learning requires capabilities but these capabilities cannot account for all the learning that must take place. Learning must also involve specific dispositions, or affective variables, which are a “domain of human attributes not attributed to knowledge, skill, or behavior” (Katz, 1988, p. 30). Carr & Claxton (2002) define dispositions as a “tendency to edit, select, adapt, and respond to the environment in a recurrent, characteristic kind of way.” Learning dispositions are “patterns of behaviors, situated in the context of the environment, that when recognized and developed by those who can manipulate the environment may lead to gains in the acquisition of knowledge, skills and understandings” (O’Byrne, & McVerry, 2009).

Due to the nature of online information (Alvermann, 2004; Gross, 2004) dispositions might be even more significant as individuals read online information (Coiro, 2011). This is due to the increased need to focus on the goal of the task, evaluating the sources being read, and having the persistence during Internet searches. In this study learning has been viewed as an interaction of students’ capabilities and dispositions (Carr & Claxton, 2002) as they read in an online space.

Recent studies have investigated students’ online reading comprehension ability (Coiro, 2007; Henry, 2007; Castek, 2008). Yet we do not know how dispositions affect online reading comprehension based on the restricted nature of the information space. In other words are dispositions more important in less restricted spaces or more restricted spaces? This study will investigate dispositions in both less restricted and more restricted information spaces.

**Measuring dispositions of online reading comprehension.** McVerry and O’Bryne (2009) using protocol and field notes from the TICA project (Leu et al. 2007-2011) identified five dispositions that are central to online reading comprehension: (a) reflective thinking, (b) critical stance, (c) collaboration, (d) flexibility, and (e) persistence. O’Byrne and McVerry then created and validated a self-report instrument to measure these dispositions. Using exploratory factor analysis
these five scales were identified. The instrument as a whole was shown to have adequate reliability. However two scales, flexibility and critical stance did not have adequate reliability.

Researchers have critiqued assessment methods that used self-report surveys and interviews for measuring dispositions (Claxton & Carr, 2004). They claim that dispositions are so situated (Sadler, 2002) they cannot be measured when the context is stripped away because they do not provide an adequately rich context for their measurement. These researchers (Carr & Claxton, 2004; Sadler, 2002) suggest that observations over extended periods of time are the only way to truly assess learning dispositions. While these tools may better capture learning dispositions they also carry reliability and practicality issues.

Another recent advancement in the measurement of dispositions is facial recognition software (D’Mello & Graesser, 2010). These tools track students’ affective states (boredom, flow/engagement, confusion, frustration, and neutral) in real-time by monitoring conversational cues, gross body language, facial features, and the language of their responses during interactions with an intelligent tutoring system. Tracking emotional states may be the future of measuring dispositions. However the cost and training of the software makes the instrument impractical at this time. Therefore this study will rely on a self-report measure as it is the most cost effective, practical, and valid tool available.

**Dispositions summary.** New dispositions are required for learners to read in online environments. These “opening mindsets” will be critical as inquiries move beyond simple “find the answer tasks” (Spiro & Deschryver, 2010) and into less restricted information spaces. Dispositions will be central to building knowledge in the moment through the act of “reading with mouse in hand.” (McWilliams & Clinton, 2012). In other words students will need to be flexible in constructing knowledge on the fly, use reflective thinking to remember their goal, be persistent in searching for the goal, and have a critical stance to question the unlimited amount of information online.
This study used the revised instrument developed by O’Byrne & McVerry (2009). The instrument includes additional items for the flexibility and critical stance scales. While there are concerns about self-report measures, other disposition assessments were impractical. Classroom observations would require too much time and have not been shown to be reliable and facial recognition programs are not currently readily available.

This study will test the relative contribution of dispositions in a model that includes a less restricted information space and a model that includes a more restricted information space. It is hypothesized, from both theoretical perspectives, that dispositions will be a significant predictor in both the less restricted model and the more restricted model. However based on the principles of cognitive flexibility theory it is hypothesized that dispositions will be a stronger predictor in the less restricted information space.

**Research on Verbal Intelligence**

There is a long tradition of research indicating that verbal intelligence has a connection both to overall intelligence and reading comprehension (Thorndike, 1974). Since the goal of this study was to examine the role background knowledge, critical evaluation, and dispositions play in predicting scores on a measure of online reading comprehension it was decided to partition out the variance caused by verbal intelligence. Using hierarchical regression methods similar to Anderson et al. (1988), it was decided to control for verbal intelligence given its high correlations with reading comprehension.

**Defining verbal intelligence.** Hunt (1978) defined verbal intelligence as involving “processes based on knowledge.” Which Hunt noted, “The ability to deal with words and the concepts they represent implies the acquisition of information” (p. 109). Using schema theory, from an information processing perspective, Hunt claimed that verbal intelligence indicated a “deep structure representation of a linguistic statement of the thoughts involved” (p. 110). Hunt,
Lunneborg, and Lewis (1975) also found that knowing a person’s verbal intelligence can predict their ability to manipulate stimuli rapidly.

Previous studies that examine searching for information or multimedia learning control use verbal intelligence as a variable of interest. Allen (1992) controlled for verbal intelligence, using the verbal comprehension measure of The Kit of Factor Referenced Test to examine how users search CD-ROMS. Allen stated, “The ability to select appropriate search vocabulary, to explore alternative expressions of ideas, and to understand the content of retrieved materials, is central to such searching.” The same conclusion could be drawn for searching the Internet for information.

It has been argued that synonym vocabulary tests are best for measuring verbal intelligence. Carrol (1974) argued that verbal intelligence needs to measure lexiosemantic information stored in long-term memory. He suggested that any other form of assessment, besides a synonym test, would conflate verbal intelligence measures with other variables. Furthermore vocabulary tests, such as verbal comprehension measure of The Kit of Factor Referenced Test correlate highly with the capacity of verbal working memory (Avons, Wragg, Cupples, & Lovegrove, 1998; Gathercole & Baddeley, 1993; Gathercole, Service, Hitch, Adams, & Martin, 1999; Masoura & Gathercole, 1999). In fact recent reviews of comprehension research found "Vocabulary knowledge and syntactic competence, account for more of the variance in reading comprehension than do individual differences” (Snow, 2002, p. 84).

**Summary of verbal intelligence.** Given that the goal of this study is to examine the contributions that background knowledge, critical evaluation skills, and dispositions make to models of online reading comprehension it was decided to control for verbal intelligence. This will allow the models to examine variance beyond that caused by differences in long-term, lexiosemantic memory. Verbal intelligence was measured using a previously validated assessment, the verbal comprehension vocabulary test of the Kit of Factor Referenced Cognitive Test (Ekstrom,
French, Harman & Derman, 1976). This is a previously validated measure tested with 7th graders. The internal consistency of the measure has ranged from .68-.88.

**Chapter Summary**

In summary this chapter reviewed the literature base of the dependent and independent variables included in this study. The literature review for this study helped to guide the design and other decisions used in this study. Empirically, research has demonstrated that there are new skills, strategies and dispositions required for online reading comprehension. Unfortunately few studies have examined how the restricted nature of the information space shapes the role of cognitive and affective variables.

Findings from the investigation into background knowledge, critical evaluation skills, and dispositions all indicate that more work is needed if we are to enrich our theoretical models of reading comprehension. First the results surrounding the contributions of background knowledge have often been contradictory. This study will add to our understanding of background knowledge and online reading comprehension. By focusing on content knowledge, and not system knowledge, the results may demonstrate if background knowledge is a strong predictor of comprehension in online spaces.

In terms of critical evaluation skills there is very little research exploring the role it plays in terms of overall online reading comprehension. This study predicts, after controlling for verbal intelligence, that it will be the single greatest factor in predicting performance in a model that also includes background knowledge and dispositions. The review of research also indicated that there was no existing measure of critical evaluation skills. Based on a review of the evidence it was decided to create a new measure that had students evaluate multiple sources in a forced response assessment.
The work on dispositions of online reading comprehension is in its infant stages. This study hopes to continue the work. It was decided that a revised DORC (O’Byrne & McVerry, 2009) would be used in this study.

This current study seeks to build on previous work by answering four research questions:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information spaces?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?

The present study will contribute insights to the existing literature investigating online reading comprehension. Most specifically this study will take the restricted nature of the information space into account as it investigates the contributions that reader characteristics of verbal intelligence, background knowledge, critical evaluation skills, and dispositions, make to
models of online reading comprehension. By testing multiple models of online reading comprehension assessment this study will add to the research base of the literacy field.

This study also will help advance efforts to measure online reading comprehension skills. As part of the study two measures of online reading comprehension and a measure of critical evaluation skills will be created and validated. Furthermore a previous instrument measuring dispositions of online reading comprehension will be revised and tested.

This study will also offer important insights into the strategy use of students with varying degrees of online reading comprehension ability. The quantitative results will be used to identify participants in the think aloud portion of this study. This data will be crucial in exploring the findings found in the quantitative models. The data will also offer important insights into the types of strategy instruction that student will need in order to make meaning in a networked society.

This study will contribute to existing literature; advance efforts to measure online reading comprehension, and offer insights into the skills strategies used by students engaged in online inquiry tasks. These conclusions will help the research community develop more robust models of reading comprehension while offering important instructional strategies for educators.
CHAPTER III

Methods and Procedures

This study sought to examine some of the complexities that appear to be a part of online reading comprehension. Specifically this study examined the relative contributions made by a reader’s background knowledge, critical evaluation skills, and dispositions in two models to predict scores on an online reading comprehension measure. The first model used a less restricted information space where students could locate any source on the topic. The second model used a more restricted information space that required students to locate specific sources. The study used a mixed-method design (Tashakkori & Teddlie, 2003) that combined qualitative and quantitative research approaches.

The present study was conducted in a series of three phases. In phase one, multiple instruments were developed to serve as independent and dependent variables. In phase two, regression analysis was used in an attempt to understand factors that explained variance estimates in scores of an online reading comprehension measure. In phase three, verbal protocol methods (Afflerbach, 2002) were used to explore strategy use among participants who varied in their online reading comprehension proficiency. These two approaches: a regression analysis and verbal protocol analysis led to an interpretation of the data through a convergence of both quantitative and qualitative data. This mixed method study explored the following research questions:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal
intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?

Quantitative Procedures

Setting and Participant Selection

There were 131 seventh grade students initially included in the quantitative procedures of this study. Seventh grade was chosen because it represents a point somewhere near the middle of grades 1-12 and thus results may be somewhat similar to students from a wider range of adjacent grade levels. Furthermore, the use of the Internet as a tool for reading informational text is more common at this grade level (Fox & Rainie, 2002). Seven school districts, from a convenience sample, were recruited through personal contacts. From this initial sample three schools were selected to ensure representation from high, medium, and low socio-economic districts as measured by the District Reference Group [DRG](State of Connecticut, 2010).

DRGs represent a statistical category created by the state of Connecticut for statistical reporting. DRGs are calculated through median family income, education and occupation level of parents, family structure, home language, and overall enrollment (Connecticut State Department of Education, 2010) and range from levels A-I, with A being the highest SES school district and I being the lowest. To ensure a reasonably representative sample, across DRG groups, the three schools selected for this study included a DRG B school, a DRG E school, and a DRG I school district. The
three school districts not only varied on their DRG reference group but also on their demographic make-up and level of special services offered. This is explained in Table 3.1.

Table 3.1

Demographic Data of Schools

<table>
<thead>
<tr>
<th>School</th>
<th>Reduced Lunch</th>
<th>Priority District</th>
<th>Non-English Speaking Home</th>
<th>ESL Services Provided</th>
<th>Special Education</th>
<th>Non-Asian Minority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DRG I</td>
<td>78%</td>
<td>Yes</td>
<td>30%</td>
<td>21%</td>
<td>17.3%</td>
<td>64%</td>
</tr>
<tr>
<td>2 DRG E</td>
<td>35.2%</td>
<td>No</td>
<td>7.6%</td>
<td>1.3%</td>
<td>12.7%</td>
<td>21%</td>
</tr>
<tr>
<td>3 DRG B</td>
<td>5.3%</td>
<td>No</td>
<td>1.8%</td>
<td>0%</td>
<td>9.2%</td>
<td>3.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School</th>
<th>African-American</th>
<th>Caucasian</th>
<th>Hispanic</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DRG I</td>
<td>11.1%</td>
<td>16.7%</td>
<td>69.4%</td>
<td>2.8%</td>
</tr>
<tr>
<td>2 DRG E</td>
<td>11.1%</td>
<td>64%</td>
<td>20%</td>
<td>8%</td>
</tr>
<tr>
<td>3 DRG B</td>
<td>2.3%</td>
<td>92.9%</td>
<td>0%</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

Quantitative Measures

Verbal intelligence. Previous research has shown that verbal intelligence correlates strongly with reading comprehension (Curtis, 1987). Studies that examine searching for information or multimedia learning control have used verbal intelligence as a controlling variable. Allen (1992), for example, controlled for verbal intelligence, using the verbal comprehension measure of The Kit of Factor Referenced Test to examine how users search CD-ROMS. Verbal intelligence in the present study was also measured using the verbal comprehension vocabulary test of the Kit of Factor Referenced Cognitive Test (Ekstrom, French, Harman & Derman, 1976). The test is designed for students from 7th to 12th grade. Reliability in previous administrations has varied from .76-.89.

The verbal comprehension test consists of 36 forced response items with three distractors. The test is organized in two, 18-question parts. Students have four minutes to complete each part. Each question contains four multiple-choice synonyms for a target word. See Figure 3.1 for an example item. Students received one point for each correct answer.
Figure 3.1 Sample Verbal Comprehension Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Sample Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. chef</td>
<td>1-cheese 2-style 3-head cook 4-candle</td>
</tr>
<tr>
<td>20. milestone</td>
<td>1-marker 2-plant 3-soft music 4-grindstone</td>
</tr>
<tr>
<td>21. chowder</td>
<td>1-dog 2-chemical 3-pigment 4-stew</td>
</tr>
<tr>
<td>22. emancipator</td>
<td>1-theorist 2-liberator 3-prophet 4-spy</td>
</tr>
<tr>
<td>23. consultative</td>
<td>1-monitor 2-conservative 3-advisory 4-narrative</td>
</tr>
</tbody>
</table>

**Background knowledge.** Background knowledge was estimated using a three-item topical knowledge questionnaire. The questionnaire was delivered using a computer-based survey. Participants were asked to respond to a prompt asking them to list all the facts or details they knew about the American Revolution. Respondents had to click a button, “Submit,” to move on. A second screen then asked, “Try to think of one or two more details about the American Revolution. Do not worry if you cannot remember any more. Just type, ‘Move On.’” Once they hit “Submit” students were brought to a third screen and asked, “Think real hard. Is there anything else you can remember about the American Revolution? It is okay if you cannot, just type, Move on.”

Background knowledge scores were determined based on the total number of idea units (Leslie & Caldwell, 1995) students provided. An idea unit was defined as a proposition. Scoring of idea units was informed by Coiro’s (2012) adaptation of Wolfe and Goldman’s (2005) measure of topic-specific background knowledge. One point was given for an accurate and relevant detail; a half point was awarded for any idea unit that somewhat accurate or relevant; a zero was given for any idea unit that was inaccurate or irrelevant. Table 3.2 gives examples of each type of response.
Table 3.2 Background knowledge Responses To the Prompt: “List everything you know about the American Revolution”

<table>
<thead>
<tr>
<th>Inaccurate or irrelevant statement (0 points)</th>
<th>Generally accurate statement (.5 points)</th>
<th>Specifically accurate statement (1 point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• People lived in fear?</td>
<td>• It was a war in America</td>
<td>• The American revolution involved George Washington</td>
</tr>
<tr>
<td>• There were thirty colonies during the war.</td>
<td>• usa army was fighting for american</td>
<td>• because of the famous saying &quot;no taxation without representation.&quot;</td>
</tr>
<tr>
<td>• To free the slaves in the south</td>
<td>• It was a war in the 1700</td>
<td>• The american revolution was when our country fought against the british rule</td>
</tr>
</tbody>
</table>

To calculate inter-rater reliability a second rater scored 20% of the responses randomly selected. First the researcher and the rater scored an anchor set of five examples. Then they each scored the 20% sample alone. Inter-rater reliability coefficients for total scores on the background knowledge measure was $r = .82$. They ranged across the three prompts from .79-.87.

**Critical evaluation.** The Critical Online Information Literacies (COIL) instrument was based on measures developed by Kiili, Laurinen & Marttunen, (2008), Brem, Russell, & Weems (2001), and Leu et al. (2010). The final instrument was delivered using SurveyMonkey, an online survey tool. The items measured each of the following constructs: author, bias, publisher, and source.

There were two types of items. The first consisted of screenshots of websites. These were either single websites or four screenshots. The second type of item required students to open links to four different websites. These websites included secondary links to author and publisher information. All of the websites involved, either static or dynamic, were recreations of actual websites that were hosted on a university owned server. An example of each item type is available.
in Figures 3.2, 3.3, and 3.4. The tasks presented in each item were situated in activities that adolescents would be engaged in as they searched for online information

*Figure 3.2. Single Screen Shot Example from COIL Assessment*
Figure 3.3 Four Screen Shot Example from COIL Assessment. Note: The four screenshots were presented vertically.
The instrument underwent three phases of development. Phase I involved defining constructs and content validation. Phase II involved a pilot test for instrument validation. Phase III used the results of the validation study to inform final item development before the instrument was used. This three-phase process led to the development of the final 14-item assessment.

**Phase I.** The construction of the COIL began with a literature review to determine factors that influence the credibility and relevancy judgment of sources (Judd, Farrow & Tims, 2006; Kiili, Laurinen & Marttunen, 2008). Previous work by other researchers was used to identify subconstructs that influenced credibility and relevancy judgments. (See Tables 3.3 and 3.4). These subconstructs were used to develop multiple-choice items for credibility and relevancy.
### Table 3.3

**Sub-Constructs of Credibility**

<table>
<thead>
<tr>
<th>Sub-Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate author</td>
<td>Judging the credibility of a website based on details about the author (Harris, 1997)</td>
</tr>
<tr>
<td>Evaluate source of claim</td>
<td>Judging the credibility of a text based on the source of information that is included (Rieh &amp; Belkin, 1998; Strømsø &amp; Bråten, 2010)</td>
</tr>
<tr>
<td>Evaluate bias</td>
<td>Judging the credibility of a website based on an inclination toward holding a particular perspective (Coiro, 2003; Fabos, 2008)</td>
</tr>
<tr>
<td>Evaluate content</td>
<td>Judging the credibility of website based on completeness of information (Harris, 1997; Kiili et al., 2008)</td>
</tr>
<tr>
<td>Evaluate argument</td>
<td>Identifying and comparing perspectives (Kiili et al., 2008)</td>
</tr>
<tr>
<td>Evaluate accuracy</td>
<td>Comparing claims with a secondary text (Meola, 2004)</td>
</tr>
</tbody>
</table>

### Table 3.4

**Sub-constructs of relevancy**

<table>
<thead>
<tr>
<th>Sub-Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate relevance of topic</td>
<td>Identifying websites or search results that will help answer a question (Kiili, et al., 2008)</td>
</tr>
<tr>
<td>Evaluate relevance of a website</td>
<td>Identifying hyperlinks or headings that will answer a question (Kiili, et al., 2008)</td>
</tr>
<tr>
<td>Evaluate purpose</td>
<td>Identifying the purpose or intended audience of a text (Harris, 1997)</td>
</tr>
<tr>
<td>Evaluate currency</td>
<td>Judging a website based on age of publication (Meola, 2004; Kiili et al., 2008)</td>
</tr>
<tr>
<td>Evaluate Usability</td>
<td>Judging a website based on ease of use and readability (Meola, 2004; Kiili et al., 2008)</td>
</tr>
</tbody>
</table>
Content validation techniques. In order to establish item validity, the instrument underwent a content validation phase with experts familiar with critical evaluation research to develop definitions for the constructs (McKenzie, Wood, Kotecki, Clark, & Brey, 1999). The six experts included professors and graduate students familiar with research in the critical evaluation of online information. The experts rated the dimensionality of each of the twenty multiple-choice items by indicating which of the construct and subconstructs the item measured. Items identified by 90% of participants as measuring the hypothesized construct were kept for further analysis (Gable & Wolfe, 1993, McKenzie et al., 1999).

A Content Validity Index (CVI) (Rubio, Berg-Weger, Tebb, Lee, & Rauch, 2003) was created for each item using the feedback provided by the experts to test for multidimensionality of items. A CVI is calculated by having each rater rank an item from one (irrelevant) to four (extremely relevant). The CVI is the proportion of items that received at least a three or four by the raters. For inclusion in the first iteration of the instrument, the CVI for each item needed to exceed a threshold of 0.70 (Rubio et al., 2003). Finally, the experts were encouraged to leave written feedback that was used to ensure the adequacy and accuracy of definitions of constructs and items constructed (McKenzie et al., 1999). Table 3.5 lists the results from the content validation study. Items are listed in the order they appeared on the assessment.
Table 3.5

Results of the Content Validation Study

<table>
<thead>
<tr>
<th>Item</th>
<th>% Correct</th>
<th>% of Experts Who Correctly Identified The Construct</th>
<th>CVI</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85</td>
<td>87.5 author</td>
<td>2.875</td>
<td>Some confusion over author and source. Collapsed source into content for second round.</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
<td>90 usability</td>
<td>2.33</td>
<td>Experts felt readability is too subjective and usability too situated. This item and subconstruct were deleted.</td>
</tr>
<tr>
<td>3</td>
<td>62.5</td>
<td>12.5 argument</td>
<td>NA-</td>
<td>Some reviewers liked argument as a subconstruct but it caused confusion. The items were collapsed under content.</td>
</tr>
<tr>
<td>4</td>
<td>88</td>
<td>100 currency</td>
<td>2.67</td>
<td>Some argued copyright of website is not clear indicator of date of info. Moved answer choice away from Avalanche.</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>62 purpose</td>
<td>1.33</td>
<td>People like the item but feel purpose is really a relevancy judgment. CVI would be higher if purpose was considered a relevancy judgment.</td>
</tr>
<tr>
<td>6</td>
<td>65</td>
<td>64 relevancy</td>
<td>2.2</td>
<td>The search results need to be less relevant if this is a relevancy judgment. Better distracters were picked.</td>
</tr>
<tr>
<td>7</td>
<td>90</td>
<td>34 relevancy</td>
<td>1.8</td>
<td>Most reviewers felt that knowing website genres was not at important to measuring critical evaluation. The item was deleted.</td>
</tr>
<tr>
<td>8</td>
<td>87.5</td>
<td>66 currency</td>
<td>2.8</td>
<td>Item kept. Examined why people did not pick currency.</td>
</tr>
<tr>
<td>9</td>
<td>87.5</td>
<td>12.5 argument</td>
<td>NA</td>
<td>Edited item so it is which website uses the best details to support the claim Pluto is not a planet. Collapsed argument under content.</td>
</tr>
<tr>
<td>10</td>
<td>100%</td>
<td>83 source</td>
<td>2.75</td>
<td>Source was collapsed under content</td>
</tr>
<tr>
<td>11</td>
<td>85</td>
<td>85.7 author</td>
<td>2.75</td>
<td>No changes</td>
</tr>
<tr>
<td>12</td>
<td>28%</td>
<td>20 usability</td>
<td>NA</td>
<td>Experts were unsure of the grade level, again some commented that reading level is subjective. Deleted all usability items.</td>
</tr>
<tr>
<td>13</td>
<td>83.3</td>
<td>50 argument</td>
<td>2.33</td>
<td>People like the item. This was collapsed under</td>
</tr>
<tr>
<td>No</td>
<td>CVI</td>
<td>Item Description</td>
<td>CVI</td>
<td>Notes</td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>------------------</td>
<td>-----</td>
<td>-------</td>
</tr>
<tr>
<td>14</td>
<td>75</td>
<td>85.7 relevance of topic</td>
<td>2.8</td>
<td>No changes</td>
</tr>
<tr>
<td>15</td>
<td>100</td>
<td>57.1 purpose</td>
<td>2.25</td>
<td>Again experts felt that evaluating purpose was a relevancy judgment.</td>
</tr>
<tr>
<td>16</td>
<td>50</td>
<td>.25 usability</td>
<td>NA</td>
<td>Deleted item or make it a relevancy judgment</td>
</tr>
<tr>
<td>17</td>
<td>85.7</td>
<td>42.8 argument</td>
<td>2.33</td>
<td>Argument was collapsed into content.</td>
</tr>
<tr>
<td>18</td>
<td>85.7</td>
<td>75 relevance of hyperlink on a website</td>
<td>2.67</td>
<td>Renamed subconstruct</td>
</tr>
<tr>
<td>19</td>
<td>100</td>
<td>75 relevance of info</td>
<td>2.67</td>
<td>Changed the name of other subconstruct.</td>
</tr>
<tr>
<td>20</td>
<td>50</td>
<td>50 source</td>
<td>2.33</td>
<td>Source was collapsed under content.</td>
</tr>
</tbody>
</table>

**Results of phase I.** As a result of the content validation, revisions were made to items to match subconstructs hypothesized by the panel of experts. These changes are listed in Table 3.6. The experts felt that purpose was more of a relevancy judgment rather than a credibility judgment. Furthermore the panel could not agree on which items measures the subconstruct of evaluate content. The content validity index for these items was too low. Given the disagreement over the subconstruct of purpose and the low CVI scores for evaluating a decision was made to revise the construct of relevancy. Therefore the subconstruct of purpose was moved from the construct of credibility to the relevance construct, and the subconstruct of evaluate content was deleted. The newly defined evaluate relevance construct was now defined by two new subconstructs. This included evaluate search results and evaluate information on a website. This led to the revision of items: 6, 14, 18, and 19.

Additionally the experts felt that the subconstruct of usability was too subjective. The items asked students to evaluate the reading levels of websites. The panel felt this subconstruct was too dependent on individual differences. Thus the subconstruct of usability was dropped. The items
were replaced with items to represent the subconstruct of bias. This led to the revision of items two and 12.

Item 20 was also revised due to the low number of experts scoring the item correctly. In the original item the participants were presented with four screenshots of websites. They were asked which website used information from the most reliable source. In the revised item specific claims and their sources were highlighted. The subconstruct was renamed “evaluate sources” to evaluate sources of information.
Table 3.6

*Revisions based on the Content Validation of the COIL*

<table>
<thead>
<tr>
<th>Draft Assessment Item in Content Validation Study</th>
<th>Assessment Items Included In Pilot Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evaluate author</td>
<td>1. Evaluate author</td>
</tr>
<tr>
<td>2. Evaluate usability</td>
<td>2. Evaluate bias</td>
</tr>
<tr>
<td>3. Evaluate argument</td>
<td>3. Evaluate argument</td>
</tr>
<tr>
<td>4. Evaluate currency</td>
<td>4. Evaluate currency</td>
</tr>
<tr>
<td>5. Evaluate purpose</td>
<td>5. Evaluate purpose</td>
</tr>
<tr>
<td>6. Evaluate relevance of topic</td>
<td>6. Evaluate relevancy search results</td>
</tr>
<tr>
<td>7. Evaluate content</td>
<td>7. Evaluate author expertise</td>
</tr>
<tr>
<td>8. Evaluate currency</td>
<td>8. Evaluate currency</td>
</tr>
<tr>
<td>9. Evaluate accuracy of claims</td>
<td>9. Evaluate accuracy of claims</td>
</tr>
<tr>
<td>10. Evaluate source or claim</td>
<td>10. Evaluate source of claim</td>
</tr>
<tr>
<td>11. Evaluate author</td>
<td>11. Evaluate author</td>
</tr>
<tr>
<td>12. Evaluate usability</td>
<td>12. Evaluate bias</td>
</tr>
<tr>
<td>13. Evaluate argument</td>
<td>13. Evaluate argument</td>
</tr>
<tr>
<td>14. Evaluate relevance of topic</td>
<td>14. Evaluate relevance of search results</td>
</tr>
<tr>
<td>15. Evaluate purpose</td>
<td>15. Evaluate purpose</td>
</tr>
<tr>
<td>16. Evaluate content</td>
<td>16. Evaluate relevance of search results</td>
</tr>
<tr>
<td>17. Evaluate accuracy of claims</td>
<td>17. Evaluate accuracy of claims</td>
</tr>
<tr>
<td>18. Evaluate relevance of topic</td>
<td>18. Evaluate relevance of information on website</td>
</tr>
<tr>
<td>19. Evaluate relevance of website</td>
<td>19. Evaluate relevance of information on website</td>
</tr>
<tr>
<td>20. Evaluate sources</td>
<td>20. Evaluate source of information</td>
</tr>
</tbody>
</table>
**Phase II.** To test the reliability, or internal consistency of the scales, a coefficient alpha was calculated (Pett et al., 2003) using results from another study (O’Byrne, 2011). A paper and pencil version of the twenty items was administered to 197 seventh graders. The achieved coefficient alpha for the two hypothesized scales was .358 for relevancy and .312 for credibility. The combined instrument had an overall coefficient alpha of .339. Investigation of the inter-item correlations revealed that the correlations between the items in the scale were low or negatively correlated. Because this assessment did not meet the threshold of 0.70 for a coefficient alpha the measure was shown to be not reliable.

**Phase III.** Given the inadequate reliability of the last iteration a decision was made to revise the instrument. It was decided to make three changes: (a) reduce the number of scales and subscales; (b) make distractors easier to recognize; and (c) simplify the testing format.

A decision was made to create items hypothesized only to measure credibility. This decision was both theoretical and practical. In both theoretical pieces (Coiro, 2003; Hartman et al., 2010) and in past instrument validation studies (McVerry, O’Byrne, and Robbins, 2009) researchers in the field of new literacies of online reading comprehension have suggested that while a relevance judgment is an evaluation of websites, the cognitive processes involved differs in important ways from judging credibility. In fact McVerry et al. (2009) found that scores on relevancy items hypothesized to load with other critical evaluation scores actually loaded on scales containing the locating scores.

Reducing the number of constructs also has advantages for improving the practicality of the instrument. The total number of items is reduced which makes it easier to administer. While fewer items reduce the overall coefficient alpha (Cronbach, 1972) a one-factor model may have greater internal consistency than a two-factor model. Thus it was decided to only measure the evaluation subconstructs of author expertise, publisher credibility, source credibility, and author bias.
**Phase III: Content validation.** This phase of the instrument was validated in three steps. The first step involved an additional round of a content validation survey by an expert panel. The second step used structurally prompted think alouds (Afflerbach, 2002) during cognitive labs (Ericsson & Simon, 1999) to elicit feedback from 7th grade students on item format and difficulty. Finally the instrument was administered to 120 7th graders from high, low, and medium SES school districts to test for reliability.

The first step in revising the instrument involved another rigorous content validation process (McKenzie et al., 1999). First 12 items were developed, three items for each of the new constructs. Then 18 experts were identified. The experts rated the construct validity of each of the twenty multiple-choice items by choosing which of the construct the item measured. All items identified by 90% of participants as measuring the hypothesized construct were kept for further analysis (Gable & Wolfe, 1993, McKenzie et al., 1999). Next a Content Validity Index (CVI) (Rubio et al., 2003) was calculated for each item. The CVI was calculated as a proportion of experts who indicated if an item was extremely relevant (4) or very relevant (3) on a four point Likert scale.

Following the calculation of a CVI, a Content Validity Ratio was also calculated to evaluate the extent to which a measure represents a given construct (McKenzie et al., 1999). To calculate a CVR, you first determine the difference between the number of experts who marked an item as essential and half the total number of experts. Then the CVR is calculated by dividing this number by half the total number of experts. For inclusion in the final version of the instrument the CVR for each item was required to exceed 0.70 (McKenzie et al., 1999). Thus, to be included items were required to have a CVI of 2.67 and a CVR of at least 0.70. Table 3.7 shows the initial results of this process. Items 2, 5, 6, 8, and 11 failed to meet either the CVI and/or the CVR criteria. These items were revised.
### Table 3.7

**Content Validation Results for Revised COIL**

<table>
<thead>
<tr>
<th>Item</th>
<th>% Of Participant Correctly Responding to Item</th>
<th>Construct Measured</th>
<th>% Who Identified the Construct</th>
<th>CVI</th>
<th>CVR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>Author</td>
<td>94.1%</td>
<td>3.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>88</td>
<td>Author</td>
<td>40.0%</td>
<td>NA</td>
<td>NA</td>
<td>Confusion between author, source, and publisher. Item reworded.</td>
</tr>
<tr>
<td>3</td>
<td>66.6%</td>
<td>Bias</td>
<td>93.3%</td>
<td>3.15</td>
<td>.866</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>93.3%</td>
<td>Publisher</td>
<td>100%</td>
<td>3.4</td>
<td>1.0</td>
<td>Hypothesized point of view as under the construct of author but all participants ranked it as bias. The construct was revised.</td>
</tr>
<tr>
<td>5</td>
<td>100%</td>
<td>Author</td>
<td>0.0%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>93.3%</td>
<td>Source</td>
<td>93.3%</td>
<td>3.08</td>
<td>.858</td>
<td>Needed more plausible distractors</td>
</tr>
<tr>
<td>7</td>
<td>85.7%</td>
<td>Publisher</td>
<td>92.2%</td>
<td>3.30</td>
<td>.858</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>80.0%</td>
<td>Author</td>
<td>80.0%</td>
<td>3.33</td>
<td>.867</td>
<td>Item was revised to add easier distractors and focus respondents to the publisher and not the author.</td>
</tr>
<tr>
<td>9</td>
<td>84.6%</td>
<td>Source</td>
<td>92.9%</td>
<td>3.23</td>
<td>.857</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>50%</td>
<td>Publisher</td>
<td>83.3%</td>
<td>3.16</td>
<td>1.0</td>
<td>Needed more discriminant distractors</td>
</tr>
<tr>
<td>11</td>
<td>85.7%</td>
<td>Bias</td>
<td>76.7%</td>
<td></td>
<td></td>
<td>Needed to choose websites with a clear author and publisher. Confusion between the two constructs.</td>
</tr>
<tr>
<td>12</td>
<td>72.7</td>
<td>Source</td>
<td>92.9%</td>
<td>3.23</td>
<td>.857</td>
<td></td>
</tr>
</tbody>
</table>
Phase III: Revisions based on content validation. Based on the content validation results there appeared to be some confusion over the definitions for several subconstructs. Specifically, there was confusion over author, source, and publisher. This was evident in item 2, as only 40% of experts correctly identified the construct. To rectify this situation several revisions were made. First, instead of providing students with a website and asking them which site used details from more reliable sources, a specific detail was chosen from each site. Items 6, 9, 12 were revised so that a specific detail in each website was highlighted. Each included the source of the information. Second, on questions asking about the credibility of publishers the correct answers and distractors were revised to include only the header or the about us page about a publisher.

Phase III: Cognitive labs. Next a series of cognitive labs (Ericsson & Simon, 1999) were conducted with eight students from an average SES school district. Structurally prompted think-alouds (Afflerbach, 2002) were used. This allowed the researcher to test item format, wording, and difficulty with the target population for all of the items.

Using think-aloud procedures, students were first asked to indicate which answer choice they thought was correct for each item. They then were asked why they thought each of the other answer choices were incorrect. Next students were asked to offer feedback on each item format.

Phase III: Cognitive labs results. Based on item descriptives and the cognitive lab results the instrument needed further refinement. See Table 3.8 for student performance on the twelve-item assessment. A one indicates a correct answer. A zero indicates an incorrect answer. The mean score is an estimate of item discrimination as the percentage of students who scored correctly on the item. These results indicated that 3, 8, and 11 had to be revised.
Table 3.8

*Cognitive Lab Item Discrimination*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1</td>
<td>.63</td>
<td>.13</td>
<td>.63</td>
<td>.88</td>
<td>.75</td>
<td>.57</td>
<td>0</td>
<td>.48</td>
<td>.43</td>
<td>.25</td>
<td>.71</td>
<td>6.30</td>
</tr>
</tbody>
</table>

The think-aloud data also suggested item refinement. The cognitive lab questions that examined bias by “asking which websites include strong words and images to influence the audience” needed more recognizable distractors. Students had difficulty understanding how information was shaped by an author or publisher. Questions three, five, and eleven were revised to make distractors more recognizable.

Student responses also indicated that some individual items needed to be revised. No students scored correctly on question eight correctly. This question had students evaluate an author’s expertise given her biography page. The distractors were revised to make the question easier.

The students from the think-aloud reported on ease of use with the Survey Monkey interface. They could click on embedded links, and could delineate between the item stem and forced choice responses. They were also asked, and given the option, to have their websites open in new windows or tabs. All of the students reported that they preferred websites to open in new tabs rather than windows. Students also suggested the wording on some items needed revisions.
Phase III: Final instrumentation and administration. The revised 12 items were then administered to the 131 students in the study. Students took the assessment in one class period, in their classroom using laptops.

A reliability analysis was run following the administration of the 12-item assessment. A coefficient alpha (Cronbach, 1972) was calculated at .43. This assessment did not meet the threshold of 0.70 for a coefficient alpha the measure was shown to be not reliable. The low reliability may have been due to the short assessment length.

Using the Spearman-Brown prophecy the test would have to increase by a factor of 3.16. Given the complexity of the assessment and the limitations of classroom schedules a 40 to 50-item assessment would not be possible. Thus the decision was made to more than double the assessment length by creating 16 new items, four each for, publisher, author, bias, and source. The items were created by mirroring items that were acceptable from the content validation survey. These items were then administered to the students in the study before they completed any other additional assessments and after a week of the initial battery of original items.

Phase III: instrumentation results. A reliability analysis was then conducted. One of the additional new items measuring author expertise was removed from the assessment a priori due to an error in administration. Twenty-seven items were included in the final analysis with an N=110. The coefficient alpha with all 27 items was 0.560. This was not acceptable for research given it did not pass our threshold for an internal consistency value of 0.700 (Peterson, 1994).

Next an examination of the descriptive statistics of the items revealed that many items had mean score of less than 0.20. This would mean less than 20% of participants scored the item correctly. Any item with a mean score of less than 0.20 was removed from the analysis; this lead to the removal of five items. See Table 3.10 for a description of the final items included in the assessment. The coefficient alpha was then recalculated without the five removed items. Internal consistency for the remaining items was calculated at .618.
Then the inter-item correlation matrix was reviewed. Any item that had a majority of negative inter-item correlations was deleted; this lead to the removal of seven additional items. A reliability analysis was conducted and the coefficient alpha was now 0.713. After examining the "scales if item deleted" table, a measure calculated by SPSS software, the decision was made to remove three additional items. The coefficient was recalculated for the remaining 14 items of the assessment at 0.722. This coefficient alpha is acceptable. The final COIL assessment consisted of the 14 items listed in Table 3.9. See Appendix C for the complete instrument. There were four items measuring author expertise, four items measuring publisher credibility, four items measuring bias, and two items measuring source credibility. Six of the items had only one screen shot, six of the items had four screenshots, and two of the items required participants to click on four hyperlinks.

Table 3.9

*Final Items in Validated and Reliable COIL*

<table>
<thead>
<tr>
<th>Items In Final Version</th>
<th>Items Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evaluate author: Where would you click to learn more about an author?*</td>
<td>3. Evaluate bias: Which website uses strong words or images to persuade the audience?***</td>
</tr>
<tr>
<td>2. Evaluate author: Which websites about Chihuahuas and asthma was created by the most knowledgeable author?***</td>
<td>6. Evaluate Source: Which website uses details from the least reliable source?***</td>
</tr>
<tr>
<td>4. Evaluate publisher: Where do you click to learn more about a publisher?*</td>
<td>7. Evaluate publisher: Which website was created by a more reliable publisher?****</td>
</tr>
<tr>
<td>5. Evaluate bias: Think about the author’s point of view. What may influence the way he thinks about energy drinks?*</td>
<td>8. Evaluate Author: Given the author's profile page what is her expertise?**</td>
</tr>
<tr>
<td>10. Evaluate publisher: Which publisher creates a website with the most credible medical information?**</td>
<td>9. Evaluate Source: Which websites uses details that are from the most reliable source about healthy snacks?***</td>
</tr>
<tr>
<td>14. Evaluate bias: Think about the authors' point of view. How does the authors' point of view influence the words and images used on the website?***</td>
<td>11. Evaluate Bias: Which website uses strong words, phrases, or images to persuade readers?***</td>
</tr>
<tr>
<td>15. Evaluate author: Look at this website. What is the author's expertise?*</td>
<td>12. Evaluate Sources: Which website uses information from the most reliable source?**</td>
</tr>
</tbody>
</table>
Online reading comprehension assessments. Two measures of online reading comprehension were created for this study: ORCA less restricted (ORCA-LR) and ORCA more restricted (ORCA-MR). The assessments were drafted and underwent numerous validity and reliability tests. In the initial iteration, each assessment consisted of two separate Internet inquiry activities (Leu et al, 2007). Each activity required students to locate, evaluate, synthesize, and communicate information. On the less restricted task students could use any website on a given topic. On the more restricted tasks students were asked to locate specific websites on a given topic. Each participant thus had a score for ORCA-LR and ORCA-MR.
The domain for the online reading comprehension tasks used in this study was social studies. This domain was chosen because previous work (Perfetti, Britt, Georgi, & Mason, 1994; Van Sledright, 2002) has highlighted the importance of reading and evaluating information across multiple sources. (Weinberg, 1991). Thus, the disciplinary demands of social studies fit nicely with the skills required to read in online environments where readers often have to locate, evaluate, and synthesize across several sources.

Topics for the Internet inquiry activities revolved around the American Revolution. This topic was chosen because it is covered in fifth grade in the state of Connecticut (State of Connecticut Department of Education, 2009). Thus, students in the study are likely to have had exposure to the topic and content. Also students, by the seventh grade, are expected to have competence in accessing information from multiple sources, evaluating arguments, and communicating answers using digital texts (State of Connecticut Department of Education, 2009). The original topics for the activities were: (a) the technologies of the American revolution- less restricted, (b) the accuracy of Leutze’s painting of George Washington Crossing the Delaware- less restricted, (c) the turning point of the American revolution- more restricted, (d) the causes of the American revolution- more restricted.

On the less restricted tasks students could find any source relevant to their topic. So, for example, students were asked to locate any website with information about the accuracy of the Leutze’s painting of George Washington Crossing the Delaware. On the more restricted tasks students were asked to find a specific article or webpage located at a specific website. For example students were asked to find the webpage “Battle of Saratoga” on the website AmericanRevolution.org for the more restricted task, the turning point of the American Revolution.

The assessments created for this study were based on ORCA assessments developed for previous studies (Coiro, 2012; Leu et al, 2012; 2008). This format has students first locate information, synthesize this information, evaluate the sources of the information, take a position,
and them communicate what was learned. Table 3.10 shows that previous administrations of online reading comprehension assessments using this format have demonstrated good estimates of both validity and reliability.

Table 3.10.

Descriptive, Validity, and Reliability Scores on ORCA assessments.

<table>
<thead>
<tr>
<th>Instrument/# Items</th>
<th>Range</th>
<th>N</th>
<th>* Validity</th>
<th>** Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-IM</td>
<td>3-36 of 38</td>
<td>12</td>
<td>66.5%</td>
<td>.85-.95</td>
</tr>
<tr>
<td>ORCA-Blog</td>
<td>0-30 of 32</td>
<td>89</td>
<td>59.2%</td>
<td>.84</td>
</tr>
<tr>
<td>ORCA-I</td>
<td>0-56 of 60</td>
<td>120</td>
<td>51.7%</td>
<td>.92</td>
</tr>
<tr>
<td>ORCA-II</td>
<td>0-56 of 60</td>
<td>120</td>
<td>44.1%</td>
<td>.91</td>
</tr>
<tr>
<td>ORCA-Iditarod</td>
<td>0-33 of 42</td>
<td>220</td>
<td>53.1%</td>
<td>.88</td>
</tr>
<tr>
<td>ORCA-Iditarod,</td>
<td>0-20 of 30</td>
<td>373</td>
<td>41.6%</td>
<td>.73</td>
</tr>
<tr>
<td>revised</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*-As measured using proportion of total variance explained
**-As measured using Coefficient Alpha (Chronbach, 1972)

Each activity originally consisted of four locating score points, four evaluation score points, four synthesis score points, and four communication score points. The activities began with a task introduction, each of which contained a problem and a description. The task introductions were designed to be as parallel as possible across the tasks, regardless of the restricted nature of the locating tasks. These are presented in Table 3.11.

The locating items differed between the ORCA-LR and the ORCA-MR. On the less restricted tasks students could locate any four relevant sources. On the more restricted tasks students had to locate four specific sources.
**Table 3.11**

*Task Introduction for the ORCA Internet Inquiry Tasks*

<table>
<thead>
<tr>
<th>Task</th>
<th>Less Restricted Task Introductions</th>
<th>More Restricted Task Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task A</strong> Introduction</td>
<td><strong>The problem: Is the painting of George Washington crossing the Delaware River historically accurate?</strong></td>
<td><strong>The problem: What was the turning point of the American Revolution?</strong></td>
</tr>
<tr>
<td></td>
<td>Mr. Barnes's history class is debating the accuracy of the painting &quot;George Washington Crossing the Delaware&quot; by Emanuel Gottlieb Leutze.</td>
<td>Mr. Barnes's history class is debating the turning point of the American revolution on the class discussion board.</td>
</tr>
<tr>
<td></td>
<td>They are debating if the painting is accurate, or truthful, on their class discussion board.</td>
<td>You will do research to help them answer the question: What was the turning point of the American Revolution?</td>
</tr>
<tr>
<td></td>
<td>You will do research online and decide if the painting is accurate.</td>
<td></td>
</tr>
<tr>
<td><strong>Task B</strong> Introduction</td>
<td><strong>The problem: What role did some women play in the American Revolution?</strong></td>
<td><strong>The problem: What were the causes of the American Revolution?</strong></td>
</tr>
<tr>
<td></td>
<td>In Mr. Barnes's history class they are discussing women and the American Revolution. His class is posting messages on the class discussion board.</td>
<td>Mr. Barnes's history class is talking about the causes of the American Revolution on their discussion board.</td>
</tr>
<tr>
<td></td>
<td>You will do research to answer the question: What role did women play during the American Revolution?</td>
<td>You will do research online to answer the question: What were the main causes of the American Revolution?</td>
</tr>
</tbody>
</table>
For each inquiry activity, students had to locate two websites on the topic. On the less restricted task this was to locate any two, relevant sources. On the more restricted task students were asked to find two, specifically defined sources. Next they had to combine the main ideas of the two websites into a synthesis statement. Then they located an additional set of two websites, following the same restricted parameters. Next they wrote another synthesis statement combining what they read on the two websites.

All of the remaining items, regardless of the restricted nature of the information space, were parallel from this point forward. The students were required to locate an author of one of their websites, evaluate the author’s expertise, evaluate the evidence used by the author, and evaluate the author’s point of view. Next students took a position and backed up their claim with evidence from what they read. Finally students were required to log on to a class discussion board, make an original post, explaining what they learned, and respond to one other person on the discussion board. The items were scored with a 1 for correct and a 0 for incorrect. The dichotomous rubric used to score each item is available in Appendix B.

**ORCA content validation.** Each ORCA assessment underwent a three-step validation process. First a panel of social studies experts evaluated the measures during a focus group. Next the measures were evaluated by a focus group of online reading comprehension experts. Finally a series of cognitive labs (Ericsson & Simon, 1999) were conducted.

**Social studies expert panel validation.** After the initial inquiry activities were developed, the assessments were given to a focus group that had expertise in the field of social studies and technologies. Experts were recruited using Twitter, a social media tool. A recruitment call went out using several hashtags, a method for categorizing messages: #sschat-social studies chat, #edtech-educational technology, and #edchat-general education discussion. Seven people responded to the
call. The final panel consisted of four experts. Two were doctoral students, and two were classroom teachers.

The panel members then reviewed the materials. They were asked to complete each of the four versions of the ORCA. The researcher then met with the panel members in a video–conference. The panel members were asked to assess the validity of the instrument. Interview questions focused on the tasks being specific to the domain of social studies. They were also asked if the online reading comprehension skills assessed in the tasks mirrored the skills used by experts in the field. Finally the expert panel was asked if the topics included in the tasks were suited for the target population of seventh grade.

Overall, the content experts felt the assessments adequately represented inquiry tasks required in the domain of social studies. They remarked that evaluating the author and sources of evidence were important skills at this level. On the communication task the experts wanted students to also note where they found their information.

The experts did recommend that the topic of technology and the revolutionary war was unsuitable for the task. They felt that websites about this topic were scarce; and those that students would find were above the normal reading level of a seventh grader. The experts recommended choosing a new topic. Technology and the American Revolution was replaced with the Role of Women During the American Revolution.

**Online reading comprehension expert panel.** The next step in content validation involved experts in the field of online reading comprehension. Two doctoral students from the New Literacies Research Lab at the University of Connecticut were recruited to validate the ORCA activities. They met with the researcher and went through each task. The reviewers felt that the four activities adequately captured the elements of locating, evaluating, synthesizing, and communicating.
Cognitive labs. The final step in content validation was a series of cognitive labs (Ericsson & Simon, 1999). Eight students from an average SES school district were selected to complete structurally prompted think-alouds (Afflerbach, 2010). A structurally prompted think aloud interrupts students at key decision points. Their screen actions and voices were captured using IshowU. This is a screen recording software that records all action on the screen along with the student’s and researcher’s voices. Students first completed a training task to familiarize themselves with completing a think-aloud. The students then completed one more restricted task and one less restricted task with a structurally prompted think aloud. After the students completed all of the think-alouds they were asked: (a) how the assessments compared to how they usually read and write in social studies; (b) how they open multiple windows; (c) how they normally take notes when conducting online research.

The think aloud data revealed numerous issues with the format of the ORCA assessment. First on locating tasks the students struggled with locating the restricted websites given only the title of the page without the URL extensions (.com, .org). For example, one webpage they were asked to find was located on a website American Revolution. There were multiple websites with the title American Revolution. Thus it was decided to add the extension to all website titles on restricted tasks. Students were now asked to, “Find the webpage ‘The Battle of Saratoga’ on the website AmericanRevolution.org,” instead of “Find the webpage ‘The Battle of Saratoga’ on the website AmericanRevolution.”

The participants also felt that finding four websites was very redundant. Furthermore many students could not complete the task in forty minutes. It was decided to reduce the number of search tasks from finding four websites to finding three websites. This lead to the revision of all four versions of the instrument from a 16-item assessment (four locate, four evaluate, four synthesize, and four communicate scorepoints) to a 12-item assessment (three locate, three evaluate, three synthesize, and three communicate scorepoints).
The final revision around the locating tasks involved adding a help feature. When students could not locate a website they were unable to proceed to additional items. In other words they could not summarize a website they could not find. This could lead to dependency issues as a low score on a synthesis point might reflect an inability to locate a page. Thus, a help feature was added to each locating task. Students, after searching for five minutes, could respond that they were unable to locate a website. They could submit IDK (I don't know) as an answer. Then they were asked, "Did you type IDK: Yes or No?" If students indicated, "Yes" they would then be given the link to an appropriate website.

The students all felt that the synthesis tasks were also redundant. Students were asked to combine information from the first two websites they found, the second two websites they found, and then take a position. The students felt that the final synthesis statement they wrote mirrored the communication task that asked them to explain what they learned. In order to reduce the feeling of redundancy both the synthesis tasks and the communication tasks were revised. On the synthesis task, students now had to summarize the key ideas on the first website they found. On the second synthesis task students had to combine the main ideas from the second two websites they found. On the third synthesis task students had to take a position and provide evidence using information that they read.

The communication tasks were also revised. The students felt being asked to take a position on the communication task was too similar to taking a position on the synthesis task. Therefore the assessment was revised so students no longer had to do an initial post on the discussion board, stating their opinion and then replying to another post on the discussion board. Instead the students now had to agree or disagree to one of the two student responses, using evidence from the websites they read, explaining where they found the information.

The final versions of the assessments are available in Appendix A. The ORCA less restricted and the ORCA more restricted each consisted of two tasks. There were 12 possible score points in
each task. Thus there were 24 possible score points for the ORCA less restricted. There were also 24 possible score points for the ORCA more restricted.

**The dispositions of online reading comprehension measure.** The Dispositions of Online Reading Comprehension instrument (DORC) (O’Byrne & McVerry, 2008) was used to estimate the dispositions of online reading comprehension among participants. In this instrument, dispositions of online reading comprehension were measured using a series of five-point Likert scales in a self-report survey. Students answered questions that fell on five scales: reflective thinking, critical stance, flexibility, collaboration, and persistence. These five scales were combined to form a composite score of a student’s disposition towards online reading comprehension. Previous work established a reliability estimate of .72 and content validity was ensured through three rounds of review, followed by revisions, using expert panels (O’Byrne & McVerry, 2008). The full instrument is available in Appendix D.

**Quantitative Procedures**

**Administering the Independent Variable Measures**

Participants first completed the background knowledge measure, the dispositions of online reading comprehension measure, and the COIL, which measured critical evaluation skills. Students were given access to a laptop computer during their normally scheduled class period. Students were assigned a computer and their number was recorded. Screen recording software, IShowU, also captured all student activity to protect against data loss.

During the first session students completed all of the independent measures before the online reading comprehension assessments. I would visit each class and complete the background knowledge measure, the dispositions of online reading comprehension, and the COIL. The background knowledge measure was administered first to ensure that no learning gains from the inquiry activities led to higher background knowledge scores. Students then completed the
dispositions of online reading comprehension. Finally students finished the first twelve items of the COIL.

Following this first session, the COIL was analyzed to check for internal consistency as a measure of adequate reliability. As outlined above, the initial, 12-item COIL did not have adequate reliability. Once it was evident that more items would be necessary I returned to the school to administer an additional 15 items.

The teachers underwent training so that they might administer the measure of verbal comprehension. They completed the assessment with the researcher and went over the procedures. The teachers then gave the assessment to the entire class in a 10-minute session. In each classroom the completion of the verbal ability measure was done after all other assessments were administered.

**Administering the Online Reading Comprehension Assessments**

All four ORCA tasks were administered to the participants (n=131) following a protocol (see Appendix C). The order of the four tasks was randomly assigned to participants to protect against a learning effect. The tasks were assigned to ensure students completed a more restricted or less restricted task followed by a more restricted task or less restricted task, respectively. There were 12 different combinations. The combinations were randomly assigned.

For example a student might be assigned the Delaware task (less restricted) followed by the Causes task (more restricted). They would then complete the Women task (less restricted) and finish with the Turning Point task (more restricted). Their score on the overall ORCA less restricted would be a sum of the score points on both the Delaware and Women task. Their score on the ORCA more restricted would be the sum of the score points on both the Turning Point and Causes task.

Students completed the assessment in four 40-minute class periods. They completed one task per class. At each school site students completed two of the tasks within the same five-day academic week. Then to reduce the possibility of a learning effect, the students did not complete the
remaining two tasks for three weeks. The researcher returned to the schools and administered the final two tasks within one, five-day calendar week.

The researcher brought 25 laptops to the classrooms. The computers were pre-distributed on student desks. The researcher prepared an entrance slip for each student. On the slip was the URL for their assessment. The entrance slip also had a username and password. Each student was assigned a unique username and password for use on the discussion board. As the instructor and researcher passed out the activity cards they would hit record on IShowU, a screen recording software.

Once every student was given their machine and activity card they were asked to enter their URL and navigate to their assigned task. The researcher then read through the two direction screens with the students. (See Appendix B). The researcher then walked around the room while students began.

The protocol provided students with five minutes for each search task. The researcher would remind students at the five minute mark to type “IDK,” if needed, and then click on the link to go to the correct website. When students finished a task they would raise their hand and the researcher would stop the screen-recording software.

**ORCA Reliability Analysis.** After the completion of the first two ORCA inquiry tasks, one less restricted and one more restricted, the researcher scored the tasks using a rubric. (See Appendix B). To ensure reliability, 20% (n=40) of the tasks were randomly chosen and given to another doctoral student studying online reading comprehension. After scoring five together the raters separated and scored the remaining 35 tasks alone. Agreement was calculated using a simple percentage and it exceeded 93%. Differences were resolved through discussion.

The researcher then scored the ORCA tasks. Tests for internal consistency were conducted using a coefficient alpha (Cronbach, 1972). Reliability testing was done at two levels. As stated, the ORCA less restricted (ORCA-LR) consisted of the Delaware and Women tasks. The ORCA more
restricted (ORCA-MR) consisted of the Turning Point and Causes tasks. First each individual task consisting of twelve score points was evaluated. Then the ORCA less restricted, which consisted of the Delaware and Women tasks for a combined 24 scorepoints, was evaluated. Then the ORCA more restricted, which consisted of Turning Point and Causes tasks for a combined 24 scorepoints was evaluated. Table 3.12 presents the reliability estimates for the ORCA-LR. Table 3.13 presents the reliability estimates for the ORCA-MR.

Table 3.12

*Internal Consistency of the ORCA-LR*

<table>
<thead>
<tr>
<th>ORCA Inquiry Task</th>
<th>Internal Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware (less restricted task A)</td>
<td>.615</td>
</tr>
<tr>
<td>Causes (less restricted task B)</td>
<td>.713</td>
</tr>
<tr>
<td>ORCA Less Restricted Total</td>
<td>.722</td>
</tr>
</tbody>
</table>

Table 3.13

*Internal Consistency of the ORCA-LR and ORCA-MR*

<table>
<thead>
<tr>
<th>ORCA Inquiry Task</th>
<th>Internal Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turning Point (more restricted task A)</td>
<td>.763</td>
</tr>
<tr>
<td>Causes (more restricted task B)</td>
<td>.769</td>
</tr>
<tr>
<td>ORCA More Restricted Total</td>
<td>.804</td>
</tr>
</tbody>
</table>

**Quantitative Analysis**

The goal of the quantitative portion of this study was to examine the unique contributions that background knowledge, critical evaluation skills, and dispositions made to models of online reading comprehension over and above verbal ability. This study examined two models. The first involved a less restricted task (ORCA-LR). The second involved a more restricted task (ORCA-MR). The quantitative portion of the study explored two research questions:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal
intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

To answer the two quantitative questions, sequential (hierarchical) regression analysis (Tabachink & Field, 2001) was used to estimate the best fit models between the independent variable of online reading comprehension scores and the dependent variables, after controlling for verbal intelligence. Hierarchical regression analysis allows the entering of variables in one model, and then additional variables are added in the second model. Given that the goal of the quantitative portion of this study was to examine model fit, the variables were added to the model using the “enter” method. The “enter” method enters all of the variables that were added to the model at the same time. This was chosen over a stepwise regression in order to ensure all of the independent variables were included in the final model. In the stepwise method, variables that do not make a significant contribution to the model, after additional variables are added, are then removed.

Before the regression models were calculated all of the dependent and independent variables were examined to ensure they met the assumptions necessary for a regression analysis. First the skewness and kurtosis of the variables were examined to ensure the assumption of normal distribution was met. Then the data was examined for outliers. Tests were also run to ensure the assumptions of homoscedasticity and multicollinearity were met. These tests are reported in chapter four.
Qualitative Procedures

Qualitative Participants

The purpose of the qualitative phase of this mixed methods studies was to explore the strategy use by students who vary in their online reading comprehension ability. Twelve students, four from each participating school, were selected for the qualitative portion of the study. Performance on the first administration of the online reading comprehension assessment, including one ORCA-LR and one ORCA-MR task, was used to determine participants in the think aloud activity. They were selected as follows.

1. First all students in their class were ranked based on scores on the first administration of the ORCA. Students were divided into two groups: the top 10% of scores and the bottom 10% of scores.
2. These groups were then reviewed by the teacher to allow for the selection of students who would be comfortable working with an adult on a verbal protocol task.
3. Then four students from each participating school were randomly selected from the list: two students who scored in the 10% of their class and two students who scored in the bottom 10% of their class.

Then, for the qualitative analysis, the twelve selected students were divided into three achievement-level groups (high, average, low) based on ORCA scores, independent of school. They were ranked using a combined score of one less restricted task and one more restricted task. The students were ranked from 1 (lowest) to 12 (highest) and broken into three groups of four. This list resulted in a median score of 10.5, out of 24. The middle group included four students within two scores of the median. The low group included scores more than two scores below the median. The high group included four students with scores more than two scores away from the median.

Ten students were included in the final analysis since two students had to be removed from the study due to errors in data collection. This included one student in the high group and one
student in the middle group. Table 3.14 presents the list of students (using pseudonyms) and their performance levels on the variables of interest by group.

Table 3.14

*Qualitative Participants*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Verbal</th>
<th>PK</th>
<th>ORCA 1</th>
<th>ORCA 2</th>
<th>Total</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>13</td>
<td>1.5</td>
<td>8</td>
<td>9</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Olivia</td>
<td>17</td>
<td>2</td>
<td>9</td>
<td>10</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Ava</td>
<td>23</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexander</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Sophia</td>
<td>5</td>
<td>0.5</td>
<td>4</td>
<td>7</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Jacob</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Ethan</td>
<td>7</td>
<td>1.5</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Michael</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Jaydan</td>
<td>7</td>
<td>0.5</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

*=ORCA Score consisted of one less restricted and one more restricted task.*

**Qualitative Procedures**

After participants for the qualitative think aloud were selected from each research site, the researcher met with students one-on-one and they completed a single online inquiry task, using structured think aloud procedures, over two consecutive days. First, the students underwent a think-aloud training session. The researcher modeled to show students how to think aloud while finding the capital of France. Then the students were asked to practice by finding the capital of New York State.

Students then completed a structurally prompted think aloud activity within an online inquiry task, being prompted at fixed structural locations to think aloud by the researcher (Afflerbach, 2002) while reading online. The students were asked, “What were you thinking?” at key decision points such as clicking on a link, leaving a website, or entering keywords. Their actions were recorded using IshowU.
Qualitative Analysis

There were two goals for the qualitative portion of this study. The first goal was to compare strategy differences between the less restricted and more restricted conditions. The second goal was to examine strategy differences between good and poor online readers as they completed online reading comprehension tasks. Thus, a two-stage approach, utilizing the methods recommended by Afflerbach (2002) and Leu et al. (2009) were used to answer the third and fourth research questions:

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?

The first stage of analysis examined differences in strategy use among participants based on the restricted nature of the information space and their online reading comprehension ability. The second stage of analysis involved a more in-depth analysis of patterns found in stage one. The goals of this second stage of analysis were twofold: 1) to provide illustrative examples that mirrored the quantitative findings; 2) to determine the underlying patterns among strategy use of participants with varying degrees of online reading comprehension ability.

Stage one data were analyzed first through the lens of the components of online reading comprehension: locating, evaluating, synthesizing, and communicating. This stage began by examining frequency tables of raw codes for patterns. Then successive passes were made through the data to allow for data reduction and themes to emerge. The purpose of this stage was to identify patterns in strategy use that could be explored during the more in-depth stage-two analysis.
The second stage of analysis built upon the results of the first stage. The goal of the more finite analysis was to identify themes that cut across the components of online reading comprehension. This stage involved making additional passes through the data to compare instances of coding across participants. The patterns and themes from stage one were then refined and reorganize data into new patterns. Pattern identification involved an iterative process of reorganizing the data from stage one and reworking groupings so that the category structures defined themes in the data.

The analysis of the think aloud data in both stages was completed following both abductive (Onwuegbuzie & Leech, 2006) methods and constant-comparative (Bogdan & Biklen, 2003; Merriam, 1988) methods. This dual approach was designed to identify patterns in cognitive processing while also allowing for the codebook to unfold as the data were examined.

**Abductive coding.** Abductive coding methods (Onwuegbuzie & Leech, 2006) employ both inductive and deductive coding procedures. Initial coding schemes were informed by previous work (Leu et al., 2004; Leu et al., 2009). Using this work, a list of expected strategies was created for each of the 12 score points in each task. The initial codebook of expected strategies appears in Table 3.15.

The qualitative data was coded using HyperRESEARCH, a software tool that allows for the coding of video data. Each video case was loaded into the program. The videos were then broken into separate frames. A series of frames was coded using the codebook as presented in Figure 3.5. In numerous instances, researcher annotations were also added to each instance of the code.

Table 3.15

*Initial codebook for abductive analysis*

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locate</strong></td>
<td></td>
</tr>
<tr>
<td>K-Locate-Keyword Entry</td>
<td>K1-Copy and paste exact words from task</td>
</tr>
<tr>
<td></td>
<td>K2-Type exact words from task</td>
</tr>
<tr>
<td></td>
<td>K3-Use keywords from task</td>
</tr>
<tr>
<td></td>
<td>K4-Revise keywords</td>
</tr>
</tbody>
</table>
| SR-Locate Read Search Results | SR1-Cursor movement indicates reading of results.  
|                             | SR2-Clicks on first link  
|                             | SR3-Clicks on a link on first page  
|                             | SR4-Moves to second page  
|                             | SR5-Returns to search results  
| LW-Locate Website       | LW1-Locates website and judges it relevant  
|                             | LW2-Locates website and judges it irrelevant  
|                             | LW3-Skims website  

**Evaluate**

| CEE-Evaluate Author Expertise | CEE1- Finds the author in the text  
|                               | CEE2- Finds the author on an about us/bio page  
|                               | CEE3- Infers the author from the text.  
|                               | CEE4- Does a secondary search for the author.  
|                               | CEE5-Does not locate the author  
|                               | CEE6-Uses an authoritative title to judge the author  
|                               | CEE7- Uses supporting details from content of the website.  
|                               | CEE8- Uses institutional information to judge author expertise  
|                               | CEE9-Uses background knowledge to judge author expertise  
| CES-Evaluate Author1s use of Evidence | CES1- Uses the source of claims/evidence to judge use of evidence  
|                                   | CES2-Uses a bibliography or reference to judge use of evidence  
|                                   | CES3-Uses a secondary source to verify information.  
|                                   | CES4-Uses overall quantity of content to judge use of evidence  
| CEP-Evaluate Author Expertise     | CEP1- Uses authors perceived level of expertise to describe point of view.  
|                                   | CEP2- Uses authors prior experience to describe point of view.  
|                                   | CEP3- Uses authors institutional affiliation to describe point of view.  
|                                   | CEP4- Uses content of website to describe point of view.  

<table>
<thead>
<tr>
<th><strong>Synthesize</strong></th>
<th></th>
</tr>
</thead>
</table>
| SEM-Locate two important details | SEM1-Copy and paste important details  
SEM2-Copy and paste entire source.  
SEM3-Copy and paste irrelevant details  
SEM4-Paraphrase important details.  
SEM4-Paraphrase irrelevant details. |
| SEC-Combine information from two sources | SEC1- Navigate between multiple tabs/windows.  
SEC2-Cursor movement provides evidence of  
reading two sources.  
SEC3-Copy and paste details from two sources  
SEC4-Copy and paste details from one source  
SEC5-Paraphrase details from two sources  
SEC6-Paraphrase details from one source |
| SEP-Take a position with evidence | SEP1-Student makes a specific claim related to task.  
SEP2-Student copies and past details in reference to claim.  
SEP3-Student paraphrases details in reference to claim.  
SEP4-Student copies and pastes information without making claim. |

<table>
<thead>
<tr>
<th><strong>Communicate</strong></th>
<th></th>
</tr>
</thead>
</table>
| CDB-Correctly use discussion board | CDB1-Student can log in to discussion board  
CDB2-Student navigates to correct discussion.  
CDB3- Student responds to another post.  
CDB4-Student replies to discussion. |
| CDB-Engage in dialogue | CED-Student agreed or disagreed with an initial post.  
CED-Student did not disagree. |
| CDE-Provide source of evidence | CDE1-Student links to a source  
CDE2-Student refers to a specific source  
CDE3-Student refers to source in general (i.e. websites I read) |
Following abductive methods, additional codes were added to the codebook during analysis. These codes developed inductively as new patterns emerged that were either not represented in a code or could not be represented exclusively by one existing code. For example, many students completed a search by using the auto-fill feature of Google, which predicts a search string. This code was added to the codebook.

**Constant-Comparative Analysis.** Analytic inductive methods (Bogdan & Biklen, 2003; Robinson, 1951) were used recursively across the video data sources. After all of the cases were coded, reports were run as a preliminary examination of patterns that developed using constant comparative analytic methods. First, an overall report was run on all of the subareas: locate, evaluate, synthesize, and communicate. The frequencies of the codes were matched with a specific timestamp in the video. This data was used for stage one analysis. I then went back to watch the coded video segments of each code instance. Finally, I compared the annotations of each code
instance. As patterns across the frequencies, video segments, and annotations emerged they were noted.

The next step in the stage one analysis was to crosscheck individual cases based on the restricted nature of the information space and the success of students on the ORCA instruments. For example, if a high performing student exhibited a tendency to “navigate multiple windows” I examined if this was similar across all participants or just high performing participants. If the code exhibited stability at either level it remained in the codebook.

The ten participants were split into thirds based on ORCA scores. They were defined as high performing online readers, average performing online readers, and low performing online readers. A report was run for each subscale: locate, evaluate, synthesize, and communicate for each group of participants. Initially, the frequency of codes for each group was compared to other groups. Then, using the initial, overall patterns found in the first pass of the data, I tried to determine if the same patterns held true based on success on the less restricted and more restricted tasks.

The next step in the stage one analysis was to identify patterns and themes from the raw codes and frequency matrices. The first level of pattern identification involved an examination of the frequency matrices. If differences emerged in the frequency of codes between higher, average, and lower performing students I returned to the video for a closer examination. Each instances of the code was reexamined and additional annotations made focused on student strategy use. The goal of stage one analysis was to identify patterns in strategy use that led to overall performance on the ORCA assessments regardless of the restricted nature of the information space. The themes and patterns found in the stage one analysis were then used to inform the stage two analysis.

The goal of the stage two analysis was to determine patterns of strategy use among participants based on their ability and the restricted nature of the information space. In order to condense the patterns and themes from stage one into more exclusive themes recursive, analytic
inductive methods were used (Bogdan & Biklen, 2003). Using the time stamps from the initial code I returned to the video and systematically and consistently examined the data to confirm, disconfirm, and generate new patterns and themes.
Chapter IV

Quantitative Results

This study explored the relationships of background knowledge, critical evaluation skills, and dispositions of online reading comprehension in predicting online reading comprehension when verbal intelligence was controlled. These relationships were tested in two different reading “spaces:” a less restricted environment, i.e., where readers could choose their sources; and a more restricted environment, i.e., where readers had to locate specific websites that were provided.

The quantitative portion of this study sought to answer two questions:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

Sequential (hierarchical) regression (Tabachink & Fidell, 2001) was used to allow for the researcher to enter verbal intelligence to the model a priori. A measure of verbal intelligence was used as it is presumed to be causally related to reading comprehension. Artley (1944) noted that verbal intelligence is a key component to comprehension. Cain, Oakhill, and Bryant (2004) found that measures of verbal ability explained the greatest amount of variance in measures of reading comprehension. Finally, Baddeley, Logie, and Nimo-Smith (1985) also found verbal ability to be a strong predictor of reading comprehension.
Since this study wanted to examine how background knowledge, critical evaluation skills, and dispositions contributed to models of online reading comprehension it was decided to control for verbal ability. The remaining independent variables: background knowledge, critical evaluation skills, and dispositions were entered in the second step to test the best fit over and above verbal ability.

This chapter is organized in four sections. The first section reviews the data screening procedures for all of the variables. The second section provides descriptive statistics for independent and dependent variables after the data screening. The third section describes the results of the regression model for the less restricted information space. The final section provides the results of the regression model for the more restricted information space.

**Data Screening**

Scores for the predictor variables were collected for 131 students. However, due to absences and loss of data 33 students were removed with list-wise deletion. This left a sample of 98 participants. This exceeds the minimum sample size of 77 for a hierarchical regression with an effect size of 0.15, a desired power of .80, and one independent variable in the first step and three independent variables in the second step (Sloper, 2011). This anticipated Cohen’s $f^2$ of 0.15 is a medium effect. The estimate of power size of .80 was chosen to ensure an adequate effect (Sloper, 2010).

The estimated effect size was chosen based on the review of the research. I examined previous studies that used similar regression techniques. If the researcher did not present an effect size I calculated the effect size from the given data. I calculated an effect size (Cohen’s $f^2$) of .0740 from the data presented by Bråten, Strømsø, & Britt (2009). This study used hierarchical regression to explore source evaluation. They used intertextual (multiple text) comprehension as dependent variable and background knowledge as an independent variable. In the same study, Bråten,
Strømsø, & Britt (2009) added trust in document type to their intertextual comprehension model. This model had an effect size (Cohen's $f^2$) of .025316.

I also used the data presented by Coiro (2011). This study examined the unique contribution an online reading comprehension measure had in predicting performance on an additional measure of online comprehension after controlling for background knowledge and offline reading ability. When offline reading ability was added to the regression model with background knowledge and the scores on the first measure of online reading comprehension there was an effect size (Cohen's $f^2$) of 0.1286 when offline reading ability was added to a regression model with online reading ability and background knowledge. When an additional measure of online reading comprehension was added to the model there was an effect size of .366. Therefore my estimated effect size of Cohen's $F^2 = 0.15$ is a conservative estimate.

**Missing data.** Each case was examined for completeness of data. To be included in the final sample students needed to have completed eight different measures on seven different school days. The majority of data loss in the sample was due to student absences on one of the seven different school days. (See Table 4.1 for a summary of missing data.) A secondary source of lost data was software malfunction or user error that did not result in scores being recorded.

Table 4.1

<table>
<thead>
<tr>
<th>Measure</th>
<th>N Missing</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA</td>
<td>19</td>
<td>9</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Background knowledge</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>COIL</td>
<td>13</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Dispositions</td>
<td>10</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Total N missing</td>
<td>33</td>
<td>14</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

**Descriptive statistics.** Means, ranges and standard deviations for the measures prior to data screening are reported in Table 4.2. After examining the descriptive statistics, tests were run to ensure that the assumptions for a multiple regression analysis were met. Examination of
skewness and kurtosis scores and outliers were used to assess the assumption of normality, linearity, and homoscedascity. Durbin-Watson scores were used to test independence of variables. Finally, collinearity diagnostics were used to assess multicollinearity issues.

Table 4.2

Range, Means, and Standard Deviations for Dependent and Independent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Intelligence</td>
<td>98</td>
<td>0</td>
<td>24</td>
<td>10.906</td>
<td>5.197</td>
</tr>
<tr>
<td>Background knowledge</td>
<td>98</td>
<td>0</td>
<td>11</td>
<td>1.67</td>
<td>2.13</td>
</tr>
<tr>
<td>COIL</td>
<td>98</td>
<td>1.0</td>
<td>11</td>
<td>5.187</td>
<td>2.094</td>
</tr>
<tr>
<td>Dispositions</td>
<td>98</td>
<td>1.95</td>
<td>5.00</td>
<td>3.419</td>
<td>.4889</td>
</tr>
<tr>
<td>Less Restricted ORCA</td>
<td>98</td>
<td>0</td>
<td>18</td>
<td>8.394</td>
<td>4.117</td>
</tr>
<tr>
<td>More Restricted ORCA</td>
<td>98</td>
<td>0</td>
<td>20</td>
<td>7.15</td>
<td>4.48</td>
</tr>
</tbody>
</table>

Normality. To assess the normality of the univariate distributions, skewness and kurtosis statistics were calculated for each of the predictor and dependent variables. These results are presented in Table 4.3. There was leptokurtic distribution indicating a high probability for extreme values in the background knowledge measure (3.569). The large number of students (n=58) who scored less than one on their recall of facts from the American Revolution may explain the extreme violation of normality.

Table 4.3

Skewness and Kurtosis Ratios for Dependent and Independent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Skewness Ratio</th>
<th>Kurtosis Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Intelligence</td>
<td>1.37</td>
<td>-.467</td>
</tr>
<tr>
<td>Background knowledge</td>
<td>1.74</td>
<td>3.59</td>
</tr>
<tr>
<td>COIL</td>
<td>.138</td>
<td>-.559</td>
</tr>
<tr>
<td>Dispositions</td>
<td>.50</td>
<td>1.794</td>
</tr>
<tr>
<td>Less Restricted ORCA</td>
<td>-.578</td>
<td>.136</td>
</tr>
<tr>
<td>More Restricted ORCA</td>
<td>-.438</td>
<td>.576</td>
</tr>
</tbody>
</table>

In order to meet the assumption of normality of univariate distributions the background knowledge measure was transformed using logarithmic transformation (Osborne, 2010). This resulted in a normal distribution as indicated in Table 4.4. This, however, did reduce much of the variance in scores
Table 4.4

*Transformed Background knowledge Independent Variable*

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background knowledge</td>
<td>1.00</td>
<td>1.32</td>
<td>1.063</td>
<td>.0725</td>
<td>1.269</td>
<td>.425</td>
</tr>
</tbody>
</table>

**Linearity, homoscedascity, and independence.** To determine if the assumptions of linearity and homoscedascity were met the residual plots were examined (see Figure 4.1). The Durbin-Watson statistic was used to test the assumption of independence of variables. The Durbin-Watson statistic for both the more restricted (1.689) and the less restricted (1.706) satisfied the assumption of independence of variables.

*Figure 4.1. Scatterplots and histograms of residual plots.*

**Outliers.** Outliers, which are poor fits for the regression model, can lower multiple correlations. To test for outliers, Cook’s distance measure was used (Tabachink & Fidell, 2001).
First Cook’s distance was calculated for the less restricted regression model. These scores were then analyzed in a box plot graph Figure 4.2 presents the box plot of Cook’s distance.

![Box plot of Cook's distance](image)

**Figure 4.2. Box plot of cook's distance.**

An examination of the box plot revealed seven outliers. The black line represents the median distance. The box represents the first and third quartiles distances. To be considered an outlier the scores had to be at a distance greater from the median score more than 1.5 times from the interquartile range. These seven scores are plotted individually as circles. Both regression models, less restricted and more restricted were then tested with and without the seven outliers. The removal of the outliers affected the variables of interest.

Next two different models were run. The first model removed all seven outliers. The second model removed the three most extreme. The models with the three extreme outliers removed were the same with all seven outliers removed. Therefore it was decided to run the models without the three most extreme outliers. This left a final sample of 95 participants.

**Multicollinearity.** Collinearity diagnostics of the bivariate correlations and related statistics indicated some multicollinearity concerns. No tolerance value was less than 0.2 and no variance inflation factors were greater than 4. However, in the more restricted model, the
eigenvalue for the fifth factor (.002) and the conditioning indices exceeded 30 (47.34). In the less restricted model the eigenvalue also approached zero (.002) and the conditioning indices exceeded 30 (47.957). This increase in multicollinearity could lead to inflated standard errors for the coefficients. To test the effect of collinearity the models were run with and without the dispositions variables. Without dispositions the $R^2 = .447$, and with dispositions included in the model the $R^2 = .431$. Since this difference was negligible it was decided to keep all independent variables in the model.

Descriptive Statistics

**Online reading comprehension assessment.** Based on the means of the ORCA assessments, the more restricted environment was a more difficult information space for students to use. An examination of descriptive statistics revealed a difference in overall performance based on SES of the school. On each item type (Locate, Evaluate, Synthesize, and Communicate) students could earn a maximum of six points. An examination of mean scores for the items (see Table 4.5) indicated that in both types of information spaces critical evaluation of websites had the lowest mean score.

Table 4.5

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Less Restricted</th>
<th>More Restricted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Locate</td>
<td>95</td>
<td>3.509</td>
<td>1.483</td>
</tr>
<tr>
<td>Evaluate</td>
<td>95</td>
<td>.9554</td>
<td>1.101</td>
</tr>
<tr>
<td>Synthesize</td>
<td>95</td>
<td>2.732</td>
<td>1.483</td>
</tr>
<tr>
<td>Communicate</td>
<td>95</td>
<td>1.554</td>
<td>1.328</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>8.394</td>
<td>4.117</td>
</tr>
</tbody>
</table>

A paired sample t-test was conducted to compare the mean scores on of the ORCA-LR and the ORCA-MR. The test was significant ($t=4.088, p=.000$) with a mean difference 1.406, SD .33). This would indicate that there was a significant difference in student scores on the ORCA-LR and
the ORCA-MR. An examination of the histograms indicates that students did not score as high on the ORCA-MR. See Figure 4.1.

A one way repeated measures analysis of variance was conducted to compare students’ scores in each of the four skill areas on the ORCA-LR. The multivariate statistics revealed a significant effect for LESC (Locate, Evaluate, Synthesize, Evaluate) skill areas, Wilks’ Lambda=.133, \( F(1,93) = 408.72 p < .005 \), multivariate partial eta squared = .818. An analysis of pairwise comparisons using a Bonferroni correction to control for Type I error found a significant difference between each of the four skill areas and each of the others skills \((p<.05\) for all pairwise comparisons). Items requiring students to locate information were the easiest \((M= 3.509 SD= 1.403)\), followed by synthesis items \((M=2.732, SD=1.483)\), communicate items \((M= 1.554, SD =1.328)\), and finally evaluate items \((MD= .9544, SD=1.101)\), which were the hardest.

A one way repeated measures analysis of variance was conducted to compare students’ scores in each of the four skill areas on the ORCA-MR. The multivariate statistics revealed a significant effect for LESC skill areas, Wilks’ Lambda=.214, \( F(1,93) = 818.68 p < .005 \), multivariate partial eta squared = .214. An analysis of pairwise comparisons using a Bonferroni correction to control for Type I error found a significant difference between each of the four skills areas and each of the others skills \((p<.05\) for all pairwise comparisons). Items requiring students to locate information were the easiest \((M = 2.755 SD = 1.508)\), followed by synthesis items \((M= 2.683, SD=1.633)\), followed by communicate items \((M = 1.206, SD =1.269)\), and finally evaluate items \((MD= .8725, SD=.9917)\), which were the hardest.

The bivariate correlation for the two test formats was .658, which was significant, \( p=.00 \). The bivariate correlations presented in Table 4.6 demonstrated that the majority of the items on the less restricted were related. The communication items, however, did not significantly correlate with the other items. The items on more restricted were also related. Once again the communication items did not correlate with the other items except for the evaluation items. Across
the formats (ORCA-MR and ORCA-LR) all of the items correlated significantly with their counterparts.

Table 4.6

**Bivariate Correlations by Item Type**

<table>
<thead>
<tr>
<th></th>
<th>LR-Evaluate</th>
<th>LR-Synthesize</th>
<th>LR-Communicate</th>
<th>MR-Locate</th>
<th>MR-Evaluate</th>
<th>MR-Synthesize</th>
<th>MR-Communicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LR-Locate</td>
<td>.295*</td>
<td>.552**</td>
<td>-.107</td>
<td>.356**</td>
<td>.301**</td>
<td>.370**</td>
<td>.180</td>
</tr>
<tr>
<td>LR-Evaluate</td>
<td></td>
<td></td>
<td>-.135</td>
<td>.346**</td>
<td>.620**</td>
<td>.442**</td>
<td>.282**</td>
</tr>
<tr>
<td>LR-Synthesize</td>
<td>.064</td>
<td></td>
<td>.441**</td>
<td>.565**</td>
<td>.607**</td>
<td>.262*</td>
<td></td>
</tr>
<tr>
<td>LR-Communicate</td>
<td></td>
<td></td>
<td></td>
<td>.042</td>
<td>.003</td>
<td>-.018</td>
<td>.214*</td>
</tr>
<tr>
<td>MR-Locate</td>
<td>.463**</td>
<td></td>
<td></td>
<td>.618**</td>
<td>.110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MR-Evaluate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.618**</td>
<td>.246*</td>
<td></td>
</tr>
<tr>
<td>MR-Synthesize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.198</td>
<td></td>
</tr>
</tbody>
</table>

**Verbal Intelligence.** The verbal comprehension vocabulary test of the Kit of Factor Referenced Cognitive Test (Ekstrom, French, Harman & Derman, 1976) was used as a measure of verbal intelligence. The mean for the test was 10.726 with a standard deviation of 5.374.

**Background knowledge.** Scores on the background knowledge measure about the American Revolution were low. The mean score was 1.758 with a standard deviation of 2.20. Forty-three of the 95 final participants included in the survey could not recall at least 1 relevant idea unit about the American Revolution. The frequency of background knowledge scores are presented in Table 4.7.
Table 4.7

Frequency of Background knowledge Scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>0.5</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>1.5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>4+</td>
<td>15</td>
</tr>
</tbody>
</table>

Critical Evaluation. A fourteen item multiple-choice assessment was used to measure students’ ability to evaluate websites. The mean score was 5.1053 with a standard deviation of 2.013. Performance on the COIL varied by construct and item type. The mean scores of each item on the COIL are presented in Table 4.8.
Table 4.8

Descriptive Statistics for COIL Items

<table>
<thead>
<tr>
<th>Items In Final Version</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evaluate author: Where would you click to learn more about an author?***</td>
<td>.84</td>
<td>.37</td>
</tr>
<tr>
<td>2. Evaluate author: Which websites about Chihuahuas and asthma was created by the most knowledgeable author?***</td>
<td>.38</td>
<td>.49</td>
</tr>
<tr>
<td>4. Evaluate publisher: Where do you click to learn more about a publisher?*</td>
<td>.62</td>
<td>.49</td>
</tr>
<tr>
<td>5. Evaluate bias: Think about the author’s point of view. What may influence the way he thinks about energy drinks?*</td>
<td>.60</td>
<td>.49</td>
</tr>
<tr>
<td>10. Evaluate publisher: Which publisher creates a website with the most credible medical information?***</td>
<td>.32</td>
<td>.47</td>
</tr>
<tr>
<td>14. Evaluate bias: Think about the authors' point of view. How does the authors' point of view influence the words and images used on the website?***</td>
<td>.48</td>
<td>.50</td>
</tr>
<tr>
<td>15. Evaluate author: Look at this website. What is the author's expertise?*</td>
<td>.71</td>
<td>.45</td>
</tr>
<tr>
<td>16. Evaluate bias: Which website uses strong words or images to persuade the audience?***</td>
<td>.52</td>
<td>.50</td>
</tr>
<tr>
<td>18: Evaluate bias: Which website uses strong words or images to persuade the audience?***</td>
<td>.28</td>
<td>.45</td>
</tr>
<tr>
<td>19: Evaluate author: Which author is the best expert on volcanoes?**</td>
<td>.44</td>
<td>.50</td>
</tr>
<tr>
<td>23: Evaluate Source: Where would you click to learn more about the sources an author used?**</td>
<td>.60</td>
<td>.49</td>
</tr>
<tr>
<td>25: Evaluate Publisher: Which website about smoking hazards was created by the most reliable publisher?***</td>
<td>.30</td>
<td>.46</td>
</tr>
<tr>
<td>26: Evaluate Source: Which source used in the websites is the most reliable source to answer the question, &quot;What killed the dinosaurs?&quot;***</td>
<td>.33</td>
<td>.47</td>
</tr>
<tr>
<td>27: Evaluate Publisher: Who is the publisher of this website?**</td>
<td>.47</td>
<td>.50</td>
</tr>
</tbody>
</table>

Notes *-one screen shot, #-click on one link, **-four screenshots, ***-click on four links

**Dispositions of Online Reading Comprehension.** Dispositions of online reading comprehension were measured using a five-point Likert scale self report survey. Students answered questions that fell on five scales: reflective thinking, critical stance, flexibility, collaboration, and persistence. These five scales were combined to form a composite score of a student’s disposition towards online reading comprehension. Mean scores on the DORC were 3.382 with a standard deviation of .471.
Results For Research Question One: Online Reading in a Less Restricted Information Space

The first research question explored the best-fit model for online reading comprehension in a less restricted information space. It asked:

*When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?*

Scores for the final analysis included 95 students after three outliers were deleted. Means, ranges and standard deviations for the measures are reported in Table 4.9. Bivariate correlations for the dependent and independent variables are listed in Table 4.10. In order to answer Research Question 1 a hierarchical regression was used. Total scores on the less restricted ORCA (ORCA-LR) were entered as the dependent variable. Verbal ability was entered in the first step. Then the independent variables: background knowledge scores, critical evaluation scores, and the newly computed disposition scores were added in a second step.

Table 4.9

*N, Minimum and Maximum Scores, Means, Standard Deviations (SD), for Dependent and Independent Variables*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Intelligence</td>
<td>95</td>
<td>0</td>
<td>24</td>
<td>10.726</td>
<td>5.374</td>
</tr>
<tr>
<td>Background knowledge</td>
<td>95</td>
<td>0</td>
<td>11</td>
<td>1.758</td>
<td>2.20</td>
</tr>
<tr>
<td>COIL</td>
<td>95</td>
<td>1.0</td>
<td>9</td>
<td>5.1053</td>
<td>2.013</td>
</tr>
<tr>
<td>Dispositions</td>
<td>95</td>
<td>1.88</td>
<td>4.56</td>
<td>3.382</td>
<td>.47114</td>
</tr>
<tr>
<td>ORCA-LR</td>
<td>95</td>
<td>0</td>
<td>20</td>
<td>6.8421</td>
<td>4.16</td>
</tr>
<tr>
<td>ORCA-MR</td>
<td>95</td>
<td>0</td>
<td>18</td>
<td>8.3053</td>
<td>3.98</td>
</tr>
</tbody>
</table>
Table 4.10

Bivariate correlations of Dependent and Independent Variables

<table>
<thead>
<tr>
<th></th>
<th>ORCA-MR</th>
<th>Verbal Intelligence</th>
<th>Background knowledge</th>
<th>COIL</th>
<th>Dispositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-LR</td>
<td>.658**</td>
<td>.422**</td>
<td>379**</td>
<td>.462**</td>
<td>.195</td>
</tr>
<tr>
<td>ORCA-MR</td>
<td></td>
<td>.414**</td>
<td>.436**</td>
<td>.574**</td>
<td>.264*</td>
</tr>
<tr>
<td>Verbal</td>
<td></td>
<td></td>
<td>.329**</td>
<td>.263**</td>
<td>-.088</td>
</tr>
<tr>
<td>Background knowledge</td>
<td></td>
<td></td>
<td></td>
<td>.314**</td>
<td>.128</td>
</tr>
<tr>
<td>Critical Evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.122</td>
</tr>
</tbody>
</table>

Note: **= Correlation significant at the .01 level, * = significant at .05 level

Results of the linear regression, as presented in Table 4.11, indicated, first that verbal intelligence, as measured by a vocabulary test, explained 16.9% of the variance, which was significant, \( F_{1,93} = 20.530, p < .001 \). After verbal ability was accounted for, the three predictor variables of background knowledge, evaluation skills, and scores on a self-report measure of dispositions of online reading comprehension explained an additional 22.4% of the variance on the scores of the less restricted ORCA, which was significant \( F_{1,92} = 15.415, p < .001 \). In the full model, scores on a critical evaluation measure explained a significant amount of unique variance (\( \beta = .335, p < .000 \)). Background knowledge also contributed significantly to the prediction of scores on the less restricted ORCA (\( \beta = .211, p = .021 \)). Dispositions of online reading comprehension did not contribute significantly to predictions in the model (\( \beta = .117, p = .162 \)). The addition of the variables in the second step of the less restricted model had a large effect, Cohen's F = .358.
Table 4.11

Results of Hierarchical Regression for the Less Restricted ORCA

<table>
<thead>
<tr>
<th>Model</th>
<th>β</th>
<th>Sig</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td>.205</td>
<td>21.030*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td>.224</td>
<td>11.454*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Evaluation</td>
<td>.270</td>
<td>.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background knowledge</td>
<td>.335</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposition</td>
<td>.241</td>
<td>.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.124</td>
<td>.137</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * = p < .01

Interaction effects refer to the combined effects of variables on the dependent variable and they should be considered in multiple regressions (Pedhazur & Schmelkin, 1991). However when testing interactions it is important to center the interactions to reduce the chance of multicollinearity (Tabachnik & Fidell, 2001). First the four independent variables were centered (Aiken & West, 1991; Judd & McClelland, 1989) by subtracting the mean from each score. This resulted in each variable having a mean of zero (Aiken & West, 1991). Then an interaction term was computed for each variable. Finally a hierarchical regression was run with the each centered variable in the first model and the centered variable and interaction term in the next model. This tested if the interaction variable should be introduced to the full model (Aiken & West, 1991).

Results of these analyses found no significant interaction between verbal ability and critical evaluation scores $t_{(93)} = 1.298, p = .198$; no significant interaction between verbal ability and background knowledge $t_{(93)} = -.368, p = .713$; no significant interaction verbal ability and dispositions $t_{(93)} = -.408, p = .684$; no significant interaction between critical evaluation scores and background knowledge $t_{(93)} = 1.340, p = .184$; no significant interaction between dispositions and background knowledge $t_{(93)} = 1.024, p = .308$.

**Summary of results to research question one.** The results from research question one indicate that after controlling for verbal intelligence, scores on a measure of students’ ability to critically evaluate websites is the best predictor of performance on an online reading
comprehension assessment in a less restricted space ($\beta = .334, p=.000$). Background knowledge was also a significant predictor of performance on an online reading comprehension assessment in a less restricted space ($\beta = .241, p=.007$). Dispositions did not make a significant prediction in performance on an online reading comprehension assessment in a less restricted space ($\beta = .124, p=.137$).

**Results For Research Question Two: Online Reading in a More Restricted Information Space**

The second research question explored the best fit model for online reading comprehension in a more restricted information space. It asked:

> When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

To answer Research Question two, another hierarchical regression was calculated. Verbal ability was added in the first step; followed by the other independent variables in the second step. Total scores on the more restricted ORCA (ORCA-MR) were entered as the dependent variable. Verbal ability was entered in the first step. Then the independent variables: background knowledge scores, critical evaluation scores, and the newly computed disposition scores were added in a second step.

In the first step, verbal ability explained 15.2% of the variance, which was significant, $F_{(1,94)} = 17.024, p< .001$. After verbal ability was accounted for, the three predictor variables of background knowledge, evaluation skills, and scores on a self-report measure of dispositions of online reading comprehension explained an additional 38.1 % of the variance on the scores of the more restricted ORCA, which was significant $F_{(1,92)} = 26.328 p< .000$. 

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In the full model scores, as presented in Table 4.12, a critical evaluation measure explained a significant amount of unique variance (β = .499 p< .000). Background knowledge also contributed significantly to the prediction of scores on the more restricted ORCA (β = .189 p = .017). Dispositions also made a significant prediction to the model (β = .291 p = .006). This explanation had a large effect, Cohen’s F = .631.

Table 4.12

<table>
<thead>
<tr>
<th>Model</th>
<th>β</th>
<th>Sig</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>.152</td>
<td>17.024*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Intelligence</td>
<td>.414</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td>.381</td>
<td>25.008*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Intelligence</td>
<td>.219</td>
<td>.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Evaluation</td>
<td>.499</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background knowledge</td>
<td>.189</td>
<td>.017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposition</td>
<td>.206</td>
<td>.006</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * = p < .01

Interaction effects were once again tested to see if they should be added to the model. Results of these analyses found no significant interaction between verbal ability and critical evaluation scores t(96) = .104, p = .917; no significant interaction between verbal ability and background knowledge t(104) = -.132, p = .895; no significant interaction verbal ability and dispositions t(96) = -.869, p = .387; no significant interaction between critical evaluation scores and background knowledge t(97) = .281, p = .780; no significant interaction between dispositions and background knowledge t(93) = .936, p = .351.

**Summary of results to research question two.** Once again, after controlling for verbal intelligence scores, a measure of critical evaluation of websites made the largest prediction in performance on a measure of online reading comprehension in a more restricted environment (β = .499 p< .000). Background knowledge also contributed significantly to the prediction of scores on the more restricted ORCA (β = .189 p = .017). A difference between the less restricted and the more
restricted environment were scores on the self-report measure of dispositions. Dispositions of online reading comprehension made a significant prediction to the more restricted model ($\beta=.291 \ p=.006$).

**Exploring bi-variate correlations.** Additional analyses were conducted to further explore the relationships between the dependent and independent variables. Background knowledge was significantly correlated with both versions of the ORCA. The Pearson correlation between background knowledge and the ORCA-LR was $\rho=.370 \ p=.000$. The correlation between background knowledge and the ORCA-MR was $\rho=.433 \ p=.000$. Table 4.13 lists the Pearson correlations for item types on each format. The background knowledge measure was significantly correlated with every item type except for the communication items.

Table 4.13

*Pearson’s r correlations between Verbal Intelligence and ORCA items*

<table>
<thead>
<tr>
<th></th>
<th>Locate</th>
<th>Evaluate</th>
<th>Synthesize</th>
<th>Communicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-LR</td>
<td>.239*</td>
<td>.372**</td>
<td>.375**</td>
<td>.028</td>
</tr>
<tr>
<td>ORCA-MR</td>
<td>.250*</td>
<td>.431**</td>
<td>.420**</td>
<td>.157</td>
</tr>
</tbody>
</table>

Note *= significant at .05 level; **= significant at .01 level

Scores on the critical evaluation measure were significantly correlated with the ORCA. The Pearson correlation for the ORCA-LR was $\rho=.462 \ p=.000$. The correlation for the ORCA-MR was $\rho=.574 \ p=.000$. Table 4.14 lists the Pearson correlations for item types on each format. The critical evaluation measure was significantly correlated with every item type except for the communication items.
Table 4.14

*Pearson's r correlations between COIL and ORCA items*

<table>
<thead>
<tr>
<th></th>
<th>Locate</th>
<th>Evaluate</th>
<th>Synthesize</th>
<th>Communicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-LR</td>
<td>.235*</td>
<td>.414**</td>
<td>.397**</td>
<td>.065</td>
</tr>
<tr>
<td>ORCA-MR</td>
<td>.432*</td>
<td>.534**</td>
<td>.575**</td>
<td>.109</td>
</tr>
</tbody>
</table>

Note * = significant at .05 level; ** = significant at .01 level

Self-report scores on the DORC did not have as strong a correlation with the ORCA as the other independent variables. The DORC and the ORCA-LR had a weak and non-significant correlation of .122 $p = .248$. The DORC and the ORCA-MR had a weak but significant correlation of .212 $p = .042$. The DORC did not significantly correlate with any item type on the ORCA-LR but did have weak, but significant correlations with the synthesis and evaluation items on the ORCA-MR. These correlations are displayed in Table 4.15.

Table 4.15

*Pearson's r correlations between COIL and ORCA items*

<table>
<thead>
<tr>
<th></th>
<th>Locate</th>
<th>Evaluate</th>
<th>Synthesize</th>
<th>Communicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORCA-LR</td>
<td>.169</td>
<td>.090</td>
<td>.093</td>
<td>-.014</td>
</tr>
<tr>
<td>ORCA-MR</td>
<td>.213*</td>
<td>.225*</td>
<td>.131</td>
<td>.065</td>
</tr>
</tbody>
</table>

Note * = significant at .05 level;

**Examining Disposition Scores.** Given the low correlation between the DORC scores and the ORCA scores a decision was made to examine the correlations of the subscales of the DORC: reflective thinking, critical stance, collaboration, flexibility, and performance on the ORCA. The data, as displayed in Table 4.16, demonstrated that scores on the collaboration subscale had a negative correlation with scores on both the ORCA less restricted but not the ORCA more restricted.
Table 4.16

_Bivariate Correlations of DORC Subscales and ORCA_

<table>
<thead>
<tr>
<th></th>
<th>ORCA-LR</th>
<th>ORCA-MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective Thinking</td>
<td>.195</td>
<td>.269**</td>
</tr>
<tr>
<td>Critical Stance</td>
<td>.164</td>
<td>.231*</td>
</tr>
<tr>
<td>Collaboration</td>
<td>-.115</td>
<td>.009</td>
</tr>
<tr>
<td>Flexibility</td>
<td>.035</td>
<td>.122</td>
</tr>
<tr>
<td>Persistence</td>
<td>.213*</td>
<td>.236*</td>
</tr>
</tbody>
</table>

Note * = significant at .05 level; ** = significant at .01 level

**Chapter Summary**

This chapter presented the results of a study seeking to further enrich our understandings about models of online reading comprehension. Two research questions were addressed in the quantitative portion of this study:

1. When predicting online reading comprehension of a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

Specifically this study examined the relative contributions of background knowledge, critical evaluation skills, and dispositions of online reading comprehension after controlling for verbal intelligence. These variables were tested in two different information spaces. The first context, a less restricted information space, allowed students to search for any relevant website.
The second information context, a more restricted information space, required participants to find specific sources.

Sequential (hierarchical) regression (Tabachink & Fidell, 2001) was used to allow the researcher to enter verbal intelligence to the model a priori. A vocabulary test was used to measure verbal intelligence. In each model the scores on the verbal intelligence measure explained a significant amount of the variance, and were entered in the first step. In the less restricted model verbal intelligence explained 16.9% of the variance, which was significant, \( F_{(1,93)} = 20.530, p < .001 \). In the more restricted model verbal intelligence explained 15.2% of the variance, which was significant, \( F_{(1,94)} = 17.024, p < .001 \). The addition of critical evaluation scores, background knowledge scores, and disposition scores in the next step explained an additional 22.4% variance in the less restricted model and an additional 38.9% of the variance in the more restricted model.

In both models, less restricted and more restricted, critical evaluation made the largest contribution after accounting for verbal intelligence. In the less restricted model scores on a measure of critical evaluation were a significant predictor (\( \beta = .334, p = .000 \)) of online reading comprehension. In the more restricted model critical evaluation was also a significant predictor of performance on a measure of online reading comprehension (\( \beta = .499, p < .000 \)).

This result was consistent with cognitive flexibility theory. It was predicted that students who scored well on a measure of critical evaluation skills may have "advanced web skills" and thus would score higher on the ORCA assessments. Furthermore students who scored low on the measure may have made errors of oversimplification or have had bias in their mental representation of the source. This would lead to scores on the critical evaluation measure being a strong predictor on the ORCA assessment.

This result was also consistent with a theory of new literacies of online reading comprehension. Critical evaluation of websites is a key component of online reading
comprehension. In both models scores on the critical evaluation instrument had the largest predictive weight.

In both models, less restricted and more restricted, background knowledge scores also made a significant prediction. Background knowledge was a significant predictor of performance on an online reading comprehension assessment in a less restricted space \((\beta = .241, p = .007)\). Background knowledge also contributed significantly to the prediction of scores on the more restricted ORCA \((\beta = .189, p = .017)\).

It was predicted, based on the principles of cognitive flexibility theory, that background knowledge would be a significant predictor in both models. Furthermore the prediction was that background knowledge would not be the strongest predictor in either the less restricted or the more restricted model as students would have to rely more on “advanced web skills” rather than topical knowledge.

It was predicted, based on the principles of a theory of new literacies of online reading comprehension that background knowledge would have a role in predicting performance on a measure of online reading comprehension but it would not be the strongest predictor of performance. Results of this study confirmed this prediction. Scores on an assessment of critical evaluation skills were the strongest predictors.

Scores on a self-report measure of dispositions of online reading comprehension were only significant predictors in the more restricted model. Dispositions did not make a significant prediction in performance on an online reading comprehension assessment in a less restricted space \((\beta = .124, p = .137)\). Dispositions of online reading comprehension made a significant prediction to the more restricted model \((\beta = .291, p = .006)\).

These results do not align with the predictions made based on cognitive flexibility theory. It was predicted that dispositions would be a significant predictor in the less restricted ORCA. This prediction was based on the idea that students who “have open mindsets” would do better in the
unfettered environment of the less restricted information and that structured searches of the more restricted ORCA, while benefiting,” would not allow for serendipitous learning. However the inverse was found in the results of this study. Scores on the dispositions of online reading comprehension were significant in the ORCA-MR model but not the ORCA-LR model.

The results also did not align with the predictions made based on a theory of new literacies of online reading comprehension. Based on this theory the prediction was made that dispositions would be a significant predictor in both models. However dispositions were only a significant predictor in the more restricted model.
Chapter V

Qualitative Results

In addition to the two quantitative research questions (numbers 1 and 2) that were previously explored in Chapter IV, this study also explored two qualitative research questions (numbers 3 and 4) using think aloud data:

3. What patterns of online reading comprehension strategies appear among high and low performing online readers during an online reading comprehension task within a less restricted information space?

4. What patterns of online reading comprehension strategies appear among high and low performing online readers during an online reading comprehension task within a more restricted information space?

I utilized a two-stage analysis. First the data were examined for themes and patterns between high and low performers across the overall ORCA assessments. Then to answer questions three and four the data were examined for themes and patterns between high and low performers: first, within a less restricted information space and then within a more restricted information space. Thus, the stage one analysis consisted of looking for patterns of strategy use that led to better overall performance when completing online reading comprehension assessments. Then in stage two these patterns were examined more closely to see if there were differences based on the nature of the information space.

Twelve students, four from each participating school, were selected for the qualitative portion of the study. Performance on the first administration of the online reading comprehension assessment was used to determine participants in the think aloud activity. They were selected as follows.
1. First all students in their class were ranked based on scores on the first administration of the ORCA. Students were divided into two groups: top 10% of scores and the bottom 10%

2. These groups were then reviewed by the teacher to allow for the selection of students who would be comfortable working with an adult on a verbal protocol task.

3. Then four students from each participating school were randomly selected from the list: two students who scored in the 10% of their class and two students who scored in the bottom 10% of their class.

Then, for the qualitative analysis, the twelve selected students were divided into three achievement-level groups (high average, low) based on ORCA scores, independent of school. They were ranked using a combined score of one less restricted task and one more restricted task. The students were ranked from 1 (lowest) to 12 (highest) and broken into three groups of four. This list resulted in a median score of 10.5, out of 24. The middle group included four students within two scores of the median. The low group included scores more than two scores below the median. The high group included four students with scores more than two scores away from the median.

Ten students were included in the final analysis since two students had to be removed from the study due to errors in data collection. This included one student in the high group and one student in the middle group. Table 5.1 lists the scores of each participant.

The students then completed two additional think-aloud sessions with the researcher. One task involved a more restricted information space, where students had to find specific sources, and the other task involved a less restricted information space, where students could select any source. Students were scored using a dichotomous rubric. This rubric appears in Appendix A.
Table 5.1

Qualitative Participants

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Verbal</th>
<th>PK</th>
<th>ORCA 1</th>
<th>ORCA 2</th>
<th>Total</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>13</td>
<td>1.5</td>
<td>8</td>
<td>9</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Olivia</td>
<td>17</td>
<td>2</td>
<td>9</td>
<td>10</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Ava</td>
<td>23</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexander</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Sophia</td>
<td>5</td>
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<td>4</td>
<td>7</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Jacob</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Ethan</td>
<td>7</td>
<td>1.5</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Michael</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Jaydan</td>
<td>7</td>
<td>.5</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: ORCA1 and ORCA2 represents the two assessments administered to select students for the think aloud task. It included both a more restricted and a less restricted task.

Qualitative Analysis: A Two-Stage Approach

This chapter presents the results of the qualitative analysis organized in two separate stages. Stage one involved looking at the data globally. The goal of stage one was to identify patterns of strategy use that lead to success on the ORCA regardless of the nature of the information space.

First frequency tables of raw codes were examined for patterns. The coding scheme consisted of observable reading strategies. Then successive passes through the data were conducted by reexamining the time stamp of coding instances. I would return to the video at specific timestamps and compare coding instances across cases. This allowed for data reduction and patterns to emerge. The data were then reexamined in order to group patterns until themes emerged. This approach lead to themes, which consisted of patterns, and each pattern, consisted of observed behaviors from frequencies of codes.
The second stage of analysis built upon the results of the first stage. The goal of the second stage was to examine the themes from stage one to answer research questions three and four. This stage involved making additional passes through the data to see if patterns emerged that were different based on the nature of the information space: more restricted or less restricted. Pattern identification involved an iterative process of reorganizing the data from stage one and reworking groupings so that the pattern structures defined themes in the data.

Examining patterns in the second stage of data analysis revealed a difference among strategy use by high and low performers. It was evident, by examining the data that the restricted nature of the information space only affected patterns of strategy use on the locating tasks. Therefore these patterns were then grouped into themes surrounding specific processes involved in locating information during the ORCA tasks.

**Stage One Themes**

The goal of stage one was to identify patterns of processes that lead to overall increased performance on the ORCA assessment. Recursive, analytic inductive methods (Angrosino, & Mays de Perez, 2000; Bogdan & Biklen, 2003) were used to make initial passes through coded videos of student think alouds to identify patterns. The patterns that emerged were evident across all elements of online reading comprehension: locating, evaluating, synthesizing, and communicating. The patterns that emerged were also evident in both the less restricted and the more restricted tasks.

These patterns were further distilled as successive passes were made to organize the patterns into themes. In the end, four global themes emerged that represented central trends in the data. These themes and their associated patterns consisted of the following:
Theme one: Overall ORCA scores appeared to be related to strategic text assembly.

1. Students with greater navigational skills were better at reading multiple sources.
2. Students who used comprehension monitoring strategies were more successful on the ORCA tasks.
3. Students more successful at synthesizing online information returned to their sources with greater frequency.

Theme two: Overall ORCA scores appeared to indicate a lack of source evaluation knowledge among participants.

1. Few students were successful at evaluating author expertise, evidence used by an author, and author's points of view.
2. Students made errors of oversimplification during online reading comprehension tasks.

Theme three: Students who recall details from memory appear to perform better on the ORCA tasks.

1. Students who recalled details from memory when combing multiple sources may be better at synthesis tasks.
2. Students who recalled details from memory may be better at taking a position.

Theme four: Students appeared unprepared to engage in the communication strategies necessary for online reading comprehension in academic settings.

1. Student responses failed to provide adequate information, especially evidence from what they have read.
2. Students did not use the affordances of online communication spaces.
Theme one: Overall ORCA scores appeared to be related to strategic text assembly.

A clear difference emerged between students with high levels of online reading comprehension and their less skilled peers around an ability to strategically assemble texts while engaged in Internet inquiry. After all the construction of texts in situ is a novel difference of online reading comprehension (Leu et al., 2004). Thus this theme was defined as the ability to read for meaning while flexibly applying both navigation strategies and comprehension monitoring strategies.

Three patterns informed this theme: (a) Students with greater navigational skills were better at reading multiple sources; (b) Students who used comprehension monitoring strategies were more successful on the ORCA tasks; (c) students more successful at taking a position while synthesizing online information used more navigation strategies.

Pattern one: Students with greater navigational skills were better at reading multiple sources. One of the first elements required for strategic text assembly is the ability to manipulate multiple windows and tabs. Participants who scored in the highest performing group on the online reading comprehension assessment were more likely to utilize multiple tabs as a tool to move between the task and their sources. This allowed them to create useful multiple source texts through self-directed text construction (Coiro & Dobler, 2008). In addition, they were more likely to click on additional links at the initial webpage they found based on search results. This allowed participants to have a wider selection of sources to select during text assemblage. These patterns are displayed in Table 5.2. This pattern included two strategies: (a) utilizing tabs to navigate between task and source and (b) using tabs to navigate between multiple sources.
Table 5.2

*Frequency of Navigational Strategies*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Moves between task and source</th>
<th>Navigate between multiple tabs or windows</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Olivia</td>
<td>29</td>
<td>11</td>
</tr>
<tr>
<td>Ava</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>64</strong></td>
<td><strong>21</strong></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Alexander</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Jacob</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Ethan</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>51</strong></td>
<td><strong>14</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Jaydan</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Michael</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>49</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

*Utilizing tabs to navigate between task and source.* A key overall difference between high and low performers was the frequency in which students moved between the task and the source or between the task and multiple sources by using tabs. The students who successfully used tab browsing seemed to rely on the tool to use navigational strategies. This strategy supported the strategic text assembly of skilled online readers. Successful students used windows or tab browsing to navigate between sources and tasks and between multiple open sources. These strategies supported their navigation as students used the tabs to move back to the task to remember their purpose in reading a source.
The advent of tabbed browsing has altered how many read online. These participants were infants when Mozilla introduced tab browsing to Firefox in 2000. Thus it was not a surprise to see a reliance on tabs across all three groups. Still it is clear that students who utilize navigational strategies such as the effective use of tabbed browsing performed better. For example students in both the high and middle groups who were more successful moved between the task and their sources with greater frequency and ease.

Ava used tabs successfully when she had to paraphrase two sources on the Causes task. Ava began the second synthesis item on the Causes task by reading the item. She had four tabs open: the task and her three sources. After reading the item Ava then clicked on the tab for the second source that she found. Ava read the website for 12 seconds, and then clicked back on the tab to the task. She then read the task asking her to combine the information she read. Ava next clicked on the second source she found. She scrolled down and read the website for a few seconds. Ava then typed:

There wasn't just one event that caused the American revolution, there were many events such as the French and Indian war, and when the British started to control how Americans bought tea and...

I then asked her where she got her information from and Ava clicked on her third source and “said this one, and this one” as she clicked on her second source. Ava then moused over links to various causes on her second source and then clicked back to her third website she found. She read the page and then clicked back on her task and added the words, “stamp act.” By clicking on the activity tab to reread the task Ava was engaging in cursor control. This helped her in completing the synthesis tasks.

Olivia was a skilled navigator of tabbed browsing. She would constantly refer back to the task in order to remind herself of the goal. After re-reading the task Olivia would move back to her source and decide if it was relevant.
Michael, in the low group, on the other hand, did not have a strong understanding of tab browsing. He often would accidently close out tabs he was using. Twice he closed out of the task tab and the task had to be restarted. In these instances I forwarded him to his last question. Michael actually opened an additional window to conduct a search. He then asked me if he could, “Exit out of these two,” while mousing over the “Close x” in the upper left hand corner. I explained, “You might need those later,” and Michael minimized the window with the task. Later he forgot he minimized the task and had to be reminded by me.

Emma, in the low group, seems to have used tabs quite often. However an examination of the video data revealed that Emma was not efficient in her use of tabs to read multiple sources. She would often click through the tabs, losing her place, forgetting what source she was trying to read.

*Using tabs to navigate between multiple sources.* Another key difference that led to higher overall performance was navigating between sources. For example Isabella, in the high group, used the task interface as a note-taking tool as she read. Isabella would seamlessly move between up to five open tabs in her browser. On the turning point task, for example, she had five tabs open. She would move through these tabs and find details on each page during the synthesis tasks. When asked about moving between tabs, Isabella said, “It is easier to find information this way.”

Alexander, in the middle group, also used tabs to paraphrase two relevant details from each source he found. While working on the causes task, Alexander said, “It says to take notes so I am going to look at all three and take notes from each of them.” Alexander then clicked on the tab for the first source he found. He clicked back on to the task and typed in two details. He then clicked on a tab to the third source he found. Alex spent a few seconds reading the source. He then tabbed back to the task and added a third detail.

Michael, on the Turning Point task, was not as successful at synthesizing information from two sources. In fact Michael never clicked on the tabs to move between sources. On the second
synthesis item Michael quickly read the task and clicked on the tab for the webpage about the Turning Point of the Revolution on socialstudeisforkids.com. He then began to paraphrase the details from the source. Besides a few phrases, Michael’s response is almost verbatim from the website. In order to get the wording, names, and dates correct Michael toggled back and forth between his source and task a total of six times. Michael never clicked on the second source.

**Pattern two: Students who used comprehension monitoring strategies were more successful on the ORCA tasks.** Another key difference in overall success on the ORCA was the use of comprehension monitoring strategies by skimming websites or reading for sustained periods. Comprehension monitoring was central to strategic text assembly. This pattern is displayed in Table 5.3. Two strategies were evident in this pattern: (a) using a strategy of skimming websites to identify key details; (b) and engaged reading within a website.

Table 5.3

*Frequency of Comprehension Monitoring Strategies Used to Read Websites*

<table>
<thead>
<tr>
<th>Participant groups by ORCA scores</th>
<th>Skims website</th>
<th>Engaged reading of relevant website</th>
<th>Summarizes a website</th>
<th>Uses internal search engine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Olivia</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ava</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>34</strong></td>
<td><strong>9</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>13</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alexander</td>
<td>15</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Jacob</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ethan</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>44</strong></td>
<td><strong>10</strong></td>
<td><strong>1</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jaydan</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Michael</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>14</strong></td>
<td><strong>6</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>
**Using a strategy of skimming websites to identify key details.** Skimming and scanning was defined as quickly scrolling up and down a website. Overall students who were more successful on tasks skimmed more sources, looking for relevant details to integrate in their responses. This was evident in both the high and middle groups. Students in the lowest performing group did not skim with great frequency.

Participants who performed well skimmed and scanned information more within a website. In essence effective online readers quickly skimmed websites, checked the source against their purpose and moved on from irrelevant sources. Olivia, for example, was very adept at quickly reading a website and disregarding irrelevant information. She would often skim and scan a website before she read the source. When asked she said, “I like to quickly look to see if it has any links or information I can use.”

Students in the middle group also used a strategy of skimming websites. The mean frequency for the middle group (10.4), however, was not quite as high as that for the top tier group (11.3). When Sophia was working on the Turning Point task she clicked on the site [SocialStudiesforkids.com](http://SocialStudiesforkids.com). Her cursor then scrolled over the headings and the first few sentences of the article. When asked what she was doing, Sophia said, “It had information about the revolutionary war. I am going to read it.”

Students who were less successful also skimmed and scanned sources. However, they used the strategy with less frequency than their more accomplished peers. Ethan for example landed on a [Wikipedia](https://en.wikipedia.org) article during the Turning Point task. He quickly scrolled down to the bottom and back up. He then recorded his answer as correct without actually reading the website.

Jaydan did not always scan his websites for relevant information. During the Delaware task Jaydan landed on the [SocialStudiesForKids](http://SocialStudiesForKids) website. He scrolled up and down and said, “It has a lot more information about it. So it might have more facts.” After skimming the page Jaydan went on to
read the site. Yet on the same task he landed on a *Wikipedia* article, selected the entire texts and copied that as his response to a synthesis prompt.

**Engaged reading of websites.** Engaged reading of sources was defined as a period of reading beyond ten seconds that was accompanied with either cursor movement or reading aloud. Basically students who relied on strategic text assembly had the conditional knowledge of when to slow down as well as speed up. In addition to skimming and scanning, students who were more successful on the ORCA task spent more time reading at selected locations.

Olivia, a member of the highest scoring group, heavily invested time in the reading of sources. On the Women task she landed on a webpage, *American Athenas* on the website *AmericanRevolution.org*. Olivia spent over five minutes reading the source. She scrolled through the source multiple times. Olivia’s approach to the Causes task was very similar. She often spent minutes on a source, where her counterparts would often read a source for less than a minute. Once Olivia finished reading a source she would provide a verbal summary.

Students in the middle group also used a strategy of engaged reading. They were also more likely to read a source out loud when compared to the high group. This strategy was more prevalent with Sophia who spent more time on sources than any student besides Olivia. When Sophia landed on the webpage titled, “What's Wrong with this Painting” during the Delaware task she explained that she was looking for information about the accuracy of the painting. Sophia then proceeded to read the website out loud. Sophia chose to read all of her websites verbally.

Alexander, also a member of the middle group, spent substantial time reading a source. When Alexander landed on a source and chose it as relevant he would read the source to himself. Alexander, like Olivia, would then provide a verbal summary. For example, on the Delaware task he was reading a site. Once he finished Alexander stopped and said, “I read a little bit of this and it says, ‘it contains an often discussed historical inaccuracy.”
Students in the lowest performing group also used a strategy of engaged reading on websites. However this strategy was employed with less frequency than their more successful peers. Once again, like students in the middle group, this strategy was noted most often when students would read a source out loud. Also the time spent on sources by these students was much less than the time spent by students in higher achievement groups such as Olivia and Sophia.

Jaydan, for example, on the Delaware task, found himself on a page on the socialstudiesforkids.com website. He started by reading the first paragraph out loud. Jaydan, however, did not read any details that were significant to the task.

Emma displayed a rudimentary use of a engaged reading on a website to identify key ideas. She would stop to read a source, but Emma often moved quickly from the source back to the task without reading the entire piece and Emma missed key details that would answer the question posed in the task. For example on the Women in the revolution task Emma spent only a few second with each source.

**Pattern three: Students more successful at synthesizing online information returned to their sources with greater frequency.** Returning to sources was another key component of strategic text assembly. This required both navigational skills and comprehension monitoring. This pattern involved two strategies: navigating to a source to read while taking a position and navigating to the source to copy and paste details. The frequencies of these strategies are displayed in Table 5.4.
Table 5.4

*Navigation Strategies Used When Taking a Position*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Student returns to the source</th>
<th>Student copies and past details in reference to claim.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Olivia</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Ava</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>21</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

| **Medium**                         |                               |                                                  |
| Sophia                             | 3                             | 1                                                |
| Alexander                          | 4                             | 0                                                |
| Jacob                              | 0                             | 0                                                |
| Ethan                              | 0                             | 0                                                |
| **TOTAL**                          | **7**                         | **1**                                            |

| **Low**                            |                               |                                                  |
| Emma                               | 1                             | 1                                                |
| Jaydan                             | 0                             | 0                                                |
| Michael                            | 0                             | 0                                                |
| **TOTAL**                          | **1**                         | **1**                                            |

**Navigating to a source to read while taking a position.** Participants who referred back to the sources they found during the final synthesis item enhanced their performance on the ORCA tasks. This strategy was defined as clicking on a source for any given time during the take a position items. It should be noted that every student in the highest performing group returned to the source a minimum of one time. Two out of three students in the middle group used this strategy, and only one student in the lowest group used this strategy.

Students in the highest performing group used a strategy of returning to the source. Olivia continued her pattern of long sustained reading on the final synthesis task. She took a total of four
minutes to complete the item, the longest of any of the participants. Olivia began by reading the item, and typing, “The women.” I asked her to explain her thinking and Olivia then clicked on to the last source she found and said, “the role that they played, um they fought for their country too, but by doing other things like sticking up for their homes.” Olivia then clicked back on the task and typed:

The women fought a different part of the war at home, they protected their home from invaders, they even decided to stop doing somethings in order to save their country that was at battle.

Olivia then moved on to the question asking her to support her position. She read silently, on a single source, for approximately one and a half minutes. She then clicked back on the task, and typed, “They ended up signing a declaration to stop using tea to help the war, also to stop the English imports that were coming.”

Only two students in the middle groups returned to the source. Alexander, for example navigated to his source during the Causes task. He began the take a position item by writing, “I think that they were that American people were very independent...” Alexander then clicked on the American Persuaders website and scrolled through the page. He clicked back on the ask and added, “and the Boston Tea party, Boston Massacre, and the Stamp Act. Alexander then moved on to the second question. He typed, “I found my first example in words from.” Alexander then clicked on the tab to his second source, socialstudiesforkids.com. He copied and pasted the URL. He then repeated this process for the third website he found.

Students in the lowest group did not return to the source while taking a position. Only Emma did once. Jaydan or Michael did not use this strategy.

**Navigating to the source to copy and paste details.** Students also relied on copying and pasting in the final synthesis task as a strategy. This strategy was defined as copying and pasting a
detail, and not the URL, from the website. The use of this strategy was not a key indicator of overall ORCA performance. One student, in each of the groups, used this strategy.

Isabella copied and pasted details from a source on the Turning Point task. She began the task by answering the first question with, “When the battles would happen the Americans were taking over and winning more than the British”. She then moved on the second question in the task. She clicked on one of her sources and copied and pasted, “American Victory at Saratoga.” Isabella then added “…because that is one of the Battles they won.” She then clicked on another source and copied and pasted “The Battle of Bennington” Isabella then finished the sentence with “…another battle they won.”

Sophia also relied on a copy and paste strategy. When she started the third synthesis item on the Turning Point task Sophia immediately typed, “When the Americans and French had surrounded the British.” She then quickly clicked on one of her sources and copy and pasted for the second half of the item.

Emma was the only student in the lowest performing group to use a strategy of copy and paste. She did not employ the strategy well. For example, on the causes task she began by reading the task. Emma then clicked on the tab to one of her sources. Emma then proceeded to read for two minutes. She then copied and pasted a line from the task for her position. She then clicked back to her source, and immediately moved back to the task and typed, “IDK,” after the sentence she copied.

**Theme two: Overall ORCA scores appeared to indicate a lack of source evaluation knowledge among participants.**

The results from the qualitative portion of this study support the conclusion that source evaluation may be the most critical component to online reading comprehension. Sourcing strategies fell along the two continuums of relevancy judgments and credibility judgments. Stage one analysis revealed that students who used more strategies to make credibility judgments on the
ORCA tasks outperformed their peers regardless of the nature of the task. Strategies for relevancy judgments were affected by the task and were analyzed in stage two.

Two patterns informed this theme: (a) few students were successful at evaluating author expertise, evidence used by an author, or author’s points of view; (b) students made errors of oversimplification when evaluating online sources.

**Pattern one: Few students were successful at evaluating author expertise, evidence used by an author, or author’s points of view.** The judging of website credibility involved complex sourcing strategies. The pattern that emerged among the participants was a general lack of effective strategies to evaluate author expertise, evidence used by an author, or author’s point of view.

**Strategies used to evaluate author expertise.** Evaluating author expertise was a two-step process. The first step was identifying an author. While reading books students know to look on the front cover, but in complex online environments the students struggle with correctly identifying the author. This is evident in Table 5.5. In this study students used a strategy of identifying the author in the text, used a strategy to identify the author on an about us page, or had an inability to find the author.
### Table 5.5

**Frequency of Strategies Used to Identify an Author**

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Finds the author in the text</th>
<th>Finds the author on an about us/bio page</th>
<th>Infers the author from the text.</th>
<th>Does a secondary search for the author.</th>
<th>Does not locate the author</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Olivia</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ava</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6</strong></td>
<td><strong>3</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alexander</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jacob</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ethan</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>7</strong></td>
<td><strong>2</strong></td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Jaydan</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Michael</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5</strong></td>
<td><strong>1</strong></td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Using a strategy of identifying the author in the text. The most frequent strategy displayed by the students was to identify the author in a text. This strategy involved looking for information under an article title, the header or the footer of the page. All of the students in the high performing group were able to identify the author on at least one of their tasks. There was also no difference between the high, medium, and low groups in the use of a strategy to identify the author in the text.

The use of this strategy was usually predicated more by the source than by the ability of the student. In other words if the author was readily available on the page the students would not apply more complex strategies such as looking for an about us page. For example many of the students chose to evaluate the website American Revolution Persuaders. The website clearly lists the author as Jeremy Jones in the title. Yet if you go to the website’s homepage by removing the file extension.
in the URL you are brought to a business. The *American Revolution Persuaders* was a child’s essay hosted on a parent’s website.

*Using a strategy of identifying the author on an about us page.* Across the tasks only five students clicked on links that would provide additional information about the author. This strategy, like most of the critical evaluation strategies was not particular to any specific group of participants.

Ava tried to utilize the strategy on both of her tasks. She was not, however, always successful. For example on the Delaware task Ava chose to review the article “What’s wrong with this painting?” hosted on the Delaware Crossing Park website. When looking for the author Ava first clicked on the home link. She then clicked on a link to site usage, which had details about renting park space. Ava then clicked on the contact us link followed by the “about us” link. Once, on the “about us” page Ava scrolled to the bottom and copied information about the Pennsylvania Governor. She entered this information as the author.

Sophia also tried to identify the author on the Delaware Crossing Park website. Sophia scrolled up and down the webpage, “What’s wrong with this painting.” She explained that she was trying to find the author. Next Sophia clicked on the “about us” link. When she could not find the author Sophia left the page and chose a source that listed the author under the title.

Jacob was able to use the strategy of finding information on a secondary link. During the Causes task Jacob was on the website *americanhistorycentral.com*. While he looked for the author he scrolled to the bottom of the page, and read the footer aloud, “Multieductator, Inc.” “Oh wait,” he added as he clicked on a “contact us” link. This opened up an email program. Jacob closed the program and clicked on the “about us” link. He read the page out loud and said, “There it is.” Jacob then entered “multieducator inc” as his author.

*Inability to apply a strategy to find an author.* Six of the participants were unable to identify the author in at least one of their tasks. Ethan could not locate the author on his task about the
historical accuracies of Gottlieb’s painting. Ethan chose to identify the author of a Wikipedia article he found. Ethan began by clicking between two websites: the Wikipedia article and another source. As he was moving through the pages, scrolling up and down, the researcher asked, “What are you thinking?” Ethan, replies, “I cannot find the author, the author to one of the websites.” He then typed “IDK” in the box for the author. It must be noted he did not click any links on either site. Ethan just scrolled up and down the pages.

Michael when looking for an author for the “women in the revolution” task quickly tabbed through all of his sources. He settled on a website for the Stony Field Battlefield State Historic Park. The site clearly listed the author at the top of the webpage as, Gillian Courtney, Park Ranger. Michael incorrectly listed the authors as Gillian Courtney and Park Ranger.

High performing students did not always identify the author. Olivia also struggled on one of her tasks. She read the task and then clicked on the tab to one of her sources, historycentral.com. She then scrolled up and down the page. The researcher asked Olivia, “What are you looking for?” She responded, “Information about the author.” Olivia then paused on the citation listed at the bottom of the page. She then clicked back over to the task and typed in the name, “Pheobe Hanafore.” This was not the author of the website but was a source cited in the website.

Isabella also could not identify the author on the Turning Point task. Isabella was looking for the author of the website AmericanRevolution.org. She spent one minute and visited three separate pages on the website looking for the author. Isabella clicked on her original source about a battle in the revolution. She then clicked on more information about the battle and finally the website’s homepage. After she could not locate the author or publisher of the website she recorded the answer, “website makers” as the author.

The second step in evaluating author expertise required readers to judge the author expertise using common markers of authority such as occupation, institutional affiliation, or education. Overall the participants struggled to evaluate the expertise of the author. The pattern is
displayed in Table 5.6. Only three students correctly responded to at least one prompt about expertise. Only one student, Ava, earned both score points for evaluating author expertise. The two most dominant strategies used were judging expertise by using the content of the website or by focusing on specific details. Students who successfully judged author expertise relied on effective markers of expertise.

Table 5.6

Frequency of Strategies Used to Judge Author Expertise

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Uses an authoritative title to judge the author</th>
<th>Uses supporting details from content of the website</th>
<th>Uses institutional information to judge author expertise</th>
<th>Uses background knowledge to judge author expertise</th>
<th>Uses completeness of information to judge author expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Olivia</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Ava</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Alexander</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Jacob</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ethan</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jaydan</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Michael</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Using effective markers of expertise. Students who correctly evaluated author expertise relied on two major strategies: institutional affiliation and author’s occupation. Ava, who could not identify the authors of a website published by the State of Pennsylvania (she listed the governor as author) noted that the authors were owners of a historical park so they must be experts. On her next task, the Turning Point of the Revolution, Ava focused on the author’s occupation. She noted
that Dan White, creator of socialstudiesforkids.com is an “educational professional with a passion for social studies.” Jaydan also noted that as a social studies teacher Dan White is an expert.

Sophia used the publisher affiliation, background knowledge, and content of secondary sources to evaluate author expertise. She wrote:

I think he is because it is a .org and those are pretty helpful. Also of what I know this all sounds right. Another reason is that they have a lot of information that the other websites didn’t.

Sophia first focused in on the URL extension. While not a guarantee of expertise it did demonstrate a higher level of source knowledge. She then checked the details used by the author. Finally she mentioned that the website had information from other websites. It must be noted that at no time did Sophia actually evaluate the author. She, like her peers, put the most value in the content of websites.

**Strategies used when evaluating evidence used by the author.** Another important strategy, when reading multiple sources online, is evaluating the credibility of a source by judging the evidence cited by the author (Goldman, 2010). This is also an important strategy for the discipline of social studies as students read online texts (Manderino, 2011). This strategy was defined as judging the credibility of the sources of claims or evidence used by an author of a website.

Overall there were no major difference between students who were more successful on the ORCA tasks and students who were less successful on the ORCA task. Only one students exhibited a strategy that evaluated the evidence in a website. Except for this student, all of the participants did not exhibit strategies to evaluate the source of evidence within a website. Therefore the only pattern evident in the data was a total lack of strategy use to judge the evidence used by an author.

**Examining the one case of successful strategy use to judge evidence used by an author.** Sophia was successful in evaluating evidence used by the author. Sophia’s strategy was to check the
evidence against a secondary source. She responded, “Because s/he give facts. And the other websites say the same thing. so He must have his Facts Correct.”

**Strategies used when evaluating author’s point of view.** Participants in the study displayed the fewest strategies when they were asked to evaluate how an author’s point of view may have shaped the words or images the author used on a website. In fact, seven of the students answered the question with a variation of “I do not know.” Furthermore only two successfully judged the author’s point of view for either the less restricted or the more restricted task. Therefore it is impossible to draw a distinction on strategy use. Once again the only pattern that emerged in the data was students’ inability to judge an author’s point of view.

The most common phenomenon noted was a lack of understanding or an inability to answer the question. Emma, Ava, and Michael all put “IDK” or “I do not know” as their answer. Emma began by reading the question. She then tabbed back over to her source, and spent a few seconds on the page. Emma then clicked on the tab for the task and typed, “IDK.” Emma also put “IDK for her response. She simply read the task and never referred back to her sources for more than a few seconds. In fact, on her other task Emma completed all of the critical evaluation questions without ever tabbing back to her sources. Michael finished the first two questions and paused. The researcher asked, “Do you know what this question is asking?” Michael responds, “I have no idea.” He then proceeded to type “IDK.”

**Using author’s purpose to judge author’s point of view.** The next group of students relied on the author’s purpose to infer his or her point of view. While they did not specifically infer how an author’ point of view affects her version of the truth the students had a rudimentary understanding that every text has a goal. Ethan, on the Delaware task, for example, wrote, “to inform readers that George Washington did really cross the Delaware.” For Ethan point of view was confirmed with a genre based idea of purpose. He read an informational website therefore the author’s point of view was to inform.
Isabella also used author's purpose to define the author's point of view. On the Delaware task she exclaimed that, "It tells you the details of the painting." On the Turning Point task Isabella was evaluating the website AmericanRevolution.org and wrote, “Yes, he shows many pictures and he is not defending one side he is telling it like it is.” In each case Isabella focused on author’s purpose.

*Examining the two cases of successful strategy use to evaluating point of view.* Only Olivia and Sophia correctly inferred the influence of an author’s point of view. Sophia correctly inferred the author’s point of view on one task, and Olivia on both of her assigned tasks. Sophia was evaluating a classroom website Sedivy.tripod.com for the Turning Point task. She wrote, “The author i think is trying to give us information on the topic, and showing us what his class can do and Learn.” Sophia focused on the teacher's desire to highlight what his class was doing and how this influenced the design of the website.

Olivia also correctly inferred the author's point of view. Olivia, when evaluating a website for the Women task wrote:

Phebe takes the point of view she took because she’s sticking up for the women to show they can do way more than people think they can do.

Olivia identified the author underlying point of view in advancing the role women have played in history. On her next task, Olivia discussed the author’s point of view by identifying revulsion for war:

The author's point of view does influence the words and images used on the website because his point of view seems to go along the same path as his words and images because you can tell he’s against what the 3 major events did to the United States of America and other countries involved in the war by his word choice and by the last sentence or two when he says that he hopes that the world will never see another American Revolution ever again.
Pattern two: Students made errors of oversimplification when evaluating online sources. In both less restricted and more restricted tasks and regardless of ability level, students made errors of oversimplification (Spiro, 2004). An oversimplification is a misconception learners have based on previous introductory learning. (Spiro & Feltovitch, 1996). In terms of online reading comprehension, errors of oversimplification occur when users view websites as regular, well-defined structures.Instances of oversimplification occurred when: (a) students overly relied on the amount of content at websites, and (b) students overly relied on website features.

Students made errors of oversimplification by overly relying on the amount of content of websites. This happened when students used the amount information at a website to evaluate author expertise and when they used the amount of information at a website to evaluate the evidence used by an author. The most common, yet unsuccessful, strategy for evaluating expertise was using the completeness of information to judge an author. This strategy was noted 11 times across the study. Students in all groups relied on this ineffective strategy (see Table 5.8).

Alexander relied on the amount of content of the website to judge author expertise. On the Causes task he was reviewing the website American Revolution Persuaders and responded, “I don’t think the author is an expert but I’m sure he know a lot about it if he knew three causes and could support them.”

Sophia also used a strategy of relying on the amount of content to judge author expertise. On the Turning Point task, for example, she responded:

No, because he did have some facts but not all nor the Main facts on the American Revolution. It was very little writing and didn’t say anything about the Turning Points.

Sophia was evaluating the author expertise using the amount of information and not common markers such as education, institutional affiliation, or experience.
Michael also relied on the completeness of the content to judge author expertise. He was evaluating a website by a park ranger for the women of the revolution task. Michael wrote in his response, “The author is because he wrote a lot and it seems he did a lot of research.” Michael’s response also reflected his actions, as he would often choose the websites with the greatest amount of information.

Students also made errors of oversimplification by overly relying on the amount of content at websites when judging evidence used by an author. Once again students relied more on the quantity and not the quality of information in the sources. Isabella, for example, on the Turning Point task, when evaluating a webpage on the Americanrevolution.org site commented that the evidence used in the website was credible because, “He talks about every part of the battle. For example during it before it and after it.”

Michael was also illustrative of students who rely on the quantity of information. Michael responded:

Yes and no, the author uses convincing evidence because it looks like he knows what he is talking about and he did not write a lot he could have wrote about the tea party or the Boston massacre.

He was not evaluating the evidence in terms of its source, but instead in terms of it completeness.

_Students made errors of oversimplification by relying on website features._ The second most common strategy used, also unsuccessfully, by the participants to judge author expertise focused on either specific details or the author’s organization of the website. Ethan, on the Turning Point task for example, said the author David White was an expert because, “He used specific details and great punctuation.”

Emma noted, on the causes task, that the author Jeremy Jones was not an expert because, “there is no persuasive language used.” Olivia focused on the amount of the information and also specific details:
Yes, because Phebe put a lot of information in the paragraphs about each woman who served in the American Revolution also she uses specific dates of when something major happened.

Jaydan also used the information to judge the credibility of sources. He did not however focus on the overall quantity but like many of his peers, on specific details in the website. When evaluating the evidence used on the website Socialstudiesforkids Jaydan replied, “Yes he uses convincing evidence. He stated that there is not just one Turning Point that there was many.” Then when evaluating a site for the crossing the Delaware task Jaydan wrote, “He says that it was a cold night. Also how the crossing was a sneak attack.” In each case he never investigated the source of the evidence.

Other students unsuccessfully used a website’s organization or features to judge the evidence used by an author. Ethan commented that the author of Socialstudiesforkids used credible evidence because, “he used great facts and easy to follow words and sentences.” Alexander also focused on the format of the website by writing, “I think he does use convincing evidence because he writes a full paragraph backing up what he thinks the causes are.”

**Theme three: Students who recall details from memory appear to perform better on the ORCA tasks.**

The data from this think aloud study indicated that a clear difference between students who perform well and students who did not perform well was the ability to recall information they had just read. Two patterns informed this theme: (a) students who recalled details from memory when combing multiple sources may be better at synthesis tasks; and (b) students who recalled details from memory may be better at taking a position. These patterns are explored in Table 5.7. While these strategies were used by every group of participants students in the higher groups recalled more details with greater accuracy than their peers.
Table 5.7

*Frequency of Using a Strategy of Recalling Details From Memory*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Recalls details from memory when combing multiple sources</th>
<th>Recalls details from memory when taking a position</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Olivia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ava</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4</strong></td>
<td><strong>18</strong></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Alexander</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Jacob</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ethan</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1</strong></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Jaydan</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Michael</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>0</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

Pattern one: Students who recalled details from memory when combing multiple sources may be better at synthesis tasks. All of the students in the high group recalled at least one detail from memory when combining multiple sources. However, only one student in the middle and low groups recalled a detail from memory when combining information from multiple sources.

Ava, in the high group, recalled details from memory on the crossing the Delaware task. Ava clicked on the task and then on the last source she read. She read quickly; scrolled to the bottom of the page, and clicked back on the task. I asked her, “What are you thinking?” Ava responds, “Like the painting shows it was daytime like with light, but it was actually done in the snow storm at night. Her response combined information from both of the sources she read but she only reviewed one source during the second synthesis task.
Jacob, in the middle group, when he was on the second synthesis for the causes task was asked, “What are you thinking?” Jacob responded by saying, “I have to combine all this,” as he tabbed through all of his opened sources. Jacob recalled the first detail from memory by almost typing a sentence from verbatim that, “There was no singular cause of the war.”

**Pattern two: students who recalled details from memory may be better at taking a position.** There were not great differences in the use of this strategy across all of the participants. There were, however, differences in the number of details recalled by some students. Ava, for example, was able to recall 14 separate ideas across her two tasks. She only referred back to one of her sources when taking a position for a brief few seconds. During the Delaware task Ava wrote:

1. no, there are many thins wrong with the painting
2. the painting has a daytime scene, but it was actually done at night in a snowstorm. Also the boats size and shape isn’t historically correct, and if george actually stood up I it, he would have drowned.

On her next task, Causes, Ava responded without returning to her sources:

1. i think the british trying to control everything and it made the americans frustrated because they came to america to get freedom, not to be bossed around.
2. the british increased taxes on the things that the americans needed or bought a lot, like stamps and tea

In each case Ava recalled all of these details from memory. Ava never clicked back on to the sources she found. In her responses she directly addressed the question posed in the task.

Students in the middle-performing group also relied on memory to recall details. However, only Sophia and Alexander were as elaborate as students in the higher performing group. Sophia begins the task by asking me, “In this question they are asking if it is right?” I replied, “You are taking a position. Tell me what you believe.”
Sophia then started typing her response by adding the word “No.” As she is typing I asked her about her answer and Sophia replied by saying, “No because they like give good points. As in like its winter, so its not going to be like with the sun out.” Sophia then wrote:

1. No, because its winter and the sun wouldn’t be out. The water wouldn’t be as mellow as it shows. And they give fact that it doesn’t even talk place in the Delaware River. 2. I found that the setting the position that George Washington is Standing is wrong, and not accurate. The thing the people are doing and even how many people were there where wrong to, so I think.

It is clear that Sophia kept the goal in mind as she took a position. She directly answered the inquiry question posed and included two details as evidence.

Alexander also recalled details from memory. On the Delaware task he replied to the question prompt with:

1. I don’t think it’s accurate because the point they raised about it being unaccurate was good. 2. I found my website saying they didn’t think the boat would be able to stay afloat with so many passengers aboard the small boat.

In this response Alexander is clearly aware of his goal. He specifically addresses the task.

On the other hand, some students in the middle group such as Jacob only implicitly addressed the task. Jacob, for example, on the crossing the Delaware task, spoke of the lack of cameras to capture the historical moment. Jacob wrote:

1. No I do not elieve it is because he wasn’t there to see it happen o he had to guess.
2. that there was no one with cameras to keep the image correct

The first source that Jacob found for the task mentioned a camera. Specifically the site, AmericanHistory.org opened with the line:

Wouldn’t it have been great if a group of news reporters with high tech cameras and sound equipment lined the shores of the Delaware River...
Jacob used this detail throughout the task as his main evidence to support the claim that the painting was not historically accurate.

Students in the lowest performing group also used a strategy of recalling details from memory. These students however were not as successful at recalling a number of relevant details. Jaydan, for example, relied on memory to develop a claim and provide evidence. On both of his ORCA tasks Jaydan never left the screen of the task that asked him to take a position on what he read. He quickly typed a response and moved on. On the Turning Point task he wrote:

1. The Turning Point was at saratoga. Some others were the Battle of Bennington. 2. It says that the battle of bennington was going to be a sneak attack but it didn't work.

On the crossing the Delaware task Jaydan wrote, “Yes i think so.-- They said it was a real happening and they said when it was painted.”

Michael struggled to use details from memory in his posts. On the Women in the Revolution task Michael wrote, “1. Thay cleaned cooked and were medic's. 2. IDK” He did not try to use another strategy such as returning to his original source.

Emma also recalled sparse details from memory in her take a position task. On the same Women in the Revolution task Emma wrote, “1. Most Battled with the men. 2. In one website I searched it told about women staying home but thousands battled

**Theme four: Students appeared unprepared to engage in the communication strategies necessary for online reading comprehension in academic settings.**

The data from this think aloud portion of the study indicated that students were not fully prepared to engage in the communication strategies necessary for online reading comprehension. This theme was evident in student responses: (a) that failed to provide adequate information, especially from the evidence that was read; and (b) when students did not use the affordances of online communication spaces.
Student responses failed to provide adequate information, especially from the evidence that was read. The student responses to the communication tasks were short, unfocused, and often did not include evidence from what they read. Except for two students no participant provided information about their sources.

When students finished the final synthesis task they would click “Next” and then were brought to a direction screen (see Figure 5.1). On the page were screenshots with directions to login to the discussion board. At the bottom of the page was a link to the discussion board. Once they logged on students could choose from the four topics (see Figure 5.2). Then when they clicked on a topic they saw a screen with an original post from a fictitious teacher and then two replies from students (see Figure 5.3).

I created two responses by fictional students under each topic. These were brief statements that contained little or no information that could be used by participants in formulating their answers. It is unknown, however, if the brevity and discourse in the initial posts influenced the length and content of the posts by peers.
Figure 5.1. Screenshot of Discussion Board Directions

Figure 5.2. Screenshot of Discussion Board Topics
The task asked students to agree or disagree with a message posted by another student. The student responses are displayed in Table 5.8. It is clear that student responses, even when they take a position are short and do not use evidence. Table 5.8 also shows that students in the highest performing groups did not engage in any communication strategies that would have increased their performance on the ORCA task.
<table>
<thead>
<tr>
<th>Student</th>
<th>More Restricted</th>
<th>Less restricted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabella</td>
<td>Turning Point-Agree</td>
<td>Delaware-disagree it happened in the dead of night, and they started in late afternoon.</td>
</tr>
<tr>
<td>Olivia</td>
<td>Causes-The Boston Tea Party and French and Indian War caused the American revolution because the British made the Americans pay their share of the war debt of the French and Indian War. Also the British put taxes on tea when they knew people didn't have a lot of money to spare on useless taxes like n tea.</td>
<td>Women-Actually the women did play a big part of the American Revolution. They cam together to fight at home to save hurt soilders, keep homes safe abd to stop imports of goods from Great Britian</td>
</tr>
<tr>
<td>Ava</td>
<td>Also the stamp act and sugar act because it increased prices of things americans used everyday.</td>
<td>Delaware-I think the painting isn't accurate, because of the boats, the fact that George is standing up, if he did that he would have drowned.</td>
</tr>
<tr>
<td>Sophia</td>
<td>Turning Point-The Battle of Saratoga was the Turning Point if this didn't happen there would have been a chance the Americans lost.</td>
<td>Delaware-This to me is wrong because the painting gives the wrong facts. The place and what he's doing is all wrong. And the painting sends out the wrong facts. So this doesn't show what it really looked liked what happened. But it does show him leading his men!</td>
</tr>
<tr>
<td>Alexander</td>
<td>I agree because I found the British made Americans pay a big share of the war debt from the French Indian War and I agree with your answer of the Boston Tea Party because that was wen Americans protested the British so that was a big cause.</td>
<td>Delaware- I think the war was real, but I do not think the painting is accurate. I thought the painting was unaccurate because of many reasons I found on my websites to support my thoughts</td>
</tr>
<tr>
<td>Jacob</td>
<td>I disagree because there are many more causes than these.</td>
<td>I disagree because beleiv the battle actually happened but the painting is fake because he wast at the battle painting so it is all correct.</td>
</tr>
<tr>
<td>Ethan</td>
<td>Turning Point- you are extremly</td>
<td>Delaware-The painting is real and if</td>
</tr>
</tbody>
</table>
right about that quote because if you go on wikipedia.org and type in the Turning Point of the revolution it will say the battle of Saratoga in that sentence you go to metmuseum.com and type in George Washington crosses the Delaware river it will tell you the true facts about this historical event.

Emma  N/A  Women did have a role and it was major. Some stayed home and were housewives others went to battle.

Jaydan  The Battle of Bennington was another Turning Point. It took place in New York. It happened August 16th, 1777  Delaware-The picture shows that there was ice and it was a cold night. So his men were tired and cold so it was hard to fight.

Michael  The battle of Saratoga was the Turning Point of the American Revolution not the battle of Bennington  They were used as medics' they cooked and cleaned

The task asked students to agree or disagree with a message posted by another student and then include evidence from what they read. Students were also asked where they found their information.

In the top performing group Isabella took a position on one task but included no evidence. In her next response Isabella took a position and included evidence. Olivia's and Ava's responses, while brief, took a position and provided evidence. No one in the top group included any details about the source of their information.

Sophia, in the middle group, for example, on the Delaware task, responded to a post by a fictitious student BrianB who wrote, “The painting is fake. The battle never took place.” Sophia replied back:

This to me is wrong because the painting gives the wrong facts. The place and what he's doing is all wrong. And the painting sends out the wrong facts. So this doesn't
show what it really looked liked what happened. But it does show him leading his men!

Based on Sophia’s response it is hard to infer if she was stating that BrianB’s position was wrong or if the painting was wrong.

Ethan took a position on the Turning Point task. In his prompt he stated that the author was “extremely correct.” Ethan then went on to explain how the Battle of Saratoga was the Turning Point. However, the post that Ethan was responding to took the position that the Battle of Bennington was the Turning Point. Therefore, even though Ethan took a position he was responding to the incorrect prompt. In other words Ethan was arguing that the fictitious student who started the thread was correct but then negated this position with his evidence.

Other students had a more implicit position. They made a claim, but the participants did not explicitly agree or disagree with a previous post. Emma for example, on the Women task, responded to Julio who originally posted, “Women played a major role in the American Revolution. They did lots of stuff. Emma responded with, “Women did have a role and it was major.” Michael took a similar approach and posted, “They were medics’ they cooked and cleaned.

In terms of explaining where students found their information the responses were once again inadequate. Only one student, Ethan, actually included any information about his source. One student, Alexander, implied the use of a source. The majority of the students, however, communicated evidence from the sources they read but did not provide any details on “where you got your information from,” as was asked in the task instructions.

Only Ethan used a strategy of embedding a cited source in his discussion board post. In each task he mentioned a website, but did not provide an address to a specific webpage. On the crossing the Delaware task Ethan first logged in. He moused over all four topics. I asked him, “What do you need to do?” Ethan responded, “You need to click on which one they were talking about.” He
then clicked on the correct discussion, scrolled down and read the task. He clicked the quote button and typed, “The painting is real and if you go to metmuseum.com....”

Alexander used a strategy of implying a source. He made a vague reference to the websites he read in both of his discussion board posts. On the causes task Alexander referred to the sources he located. He wrote, “I agree because I found the British made Americans pay a big share of the war debt....” On the Delaware task Alexander wrote, “I thought the painting was unaccurate because of many reasons I found on my websites to support my thoughts.” In each of these examples Alexander demonstrated some knowledge of how to use sources.

**Students did not use the affordances of online communication spaces.** The participants did not use the hypertext features that were available to them. This is a key strategy to improving communication in online spaces. (Burnett & Meyers, 2006). The discussion board tool included a common text editor, which allowed students to bold, underline, and use lists. I transcribed and examined student responses (See Table 5.8) and no one used the editor to include hyperlinks to sources. Only Ethan included a typed URL when he wrote, “The painting is real and if you go to metmuseum.com.” This lack of using online writing tools indicates that student used surface only textual features to communicate (Burnett & Meyers, 2006).

Evidence from student verbal feedback also supports the pattern that students do not use textual features to communicate ideas in online spaces. No students voiced any attempt of using hypertext when prompted by the researcher. As students were typing their responses, I asked, “Why did you write it this way” or “Why did you format your response this way.” Each answer only referred to the content and not the design of the response. Not one respondent mentioned the use of textual and multimodal elements to improve their ability to communicate in a digital age (Merchant, 2007).
Stage One Summary

Stage one analysis highlighted general themes that affected overall performance on the ORCA task regardless of the restricted nature of the information space and may help to explain some of the quantitative findings. The first theme suggested that overall ORCA scores were related to an ability to strategically assemble texts during online reading comprehension tasks. This helps to illuminate the findings from the quantitative portion of the study. First mean scores on the ORCA-MR were lower than mean scores on the ORCA-LR. This could indicate that navigation required within a website made tasks more difficult for students who could not successfully use text assembly strategies. The results of this qualitative study may indicate that participants with greater navigational strategies may have scored higher in a more restricted information space. The observations of the students who scored the highest on the ORCA indicate that they made many more navigational moves than the students who scored in the lowest group. The first theme may also illustrate why critical evaluation scores were the strongest predictors in both models. The critical evaluation instrument required students to make navigational choices. Therefore students who read with cursor control may have done well on both assessments.

The second theme appeared to indicate an overall lack of source evaluation knowledge. This theme indicated that the majority of students were not prepared to evaluate online information. The result may explain the low mean score of 5.10 on the 12-item assessment with 9 being the highest score on the Critical Online Information Literacies assessment. The patterns of strategy use around the evaluation of online sources may also explain why scores on the critical evaluation measure were the strongest predictor of online reading comprehension scores. It is clear based on the qualitative observations that students in general lacked sourcing skills. It is also evident from the qualitative data that critical evaluation is central to online reading comprehension. Therefore scores of the students who did well on the COIL may have been correlated with a high score on the ORCA. Conversely low COIL scores may have been correlated with a low score on the ORCA. Finally
the illustrative examples included in the qualitative portion of this study demonstrate why the evaluate items were the most difficult for students in both the ORCA-LR and the ORCA-MR. In fact in examining the ten students included in the study there were only two examples of students who successfully judged author expertise and author point of view. If this pattern held true across all of the quantitative participants, the evaluate items of the ORCA-LR and the ORCA-MR would be the most difficult.

The third theme indicated that the ability to recall details when reading multiple sources or taking a position was a key indicator on success on the ORCA task. Students in the highest group relied on a strategy of recalling details more than students in the lowest group. Therefore this study may provide evidence that more successful online readers engage in “flexible assemblage” (Deschryver & Spiro, 2008 p. 15) of knowledge by creating “schema at the moment.” This would indicate that the role of background knowledge may not be as important as we transition away from a print based world. This may simply be due to the Internet being the world’s largest external storage of human knowledge. In other words why remember something if you can “Google It”.

The fourth theme indicated that students were unprepared to engage in the communication strategies necessary for online reading comprehension in academic settings. This result is reflected in the quantitative findings of the study in that mean scores on the communication items were the second lowest on both the ORCA-LR (1.55) and the ORCA-MR (1.206). It was evident from the qualitative data that students often failed to provide evidence from what they had read. If this pattern held true across all the quantitative participants it would help explain the low communication scores. Similarly in this study students did not fully use the affordances of online communication spaces. If this pattern held true in the quantitative data it might help explain why many students did not receive points for explaining where they found their information.

The purpose of stage one analysis was to identify differences in strategy use across the ORCA tasks regardless of the restricted nature of the information space. This analysis examined
differences in strategy use based on performance on the ORCA. The following strategies were utilized by the higher performing students:

- utilizing tabs to navigate between task and source;
- using tabs to navigate between multiple sources;
- using a strategy of skimming websites to identify key details;
- engaged reading within a website;
- navigating to a source to read while taking a position;
- navigating to the source to copy and paste details;
- identifying the author on an about us page;
- evaluating author using effective markers of expertise;
- checking evidence against a secondary source;
- inferring an author’s point of view;
- recalling details from memory when combining sources;
- recalling details from memory when taking a position.

**Stage Two Themes**

Themes that emerged from stage one, highlighted differences in strategy use that affected overall ORCA performance. The goal of the stage two analysis was to examine the data in order to answer research questions three and four to see if high and low performing students utilize different strategies in less restricted information spaces and more restricted information spaces. Once again recursive, analytic inductive methods (Angrosino, & Mays de Perez, 2000; Bogdan & Bilken, 2003) were used to make additional passes through coded videos of student think alouds to identify patterns.

It was evident from this initial analysis that only a single difference appeared between high and low performing students, in relation to the nature of the information space, and this appeared on the locating items. Thus, in the stage two analysis, I returned to the data to look for different
patterns of strategy use on the locating tasks. This analysis, using recursive, analytic inductive methods (Angrosino, & Mays de Perez, 2000; Bogdan & Biklen, 2003) was conducted in relation to research questions three and four:

Research Question Three: What patterns of online reading comprehension strategies appear among high and low performing online readers during an online reading comprehension task within a less restricted information space?
Research Question Four: What patterns of online reading comprehension strategies appear among high and low performing online readers during an online reading comprehension task within a more restricted information space?

What Patterns of Online Reading Comprehension Strategies Appear Among High and Low Performing Online Readers During an Online Reading Comprehension Task Within a Less Restricted Information Space?

In the stage two analysis it was clear that the restricted nature of the information space only affected strategy use on the locating tasks. There were two less restricted tasks included in the ORCA assessment. Students had to complete one of the two for the qualitative part of this study. The first topic was the role of Women in the American Revolution (Women). The second topic was the historical accuracy of Emmanuel Leutze’s painting of George Washington crossing the Delaware (Delaware). Students were asked, for example to, “Find one website about the historical accuracy of Emmanuel Leutze’s painting of George Washington crossing the Delaware.” Three patterns emerged when examining the differences of strategy use among high and low performers on the less restricted ORCA task:

1. Students who performed better on the less restricted ORCA used more effective strategies for entering keywords.
2. Students who performed better on the less restricted ORCA used more effective strategies for reading search results.
3. Students who performed better on the less restricted ORCA made more accurate relevancy judgments.

**Pattern one: Students who performed better on the less restricted ORCA used more effective strategies for entering keywords.** A clear difference of strategy use among students who were more successful and less successful on the less restricted task appeared in the strategies used to enter keywords. Three strategies were evident in this pattern: (a) more successful students included both the topic and focus of the task when they entered keywords; and (b) more successful students included both the topic and focus when they copied and pasted keywords; (c) and search engine features often impeded effective searches.

*More successful students included both the topic and focus of the task when they entered keywords.* The majority of students on the ORCA less restricted task relied on a strategy of using keywords from the task. The pattern is displayed in Table 5.9. Yet the students who were successful at keyword entry included both topic (e.g. painting of George Washington Crossing the Delaware) and focus (historically accurate) (Eagleton & Guinee, 2002). The inclusion of both topic and focus posed in the task was a more effective strategy for locating websites on the less restricted task.
Successful key word entry varied somewhat for participants in the highest group of scores. Students who remembered both the topic and the focus (Eagleton & Guinee, 2002) demonstrated more successful keyword entry. Ava, a high performing student, for example, began the Delaware task by going to Google. She then typed in the keywords, “George Washington crossing the Delaware accuracy.” Ava then said, “I added accuracy because it means truthful.”

Olivia was also successful on the keyword task. It must be noted that on the Women in the American Revolution, less restricted task, there were more search strings that would return relevant sites. On her first keyword entry Olivia used, “Women in the American Revolution.” On her next two queries Olivia used the phrase, “Women and the American Revolution War.”
Isabella did not begin her search strings with effective keywords on the Painting task. On her first search Isabella used “Emanuele Gottlieb Leutze picture on George Washington.” Then Isabella used, Emanuel Gottlieb Leutze Painting of George Washington. Finally, when looking for the third website, Isabella, used the search term, “Painting of George Washington by Emmanuel.” I asked her what she was thinking and Isabella said, “I am looking for info on the painting.” While she mentioned the topic Isabella did not make reference to the focus of the task.

No students in the middle group began their initial search string with both the topic and the focus. Alexander searched just for the topic on the Delaware task. For example, Alexander began his first search looking for “George Washington Crossing the Delaware.” This loaded websites with only historical information. Alexander was unable to find relevant websites using his keywords.

Students in the lowest group also struggled with keyword entry on the Delaware task but were able to enter keywords on the Women in the Revolution Task. Ethan began by typing “George Washington Crossing the Delaware.” The auto-fill suggestions gave him results for “George Washington Crossing Delaware River historically accurate.” Ethan then deleted the words: historically accurate. His next two searches were a variation of the artists name and the painting.

Jaydan, looked for information using the search terms “the painting of George Washington crossing the Delaware.” This returned search results about the actual painting. Websites that discussed the historical accuracy of the painting were not in the top search results.

On the Women task the low performing students fared better. Emma began with the key words “the role women played in the American Revolution.” She included the topic “women in the American Revolution” and the focus “role.” On her next two searches she used, “women and the American Revolution.” Michael also began with “women of the American revolution” and followed this up with “women in the American Revolution.”

More successful students included both the topic and focus when they copied and pasted keywords. Only three students used a strategy of copy and paste so it is hard to draw
patterns about this strategy use. None of the highest performing students used this keyword strategy. However, Sophia, a mid-level student, included the topic and focus in the task. Sophia used a copy paste strategy to enter the author's name but then typed the rest of her key words. She relied on copy and paste throughout the tasks for hard spellings such as names and cities. She included both the topic and focus in her final task and succeeded on finding a website for the second search item.

Students who copied and pasted keywords without the topic and focus did not succeed. Jacob for example, on the Delaware task only searched for “Emanuel Gottlieb Leutze's George Washington Crossing the Delaware.” Relevant search results were further down the list. Ethan also was unsuccessful at using a copy and paste strategy. He copied and pasted, Emanuel Gottlieb Leutze’s painting of George Washington.

**Search engine features often impeded effective searches.** There was greater use of search tools built into the search engine on the less restricted task. Yet the reliance on the search engine tools actually hindered students searching abilities rather than help to scaffold their Internet inquiries.

Isabella used the auto-fill feature. Auto-fill tries to predict search terms. It gives you a drop down list of options and fills in the search bar with the “best prediction.” She typed “George Washington crossing...” and then chose “George Washington crossing delaware river” from the suggested searchers. There were better key words suggested by auto-fill. These search terms included both the topic and the focus. Isabella did not use these. She picked the first auto-fill suggestion. On the next search Isabella typed, “George Washington...” and selected “George Washington painting” She then typed “de...” and selected “George Washington painting delaware river.”

Alexander used the auto-fill to finish his keywords. These keywords, however, included only the topic and not the focus. Alexander began by typing, “George Washington cr...” he then let the

Sophia also used the auto fill. She typed, “George Washington crossing.” She then selected “George Washington crossing the delaware painting.” The suggested search terms did not included any information about the accuracy of the painting.

Michael also used the auto-fill feature. He began by typing “women of the am..” He then selected the suggested search term of, “women of the American revolution.” Once he clicked on the search term he was brought to the result page.

A second search engine feature that students relied on was the suggested spelling. There were not enough instances to draw clear patterns, but once again the suggested spelling often served as a hindrance rather than a supportive scaffold searching the Internet.

Emma, a second language student, used the suggested spelling feature. She originally searched for, “the role women played in the American revolution. Google displayed results for the correct spelling but gave links to searches using the incorrect and the correct spelling. Emma chose the incorrect spelling link. The page that loaded displayed a link to the search results with the correct spelling. Emma eventually picked the correct link.

Ava, a high performing student, was the only student to use the search engine features correctly. Ava used the corrected spelling tools built into the Google search engine. She forgot a space between Delaware and painting. Google displayed the results for the correct spelling but provided a link to the search results for both the correct and incorrect spelling. Ava clicked on the link for the correct spelling.

**Pattern Two: Students who performed better on the less restricted ORCA used more effective strategies for reading search results.** The second pattern of strategy use among
students more successful on the less restricted ORCA was the use of more effective strategies for reading search results. Two patterns of strategy use were noted: (a) actively reading search results; and (b) navigating back to search results on the less restricted tasks.

**Actively reading search results.** The qualitative results suggest that how students read search results may be one of the more defining indicators of their performance on the online reading comprehension assessments in less restricted information spaces. These patterns are displayed in table 5.10, which shows the frequency of search engine reading strategies noted. Overall students in the highest and middle performing groups actively read search results, returned to the search results, and clicked on more links.

Table 5.10

*Frequency of Strategies to Read Search Engine Results*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Cursor movement or verbalization indicates reading of results</th>
<th>Clicks on first link without skimming</th>
<th>Moves to second page</th>
<th>Clicks on a search result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Olivia</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Ava</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td><strong>10</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>13</strong></td>
</tr>
<tr>
<td><strong>Middle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Alexander</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Jacob</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ethan</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td><strong>14</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>19</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Jaydan</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Michael</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>
The active reading of search results was defined as reading more than the first or one link. It required either a verbalization or cursor movement. This strategy was more prevalent among the highest performing participants. Olivia, for example, on the Women task began by entering in the search terms, “women and the American revolution.” She then spent 39 seconds reading the search results. I asked, “What are you thinking?” Olivia hovered over a search result for “American Athena” and said, “I think this is it because it says americanrevolution.org.

On the next search task Olivia used the same key words. I again asked Olivia what she was thinking. Olivia replied, referring to the search results, “I am just going through, like, and reading the little description, kinda, underneath.” After 30 seconds she clicked on a search result.

Ava also spent a considerable amount of time thinking about the search results she would click on. On the Delaware task she began by entering the keywords, “george washington painting crossing the delaware accuracy.” Her cursor hovered over the first three search results moving left to right as she read. Ava then clicked on a search result to a webpage titled, “Did George Washington really stand up in his boat when crossing the Delaware” on the website “ushistory.org.” I asked, “Why did you click on that one?” Ava explains, “umm. It looked like the most relevant to what I typed in.”

Students in the lowest performing groups did display some rudimentary reading of search results, but did not think about the links they clicked on. Emma for example clicked on a suggested spelling link and expected it to take her to a website. When asked about why she clicked on the link Emma said, “because it had like everything I typed.” Then Emma moved down the page with her cursor. She focused on another link to an irrelevant website because the URL ended in .org. Emma did not click the link. She then clicked on the correct spelling and said, “I am not sure if I should click on this because it is Wikipedia...well some times people put their own opinions. I heard that the
guy who created *Wikipedia* went through and changed everything.” Emma then clicked on *Wikipedia* and used it as her source.

Jacob moved quickly through search results without actively reading them. He began by copying and pasting, “Emanuel Gottlieb Letutze’s painting of George Washington crossing the Delaware” from the task. He then clicked search and immediately clicked on the first link in the results, reading only the website title out loud. Jacob did realize that the result was irrelevant and did not choose a better site.

On the next search task Jacob used the same keywords. Once on the search results page he quickly said, “This seems like a good one,” and clicked on the fourth search result. I asked, “Which did you pick?” and Jacob replied, “Globalwholesaleart.” He did not make the connection from the search results that this was a commercial website. On his next click he also made the same mistake and just said, “I will try this one,” and Jacob clicked on “allposters.com.” It is apparent that he was on a click and hunt mission.

Michael relied only on the title of the links to choose the search results to click on. He did not read the description under the link or the URL. On the Women task Michael clicked the second link on the search results page. He said he chose it, “because it said women in the American Revolution.” He left the page and the next link he picked was also solely based on the title.

Emma also did not spend too much time judging the relevancy of her sources. On the Women task she clicked on a search result for the *Wikipedia* article on the topic. She skimmed the article and decided, “It has information on the topic.” Emma repeated the pattern when searching for her next two sources. She automatically went with the first source she clicked on. It must be noted that these results were relevant to the task. Emma, however, unlike her more successful peers, did not compare sources before choosing one she believed to be relevant.

*Navigating back to search results on the less restricted tasks.* There was a difference in the number of times students returned to search results on the ORCA less restricted tasks with
cursor control. The frequency of these navigation strategies are displayed in Table 5.11. Students in the two highest performing groups frequently returned to their search results to find a better source, using the cursor. Only one student in the low group returned to search results.

Table 5.11

*Frequency of Navigation strategies when reading search engines during the less restricted task*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Cursor movement verbalization indicates reading of results</th>
<th>Returns to search results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabella</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Olivia</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Ava</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>10</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Sophia</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Alexander</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Jacob</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ethan</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>14</strong></td>
<td><strong>11</strong></td>
</tr>
<tr>
<td>Emma</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Jaydan</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Michael</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

Ava and Isabella, both high performers, did not return to their search results on the less restricted task. This, however, was a result of their good keyword entry and their careful reading of search results. Ava, for example, always included the word “accuracy” in her key words on the Delaware task. She also carefully read search results before selecting a link to click on.

Olivia was very methodological in returning to search results. After she read a website she would go back to the search results to make sure there was not a better option. For example during the Women task, after spending a few minutes on a site Olivia left because it, “It didn’t have that
much information. Other sites had like pictures and stuff.” On her next site Olivia left because the website, “Didn’t really talk about women AND the revolution.”

One of the clear differences between students in the middle group and students in the lowest group was navigating back to search results. Alexander returned to his search results on his third search task. The first website he visited was a print company. As he left Alexander said, “This one is mostly like selling. So back out of that” He returned to the search results and said, “Click on the one above it because it says Washington crossing the Delaware by that name” (referring to the artist).

Sophia also returned to her search results. After entering her keywords on the Delaware task (missing any claims about accuracy) Sophia first clicked on a link to a museum site. As she hit the back button Sophia said, “It just talks about how pretty the picture is.”

Jacob returned to his search results more than once. As Jacob progressed his search terms improved. By the third search task Jacob was including the word accuracy in his keywords. After reading a museum website Jacob left after saying, “It doesn’t have much on accuracy.”

In the lowest group only Michael returned to his search results on the less restricted task. He did not verbalize his decision. He just went back to the search results after visiting a relevant page that would have worked for the task.

**Pattern three:** Students who performed better on the ORCA less restricted task more frequently were able to determine that websites were irrelevant. Successful students were able to determine that websites were irrelevant. This pattern is detailed in Table 5.12. Two major strategies were noted in the locating of relevant websites: (a) Students who successfully made relevancy judgments during the less restricted ORCA skimmed websites; and (b) Students who chose irrelevant websites relied on a strategy of choosing the first link.
Table 5.12

*Frequency of Relevancy Judgments on less restricted tasks*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Locates website and judges it relevant</th>
<th>Locates website and judges it irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabella</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ava</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Olivia</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>8</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Sophia</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Alexander</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Jacob</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Ethan</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>8</strong></td>
<td><strong>15</strong></td>
</tr>
<tr>
<td>Emma</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Jaydan</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Michael</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>8</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

*Students who successfully made relevancy judgments during the less restricted ORCA skimmed websites.* Olivia is a great example of a student who spent time considering the relevancy of each website she read. She began the Women task by first clicking on a website entitled “American Revolution.” When she left the site I asked her, “What are you thinking?” She replied that the site “…didn’t have a lot of information, like other websites. That had, like, pictures and facts.” Olivia then clicked on another website that listed links to specific biographical information about famous women of the revolution. She left the website and I asked, “Why didn’t you pick that website?” Olivia responded that it didn’t really talk about, “…women AND the American revolution. It just talks about women who fought in it.” Olivia then went back and reread the task. She then looked at two more sources, and decided after all that the website she first clicked on was the most relevant.
Sophia also spent considerable time considering the relevancy of her sources on the Delaware task. She began by first clicking on the Wikipedia article about the battle. Sophia quickly returned to her search results and changed the keywords. I asked Sophia why she left the page and she stated, “I don’t think it had the right information.” Sophia then skimmed over the search result and clicked on the first link because she said, “it came from a museum.” Sophia then said, “It just talks about how big the picture is,” and she returned back to the search results. Sophia rejected the museum webpage as irrelevant once she read it. Sophia then clicked on a website titled, “What is wrong with this painting?” Sophia picked this source as being relevant to the topic. By examining three different sources Sophia made relevancy judgments until she located a useful source.

Students who chose irrelevant websites relied on a strategy of choosing the first link. On the other hand Jaydan represents the type of reader who did not judge the relevancy of sources and quickly chose a website from their search results. This pattern was common in the lowest group of performers. Jaydan at first did not like the search results he got for “George Washington Crossing the Delaware” and added to the keywords “was it accurate.” Jaydan then clicked on a first link to a Wikipedia article about the crossing. Before Jaydan even skimmed the article he copied and pasted the links into the task. Jaydan repeated this pattern on the next two search tasks. He always accepted the first website he clicked on as relevant.

Emma, also in the lowest group, never judged any website as irrelevant on the less restricted task. On the Women task Emma always went with her first click. She never returned to the search results after reading a website.

What Patterns of Online Reading Comprehension Strategies Appear Among High and Low Performing Online Readers During An Online Reading Comprehension Task within a More Restricted Information Space?

Stage two analysis revealed that the only difference between strategy patterns appeared in the locating tasks. There were two, more restricted tasks included in the ORCA. Students in the
qualitative portion completed one of the two. The two topics were: a) the causes of the American Revolution (Causes) and b) the Turning Point of the American Revolution (Turning Point).

On the Causes task students had to find three different websites. The first task asked students to, “Find the webpage Causes of Revolutionary War on the website SocialStudiesforKids.com.” The second task asked, “Find the webpage List of Causes of the War on the website historycentral.com.” The final locating task asked students to, “Find the website titled American Revolution Persuaders.”

Students also had to find three websites for the Turning Point restricted task. The first task said, “Candace posted the question to the website Yahoo Answers, ‘What is the Turning Point of the American Revolution?’ Locate this discussion.” The directions for finding the second website asked, “Find the article about the Battle of Bennington on the website TheAmericanRevolution.org.” On the final search task students were asked to find the articles about the Battle of Saratoga on the website SocialStudiesForKids.com.”

Stage two analysis found that the pattern of strategy use to locate websites differed on the more restricted tasks. The restricted nature of the task, that is having students look for a specific source, reduced the number of instances of keyword use. Instead many of the students went directly to a website and searched within the site for the required information. Three patterns emerged in the analysis of the more restricted task:

1. Students who performed better on the more restricted ORCA used more effective strategies to search within a website.

2. Students who performed better on the more restricted ORCA used keywords including both the topic and the source.

3. Students who performed better on the more restricted ORCA made more accurate relevancy judgments.
Pattern one: Students who performed better on the more restricted ORCA used more effective strategies to search within a website. Students who were successful on locating information during the more restricted task demonstrated the ability to search within a webpage. Often this required better forward inferencing (Coiro & Dobler, 2007), or predicting where links will take you, when students searched within a website. The students in the highest performing groups were more adept at locating a page within a website. Students in the lowest group often struggled to find a webpage within a site. These patterns are illustrated in Table 5.13.

Table 5.13

*Frequency of Locating Strategies on the More Restricted ORCA*

<table>
<thead>
<tr>
<th></th>
<th>Navigates directly to the source</th>
<th>Searches successfully within a website for a source</th>
<th>Uses both topic and source in keywords</th>
<th>Copies and pastes exact words from task</th>
<th>Uses Search Engine Tools</th>
<th>Revises keywords</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olivia</td>
<td>2</td>
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<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Ava</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>4</strong></td>
<td><strong>2</strong></td>
<td><strong>2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophia</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Alexander</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Jacob</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Ethan</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
<td><strong>6</strong></td>
<td><strong>2</strong></td>
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<td><strong>3</strong></td>
<td><strong>0</strong></td>
<td><strong>9</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Jaydan</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Michael</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>3</strong></td>
<td><strong>2</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>
Students in the highest performing group typically went directly to the website by typing the URL into the navigation bar of the browser. They then searched within the website. Olivia began by typing the URL to socialstudiesforkids.com in the navigation bar. She then clicked back on the task. Olivia clicked back on her source and scrolled up and down the page and said, “I am trying to think of where it would be.” She clicked on “US at War” in the left menu bar. Next Olivia clicked on “Revolutionary War.” She scrolled up and down the page, and clicked on the “2” at the bottom of the page to go to the next page. Next Olivia clicked back and said, “I read all the descriptions and this is best.” She clicked on a link about the American Revolution and found the link to the correct page that explained the causes of the Revolutionary War.

Ava also searched within a page by making forward inferences about links. She started by first searching just for the source using Google. Once she found the source Ava searched within the source. Ava searched for the specified website, Social Studies For Kids, in Google rather than the webpage that listed causes of the American Revolution. Once on the website Ava scrolled down the homepage and clicked on a link in the left navigation bar titled “U.S. at War.” She then scrolled down and clicked on the “American Revolution.” She then read the page and did not see a link to “causes of the war” in the left tool bar. She did not find the exact link but was able to infer the causes of the war on the website.

On her next search task Ava entered in the URL address directly into the navigation bar. She was looking for the webpage on the website AmericanRevolution.org. Once she was on the page Ava moved her cursor through the side navigation bar. She found the correct link and said, “This is it.”

Students in the middle group were somewhat successful at searching within a website. They performed in a similar fashion to their peers who had higher online reading comprehension ability. Alexander for example made a total of nine clicks before he located the correct page on the Causes task. He entered the URL to socialstudiesforkids.com in the navigation bar. Alexander then said, “I am going to look around on this tab. It says links and stuff so I am going to go to history.” He then
scrolled up and down and said, “I am going to look for causes of the revolution or causes of the American Revolution.” Alexander then clicked on, “US Government” and scrolled up and down the page. He then clicked back on the task and said, “I am looking for causes of the revolutionary war. He then clicked on “wars around the world.” Alexander scrolled up and down; he clicked on a link for a second page of results. The link to the American Revolution was at the top of the page. Alexander clicked on it. He scrolled up and down the page and said, “Maybe if I click on timeline.” He clicked on the link, scrolled up and down the page, and did not find the webpage. He then said, “I’ll go back...,” and he clicked the back arrow. As he hovered over a link Alexander added, “...and maybe this and find information in it.” He clicked on a link to the American Revolution. This brought Alexander to a page off of the website. He said, “Not it,” and clicked the back arrow. He moused over an additional link and said, “That one looks like a specific person. So I am going to do that one.” He clicked on a link about the Revolution and then clicked on the link to the required webpage that was listed on the right of the page in a menu frame.

Sophia was able to locate the specified website. She was looking for the webpage “Causes of War” on the website historycentral.com. She copied and pasted historycentral.com into the navigation bar. She said, “On the website I got I am just going to look for List of Causes.” Sophia scrolled up and down the page and then found the link to American Revolution in the left tool bar. A pop up window offering a free iPad opened up. Sophia was able to close it without clicking on any of the hidden links. She skimed the page and clicked on the link to Causes of the War.

Jacob found two of his three sources by searching within a page. On the Causes task he found the webpage on socialstudiesforkids.com by using the internal search engine. He was the only student in the study to utilize this strategy. As he was skimming the page he said, “I am going to try searching in this thing.” He then moved his cursor to the search bar.

The students in the lowest group did not perform in a similar fashion as students in the middle and the high group. Their search strategies were more limited and less successful. No
student found the pages within a website. Two students accepted the homepage of a website as the correct page they were looking for. One student had to be directed to the sources by me.

Jaydan was unable to find the correct websites. He submitted the homepages as the correct sites. When he got to the synthesis site he said, “I can’t find it. Maybe history.” After a few minutes I found both websites for him using the internal search engine.

Emma was unable to find any of the targeted websites. She searched for two webpages within a website. On the Causes task she entered the URL for socialstudiesforkids.com and the submitted the homepage URL as an answer. Then she moved on to the AmericanRevolution.org task and once again submitted the homepage as her answer to the locate task. When Emma moved on to the synthesis task she clicked on socialstudiesforkids.com. She then clicked on a link to “How Presidents get elected” and said, “Umm I don’t know what to do.” I found the two required pages for her.

**Pattern two: Students who performed better on the more restricted ORCA used keywords including both the topic and the source.** Higher performing and middle level students typically used the URL to locate information on the more restricted task. Students in the lowest performing groups more often used a search engine. When they did, those who searched for both the title of the webpage and the source were successful at the task. Isabella, for example, on the Turning Point task, put the keywords “AmericanRevolution.org battle of bennington” in Google. She was able to find the required source.

Middle and low performing students who searched for the title of websites without the source name were less successful on the task. Sophia, for example, used the words, “Turning Point of the American Revolution.” However, she did not mention the specific source, Yahoo Answers that students were tasked to find. While the correct website appeared on the first page of the results it was further down in the search results.
Emma also never included any information about the source in her answer. She entered in the keywords “list of causes” when looking for a website for the Causes task. She then spent time reading the results saying, “I am just trying to figure out which it would be. Emma never included any information about the source, and never found the correct website.

**Pattern three:** Students who performed better on the more restricted ORCA made more accurate relevancy judgments. Students who were more successful on the restricted task were more able to judge websites they visited as irrelevant. This strategy was defined as navigating to a website or webpage and then leaving after determining it was not useful. Students in both the high and medium groups utilized this strategy. No students in the lowest third judged a website they visited as irrelevant. The pattern is explored in Table 5.14.
Table 5.14

*Frequency of Strategy Use on More Restricted Locating Tasks*

<table>
<thead>
<tr>
<th>Participants grouped by ORCA scores</th>
<th>Locates website and judges it irrelevant</th>
<th>Locates website by typing URL in Navigation bar</th>
<th>Locates specified webpage within a website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabella</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Olivia</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ava</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3</strong></td>
<td><strong>2</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Sophia</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Alexander</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Jacob</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Ethan</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1</strong></td>
<td><strong>8</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td>Emma</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Jaydan</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Michael</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>0</strong></td>
<td><strong>6</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

Isabella on the Turning Point task could judge a website irrelevant. While she was searching for the Yahoo answers discussion she clicked through each website and judged them to be irrelevant. At one point the research stopped and asked her, “Why did you pick that one” when she clicked on an irrelevant website, “It looked okay,” she responded, referring to the search results, “but it was a shop.” The website sold history DVDs. Even though Isabella did not find the specified website she did exhibit better strategic reading in terms of judging website relevancy.

On the other hand students who were not as successful on the ORCA tasks had a tendency to accept the first link they chose from the search results or to copy and paste a URL into the navigation bar as the legitimate source the task ask them to find. For example Ethan, when looking for the Yahoo discussion board, first clicked on an article on Wikipedia about the American
Revolution. He says, "This has some stuff I am looking for," and he copied the link to the SurveyMonkey task. Later in the task when Ethan was looking for the American Persuaders website he clicked on a website selling student essays. Seeing the title of the article he copied and pasted and submitted the URL as correct.

**Stage Two Summary**

The purpose of stage two analysis was to examine the data to see if the nature of the information space affected patterns of strategy use among high and low performers on the ORCA assessment. Initial analysis determined that the nature of the information space only affected strategy use on the locating tasks. Therefore stage two analysis examine differences in strategy use on the locating tasks in the less restricted space. Then stage two analysis examined differences in locating strategy use a more restricted information space. These differences were analyzed by comparing students on their performance level.

On the less restricted tasks students who performed better than their peers used specific strategies. First they were more apt at developing keywords. These keywords included both the topic and the focus. They also read search results. Finally more proficient students made more accurate relevancy judgments in the less restricted environment. The following strategies were noted among better performing students in the less restricted locating tasks:

- using keyword that included both the topic and focus;
- copying and pasting keywords that include both the topic and focus;
- actively reading search results;
- navigating back to search results;
- skimming websites to make accurate relevancy judgment.

On the more restricted ORCA tasks students who performed better than their peers used specific strategies. More successful students generally searched within a website rather than used a search engine. When students did use a search engine, those who included a topic and source
performed well. Similar to the less restricted task, students who made more relevancy judgments on the more restricted task outscored their peers on the ORCA assessments. The following strategies were noted among better performing students in the more restricted locating tasks:

- navigating directly to a source;
- searching for a specific source;
- searching within a website;
- using keywords with topic and source;
- making accurate relevancy judgments.

The stage two findings also illuminated the quantitative findings of this study. Specifically the stage two themes may explain differences in scores on the ORCA-LR (8.394) and the ORCA-MR (7.15). Stage two analysis revealed that more proficient users utilized very different strategies to search within a source on the more restricted task. On the less restricted task both students in the high and middle group searched for websites using effective keywords. The fact that the locating tasks on the more restricted ORCA required specific skills only observed in the most proficient reader could have contributed to differences in the mean scores for the six locating scorepoints on the ORCA-LR was 3.599. The mean score for the six locating scorepoints on the ORCA-MR was 2.755.

Furthermore the stage two results may explain why scores on the self-report dispositions measure were significant in the ORCA-MR model but not in the ORCA-LR model. Based on the think aloud data searching within a source was a strategy prevalent among proficient users during ORCA-MR. The instances of this strategy use indicate that the ability to search within a website required more reflective thinking, persistence and flexibility. These are three subscales of the dispositions of online reading comprehension instrument. The students who were more successful on the ORCA-MR task demonstrated an ability beyond that of cognitive skills.
Chapter Summary

The goal of the qualitative portion of this study was to examine differences of online reading comprehension strategy use among high and low performers on an assessment of online reading comprehension in a less restricted information and also in a more restricted information space. This analysis was designed to explain the quantitative differences found in Chapter Four. A two-stage qualitative analysis was utilized to examine think-aloud data.

Analysis in stage one identified actions that affected performance regardless of the information space. These included greater source knowledge and cursor control. Furthermore stage one analysis how a lack of critical evaluation and communication skills limited student performance.

The stage one results helped to illustrate some of the quantitative findings of this study. Most strikingly the think aloud data explored the difficulty students had with both the evaluation and communication items. Statistical evidence found these to be the hardest item clusters on both the ORCA-LR and the ORCA-MR. Stage one results revealed that students seldom had the strategies to evaluate online information and were unprepared to communicate in online spaces.

The stage one results may also help to explain why background knowledge, while significant, was not the best predictor of performance in either the ORCA-LR or the ORCA-MR. Students who did well in both formats could quickly “reassemble” information they read while synthesizing sources. This ability required greater cursor control rather than background knowledge.

In stage two the qualitative analysis identified different patterns of strategy use based on the restricted information space. The only difference in strategy use among high performing students and low performing students was on the items measuring locating skills. On the less restricted tasks students who searched for a topic and focus, read search results, and made relevancy judgments outperformed their peers. On the more restricted tasks students who
successfully searched within websites outperformed their peers in the restricted information space. In fact the most proficient users navigated directly to the source by entering the URL into the navigation bar. When students did use keywords those students who included the topic and source outperformed their peers. Finally students who made more relevancy judgments did well on the ORCA more restricted locating items.

The stage two results help to highlight many of the quantitative findings of this study. Most importantly they may shed light on the differences in the overall mean scores of the ORCA-LR (M=8.394 SD=4.117) and scores of the ORCA-MR (M=7.15 SD=4.48). The results of the think aloud study indicate that it was more difficult for students to search for a specific source rather than information on a given topic.

This study also helped to identify strategies that are used by more proficient students as they use the Internet to learn. This study took place in the discipline of social studies. The strategies that were observed in the more proficient students include:

- **Locating strategies on a less restricted task**
  - using keyword that included both the topic and focus;
  - copying and pasting keywords that include both the topic and focus;
  - actively reading search results;
  - navigating back to search results;
  - skimming websites to make accurate relevancy judgment.

- **Locating strategies on a more restricted task**
  - navigating directly to a source;
  - searching for a specific source;
  - searching within a website;
  - using keywords with topic and source;
  - making accurate relevancy judgments. utilizing tabs to navigate between task and source;
• Strategies regardless of the restricted nature of the information space
  o using tabs to navigate between multiple sources;
  o using a strategy of skimming websites to identify key details;
  o engaged reading within a website;
  o navigating to a source to read while taking a position;
  o navigating to the source to copy and paste details;
  o identifying the author on an about us page;
  o evaluating author using effective markers of expertise;
  o checking evidence against a secondary source;
  o inferring an author’s point of view;
  o recalling details from memory when combining sources;
  o recalling details from memory when taking a position.
Chapter VI

DISCUSSION OF THE FINDINGS

Introduction

The purpose of this mixed methods study was to investigate the role that background knowledge, critical evaluation of information, and a reader’s dispositions play in predicting online reading comprehension performance, during comprehension tasks that take place in either less restricted or more restricted information spaces. Specifically this study sought to answer four questions:

1. When predicting online reading comprehension during a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

2. When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?
Quantitative methods were used to address the first two research questions. Hierarchical regression, controlling for verbal intelligence, was used to test two different models. The first model included a less restricted information space. The second model involved a more restricted space. In both cases scores on a background knowledge measure, a critical evaluation measure, and a disposition measure were used to predict scores on either an online reading comprehension assessment in a less restricted information space and an online reading comprehension assessment in a more restricted information space.

Qualitative methods were used to answer the second two research questions. Verbal protocol analysis using abductive (Onwuegbuzie & Leech, 2006) coding methods followed by a constant-comparative (Bogdan & Biklen, 2003; Merriam, 1988) analysis were used. The goal of the qualitative component was to analyze patterns of processing among students with varying degrees of online reading comprehension ability. Ten participants each completed two online reading comprehension assessment tasks: a less restricted task and a more restricted task. Screencasts were made of the activities and patterns of strategy use were identified using constant comparative methods.

The use of this mixed method approach allowed me to understand not only the unique contributions the variables of interest made to the model but also how these variables might look in classroom contexts. By examining both the quantitative and qualitative findings the implications for research and classroom practice emerge.

**Discussion of the Quantitative Results**

**Online Reading Comprehension Assessment: Descriptive Statistics**

The descriptive statistics reveal important insights into the results of this study. As noted statistical testing found significant differences between the mean scores of the two ORCA formats ($t=4.088, p=.000$). Thus would indicate that there was a significant difference in student scores on
the ORCA-LR and the ORCA-MR with scores on ORCA-MR being significantly lower. A one way repeated measures analysis of variance was conducted to compare students’ scores in each of the four skill areas on the ORCA-LR and the ORCA-MR respectively. In both models, the mean scores were significantly different. Follow up post-hoc tests found, for both the ORCA-LR and the ORCA-MR, that location items were the easiest items, followed by synthesis items, then communicate items, and finally evaluate items.

These results somewhat replicate recent studies that have evaluated patterns in the scores of Locate, Evaluate, Synthesize, and Communicate items. Forzani and Burlingame (2012), for example, when analyzing a related ORCA assessment found that synthesis was the easiest skill area, followed by locate, then communicate items and, finally, by evaluate items. Both of these studies found that communicate items and evaluate items were the hardest and had the lowest student scores.

These findings have important implications for instruction and research in online reading comprehension. In terms of classroom practice it appears that students struggle to communicate what they learn and to evaluate the sources they read online. This is a critical issue for schools as these are both areas emphasized in the Common Core State Standards (CCSS, 2010). Future studies should be conducted to see if similar patterns of student scores are replicated. If they are, instructional studies should be conducted to evaluate how best to teach these areas where students perform lowest.

**Summary of the Less Restricted Model: Research Question One**

Research question one asked:

When predicting online reading comprehension during a problem solving task within a less restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance
 accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension?

Results of the linear regression indicated first, that verbal ability, as measured by a vocabulary test, explained 16.9% of the variance, which was significant, $F_{(1,93)} = 20.530, p<.001$. In the full model, scores on a critical evaluation measure explained a significant amount of unique variance ($\beta = .335 p<.000$). Background knowledge also contributed significantly to the prediction of scores on the unrestricted ORCA ($\beta = .211 p = .021$). Dispositions of online reading comprehension did not contribute significantly to predictions in the model ($\beta = .117 p = .162$). The total explanation had a large effect, Cohen’s $F = .358$.

In the less restricted model scores on the critical evaluation measure had the largest predictive weight. This finding is consistent with both Cognitive Flexibility Theory (CFT) the new literacies of online reading comprehension. It was predicted based on CFT that scores on the critical evaluation assessment would be a significant predictor in the less restricted model. This is due to students with “advanced web skills” performing better in an open Internet space.

The predictive power of COIL scores also aligned with a theory of new literacies of online reading comprehension. The principles of the broader capital letter New Literacies has recognized the central role that critical literacies play in digital environments (Leu, Kinzer, Coiro, Castek, & Henry, 2013). More specifically the new literacies of online reading comprehension theorists have also long argued that the critical evaluation of online sources is a key difference (Coiro, 2003; Coiro et al, 2008; Leu et al., 2004).

In the less restricted model background knowledge was a significant, but not the largest, predictor. This result is also congruent with the predictions made based on both Cognitive Flexibility Theory and a theory of new literacies of online reading comprehension. These theories have suggested that the role of background knowledge in predicting reading comprehension changes in online information contexts. While background knowledge has been one of the most
stable findings of comprehension research this study may add credence to the claim that we must rethink the role of background knowledge when developing theoretical models of online reading comprehension.

In the less restricted model scores on a self-report measure of dispositions of online reading comprehension were not a significant predictor. This result did not align with the predictions made from either theoretical perspective. Cognitive Flexibility Theory argues that students with “open mindsets” are better prepared to read in the ill-structured space of the Internet. New literacies of online reading comprehension argues that new dispositions are central to making meaning online. Yet in the less restricted model a score on a dispositions measure was not a significant predictor.

**Summary of the More Restricted Model to Address Research Question Two**

Research question two asked:

When predicting online reading comprehension of a problem solving task within a more restricted information space, what is the best fit model, after controlling for verbal intelligence, of the percentage of variance accounted for by each of the following variables: background knowledge, critical evaluation, and dispositions of online reading comprehension.

Results for the linear regression indicate that after controlling for verbal intelligence, the three predictor variables of background knowledge, evaluation skills, and scores on a self-report measure of dispositions of online reading comprehension explained an additional 38.1% of the variance on the scores of the more restricted ORCA, which was significant $F_{(1,92)} = 26.328 \ p < .000$. In the full model scores on a critical evaluation measure explained a significant amount of unique variance ($\beta = .499 \ p < .000$). Background knowledge also contributed significantly to the prediction of scores on the unrestricted ORCA ($\beta = .189 \ p = .017$). Dispositions also made a significant prediction to the model ($\beta = .291 \ p = .006$). This total explanation had a large effect, Cohen’s $F = .631$. 
In the more restricted model, similar to the less restricted model, scores on the COIL, a measure of critical evaluation skills, was a significant predictor with the largest beta weight in the model. This finding mirrored the predictions that were made based on both CFT and a theory of new literacies of online reading comprehension. This would once again suggest the ability to flexibly apply new strategies in a variety of situations is a central requirement for success when making meaning in online spaces.

In the more restricted model background knowledge was a significant, but not the largest, predictor of performance on the ORCA-MR. This result did not align with the prediction made based on the principles of Cognitive Flexibility Theory. It was predicted that background knowledge would be significant in both models. However it was believed that background knowledge would be the strongest predictor in the more restricted space, as learners would not benefit from “flexible schema assembly” and “serendipitous” learning while looking for specific sources. In other words because students could not build up their knowledge while conducting open Internet searches those with higher background knowledge would have a greater chance of success looking for specific sources. Yet in the more restricted model it was critical evaluation and not background knowledge that was the strongest predictor.

In the more restricted model, scores on a self-report measure of dispositions of online reading comprehension were a significant predictor of performance on the ORCA-MR. This differed from the results of the ORCA-LR model. This finding aligned with predictions made based on Cognitive Flexibility Theory and a theory of new literacies of online reading comprehension. In CFT it is argued that readers with “open mind sets” will fair better in online spaces (Spiro & Deschryver, 2010). New literacies of online reading comprehension theorists also argue that new dispositions are required to make meaning when reading online (Leu et al., 2004).

Exploring The Implication of Both Models
**Theoretical models of reading comprehension.** The results of these two models indicate the need to expand our models of reading comprehension to account for the rise of online texts. Most theoretical models of reading are drawn on principles of static and consistent constructs. For example the heuristic of reader, text, and activity (Snow, 2002) relies on well-founded results established through decades of comprehension research. Yet this study, and similar work, calls into question static models of reading comprehension.

Over the past three decades researchers have identified stable factors to include in models of reading comprehension (Snow, 2002). Yet in a digital age when new texts and tools for literacy emerge every day (Coiro et al., 2008) researchers can no longer solely rely on stable findings. As new text and literacy practices emerge with the shift from page to pixel (Hartman et al., 2010) new variables of interest will emerge and confound our previous models. These factors, for example, could include the centrality of evaluation and navigation as noted in this study. They will also include variables yet to be identified as the Internet continues to evolve. We can no longer rely on static models of reading comprehension.

Instead we need to continue to develop dynamic models of reading comprehension (Hartman et al., 2010) that can account for constant change (Leu, 2000). This study helps to illuminate some possible elements of dynamic models of reading comprehension. First in these models the evaluation of multiple sources as a fluid text must be at the center of reading. Also in these new theoretical models the reader may rely on actively constructing knowledge and texts in the moment (Deschryver and Spiro) rather than solely relying on background knowledge. Finally these models may have to account for epistemological processes and habits of mind in order to account for new dispositions.

**Critical evaluation.** The most compelling finding from the quantitative findings of this study is the central role of critical evaluation. After controlling for verbal comprehension, scores on the COIL assessment were the best predictors ($\beta=.429$) of scores on the less restricted information
space and also on the more restricted model (β=.499). The fact that critical evaluation, not background knowledge, was the best predictor of online reading comprehension may lend additional support to studies suggesting that online reading comprehension is different from offline reading comprehension. This finding adds weight to recent research (Braten, Stromso, & Samuelstuen, 2008; Coiro, 2011; Goldman, Braasch, Wiley, Graesser, & Brodowinska, 2012). Goldman et al., (2012) using a think aloud method among adults found that expert readers used more evaluative strategies when compared to novices. Coiro (2011) found that after controlling for background knowledge and offline reading ability that knowing a student’s online reading comprehension skill predicted additional variance in scores on an online reading comprehension assessment. Her results indicate that new knowledge, skills, and dispositions are involved in online reading comprehension assessment. This study suggests that, in addition, the relative contribution of critical evaluation skills may be greater in online reading comprehension, compared to offline reading comprehension.

Braten, Stromso, and Samuelstuen (2008) found that knowing a students’ sourcing skills best predicted their ability with multiple source comprehension in offline reading contexts. Similarly this study found that knowing students’ critical evaluation skills best predicts their online reading comprehension ability. Since online reading comprehension typically involves multiple source reading, this may indicate that multiple source reading is an important difference between offline and online reading comprehension. Furthermore it may indicate that evaluating sources is central to both multiple source reading offline and online reading comprehension. However, given that multiple source reading offline usually involves pre-vetted sources such as newspapers and journals, additional evaluation skills may be required in online environments.

Assessing Critical Evaluation. Perhaps one of the greatest challenges that literacy researchers face is the further refinement and development of measures to evaluate critical evaluation skills. The final 12 item Critical Online Information Literacies assessment (COIL) had a
coefficient alpha of .71. While this level of a reliability estimate is acceptable one might have greater confidence in the measure had it been higher.

Research must also be conducted to understand how item format effects item difficulty. The COIL contained forced response answers that included entire screenshots of websites. This violates basic principles of comprehension assessment that call for short distractors (Fuchs, Fuchs, & Maxwell, 1988; Keenan & Betjemann, 2008). Items in the COIL were also presented in different formats. Some items contained single screenshots, other items contained four screenshots, and finally items could have had four hyperlinks to recreations of actual websites. This item format may have influenced item loadings. Future studies should be conducted using item response theory (Baker, 2001) to test if distractor length and item format influences item difficulty.

**Background knowledge.** Based on the linear regression models in this study, background knowledge was a significant predictor of scores on the less restricted ORCA ($\beta=.241$). It was also a significant predictor of scores on the more restricted ORCA ($\beta=.189$). Background knowledge is one of the most widely accepted predictors of reading comprehension. It has been demonstrated that background knowledge affects comprehension (Anderson & Pearson, 1984; Kintsch, Patel, & Ericson, 1999; Voss, Fincher, Keifer, Green, Post, 1985). The overarching theory is that good readers relate their background knowledge to the text and the task.

This study may call into question the long-standing dominance of background knowledge in comprehension. It has been argued, when examining print based comprehension that knowledge is comprehension (Willingham, 2010). Yet when examining the results of this study it is clear that new knowledge, skills, and strategies may be just as, or even more important, than background knowledge. This finding calls into question much of our long-standing beliefs about the role or background knowledge.

In fact there is ongoing debate as to the role background knowledge will play in online reading comprehension. The results of this study parallel those such as Hill and Hannifin (1997)
and Coiro (2012) who found that background knowledge predicted performance in online reading comprehension tasks. However, Bilal (2000; 2001) found that background knowledge did not play a significant role in determining success when conducting Internet inquires. This study adds evidence to the debate.

Most of the research on the role of background knowledge assumes a cognitive structure based on the principles of information processing theories (Kirschner, Sweller, & Clark, 2006). This includes a cognitive architecture with elements of long-term memory, short-term memory, and working memory. Based on this theory background knowledge is considered to be an element of long-term memory. Yet the results of this study and recent findings by Bilal (2000; 2001) and Coiro (2012) may call into question these theoretical models. Instead of recalling details from long-term memory storage online readers may be creating what CFT theorists have labeled “schema at the moment” which is created through “flexible assemblage” of information encountered online in real-time.

These observations may align better with situated cognition models, which suggest that knowledge exists “in situ, inseparable from context, activity, people, culture, and language.” (McVerry, 2010, para. 1) The literacy community may benefit from a line of research into the role of background knowledge with research designs that draw on principles of situated cognition (Greeno, 1989) as well as traditional information processing theories (Kirschner, Sweller, & Clark, 2006; LaBerge, & Samuels, 1974).

Future studies should also include measures of systems knowledge and not simply content knowledge. One of the key differences between studies that found a role for background knowledge (Coiro, 2012; Hill & Hannafin, 1997) and those that did not (Bilal, 2000; 2001) was the inclusion of items to measure systems knowledge about the Internet. This study only included a measure of topical knowledge on the American Revolution. Follow up studies might include background knowledge scores from a basic navigation test.
**Dispositions of online reading comprehension.** The fact that scores on the self-report measure of dispositions of online reading comprehension were not a significant predictor in the ORCA less restricted model ($\beta=.124$) but were a significant predictor in the more restricted model ($\beta=.206$) is a very interesting outcome. These findings may indicate that the information space has an influence during online reading. Furthermore, the results may suggest that more targeted and specialized searches, which utilize more restricted spaces, require readers who can adapt to new situations.

The bivariate correlations of the DORC were very informative in exploring this finding. Of most interest was the negative correlation of the items on the collaboration subscale. Collaboration had no correlation with the less restricted ORCA and an almost non-existent and insignificant correlation with the more restricted ORCA.

Yet at the same time recent work has highlighted how important collaboration is during in online reading comprehension (Coiro, Castek, and Guzniczak, 2011; Kiili, Laurinen, Marttunen, & Leu, 2011; O'Byrne, 2011; Zawilinski 2011). In each of these studies, collaboration improved student performance when conducting Internet inquiry activities. Kiili et al. (2011) found that collaborative groups reading online compared multiple perspectives and sought deeper meaning than individuals reading online. O'Byrne found that students working in groups to create spoof websites improved their evaluation skills. Finally Zawilinski found that first graders and fifth graders blogging together improved communication skills. These results have lead researchers (Coiro, Castek, & Guzniczak, 2011; Killi et al., 2011) to argue that we must view online reading comprehension as a collaborative social practice.

It is clear based on these studies that openness to collaboration is a central disposition to online reading comprehension. Yet in this study the collaboration elements of the DORC were not significantly correlated with performance on the ORCA. This may be an artifact of the solitary
nature of the testing environment. In other words the assessment design did not allow students to take advantage of the affordances that a willingness to collaborate provides.

Future work should also be conducted to further refine measures of dispositions for online reading comprehension. This study used a previously validated instrument that included five subscales: reflective thinking, critical stance, persistence, flexibility and collaboration. Other work being conducted (Putman, in press) has examined motivation, self-efficacy, value and anxiety.

Furthermore some researchers have critiqued self-report measures of dispositions (Carr & Claxton, 2002). The most promising direction for the field may be not in instrumentation but in facial recognition software (D’Mello & Graesser, 2010). This research can capture real time indicators of dispositions in play by capturing subtle difference in facial expression, which can recognize persistence, frustration, and success.

Research should also be conducted that measures the predictive value of the DORC when students are completing online reading comprehension tasks in pairs or in groups. Given that recent work has found such a strong role for collaboration is assisting online reading comprehension it would be beneficial to the reading research community to understand how collaboration changes comprehension. We need to identify the affective variables that predict success in collaborative environments.

**Summary of the quantitative implications.** This study examined models of online reading comprehension. Specifically it examined the relative contributions that critical evaluation, background knowledge, and dispositions make to online reading comprehension after controlling for verbal intelligence. This model was tested in both a less restricted information space, where students could search for any website, and a more restricted information, where students had to find specific websites. In both models critical evaluation scores were the largest predictors of performance. Background knowledge was also a significant predictor in both models. The score on the disposition measure was only a significant predictor in the more restricted model.
These results indicate that researchers and teachers might more carefully consider the different spaces in which online reading comprehension takes place. We will need an increased effort in understanding how the information field influences the performance of students during online reading comprehension. We also need to develop models of instruction that prepare students for the “open mind sets” and “advanced web skills” necessary for online reading comprehension (Deschryver & Spiro, 2010, p. 4).

After all, the Common Core State Standards call for online research and media skills to be embedded in all content areas and across all classrooms. The results of this study indicate that a large-scale effort must be taken to prepare students for online reading comprehension. Based on the mean ORCA scores and the COIL scores it is clear that students are ill prepared to make meaning in online spaces. The research community and educators alike must work together to develop new instructional routines to address this challenge.

**Discussion of the Qualitative Results**

The purpose of the qualitative study was to investigate differences of strategy use among students with varying degrees of online reading comprehension proficiency. Ten students were included in the final analysis. Each participant completed a less restricted ORCA and a more restricted ORCA task. Using verbal protocol analysis (Afflerbach, 2002) and abductive coding methods followed by constant comparative methods (Bogdan & Biklen, 2003; Merriam, 1988), this study sought to answer the third and fourth research questions:

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?
To answer these questions a two-stage analysis was used. In the first stage, patterns of processing were identified that improved overall performance on the ORCA assessments regardless of the nature of the information space. In the second stage of analysis, patterns of processing were identified that changed based on the nature of the information space. Both stages of analysis helped to illuminate the quantitative findings.

**Qualitative Results: Discussion of Stage One Findings**

Stage one analysis identified processing patterns that led to increases in overall performance regardless of the information space. Four themes were identified in this stage of analysis: (a) overall ORCA scores appeared to be related to strategic text assembly; (b) overall ORCA scores indicated a lack of source evaluation knowledge among participants; (c) students who recalled details from memory appeared to perform better on the ORCA tasks; and (d) students appeared unprepared to engage in the communication strategies necessary for online reading comprehension in academic settings.

**Overall ORCA scores appeared to be related to strategic text assembly.** The first theme in stage one analysis highlighted how important navigational and comprehension monitoring skills were in determining success at online reading comprehension. Students, who navigated between sources, returned to the task and altered their cursor speed while reading outperformed their peers who do these less frequently.

This finding is consistent with previous research that has found reading online requires similar but more complex reading skills (Coiro & Dobler, 2007; Goldman et al., 2012). One of these new complexities may be in the ability to navigate informational spaces. In fact Goldman et al., using think aloud procedures to compare college age expert and novice readers found navigation to be a crucial difference. Similar to this study, Goldman et al. found that expert online readers made significantly more navigational choices back to reliable sources and away from unreliable sources.

McWilliams and Clinton (2010) argued that “reading with mouse in hand” is a fundamental
difference in online spaces. O’Hanlon (2002) argues that students enter college without basic navigational abilities to conduct online research. If students are to graduate high school with the online research and media skills to be college and career ready (CCSS, 2010) then efforts must be undertaken to increase the full range of navigational skills.

Comprehension monitoring was defined in this study as also knowing when to skim and scan sources and when to slow down for engaged reading. In this study the expert readers used strategies to skim sources and used strategies of engaged reading with a greater frequency than their peers. This is similar to the results found Goldman et al. (2012) where expert undergraduate readers spent considerable more time reading reliable sources and less time reading unreliable sources than their peers.

This first theme, that performance on the ORCA requires strategic text assembly, may also inform the quantitative findings of this study. In both the less restricted and the more restricted model students’ scores on the critical evaluation measure were the strongest predictor of performance on the ORCA-LR and ORCA-MR. This could be due to the number of navigational choices required in the COIL instrument. The COIL consisted of four different item types: a static screenshot of a single webpage, a static image of four screenshots, a webpage with hyperlinks, and list of four hyperlinks. Thus students who have a higher ability to read with cursor control may have succeeded on the COIL as well as the ORCA.

An important contribution that emerged from theme one is highlighting the importance of navigational skills across all elements of online reading comprehension. This study found that students who move between the task and the source, especially the participants who used tabbed browsing, out performed their peers on the ORCA tasks. This study also found that expert students moved between sources with a greater frequency than their novice peers. These students made use of navigational strategies throughout the ORCA assessment but patterns especially emerged during the synthesis and communication tasks.
Many previous studies have operationalized navigational strategies as part of search engine use (Bilal, 2000; 2001; Hill and Hannifin, 1997). Yet this study, in alignment with the work by Goldman and her peers, found that navigational strategies are just as important across all elements of online reading comprehension.

**Implications.** The role of navigational ability found in this study may have important consequences for classroom practice. First of all the next generation of high stakes testing will be delivered electronically. The tests are to be compatible with desktop, laptop, and tablet computing (SBAC, 2012; PARCC, 2012). Given that this study found that the ability to navigate an information space is critical to performance teachers will need to ensure that students are prepared for this type of testing environment. It is also clear that educators need to increase their instruction in the use of multiple online sources in classroom. Based on the findings of this theme much of this instruction should focus on goal directed navigational strategies.

**Overall ORCA scores appeared to indicate a lack of source evaluation knowledge among participants.** The second theme indicated that the majority of students simply do not evaluate sources they encounter online and if they do, they rely on very superficial markers of relevancy and reliability. The fact that very few differences in patterns of processing were identified among students based on their proficiency level is striking. In reality few students had the ability to evaluate author’s expertise, evidence used by the author, and author’s point of view. When students did try to do these, they often made errors of oversimplification.

This theme reflects many of the recent findings of research in online reading comprehension. Braasch et al, (2009) found that middle school students rarely evaluated the usefulness of sources. Leu et al. (2007) found students had an inability to identify spoof sites. Goldman et al. (2012) also found no significant difference in the website rankings of reliability among expert and novice undergraduate readers. Coiro (2012) using a case study analysis of three
students, found that the students either lacked critical evaluation skills or relied on surface level information to judge sources.

This theme also helped to inform the quantitative findings of this study. It is consistent with outcomes on both the COIL assessment and the ORCA assessments. In terms of the COIL assessment the think aloud data illustrates why mean scores were low. It is clear from these ten participants that so few could use processes for source evaluation correctly. In fact only two students was successfully able to judge an author’s point of view. This, adds additional evidence for the validity of this measure. The qualitative study also helps to explain why the evaluate items were the most difficult for students in both the ORCA-LR and the ORCA-MR.

**Implications.** Given that students rarely utilized critical evaluation strategies, and when students did use these strategies they often made errors of oversimplification, it is clear that current classroom practices to teach source evaluation may be insufficient. The qualitative portion of this study indicated that these errors of oversimplification may help to explain common results in studies that use critical evaluation measures. In this study and in similar research investigating critical evaluation, students often relied on surface level features to judge sources.

Studies (Goldman et al., 2012; Sanchez et al., 2006; Zhang & Duke, 2007), for example, that use website rankings to compare novice and expert readers find no significant difference in their evaluation ability (Goldman et al., 2012). Furthermore Zhang & Duke (2007) and Sanchez et al. (2006) found that students’ performance at ranking websites did not significantly improve, following an intervention, but student written justifications did significantly improve. These results mirror the lack of evaluation skills noted in this study.

Across all of the studies that either use measures of critical evaluation (Goldman et al., 2012; Sanchez et al., 2006; Wiley, 2009; Zhang & Duke, 2007;) or verbal protocol studies (Coiro, 2011; Coiro & Dobler, 2007) students made errors of oversimplification by relying on surface level
text features. The patterns in this theme support this conclusion. In this study students also overly relied on website content and website design to judge online sources.

Given the relative stability of students overly relying on textual features to judge websites there have been calls to move away from a top-down taxonomy approach of teaching critical evaluation skills (Goldman et al., 2012). Instead researchers call for theoretical and instructional models that view source evaluation as more integral to the meaning making process (Goldman et al., 2012). One alternative to top down taxonomies would be to draw on the principles of instruction outlined in Cognitive Flexibility Theory (Spiro, 2004). This calls for multiple representations of material in diverse cases. Such an approach would align well with the theoretical model outlined by Goldman et al. (2012).

**Students who recall details from memory appear to perform better on the ORCA tasks.** The third theme in stage one analysis indicated that students who recalled details of what they read during the ORCA tasks outperformed their peers. These patterns were especially evident when students combined information from what they read. This theme was also observed when students took a position on the final inquiry task.

This result reflects recent work examining the role of short term and working memory during Internet inquiry. Laberge and Scafalia (2013) found working memory capacity to be a strong predictor of performance in adults engaged in reading a single website. Herder & Juvina, (2004) found that weak navigational choices were associated with lower scores on measures of working memory. With similar findings this study found that students who are able to recall more details about the sources they read may perform better at online reading comprehension tasks.

**Implications.** This finding supports the idea that research should continue to investigate the role memory plays in online reading comprehension. This study examined the role background knowledge, as operationalized as content knowledge, played in predicting online reading comprehension scores. However given that the think aloud data found students who recalled
details from memory out performed students who did not, future research is needed into the role of memory. Specifically, studies should be created that examine the combined predictive power of multiple sources of background knowledge such as content knowledge and systems knowledge of search engines. Studies could also examine the predictive capacity of short-term memory capacity, and working memory capacity. This would provide a clearer picture of the role of various elements that might contribute to background knowledge use during online reading comprehension.

**Students appeared unprepared to engage in the communication strategies necessary for online reading comprehension in academic settings.** The fourth theme from the stage one analysis suggests that students are ill prepared to convey meaning in formal online academic settings. This was especially true when students did not include the information they read in their final posts on a simulated discussion board.

The participants in this study rarely used evidence to back up claims and only one student included any information identifying a source. The participants in this study lacked the basic discourse moves and argumentative (Tillman, 1956) structures necessary for academic writing. This would indicate that students need additional instruction in the use of argumentative text structure in online spaces.

Students also did not fully use the affordances available in an online communication tool to improve their writing. No student embedded hyperlinks to sources or images. In fact the only multimodal feature used were emoticons, or small smiley faces. This study could indicate that students, without formal instruction, may be more biased to casual writing in online spaces.

The results of this study reflect similar research into academic writing in online spaces. While there is significant evidence of high quality communication strategies in informal spaces (Black, 2007; Stone, 2007) there is a growing body of evidence to support that students are not prepared for academic discourse in online contexts. Forzani and Burlingame (2012), in evaluating item difficulty on an ORCA assessment, found that scores on communication items were the second
lowest, behind evaluation scores. Their environment tested both wiki and email communication tools. This study reached the same conclusion using a discussion board format.

This theme, a lack of communication strategies, also informs the quantitative findings of this study. Mean scores on both the ORCA-LR and the ORCA-MR were low for the communication items. Only evaluation scores were lower. The qualitative instances and an examination of the student discussion board posts put these scores into focus. Students are simply ill prepared for academic writing in online spaces.

**Implications.** We need additional effort to increase the amount of opportunities students have to utilize online communication tools in their classrooms. Every student should have access to school assigned, child-safe, email. Every teacher evaluation plan should measure a teacher’s ability to utilize hybrid-teaching environments. Given that 70% of current college students will take an online class during their secondary educational career (Sloan, 2010) it is hard to argue that high schools can graduate students who are college and career ready if they cannot use online spaces for academic, argumentative writing.

**Qualitative Results: Discussion of Stage Two Findings**

The purpose of the stage two analysis was to examine if there were differences in patterns of processing that were affected by the information space. Whereas stage one analysis identified patterns of processing that affected overall performance, stage two analysis focused on research questions three and four:

3. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?

4. What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space?
An analysis of the data indicated that the only differences in the patterns of processing, based on the information space, appeared on the locating items.

**What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a less restricted information space?** Three patterns were identified in the less restricted information space. First students who performed better on the ORCA-LR used more effective strategies for entering keywords. Also students who performed better on the ORCA-LR used more effective strategies for reading search results. Finally students who performed better on the ORCA-LR made more relevancy judgments.

These three patterns reflect much of the current work investigating student search habits (Coiro & Dobler 2007; Reih, 2004; Tabatabai & Shore, 2005). While keyword selection often begins with general terms, research has found more skillful readers revise keyword during the search process (Rieh, 2004). Furthermore Tabatabai & Shore (2005) found that experts used more keywords than novices. Coiro & Dobler (2007) found that locating skills might add to the complexity of online reading. This study builds on these findings by suggesting skilled users may adapt their searching behavior to the information space.

The examination of processing patterns on the less restricted locating tasks may also illuminate the quantitative findings of this study. Specifically the results of the think aloud indicated that students who made more relevancy judgments out performed their peers. Given that there were more acceptable answers on the ORCA-LR task when compared to the ORCA-MR this may have lead to the differences in mean scores on the locating items on the ORCA-LR (3.599) and the ORCA-MR (2.755). It may have contributed to the overall, and significant, differences in scores on the ORCA-LR and the ORCA-MR. On the ORCA-LR items students often chose to evaluate websites where the author was easily identifiable. This was not an option on the ORCA-MR items. This may have lowered evaluation items. On the ORCA-MR synthesis items the inability to find the required
source may have impacted the websites that were used to combine details. These factors may have lead to significantly lower scores on the ORCA-MR.

What patterns of processing appear among readers with varying levels of online reading comprehension ability during an online reading comprehension task within a more restricted information space? There were major differences in the patterns of processing on the ORCA-MR when compared to the ORCA-LR. On the more restricted ORCA students who used strategies to search within a webpage outperformed their peers who did not. When students did use search engines those who included both the topic and the source scored better than their peers. Finally, and comparable to the ORCA-LR, students who made more relevancy judgments outperformed their peers.

These results also reflect findings in previous research. Successful readers infer which link may be most useful on a webpage (Coiro & Dobler, 2008; Henry, 2006) during online reading comprehension. Furthermore researchers (McDonald & Stevenson, 1996; Rouet, 2006) have found that more skilled online readers efficiently scan for relevant information within websites. Goldman et al, (2012) found that expert readers could navigate within a website when compared to their novice peers. Similarly, in this study there was a clear difference between the proficient online readers and their peers. More successful online readers could navigate directly to a website and search within that site. Less proficient online readers often searched for a website using a search engine and accepted their first click on the homepage as a relevant source.

The patterns of processing on the locating tasks of the ORCA-MR may also help to explain the quantitative findings of this study. Specifically the ability of proficient readers to keep digging within a source until they found the specified website may explain why dispositions scores were significant in the ORCA-MR model but not the ORCA-LR model. Based on the think aloud data searching within a source required more reflective thinking, persistence, and flexibility. These variables were measured by the dispositions of online reading comprehension assessment.
Exploring The Implications Of Different Patterns Of Processing Due To The Information Space

**Implications for research.** In this study only the information space, specifically the locating tasks, were restricted. This influenced how the variables of interest behaved in the models. If other elements of the information space, beyond the locating tasks, were restricted the models may have been different. There are two additional methods for restricting the information space that might be attempted in future work: restricting the online reading comprehension assessment items and restricting the overall inquiry task.

Future work must continue to see what the relative contributions of background knowledge, critical evaluation skills, and disposition scores play in predicting scores on online reading comprehension assessment when the restricted nature of evaluation, synthesis and communication items is manipulated. For example students could be given the source to evaluate rather than choosing a source to evaluate. Giving students a notebook tool with scaffolded prompts could restrict the synthesis items. Finally providing “sentence starters” could restrict communication items. Each of these elements would further restrict the information spaces being used by students and could influence the contributions that background knowledge, critical evaluation skills, and disposition scores play in predicting scores during online reading comprehension.

Future work also needs to continue to explore how task differences affect online reading comprehension. It is well known that the nature of the task influences comprehension (Snow, 2002). Therefore studies could be conducted that restrict the inquiry task rather than the elements of online reading comprehension. For example This study would be informed by future work that that tests the same inquiry task, such as the Crossing the Delaware task, in both a less restricted and more restricted information space. This would help us draw a distinction between task differences and the information space.
In future work the inquiry prompt itself should be evaluated based on how it affects the contribution that background knowledge, critical evaluation skills, and disposition scores play in predicting scores on online reading comprehension assessment. In these studies the inquiry prompt and task could be the varied as a factor in determining the nature of the information space. For example online reading comprehension assessments could be built that ask students to find a specific answer to a more restricted question such as, “What is the distance to the moon?” Other assessments could ask less restricted questions such as, “What is the best way to fight global hunger?” Research may find that restricting the information space by altering the inquiry question may affect the contribution that background knowledge, critical evaluation skills, and disposition scores play in predicting online reading comprehension performance.

Implications for practice. The stage two themes also add to the growing evidence that teaching students to locate sources on the Internet should become a central practice in today's classroom. The patterns found in this study add to research which concluded that good online readers generate effective keyword search strategies (Bilal, 2000; Kuiper & Volman, 2008), make forward inferences (Coiro, 2011) in order to judge the relevancy of links (Henry, 2006), and effectively skim and scan sources to find details within a source (Rouet, 2006; Rouet et al., 2011). The findings from this study suggest that we need an increased instructional focus on teaching these skills within different types of information spaces. The patterns of processing on the locating tasks were quite stark between the more proficient online readers and their peers.

Limitations

This study of seventh grade students in three diverse school districts was designed to test the contributions that background knowledge, critical evaluation skills, and dispositions of online reading comprehension made on scores of a measure of online after controlling for verbal intelligence. Two different models were tested, a less restricted information space and a more restricted information space. Furthermore qualitative analyses were conducted to examine the
differences in strategy use among students who varied on their online reading comprehension ability. Potential limitations to this study need to be recognized in any interpretation.

**Instrumentation**

The theoretical models in this study are as only good as the instruments used to calculate student scores. This study required the creation and validation of four separate instruments. Therefore results from this study should not be generalized until the instruments can undergo further testing and the models verified with confirmatory studies. There are limitations to the ORCA assessments, the background knowledge measure, and the dispositions of online reading comprehension measure that may limit the interpretive power of this study.

**Online reading comprehension assessments.** The reliabilities for the ORCA-LR and ORCIA-MR were acceptable but low. Reliability for the less restricted ORCA was estimated by a coefficient alpha of .72 (Cronbach, 192). The coefficient alpha for the more restricted ORCA was .804. These are acceptable for research (Nunnally, 1978). However reliability estimates in this range can sometimes lead to the over estimation of effect sizes in multiple regression analyses (Osborne, 2002). In fact in multiple regression models, "With the addition of one independent variable with less than perfect reliability, each succeeding variable entered has the opportunity to claim part of the error variance left over by the unreliable variable" (Osborne & Waters, 2002, para. 12). Given the exploratory nature of this study, and the fact that reliability estimates exceed those required for research (Nunnally, 1978) the internal consistency of the quantitative measures was deemed adequate.

**Background knowledge measure.** The background knowledge measure used in this study has limitations associated with the variable’s use in the regression model. The biggest threat to the study was the overall number of students who received a zero on the measure indicating that they could not recall any information about the American Revolution. This presents a number of issues.
First it is highly unlikely that the students did not have any background knowledge of the American Revolution. This study, by using the background knowledge measure, may have underestimated participants’ background knowledge. The background knowledge measure used an online form, in a group setting, to ask students to recall as many details as possible about the American Revolution. It may be that another method such as a constructed response test or administering the same instrument orally and one on one would have been a better method to estimate background knowledge.

The frequency of low scores on the assessment also violated the assumption of normality required for regression models. The scores had to be transformed due to excessively high kurtosis. The use of this logarithmic transformation also limits the interpretations of this study. The variable used in the model was not the observed but rather the result of a transformation and may contain new biases (Beauchamp & Olson, 1973). Thus any interpretation of the model, especially of the background knowledge variable should be undertaken with caution.

The lack of variability of the transformed background knowledge variable also presents a limitation to interpretation. After the transformation the standard deviation for the background knowledge score was .0725. This lack of variance threatens the overall regression models. Lower variance can lead to larger standard errors (Osborne & Waters, 2002). Inflated standard errors can lead to increased Type I error rate.

The format of the background knowledge assessment may have led to the low mean score and overall low variance in the scores. The task had students answer a prompt to list all that they knew about the American Revolution. They were then given two more chances to answer the same prompt. This format may not have elicited all of the background knowledge students had about the American Revolution. Future work should try to elicit additional background knowledge connected to the disciplinary literacies of social studies (Shanahan & Shanahan, 2008). One possible method would be to provide students with blank concept maps with concepts associated with the American
Revolution. There could be different areas for leaders of the Revolution, battles, causes, dates, etc. This method of assessment may be better aligned with the types of knowledge needed in the discipline.

**Dispositions of Online Reading Comprehension Measure.** The biggest limitation of the dispositions of online reading comprehension measure (DORC) was the treatment of ordinal data as interval data in the regression models. The DORC used a five point Likert scale. Labowitz (1967; 1970) argues that the value of treating ordinal data, such as the DORC scores, as interval data in multivariate analysis outweighs the risk of including ordinal data in regression models.

The operational definitions of the constructs measured by the dispositions instrument also present a limitation to the study. It may be that the DORC failed to capture the epistemological and ontological stances of “open mindsets” (Deschryver & Spiro, 2010) necessary for online reading comprehension. In terms of the restricted nature of the information space, for example, it may be that different mindsets are needed to succeed in a restricted space when compared to a less restricted space. Therefore a reader who has the ability to adopt multiple perspectives may succeed at online reading comprehension tasks. The items included in the DORC do not attempt to measure these types of epistemological shifts in the reader.

Future measures of dispositions should try to capture both the “open mindsets” and the ability of readers to shift worldviews and mindsets based on the information space. This would require the creation of a two-scale instrument with items indicating an open mindset or a closed mindset. This instrument could then be applied to multiple models.

**Missing Data and Sample Size**

Another limitation to this study is the high rate of missing data. The sample started with 131 students. After three outliers were removed the final n equaled 95 students. This high rate of attrition could lead to important students being left out of the model. The attrition rate was similar across the three research sites. The large number of missing data was due mainly to one researcher
being responsible for the administration of so many assessments. It was impossible to ensure all the students completed each task and all absentees were accounted for in a manageable timeframe. A smaller number of students were lost to corrupted data.

The missing data led to a smaller sample size. In order to ensure there was enough power in the model the ten students who conducted the verbal protocol portion of the study were included in the final sample. The mean scores, on the ORCA-LR and the ORCA-MR were higher for the qualitative participants than the overall mean scores on the ORCA-LR and the ORCA-MR of students who did not participate in the verbal protocols. It could be that eliciting students to think aloud about the strategies they used resulted in raising their performance (Gerjets, Kammerer, & Werner, 2010).

**Researcher Bias in Qualitative Analysis**

As the only person coding and analyzing data the qualitative portion of this study could have been threatened by my inherent epistemological and ontological views. My desire to find differences among student strategy use could have influenced my results. In order to control for this a codebook was developed and another researcher utilized to ensure inter-rater reliability. I was also able to provide self-checks throughout the study to ensure patterns I found were consistent with the data. During the analysis process I was able to repeatedly return to the video data for self-checks. I would ensure that idea units only fit a specific code. Once the codes were collapsed into patterns I returned to the video data to ensure that patterns were unique and did not overlap. Once the patterns were collapsed into themes I returned to the video data to ensure the themes encompassed all of the patterns they captured. The use of an inter-rater reliability check and the recursive self checks helped to minimize the threat of researcher bias.

**Addressing the Growing Challenges of Online Reading Comprehension**

The results of this study contribute to both research and practice. For research, the results inform richer and more complex models of online reading comprehension. This was one of the few
studies to consider how the restricted nature of online reading comprehension tasks influences student performance. It suggests that the nature of the information space for online reading comprehension does, indeed, make a difference.

Recent calls to address adolescent literacy have emerged across the nation (CCAAL, 2010; Council of State Governments, 2010; Snow & Biancarossa, 2003). In fact these calls have culminated into the Common Core State Standards placing a heavy emphasis on preparing students who are “college and career ready” (CCSS, 2010, p.5). While this is a noble cause, researchers have noted that new state standards place too heavy an emphasis on offline definitions of text (Draper, 2012; Leu et al., 2011). In fact this study helps to demonstrate that any call to action to improve adolescent literacy must place a strong emphasis on online reading comprehension and the nature of the information space.

As these calls for improved adolescent literacy have emerged the Internet has grown in its dominance as the text of choice for our students. Adolescents now spend more time reading online than offline (Kaiser Family Foundation, 2005). Furthermore the Internet is the primary source when doing homework the Internet for homework. Therefore any efforts to improve adolescent literacy must also include efforts to improve meaning making in online spaces, and the literacy research community needs more robust models of comprehension in online contexts.

These online spaces are very diverse. In fact one of the greatest demands placed on the reader when reading online is the shifting information space (Leu, 2002) After all when reading online the size of the information field constantly shifts based on the task of the reader. This study sought to enrich the theoretical models of online reading comprehension by examining shifting information spaces.

In this study it was evident that the restricted nature of the information space affects online reading comprehension. Using both quantitative and qualitative methods this study demonstrated that reader characteristics behave differently when the information space is altered during online
reading comprehension tasks. In natural settings the information space used in online reading comprehension tasks will always change. Thus researchers need to develop theoretical models of reading that account for this constant flux (Hartman et al., 2010; Leu et al., 2004).

It is also clear from this study that long held assumptions about reading comprehension may have to be reconsidered. Specifically the role background knowledge plays in determining comprehension may be lessened in online spaces. In this study scores on a critical evaluation measure, not background knowledge, were the strongest predictor of performance on both the less restricted model of online reading comprehension and the more restricted model of online reading comprehension. Thus it is clear that critical evaluation skills are central to successful online reading comprehension (Coiro, 2003).

Unfortunately studies have consistently shown that students are ill equipped to evaluate online information (Bennett, Maton, & Kervin, 2008; Goldman et al., 2012; Jewitt, 2008; Johnson & Kaye, 1998; Livingstone, 2004; Leu et al., 2007b Rieh & Belkin, 1998;). Both the quantitative and qualitative data of this duty support this conclusion. If we are to address adolescent literacy it is clear that a concerted effort is needed to teach students critical evaluation skills. This issue will be paramount for both educators and researchers.

For practice, the results inform teachers charged with teaching literacy in a constantly evolving world, one in which the Internet is increasingly important to both reading and learning (Snow, 2002). This study highlights that teachers need to consider four critical areas for online reading comprehension: search strategies, navigational strategies, evaluation strategies and communication strategies. While building instructional routines that focus on these strategies this study also suggests that teachers build in opportunities to measure and develop dispositions central to online reading comprehension.

If we are to meet the call to improve adolescent literacy online reading comprehension cannot be ignore. It is a critical issue facing literacy researchers and educators. As the Internet’s
global reach continues to spread we must have students prepared to make meaning with digital texts.


http://sloanconsortium.org/sites/default/files/class_differences.pdf


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### Appendix A: Online Reading Comprehension Assessment

#### Crossing the Delaware

<table>
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<th>1. Welcome to the Online Reading Comprehension Assessment</th>
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<td>Last Name</td>
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<tr>
<td>School</td>
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</table>
2. TASK INTRODUCTION

The problem: Is the painting of George Washington crossing the Delaware River historically accurate?

Mr. Barnes's history class is debating the accuracy of the painting "George Washington Crossing the Delaware" by Emanuel Gottlieb Leutz.

They are debating if the painting is accurate, or truthful, on their class discussion board.

You will do research online and decide if the painting is accurate.
Crossing the Delaware

3.

George Washington Crossing the Delaware, 1851
by: Emanuel Gottlieb Leutze, American

Find one website that discusses the accuracy of Emanuel Gottlieb Leutze's painting of George Washington crossing the Delaware.

Keep this website open you will need it later. Click Here to begin your search.

1. What is the address for the website you found?

2. Did you type IDK for the web address?
   
   ☐ Yes
   ☐ No
## Crossing the Delaware

### 4.

What are the two most important details on this website?

*1. Use this space to take notes and share what you learned about the accuracy of the painting.*
Crossing the Delaware

5.

Find a second website that discusses the accuracy of Emanuel Gottlieb Leutze’s painting of George Washington crossing the Delaware.

Keep this website open you will need it later.

Click Here to begin your search.

**1. What is the address for the website you found?**

2. Did you type IDK for the web address?

  - Yes
  - No
**Crossing the Delaware**

6.

Find a third website that discusses the accuracy of Emanuel Gottlieb Leutze's painting of George Washington crossing the Delaware.

Keep this website open you will need it later.

[Click Here](#) to begin your search.

*1. What is the address for the website you found?*

<table>
<thead>
<tr>
<th>Address</th>
</tr>
</thead>
</table>

2. Did you type IDK for the web address?

- [ ] Yes
- [ ] No
Crossing the Delaware

7.

Combine what you read on these two websites.

Use this notepad to explain what you learned about the historical accuracies of the painting.

**1. Use this space to take notes and share what you learned about the painting.**
1. Can you determine the author of one of the four websites that you read?

Pick one of the websites you read. Find the author.

Which of the four websites did you choose? Send me the link to that website.

2. Who is the author of this website?

3. Did you type IDK for the web address or name of the author?
   - Yes
   - No
Crossing the Delaware

9.

* 1. Is this author an expert on the American Revolution?

* 2. Does this author use convincing evidence? How do you know?

* 3. What is the author's point of view? How does this influence the words and images the author uses?
Crossing the Delaware

10.

*1. Take a position: Is the painting of George Washington crossing the Delaware River historically accurate?

*2. What evidence did you find to support your position?
Crossing the Delaware

11.

Log in to the class discussion board. Then find the discussion about art and the American Revolution.

First log in using the information on your card.

[Login form]

Put Username here

Put Password Here

Then click on Mr Barnes’s forum.

[Forum]

Click Here to go to the class discussion board.
## Crossing the Delaware

### 12. Help Task Locate One

Use this link read about the accuracy of the painting: [What's wrong with this painting.](#)

**1. Click Here to Return to the Activity.**

- [ ] Click Here
## Crossing the Delaware

### 13. Help Task Locate Two

Use this link read about the accuracy of the painting: [Helium](#)

**1. Click Here to Return to the Activity.**

- [ ] Click Here
Crossing the Delaware

14. Help Task Locate Three

Use this link read about the accuracy of the painting: Washington Crossing the Delaware

*1. Click Here to Return to the Activity.

☐ Click Here
Crossing the Delaware

15. Help Task Critical Evaluation One

Jerry Curtis is the author of the website: Helium

*1. Click Here to Return to the Activity.

☐ Click Here
## Crossing the Delaware

### 16. Thank You

Thank You for Completing this Activity!
### Women of the American Revolution

#### 1. Welcome to the Online Reading Comprehension Assessment

**1. Please type your first name, last name, and school.**

<table>
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<td>School</td>
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</table>
Women of the American Revolution

**2. TASK INTRODUCTION**

The problem: What role did some women play in the American Revolution?

In Mr. Barnes's history class they are discussing women and the American Revolution.

His class is posting messages on the class discussion board.

You will do research to answer the question: What role did women play during the American Revolution?
Women of the American Revolution

3.

Find one website that discusses women and the American Revolution.

Keep this website open you will need it later.

Click Here to begin your search.

* 1. What is the address for the website you found?

2. Did you type IDK for the website address?
   ○ Yes
   ○ No
Women of the American Revolution

4.

What are the two most important details on this website?

*1. Use this space to take notes on what you learned about the role of women during the American Revolution.
Women of the American Revolution

5.

Find a second website that discusses women and the American Revolution.

Keep this website open you will need it later.

Click Here to begin your search.

* 1. What is the address for the website you found?

2. Did you type IDK for the website address?
   - Yes
   - No
Women of the American Revolution

6.

Find a third website that discusses women and the American Revolution.

Keep this website open you will need it later.

Click Here to begin your search.

* 1. What is the address for the website you found?

   

2. Did you type IDK for the website address?
   
   ☐ Yes
   ☐ No
Women of the American Revolution

7.

Combine what you read on these two websites.

**1. Use this space to take notes and explain what you learned about the role of women during the American Revolution.**
Women of the American Revolution

8.

1. Can you determine the author of one of the four websites that you read?

Which of the four websites did you choose? Send the web address of that website.

*2. Who is the author of the website you chose?

3. Did you type IDK for the web address or author's name?

- Yes
- No
Women of the American Revolution

9.

*1. Is this author an expert on the American Revolution?

How do you know?

*2. Does the author use convincing evidence? How do you know?

*3. Think about the author's point of view. Why does the author take this point of view?
Women of the American Revolution

10.

* 1. Take a position: What role did women play during the American Revolution?

* 2. What evidence did you find to support your position?
Log in. Then find the discussion about women and the American Revolution.

First log on using the information on your card.

Put Username here

Put Password Here

Then click on Mr. Barnes’s forum.

Then click here and find your post

Click Here to go to the class discussion board.
**Women of the American Revolution**

**12. Help Task Locate 1**

Use this link to read about women in the American Revolution: [American Athena](#)

**1. Click Here to Continue**

[Click Here](#)
Women of the American Revolution

13. Help Task Locate 2

Click on this link to read about women in the American Revolution: Contributions of Women during the American Revolution

* 1. Click Here to Continue

☐ Click Here
Women of the American Revolution

14. Help Task Locate 3

Click on this link to read about women in the American Revolution: Women in the American Revolution

1. Click Here to Continue.

☐ Click Here
Women of the American Revolution

15. Help Task Evaluate 1

Gillian Courtney is the author of the webpage: Contributions of Women during the American Revolution

*1. Click Here to Continue

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<table>
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<th>Women of the American Revolution</th>
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<tr>
<td><strong>16. Thank You</strong></td>
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Thank you for completing this activity.
Causes of the Revolution

1. Welcome to the Online Reading Comprehension Assessment

*1. Please type your first name, last name, and school.

First Name
Last Name
School
### Causes of the Revolution

#### 2. Task Introduction

Mr. Barnes's history class is talking about the causes of the American Revolution on their discussion board.

*You will do research online to answer the question: What were the main causes of the American Revolution?*
## Causes of the Revolution

3.

Find the webpage Causes of Revolutionary War on the website SocialStudiesforKids.com.

Keep this website open you will need it later.

Click Here to begin your search.

**1. What is the address for the website you found?**

2. Did you write IDK for the web address?

- Yes
- No
Causes of the Revolution

4.

Read the webpage. What are the two most important ideas on the page?

*1. Use this space to take notes and share what you learned about the causes of the American Revolution.
Causes of the Revolution

5.

Find the webpage List of Causes of the War on the website historycentral.com.

Keep the website open. You will need it later.

Click Here to begin your search.

* 1. What is the address for the website you found?

2. Did you write IDK for the website address?

  ○ Yes
  ○ No
 Causes of the Revolution

6.

Find the website titled American Revolution Persuaders.

Keep this website open you will need it later.

[Click Here to begin your search.]

* 1. What is the address for the website you found?

2. Did you type IDK for the web address?

  ( ) Yes

  ( ) No
Causes of the Revolution

7.

Read the two websites.

Tell us what you learned. Combine the information you read on these two websites.

* 1. Use this space to take notes and share what you learned about the causes of the American Revolution.
Causes of the Revolution

8. EVALUATE

*1. Can you determine the author of one of the four websites that you read? It will be important to know who wrote the information that you're sharing.

Which of the four websites did you choose? Send the link to that website.

*2. Who is the author of this website?

3. Did you type IDK for the web address or author?
   ○ Yes
   ○ No
Causes of the Revolution

9.

*1. Is this author an expert on the American Revolution? How do you know?

*2. Does the author use convincing evidence? How do you know?

*3. Think about the author's point of view.

How does the author's point of view influence the words and images used on the website?
Causes of the Revolution

10.

*1. Take a position: What were the two most important causes of the American Revolution?

*2. What evidence did you find to support your position?
Log in to the class discussion board. Then find the discussion about causes of the American Revolution.

First log in using the information on your card.

Then click on Mr. Barnes’s Forum

Then click here and find your post
Causes of the Revolution

12. Help Task Locate 1

Use this link to the website SocialStudiesforKids.com: Causes of the Revolution

*1. Click here to return to the activity.

☐ Click Here
### Causes of the Revolution

#### 13. Help Task Locate 2

Use this link to the website historycentral.com: [List of Causes of the War](#)

**1. Click Here to Return to Activity**

- [Click Here](#)
Causes of the Revolution

14. Help Task Locate 3

Use this link to the website: American Persuaders

*1. Click here to return to the activity

☐ Click Here
## Causes of the Revolution

### 15. Help Evaluate Task 1

David White is the Author of the website [Social Studies for Kids](https://www.socialstudiesforkids.com)

*1. Click here to return to the activity*

- [ ] Click Here
Causes of the Revolution

16. Thank You

Thank You For Completing this Activity!
# Turning Point of the Revolution

## 1. Welcome to the Online Reading Comprehension Assessment

1. Please type your first name, last name, and school.

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</table>
Turning Point of the Revolution

2. TASK INTRODUCTION

The problem: What was the turning point of the American Revolution?

Mr. Barnes's history class is debating the turning point of the American revolution on the class discussion board.

You will do research to help them answer the question: What was the turning point of the American Revolution?
Cadence posted this question to the website Yahoo answers, "What is the turning point of the American Revolution?"

Locate this discussion on the website Yahoo Answers.

Keep the website open. You will need it later.

Click Here to begin your search.

1. What is the address for the website you found?

2. Did you type IDK for the web address?
   - Yes
   - No
Turning Point of the Revolution

4.

What are the two most important details on this page?

*1. Use this space to take notes. Explain what you learned about the turning point of the American Revolution.
Turning Point of the Revolution

5.

Find the article about the Battle of Bennington on the website TheAmericanRevolution.org.

Keep this website open you will need it later.

Click Here to begin your search.

* 1. What is the address for the website you found?

2. Did you type IDK for the web address?

☐ Yes

☐ No
### Turning Point of the Revolution

**6.**

Find the article about the Battle of Saratoga on the website SocialStudiesForKids.com

Keep this website open you will need it later.

[Click Here](#) to begin your search.

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</table>
Turning Point of the Revolution

7.

Combine what you read on these two websites

*1. Use this space to take notes. Explain what you learned about the turning point of the revolutionary war.
Turning Point of the Revolution

8.

1. Can you determine the author of one of the four websites that you read? It will be important to know who wrote the information that you're sharing.

Which of the four websites did you choose? Send the link to the website.

* 2. Who is the author of this website?

3. Did you type IDK for the web address or the author's name?
   - [ ] Yes
   - [ ] No
Turning Point of the Revolution

9.

∗1. Is this author an expert on the American Revolution? How do you know?

∗2. Does the author use convincing evidence? How do you know?

∗3. Think about the author's point of view.

How does the author's point of view influence the words and images used on the website?
10.

*1. Take a position: What was the turning point of the American Revolution?

*2. In your own words provide at least two details to support your position.
Log in to discussion board. Then find the discussion on the Turning point of the American Revolution.

First log in using the information on your card.

Then click on Mr. Barnes’s forum.

Then click here and find your post.
Turning Point of the Revolution

12. Help Task Locate 1

Click on this link to read the Yahoo Answers Discussion: Turning Point of the American Revolution?

*1. Click here to return to the activity.

☐ Click Here
Turning Point of the Revolution

13. Help Task Locate 2

Click on this link to read about the Battle of Bennington [The Battle of Bennington]

*1. Click here to return to the activity

☐ Click Here
14. Help Task Locate 3

Click on this link to read about the Battle of Saratoga Revolution: Saratoga

*1. Click here to return to the activity.

☐ Click Here
David White is the Author of the website Social Studies for Kids

1. Click here to return to the activity.
   
   Click Here
<table>
<thead>
<tr>
<th>Turning Point of the Revolution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>16. Thank You</strong></td>
</tr>
</tbody>
</table>

Thank You for Completing the Activity!
Appendix B ORCA Protocol

Before the day of the assessment
1. Test wireless router
2. Make sure all websites required for the assessment are unblocked.

Before the Assessment Begins:
1. Pass out id cards
   a. Computer #
   b. Name
   c. Shortened link to assessment
   d. Username and password for discussion board
2. Sign in lap-tops
   a. UserName: Meg(x).
   b. Password: newill4life
3. Start IshowU
   a. Launch IshowU
   b. Check all settings.
      i. Double check-audio
      ii. Set screen-recording size to full screen
      iii. Start recording

During the Assessment
1. Say: Please do not open you laptops (Do not move on until all lids are shut)
2. I distributed a card today (Hold up example). You will record the number of the computer on your desk on the card. I will collect these cards once the assessment is done. These are your exit slips.
3. You have been assigned a laptop today. There is a number on the upper right hand corner. Please record that number on the line.
4. On this card you will find a username and password. You will use these at the end of activity to log in to the class discussion board.
5. You will also see a web address. Please open your laptops and go to this address now.
6. Enter in your name and school. Please wait at the next screen.
7. Click NextY
8. We will read this screen together.
9. You will be completing an activity to see how you use the Internet to learn. In this activity you will asked to search for websites, click on links, and share what you learned.
10. Sometimes you will be given a link to click on. When you click on the given link the link will open in a new TAB (point to students to image on their screen).
11. The new link will open to the LEFT of this activity. Make sure you do not click X on the tab that says SurveyMonkey. If you accidentally close the first tab called SurveyMonkey raise your hand and I will come around to help
12. You have been given a mouse. You may use the mouse or the trackpad. If you normally use the Control button on a Windows PC you will now use the apple
key.
13. Once you begin you may work through the activity.
14. I will provide time reminders to tell you if you need to move on.
15. If you finish a question before I say the time reminder you can move on.
16. Click Next.
17. After 30 seconds say: Please finish reading the task introduction and click
next.
18. After 4 minutes say: If you have not found the website please put IDK in the
box and click yes.
19. After 2 minutes say: You have one more minute to type the two most
important ideas on the page.
20. After 1 minute say: Please click next.
21. After 4 minutes say: If you have not found the website please put IDK in the
box and click yes.
22. After 4 minutes say: If you have not found the website please put IDK in the
box and click yes.
23. After 2 minutes say: You have two more minutes to combine the ideas from
these two page.
25. After 2 minutes say: You have one more minute to find an author.
26. After 1 minute say: Please type IDK for the web address or author and click
yes.
27. After 2 minutes say: You have one more minute to tell me if the author is an
expert.
28. After 1 minute say: Please move on to the next question.
29. After 2 minutes say: You have one more minute to tell me about the evidence
the author used.
30. After 1 minute say: Please move on to the next question.
31. After 2 minutes say: You have one more minute to tell me about the author’s
point of view.
32. After 1 minute say: Please click next.
33. After 2 minutes say: You have two more minutes to take a position.
34. After 2 minutes say: Please click next.
35. Say: Please sign into the class discussion board. If you can not sign in
please quietly raise your hand and we will walk around to help.
36. After 5 minutes say: You have two more minutes to respond to someone on
the discussion board.
37. After 2 minutes say: Thank you for finishing this activity. Please click post
message. Then go back to surveymonkey and click finished.

After the Assessment.
1. Make sure everyone posts their message.
2. End the IshowU recordings.
3. Erase the history and cookies from Firefox.
Appendix C: Critical Online Information Literacies Assessment Items

Where would you click to learn more about an author?

Fitness

Question
Energy drinks: OK for athletes?
I like to kick-start my workouts with energy drinks, such as Red Bull. Is this OK?

Answer
from Edward R. Laskowski, M.D.
Occasional energy drinks are safe for most people. Caution is important, however, especially if you have underlying heart problems.

Energy drinks — which are often loaded with caffeine, sugar and herbal stimulants — may pose various health risks, including:

- **Restlessness and irritability.** The caffeine in energy drinks can make you irritable, restless and nervous. Excessive caffeine is also associated with headaches, tremors, nausea and insomnia.

- **Increased blood pressure.** The caffeine in energy drinks can increase your blood pressure and make your heart beat faster. In some cases, this can trigger potentially dangerous changes in your heart rhythm. Mixing energy drinks and alcohol compounds the effect, since alcohol also makes your heart beat faster.

- **Possible dehydration.** Some studies suggest that the caffeine in energy drinks may increase the risk of dehydration during exercise, but results are mixed. Other studies don’t associate caffeine with dehydration.

- **Weight gain.** The sugar in most energy drinks can contribute to weight gain, especially for people who don’t exercise regularly and those who struggle with their weight.

In addition, excessive amounts of energy drinks have been associated with manic episodes, seizures, chest pain, heart attacks and sudden cardiac death.

Before and during exercise, plain water is usually best. During workouts that last 60 minutes or longer, you might sip sports drinks — typically made of water and carbohydrates — to boost your endurance. If you
*Where would you click to learn more about an author?*

- A In-depth
- B Read biography
- C Heart rate
- D Ankle weights
Which website about chihuahuas and asthma was created by the most knowledgeable author?

Please click on the links below to visit the websites.

Yahoo Answers

Snopes

Article Dashboard

PCCA
SeaWorld orca attack raises questions about keeping large animals in captivity
March 1, 2010 | 7:48 pm

ORLANDO, Fla. — Rocky, a 700-pound grizzly considered one of the gentlest animals among Hollywood’s performing beasts, bites down on the neck of a veteran trainer. Illusionist Roy Horn is severely mauled by a show tiger during a Las Vegas performance. An elephant at an Indonesian tourist resort tramples its longtime handler to death.

And now the latest -- a 40-year-old trainer at SeaWorld Orlando is drowned by a massive 12,000-pound killer whale named Tilikum, an incident that raises anew the question of whether some beasts, especially the biggest ones, have any business being tamed to entertain.

Descriptions of Tilikum, the 22-foot orca that has now killed two trainers, inevitably come around to his intimidating size.

At nearly six tons, the bull bought for breeding is a giant among killer whales, the largest in captivity.
Humans trying to incarcerate orcas or elephants or any type of large-brain or large-society species, it's proven it doesn't work," said Mark Berman, associate director at the environmental group Earth Island Institute in Berkeley. "They're just too big."

No animals were meant to entertain humans, he said.

GENERAL DESCRIPTION
The orca or killer whale is a toothed whale that is an efficient predator, even attacking huge young blue whales. Their only enemy is human beings. Orcas live in small, close-knit, life-long pods and have 1 blowhole. The killer whale belongs to the family of dolphins and is the biggest dolphin. It is sometimes called the "wolf of the sea" because its behavior is similar to that of wolves.
**SIZE**
Orcas grow to be about 27-33 feet (8-10 m) long, weighing more than 8,000-12,000 pounds (3,600-5,400 kg). The male orca is larger than the female. They are the largest member of the dolphin family.

---

**HELP BRING LOLITA HOME!**

For those of us who are tiring of hearing that zoos and aquariums foster humane or environmental attitudes here are two serious and scientific looks at those claims:


- *When Lolita Comes Swimming Home Again*
  August 6, 2009 (Seattle Post-Intelligencer blog)
Federal records from past injury investigation offer glimpse at risks SeaWorld killer-whale trainers face

SeaWorld trainers know risks of working with orcas

By Jason Garcia, Orlando Sentinel
April 25, 2010

Four years ago, a killer-whale trainer at SeaWorld San Diego suffered a torn ligament when an orca bit him on the ankle and pulled him underwater for nearly 30 seconds.

Two years before that, a killer whale at SeaWorld San Antonio repeatedly launched itself on top of a trainer during a performance and prevented him from leaving the pool, though the trainer was not hurt.

And three years before that, another SeaWorld San Diego trainer was pulled into a tank by an orca and broke an arm.
Which website tries to influence the audience with strong words or images?

☐ A
☐ B
☐ C
☐ D
Where do you click to find information on the publisher of this website?

- [ ] A Internet
- [ ] B About
- [ ] C Contact Us
- [ ] D The Book

Greatest Engineering Achievements of the Twentieth Century

Welcome!
How many of the 20th century’s greatest engineering achievements will you use today? A car? Computer? Television? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

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Think about the author’s point of view. What may influence the way he thinks about energy drinks?

Danger...Athletes and “Energy” Drinks!

OCTOBER 13, 2009 - 4:46 AM

By Marcus Borden

Do you believe that you need a “boost” or “jolt” before you play the game? Many high school and college athletes are caught up with the idea that they need something extra in the tank to produce a quality performance. That 2-ounce, lemon-lime 5-hour Energy bottle claims the following: Hours of energy, no crash later; no sugar, only 4 calories and “Feel it in minutes “Lasts for hours.”

Dr. Ann Slattery, a clinical toxicologist with Children’s Hospital in Birmingham warns that athletes can suffer dehydration and possible seizures from a caffeine overdose. Many energy drinks do not name caffeine as an ingredient, opting instead to use herbal names. The Food and Drug Administration does not regulate the amount of caffeine in “herbal supplements.” Therefore, some athletes may not be aware of the amount of caffeine that is being ingested.

The effect on the athlete’s body can be severe and dangerous. This is especially true during the heat of August and early September. Dr. Slattery adds, “If you’re out there in (sports) practice, you have a stimulant (caffeine) on board, you have an increase in your heart rate, an increase in physical activity, which increases your heart rate (even more), then you become dehydrated, which lowers blood pressure, which increases your heart rate...there could be some problems there.”

It is the responsibility of the parents, coaches and athletic trainers to make athletes aware of the inherent risks of consuming “energy drinks.” Proper diet, rest and
re-hydration are good old-fashion remedies for maintaining optimum athletic performance!

Think about the author's point of view. What may influence the way he thinks about energy drinks?

- He wants to win more games so Marcus Borden encourages athletes to use energy drinks.
- As Coach of the Year he is most concerned about his public image.
- He works for the energy drink companies and promotes energy drinks.
- As a coach and teacher Marcus Borden is concerned for the health of his students.
Which website uses information from the LEAST reliable source?

MP3 Players: How Loud Is Too Loud? -- Acoustic Study Shows Safe Levels

June 1, 2007 — Loud, sustained sound can damage tiny hairs in the cochlea, and yet 80 percent of people listen to personal music devices at dangerous levels above background noise, a study by acousticians shows. Certain models of earphones are safer for the ear, the study also concluded.

See also:
- Health & Medicine
  - Hearing Loss
  - Disability
- Mind & Brain
  - Hearing Impairment
  - Tinnitus
- Matter & Energy
  - Acoustics
  - Thermodynamics
- Reference
  - Tinnitus
  - Hearing Impairment
  - Acoustics
  - Auditory system

Can you hear me now? Not if you've pumped up the volume on your MP3 player. In noisy places, everyone is tuning up the tunes, and they could be drowning out their own hearing. A new study tells how loud is too loud.

Audiologists Brian Fligor, Sc.D., and Terri Ives have identified safe volume levels for you to use in noisy places. Dr. Fligor, an audiologist and Director of Diagnostic Audiology at Children's Hospital Boston says, "Your typical listener is not at risk if they are listening in a quiet situation, but if they are in a noisier situation, such as commuting, they very easily are going to be at risk." Their study concludes that 80 percent of people listen at dangerous levels when background noise comes into play.
Debate: Should the government regulate volume levels for headphones to prevent hearing damage?


After a mere hour of listening to my iPod, my ears hurt. Millions of people, however, listen to their mp3 players daily, and usually listen to them longer than one hour. People play them to drown out other noises, and to relax, but they don't realize how much damage they are doing to their hearing. Most of these people are children, which is even more cause for concern. Countless times have I seen/heard my friends blasting their music through their headphones, and I can't imagine how much damage they are doing to their eardrums. The data shows there needs to be a limit on the maximum volume of these devices to eliminate this problem, or at the very least more warnings on these products.

I guarantee the number of hearing impaired people will increase dramatically as my generation ages. There are no warnings of possible hearing damage on the iPod itself, or any other mp3 players for that matter. There is a way to restrict the maximum volume, but who is going to limit the maximum volume if they don't know there is a possibility of hearing damage? Despite recent reports of the very likely threat of hearing damage from these products, why isn't there government involvement on the issue. The government needs to step in and force companies to warn consumers of the possibility of hearing damage. Until then, people won't realize they are damaging their hearing, and how important their hearing is, until they've lost it.
How to avoid iPod ear damage

If someone can hear your music "leakage," it's too loud!

When using personal listening devices, the American Speech-Language-Hearing Association recommends turning the volume down, limiting listening time to an hour a day and taking frequent listening breaks.

Here are more tips from ASHA and audiologist Dennis Burrows.

- If you have a 10-notch scale, keep the setting at 6 or below.
- If your ears are ringing or feel "full" or if speech sounds muffled, the music was too loud.
- iPods now include software that allow you to "lock" the volume at a safe level. Parents can set a combination that kids can't crack.
- Upgrade from earbuds to headphones that fit outside the ear and block out unwanted sound. Look for earphones or headphones that block out excess background noise like sound isolating earphones from Shure or noise cancelling headphones like those from Bose. "Blocking out excess background noise is what really allows you to listen at a lower level - it doesn't really matter if the earphones are inside your ears or positioned on the outside," said a spokeswoman for Shure.
- Remember that earbuds don't eliminate background noise, which means listeners tend to

Which website used information from the least reliable source?

☐ A
☐ B
☐ C
☐ D
Which website was created by a more reliable publisher?

* Please click on the link to visit the websites

ABCNews
Glass Crafter
About.Com

Methods of Healing

☐ ABC News
☐ Glass Crafter
☐ About.com
☐ Methods of Healing
Given this author's profile page, what is her expertise?

- Medical Expert
- Veterinarian
- News Reporter
- Parent
Which website uses information from the MOST reliable source about healthy snacks?

Please click on the links to visit the websites

Healthy Eating Made Easy
Eating Well
Natural Health Restored

Snack Picks

- Healthy Eating Made Easy
- Eating Well
- Natural Health Restored
- Snack Picks
Which publisher creates the website with the most credible medical information?

A

Performance Enhancing Drugs Can
Get the Facts about Health Risks from Steroids, Stimulants

About Coaches Corner

Blog contributors include:

Joe Keenan
As executive vice president and director of digital product development, Joe Keenan is responsible for the Partnership for a Drug-Free America’s web communications and operations, including program websites, content development, online advertising and social networking initiatives. In his 8 years at the Partnership, Joe has grown the Partnership’s website, drugfree.org, from a single site to a suite of robust informational sites and online tools in support of the Partnership’s mission to reduce illicit drug use and support healthy families.

A competitive distance runner since 1974, Joe has competed in two New York City Marathons and many local and regional cross-country races. He lives in New Jersey with his wife and two teenage daughters -- both avid soccer players in high school and club programs.
OUR HISTORY

Milestones
We’ve been working to support the cancer community for more than 10 years. See what we’ve done.

LEARN MORE

Lance’s Story
At age 25, Lance Armstrong was one of the world’s best cyclists. Then they told him he had cancer.

LEARN MORE

Since 1997, we’ve been working to improve the lives of people affected by cancer. We started as a small group trying to raise money to fight this disease. As cancer has quietly become the world’s leading cause of death, our work has expanded and now reaches every corner of the globe.
ABOUT US

Boston.com was launched in October of 1995 and the site has grown into one of the most visited regional portals in the country with more than 4 million unique users each and every month. The site is the exclusive online home of The Boston Globe. We take pride in our up-to-the-minute news and features such as dynamic sports coverage, arts and entertainment, weather and traffic. Our suite of online classified services (Cars, Real Estate, Boston.com Monster and Personals) will help you find your next vehicle, house, job, or date.

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We are committed to editorial integrity. We aspire to be the most accurate and reliable source of local news and information on the Web. But we are human and we ask that you remember that when you send us feedback.

Why you should get to know us?: We're honest and good natured, and we know how to have fun. We're the kind of site you'd like to relax with. We applaud courage, confidence, and a healthy sense of irreverence.

Think you'd like it here? If you're interested in working at Boston.com, check out our job openings.
*Which publisher creates the website with the most credible medical information?*

- A
- B
- C
- D
Which website uses strong words, phrases, and images to influence readers?

*Please click on the links to visit the websites*

- **New York Times**
- **Liquidity Preference**
- **Huffington Post**
- **University of California**

- [ ] New York Times
- [ ] Liquidity Preference
- [ ] Huffington Post
- [ ] University of California
Which website uses information from the most reliable source?

A

://www.boston.com/news/science/articles/2006/08/16/nine_no_longer_panel_declarations_12_planets/

Nine no longer: Panel declares 12 planets

By Gareth Cook, Globe Staff | August 16, 2006

The solar system has 12 planets.

That is the conclusion, to be announced today, of an international panel formed to devise a scientific definition of a planet and settle an increasingly intense dispute over whether Pluto qualifies. The panel suggests retaining Pluto and immediately adding three new planets to the nine that are familiar to any schoolchild: Ceres, currently considered a large asteroid; Charon, now considered a moon of Pluto; and Xena, a recently discovered object that is larger than Pluto.

But the group's proposal also makes clear that many more objects in the solar system -- perhaps dozens of them -- could qualify as planets after further study.
GRESHAM & EAST COUNTY NEWS
Breaking news from Gresham, Multnomah County, Troutdale, Sandy and Corbett

Gresham declares Pluto a planet
By James Mayer, The Oregonian
February 11, 2010, 12:42PM

In 2006, the International Astronomical Union reclassified Pluto as a "dwarf planet."

That didn't sit well with all lot of amateur stargazers, and now Gresham is among them. The city is moving to restore Pluto to its rightful place in the solar system — at least in this east county city of 100,000.

Next Tuesday, Mayor Shane Bemis will read a proclamation declaring Feb. 18, the anniversary of Pluto's discovery by the astronomer Clyde Tombaugh in 1930, as "Pluto Day" in Gresham.
Is Pluto a Planet

While most people have grown up with the knowledge that there are 9 planets in the solar system, we suddenly find that our textbooks tell us that Pluto is not a planet.

When I was growing up, there were supposed to be 9 planets in the solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. There were also various other celestial bodies including asteroids which formed the asteroid belt that lay between the planet Mars and Jupiter and the various ‘moons’ which were pulled by the gravitational pull of each planet. And of course the Sun, which ran the whole show, apart from being the protagonist of what we call the Solar System. But recently, there was some kind of convention on our humble planet that felt that Pluto didn’t quite make the grade as a ‘planet’ and stripped it of its planetary status. Hence, in the light of all these events, the common people around the world cannot help but wonder, is Pluto a planet?

Is Pluto a Planet or Not?

Before we get down to whether Pluto is a planet, let us do a bit of background check on Pluto. Pluto or 134340 Pluto as it was formally known, was first discovered in 1930. It was instantly accorded the status of a planet, as it seemed like a celestial body which orbited the Sun. Later a group of experts in the field of astronomy started questioning the correctness of labeling Pluto a planet. In the 1970s, astronomers started finding more celestial bodies beyond Pluto, notably 2003 Chronos (not to be confused with Pluto’s moon Charon), which fueled a debate for the first time about the inadequacy of Pluto to be called a planet. The topic went hot and cold for a few years till in 2006, a convention of the International Astronomical Union (IAU) decided that there should be a formal definition for the word ‘planet’ that ought to be able to possess certain characteristics. Unfortunately for Pluto, it did not get the pass marks in all the required criteria and hence

The criteria that the IAU wanted every celestial body to meet were:

- The body must have its orbit around the Sun.
- It should be spherical by the merit of its own gravitational force. Meaning, its gravity should be able to pull itself into a shape which
- It should be the biggest, most gravitationally dominant planet in its own orbit.

The IAU ruled that Pluto doesn’t qualify the third criterion and it does not qualify as a planet. So unfortunately for Pluto and its founder, Clyde Tombaugh, the planet. It is now officially a ‘dwarf’ planet.
Why is Pluto no longer classified as a planet?

In: Dwarf Planet Pluto

Answer

The new definition of "planet" excludes Pluto because the new definition states that a planet "must be a clearing in its orbit." This eliminates Pluto because Pluto is a part of the Kuiper asteroid belt, a satellites of itself. Pluto is a dwarf planet now, because it still has more considerable mass.

Answer

Pluto is not a planet because it has not cleared everything from its orbit. The rules of
Appendix D: Dispositions of Online Reading Comprehension Assessment

Appendix D DORC Items

1. I trust what I read on the Internet.
2. Authors tell the truth when writing on the Internet.
3. I don’t like doing projects with other people when using the Internet.
4. I like to help others learn how to use the Internet.
5. It is important to keep your goal in mind when reading online.
6. I think about my opinion of a subject when reading websites.
7. I quit when I can’t find information online.
8. When I make a mistake when using the Internet I keep trying until I get it right.
9. I am ready to learn new things on the Internet even when they are hard.
10. When using the Internet I understand what I read by combining information from different websites.
11. When searching online I often have to change the strategies I have used in the past.
12. Solving problems using the Internet often takes strategies I learned somewhere else.
13. Websites are full of opinions.
14. I like working with friends to make and post stuff online.
15. I enjoy working with classmates when using the Internet.
16. I can work with a partner to solve problems online.
17. When one strategy does not work to find information on the Internet I pick another and keep trying.
18. I look for quicker and better ways to read online.
19. When searching online gets tough, I am willing to spend extra time.
20. When reading the Internet you have to look at information by moving between different viewpoints.
21. When I choose a website to read I think back to what I already know.
22. When looking for information on websites I know there is one truthful answer.
23. When I work on the Internet with others they often teach me strategies or tricks.
24. Using the Internet requires me to make quick changes in how I read.
25. I think about the words I choose when I write an email or comment.
26. I believe the information I find on websites.
27. I try hard when using the Internet to learn new things.
28. You can trust the pictures on websites.
29. I think about how I am reading when I visit websites.
30. I never think about what I am doing as I use the Internet.
Appendix E: Online Reading Comprehension Assessment

Locate

<table>
<thead>
<tr>
<th>Did the student use keywords that contained the topic and claim or title</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the student able to locate the first website?</td>
<td>1/0</td>
</tr>
<tr>
<td>Was the student able to locate the next two websites?</td>
<td>1/0</td>
</tr>
</tbody>
</table>

Evaluate

<table>
<thead>
<tr>
<th>Was the student able to explain their judgment of author's expertise by using:</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Author's title</td>
<td></td>
</tr>
<tr>
<td>- Author's affiliation</td>
<td></td>
</tr>
<tr>
<td>- Information on a secondary search of the author</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Was the student able to explain their judgment of author's use of convincing evidence by:</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Referring to a source of claims/evidence</td>
<td></td>
</tr>
<tr>
<td>- Mentioning the inclusion of a bibliography</td>
<td></td>
</tr>
<tr>
<td>- Verifying information with a secondary source</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Was the student able to describe the author's point of view by:</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Noting the url</td>
<td></td>
</tr>
<tr>
<td>- Publisher affiliation</td>
<td></td>
</tr>
<tr>
<td>- Markers of persuasion that indicate a bias</td>
<td></td>
</tr>
</tbody>
</table>

Synthesis

<table>
<thead>
<tr>
<th>- Was the student able to provide two details that support the thesis of the website?</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Was the student able to write a synthesis statement that combined information from both sources.</td>
<td>1/0</td>
</tr>
<tr>
<td>- Was the student able to take a position and back up their claim with evidence.</td>
<td>1/0</td>
</tr>
</tbody>
</table>

Communicate

<table>
<thead>
<tr>
<th>Was the student able to use the tool by correctly responding to a previous post under the correct topic?</th>
<th>1/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the student write a claim?</td>
<td>1/0</td>
</tr>
<tr>
<td>Was the student able to support their claim with evidence from a cited source?</td>
<td>1/0</td>
</tr>
<tr>
<td>- Includes mentioning or linking to source</td>
<td></td>
</tr>
</tbody>
</table>