NEGOTIATING NEW LITERACIES IN SCIENCE: AN EXAMINATION OF AT-RISK AND AVERAGE-ACHIEVING NINTH-GRADE READERS' ONLINE READING COMPREHENSION STRATEGIES

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ABSTRACT

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In today's digital world the Internet is becoming an increasingly predominant resource for science information, rapidly eclipsing the traditional science textbook in content area classrooms (Lawless & Schrader, 2008). The shift challenges researchers, educators, administrators, and policy makers to reconsider what it means to read and comprehend online science information. The research on digital literacy is still in its infancy and little is known about the strategies and processes students use when reading science content on the Internet. Even less is known about how at-risk readers comprehend digital science content. Therefore, this study addresses three research questions: (1) What strategies and processes do at-risk and average-achieving readers use as they locate information and generate meaning from science websites? (2) What navigational profiles emerge as at-risk and average-achieving readers construct traversals (unique online paths of information) they locate information and generate meaning from science websites? (3) What individual characteristics influenced students' strategies as they locate information and generate meaning from science websites?

Participants were six ninth-grade students in general education biology classrooms. Three were average-achieving readers and three were at-risk readers based on assessments of reading comprehension in traditional print-based texts. The students engaged in a three-day research project about the rainforest biome, locating information online, taking notes, and constructing an information brochure about the rainforest for peers. Data measures prior to and during the

research included an Internet use survey, verbal protocols, screen captures of online activity, oral reading fluency assessments, and prior knowledge and topic engagement surveys. Quantitative descriptive and univariate analyses as well as qualitative abductive coding were employed over multiple phases to analyze the data.

First, the results suggest that students employed a variety of online reading comprehension strategies in complex and dynamic ways. Among the many strategies revealed, the group of self-regulatory strategies (planning, predicting, monitoring, and evaluating) played a significant role, influencing students' use of all other strategies for locating and generating meaning from science websites. Second, the results also suggested that patterns of strategy use could be examined as unique navigational profiles. Rather than remaining fixed, the navigational profiles of each student altered in response to tasks and research methods. Importantly, all at-risk readers revealed more effective navigational profiles on Day 3 when they were forced by design of the task to attend to project goals and employ more self-regulatory strategies. Third, the results revealed that traditional reading comprehension strategies and prior knowledge of the rainforest also influenced online reading comprehension. Specifically, the at-risk readers with the lowest reading comprehension, oral reading fluency, and prior knowledge scores were more likely than the average-achieving readers to encounter issues in online texts that resulted in constructing ineffective traversals, or online reading paths, and spending significant time investing in online reading that was irrelevant to the research project. Ultimately, this study advanced the understanding about online reading comprehension for average-achieving and at-risk readers in science classrooms, contributing to a gap in the research, suggesting implications for practice, and promoting future research questions.

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CHAPTER 1

INTRODUCTION

"As technologies become more sophisticated, their links to science become stronger…New technology often requires new understanding." - *Science For All Americans, 1985*

In 1985, when The American Association for the Advancement of Science first published its initiative Project 2061, designed to strengthen improve the literacy of all Americans in science, math, and technology, they foreshadowed a growing interdependence between science and technology. Now twenty-five years later, one of the most revolutionary technologies to transform the field of science is the Internet. The Internet has transformed the way citizens and professional scientists alike engage in learning, thinking, and communicating about science. The inextricable link between the Internet and science require both new understanding of the very ways in which the Internet shapes the practices of science and the ways in which we can prepare students to become scientifically literate citizens in this technology age.

Preparing scientifically literate citizens requires educators to apprentice students into ways of knowing, thinking, and doing science (Murcia, 2009; Roth, 1998). Integral to scientific literacy is the *fundamental* or *traditional* sense of literacy known as reading (Norris & Phillips, 2003). Reading plays a pivotal role in science and is essential for the development of knowledge, critical thinking, and communication skills (Glynn & Muth, 1994; Norris & Phillips, 2003; Osborne, 2002). Therefore, reading functions as a gateway to scientific literacy. Before the Internet, students who expected to fully participate in the secondary science curriculum were forced to rely on print-based, content area texts, which were the principal source of information in secondary classrooms. However, in today's digital world, the Internet is becoming an

increasingly predominant resource for science information, rapidly eclipsing the traditional science textbook in content area classrooms (Lawless & Schrader, 2008). Students must now learn to read, comprehend, and navigate online information, tasks requiring new reading processes than those used in print-based texts (Coiro, 2011; Spiro, 2004). A growing body of research reveals that while reading online certainly draws on some of the strategies necessary for offline, print-based reading, an entirely new set of skills, strategies, and dispositions are also essential (Coiro, 2011; Duke & Carlisle, 2011; Leu, Kinzer, Coiro, & Cammack, 2004). These skills, strategies, and dispositions have been referred to as the *new literacies of online reading comprehension* (Leu et al., 2004).

Ironically, for the past decade, policy makers, educators, and researchers have largely ignored or dismissed the importance of new literacies despite the expansion of the Internet (Leu, Zawilinski et al., 2007). Yet there is a shifting tide, a growing awareness of the significance of new literacies, and a corresponding increase in research. This research suggests that online reading comprehension, much like traditional reading comprehension, is influenced by reader characteristics (e.g., engagement, prior knowledge, etc.) (Coiro & Dobler, 2007; Coiro, Knobel, Lankshear, & Leu, 2008). In addition, online reading comprehension is highly dependent upon a student's repertoire of strategies, which must be applied flexibly based upon the task, context, and specific webpage characteristics (Cho, 2011; Coiro & Dobler, 2007). Finally, the research suggests that explicitly teaching online reading comprehension strategies increases students' online reading performance (Castek, Coiro, Fogarty, Hartman, Henry, & Leu, 2005; Hoffman, Wu, Krajcik, & Soloway, 2003). However, the research that will inform the conceptual foundations of the literature on new literacies is still in its infancy, and to date, the vast majority of this research has focused on skilled or average readers. Recent research (Castek, Zawilinski,

McVerry, O'Byrne, & Leu, 2011; Leu, Zawilinski et al., 2007) suggests that some students with learning disabilities who struggle with print-based reading may actually excel at online reading. Nevertheless, these results are preliminary, and there remains a substantial gap in the literature regarding how students with learning disabilities engage in the new literacies of online reading comprehension relative to their same-age peers.

The urgency for engaging in research that addresses this gap in the literature is pressing due to present unique opportunities. While new literacies are gaining traction in research, there has not been widespread attention by educators to teach the new literacies of online reading comprehension in schools. Prior to any significant attention and subsequent implementation efforts in schools, a research base that purposefully includes students with learning disabilities will ensure that these students' needs are met with online comprehension curricula, rather than incorporated as an afterthought. Such a research base must begin with studies that explore the nature of online reading comprehension processes (Coiro & Dobler, 2007). Studies in specific content areas can yield more explicit findings on the nature of online reading comprehension processes, particularly, how students' online reading comprehension is shaped by the discourse of the disciplines. Once online reading comprehension processes are identified, the field can identify new literacies strategies that will support students with learning disabilities in content-area classrooms.

Statement of Purpose

The purpose of this study is to advance the knowledge of online reading comprehension for students with learning disabilities in the disciplines of science, this exploratory study investigates the online reading comprehension skills and strategies used by secondary students with learning disabilities, as well as their peers without learning disabilities, specifically in

relation to science websites integrated into the curriculum. The study also examines contextual variables and the unique characteristics of online text that may impact online reading comprehension and inevitably affect online reading comprehension instruction.

Research Questions

There are three questions addressed in this study:

1) What strategies do students with and without learning disabilities use as they locate, evaluate, and synthesize information on science websites?

2) What navigational profiles emerge as students with and without learning disabilities construct traversals (unique online paths of information) while they locate, evaluate, and synthesize information on science websites?

3) What individual characteristics influence student choices as they locate, evaluate, and synthesize information on science websites?

CHAPTER 2

LITERATURE REVIEW

Examination of the Problem

New information and communication technologies (ICTs) and the Internet are rapidly redefining the skills necessary to effectively prepare students for active citizenship and work in a digital age (International Reading Association, 2009). ICTs, and the Internet specifically, "are becoming the town square for the global village of tomorrow" (Gates). The Internet is the hub through which individuals engage in social, civic, and economic participation and communication. Between 2000 and 2011, Internet users increased from roughly 360 million to over 2 billion individuals, a growth of nearly 480% in 11 years (Internet World Statistics, 2010). As Internet usage surges, new technologies will continue to emerge, shaping the very nature of literacy as well as the purposes and practices of literacy (Coiro, Knobel, Lankshear, & Leu, 2008; Leu, Kinzer, Coiro, & Cammack, 2004; International Reading Association, 2009). The shifting nature of literacy will affect how students should be prepared for the demands of a digital world (International Reading Association, 2009). For science educators, this means understanding how the Internet will transform the preparation and development of scientifically literate students. Unquestionably, scientifically literate students will need to know how to read and comprehend information online. While research is emerging about the skills and strategies necessary for online reading and comprehension (Coiro, Knobel, Lankshear, & Leu, 2008), there is limited information about online reading and comprehension specific to the disciplines of science. Given the limited, albeit growing body of research about online reading and comprehension, it is no surprise that even less is known about how individuals with disabilities read and comprehend online information (Castek, Zawilinski, McVerry, O'Byrne, & Leu, 2011).

This research seeks to contribute to research about individuals with disabilities as they participate in the new literacies of online reading comprehension in science.

Conceptual Frameworks

Research addressing the complexity of online reading comprehension is most thoroughly examined through multiple frameworks. Four key literatures provide a foundation for this study: scientific literacy, social semiotic theory, a new literacies perspective, and Constructively Responsive Reading. It is relevant to recognize that many other theories and perspectives have also influenced portions of this work, however these four literatures have the greatest relevance and impact on this research. These literatures inform one another, so discussing each in turn fails to appreciate their integrated contribution to an understanding of online reading comprehension in science. Therefore, they will be integrated to construct a rich, integrative framework for this research.

The chapter will begin with a statement addressing the rationale for situating the study of online reading comprehension within the disciplines of science. First, the chapter will define scientific literacy and the role of reading as a central tenet to scientific literacy, which will incorporate a social semiotic perspective on meaning-making in science and define what counts as science texts. Second, the chapter will examine the unique nature of online texts. Third, the section will provide an overview of reading comprehension as an interaction between the reader, text, and context. Fourth, the framework of the nature of Constructively Responsive Reading in print-based and online texts and the related empirical research will be introduced. Fifth, the conceptual frameworks section will conclude with a discussion of the new literacies of online reading comprehension including a review of the related empirical research.

Rationale for Situating Online Reading in Science

In the following review of conceptual frameworks that gird this study, online reading comprehension is situated within the disciplines of science. The choice to examine online reading comprehension as a practice within science is wholly intentional and grounded in the notion that learning occurs in "communities of practice" (Lave & Wenger, 1991). Communities of practice, like the disciplines of science, are spaces where learners interact and participate in a joint venture that are shaped by a shared repertoire of communal resources (e.g. tools, routines, language, dispositions) (Lave & Wenger, 1991). It is participation within given communities of practice that "constitutes knowing and learning" (Roth, 1998). Reading, as a way of knowing and learning, is shaped specifically by the members operating in the discipline of science (Lemke, 2000; Moje, Stockdill, Kim, and Kim, 2011; Roth, 1998; Yore, Bisanz, & Hand, 2003). The particular disciplines of science, for example, shape what types of texts are read, the purposes for reading text, and the ways in which individuals read those texts. Reading in science is inherently different than reading in history or mathematics. For example, reading in science requires intense scrutiny of methods and results, and attention to conceptual relationships and dense technical vocabulary (Shanahan & Shanahan, 2008). Furthermore, reading science texts requires the synthesis of visual representations including mathematical equations, graphs, process diagrams, and images (Lemke, 2002). In this sense, reading is situated specifically within the disciplines of science (Roth, 1998).

Students do not naturally acquire the particular habits of reading that distinguish reading in science; instead they must be apprenticed into them (Gee, 2000; Roth 1998). As Gee (2012) suggests, "A way of reading a certain type of text is only acquired, when it is acquired in a "fluent" or "native-like" way, by one's being embedded (apprenticed) as a member of a social practice wherein people not only read texts of this type in this way, but also talk about such texts

in certain ways, hold certain attitudes and values about them, and socially interact over them in certain ways" (p. 41). The science classroom is a community of practice where students are apprenticed into the habits of reading particular to the disciplines of science (Roth, 1998). Therefore, educational research that seeks to examine how students read and comprehend science text, whether traditional printed text or online text, must recognize the ways in which reading is situated within the community of practice known as science. The following section first examines what it means to be scientifically literate, and then within that framework, what role reading plays in scientific literacy.

The Role of Reading in Science and Scientific Literacy

Science educators are charged with the task of helping all students become scientifically literate. The American Association for the Advancement of Science (AAAS) defined scientific literacy as " being familiar with the natural world and respecting its unity; being aware of some of the important ways in which mathematics, technology and the sciences depend upon one another; understanding some of the key concepts and principles of science; having a capacity for scientific ways of thinking; knowing that science, mathematics and technology are human enterprises, and knowing what that implies about their strengths and limitations; and being able to use scientific knowledge and ways of thinking for personal and social purposes" (p. 4).

While the definition advanced by the AAAS is widely adopted, multiple definitions of scientific literacy have evolved (e.g., AAAS, 1993; Bybee, 1997; DeBoer, 2000). Yet, an examination of multiple definitions revealed that, at their core, nearly all embraced knowledge about 1) the nature of science, 2) relationships between science and society, and 3) seminal scientific concepts and vocabulary (Murcia, 2009). Furthermore, all definitions contribute to the notion that scientific literacy is a way of knowing, thinking, and doing science (Murcia, 2009).

Integral to scientific literacy is the *fundamental* sense of scientific literacy known as reading (Norris & Phillips, 2002), which is pivotal in the development of knowledge, critical thinking, and communication (Glynn & Muth, 1994; Norris & Phillips, 2002; Osborne, 2002). However, until the past decade, little attention has been given to thinking about the specific role of reading in science, as most science educators have been focused instead on preparing students through teaching science content (Wellington & Osborne; 2001).

The increasing attention to reading and writing within science has demonstrated that the act of reading is inherently shaped by norms of the disciplines (Moje, Stockdill, Kim, and Kim, 2011; Shanahan & Shanahan, 2008). Reading in science is different from reading in math or history regarding the nature of the purposes and practices for reading and the type and variety of the texts that are read (Shanahan & Shanahan, 2008). Reading is one of many ways of making meaning in science. In order to understand how students make meaning through reading first requires understanding that meaning is represented and constructed in science in ways unique to the discipline (Chandler, 2002; Lemke, 2000) and as a result science texts are also unique.

What are science texts? Science texts share commonalities with other content-area expository texts, however there are several facets in which they are unique. The number of disciplinary-specific nuances in science texts is vast, but four major distinctions are examined below. First, science texts are more than printed words; they are constructions of intricate combinations of semiotic modalities: printed text, images, mathematical equations, videos, etc. (Lemke, 2002; Norris & Phillips, 2003; Tang & Moje, 2010). Understanding that meaning is constructed through the integration of these multiple modalities provides a broader conception of text (Tang & Moje, 2010). Students must develop and apply strategies for attending to all the modalities for a comprehensive understanding of the text (Norris & Phillips, 2003; Tang & Moje,

2010; Waldrip, Prain, & Carolan, 2010). Second, science texts are written for a variety of purposes (ex. firsthand investigations, secondhand investigations, advancement of methods, dissemination of investigations in popular media for the general public, etc.) (Norris & Phillips, 2003; Palincsar & Magnusson, 2000). Students must discern the purpose of the text and engage in ways of reading that are appropriate for the given text. Third, science texts are replete with ill-structured expository text structures. Within any given text, a reader may encounter multiple forms of expository text (e.g. procedural, compare-and-contrast, cause-and-effect, sequential), interwoven with only limited textual cues that a transition has even occurred (Gersten, Fuchs, Williams, & Baker, 2001; Palincsar & Magnusson, 2000). Students must attend to and discern the shifts in text structure (Gersten et al., 2001). Fourth, science texts incorporate dense content-specific vocabulary (Groves, 1995; Shanahan & Shanahan, 2008). Students must grasp a firm understanding of both the definition of the general and specific meanings of vocabulary (Shanahan & Shanahan, 2008). For instance, students should understand the general concept of a cell as a small cavity or compartment but more specifically they must recognize the meaning of cell in the context of human biology (cell in the body), meteorology (weather cell), and energy (fuel cell). The unique disciplinary features present in traditional printed text continue to inform online science texts; however, online science texts also integrate novel features which digitally literate students must also master to make meaning from science texts.

What are online science texts? Students in this digital age must also attend to the *hypermodality* of online science texts. The Internet has further expanded the possibilities of what "counts" as text and which modalities are privileged in the semiotic process (Kress & van Leeuwen, 1996). *Hypermodality* is the way of thinking about "the new interactions of word-, image-, and sound- based meanings" in online texts (Lemke, 2002, p. 1). Hypermodality attends

to the possible universe of interconnections within and across the semiotic modalities of words, images, and sound due to the hypertext nature of the Internet (Lemke, 2002). Hypermodality therefore is a unique extension of multimodality. Therefore, online science texts are not only multimodal, but hypermodal as well. Scientifically literate students in the 21st century will undoubtedly need to understand both the multimodal and hypermodal nature of science text and apply strategies to effectively comprehend the information if they are to effectively comprehend what they read online (Lemke, 2000; Lemke, 2002).

Reading Comprehension: Interactions Between the Reader, Text, and Context

Reading comprehension is a dynamic process, an active interplay between the reader, text, and context (RAND Reading Study Group, 2002). Each element influences the constructed meaning, the outcome of the reading comprehension process (Wilkinson & Hye Son, 2011). Therefore, research that seeks to explore reading comprehension must consider each element and the complex interactions between these elements.

The reader. Research has firmly established that each reader's individual cognitive and affective characteristics influence reading comprehension (Pressley & Afflerbach, 1995; Tierney & Cunningham, 1984). For example, research demonstrates that skilled readers, in comparison to at-risk readers, are aware of at a metacognitive level of the need to be selectively attentive and they employ strategies that allow them to focus on main ideas and filter out irrelevant or minor ideas in the reading (Pressley & Afflerbach, 1995). These individual metacognitive skills and strengths positively influences students' abilities to successfully read comprehend texts. Conversely, students with learning disabilities, who demonstrate unique individual weakness in metacognitive tasks, often struggle with reading comprehension (Conley, 2008; Englert et al.,

2009; Gersten et al., 2001; Williams, 2003). Therefore, understanding reading comprehension requires an intentional examination of these individual characteristics.

The text. The text also plays an integral role in reading comprehension. As students read, they are constantly selecting text, organizing the textual information, and generating connections between and among texts (Spivey, 1984; Spivey & King, 1989). Consequently, the very nature of the text students read influences the construction of meaning. Recall that the scope of multi-modal resources considered "text" are far broader than printed words, as discussed previously in the literature review. A student engaged in online reading does not purely make meaning from a single, isolated text (e.g., printed words, image, web page, video). Instead a student "transposes texts into other texts, absorbs one text into another, and builds a mosaic of intersecting texts," or intertextual links (Hartman, 1992, p. 299). During this process, students are continually constructing, adapting, and revising texts within their own mind to create a unique "inner text" (Pearson and Tierney, 1984).

The online nature of text demands particular attention precisely because information on the Internet is ill-structured and complex, promoting the necessity for students to employ new, flexible, open processes and mindsets for engaging in reading (Spiro, 2004; Spiro & DeSchryver, 2008). Online texts, often referred to as hypertexts, promote linking within and across texts to an extent that was not possible with printed texts (Kuiper & Volman, 2005, Kuiper et al., 2008). Students may construct meaning by following a series of links, creating a unique path, or traversal, through online text (Lemke, 2002) constructing intricate intertextual connections between words, images, animations, and sound, connections that were not possible in printed texts. Therefore, meaning making is influenced by the reality that students have a universe of possible semiotic resources, or texts, available to choose from on the Internet. In this sense, a

group of students reading online texts to answer the same question and even starting from the same webpage will each travel their own unique traversal through the textual data, informing the way they construct meaning. Each student is likely to construct a range of different answers to the same question, with varying degrees of accuracy and depth depending upon the traversals they create and their abilities to locate, evaluate, synthesize, and communicate the information they discover online.

The context. To this point, the discussion of how meaning is constructed through reading has been situated between the reader and the text. However, the context also influences meaning (Lemke, 2000). Examining the fully contextualized nature of online reading in science is beyond the scope of this conceptual framework, instead the following will focus on the contextual influences that are of particular interest in this study.

The context of the reading activity will influence the way meaning is constructed. For example, the meaning that a student constructs will vary based on the purpose for the task, the demands of the task, the outcome associated with the task, the interactions or collaborations with other individuals during the task (RAND, 2002). Two students, starting from the same website about DNA, will construct entirely different meanings if one student is reading for the purpose of identifying common methods for chromatography while the other student is reading for the purpose of synthesizing and reporting the results of an experiment using chromatography methods.

Expanding context more broadly requires examination of the discourses of science. The way that a student reads and constructs meaning in a science classroom is influenced by the nature of the discourse of science and the activity (Gee, 2000; Lemke, Moje, Stockdill, Kim, and Kim, 2011; Shanahan & Shanahan, 2008). The extent to which discursive practices actually

shape any individual's processes of reading and meaning-making will vary with knowledge of and experience in the discipline as well as their willingness and motivation to engage in the practices associated with science (Gee, 2000). So examining reading comprehension in adolescent students that are being apprenticed into scientifically literate practices must recognize variability in the extent to which students operate within discursive reading practices.

Reading Comprehension: Constructively Responsive Reading Strategies

A wide body of research over the past 50 years has contributed to a comprehensive understanding of reading comprehension as influenced by the reader, text, and context, but this review will examine the research that is most relevant to the current project. Therefore, this section will introduce reading comprehension with a specific focus on the nature of Constructively Responsive Reading in print-based texts (Pressley & Afflerbach, 1995). Then, the section will conclude with a relatively recent extension of the model of Constructively Responsive Reading to online texts (Afflerbach & Cho, 2009).

Reading strategies of skilled readers in print-based texts. Research reveals that expert readers engage in strategic reading processes (Afflerbach, Pearson, & Paris, 2008). These expert readers set goals, deliberately select and use strategies to achieve the goal, demonstrate motivation to use strategies, monitor progress toward the goal, continually adapt their reading processes as they seek to achieve the goal (Afflerbach et. al, 2008; Paris, Wasick, & Turner, 1991). For expert readers, at times reading is automatic and proceeds relatively unconsciously, but when the reader encounters challenges with comprehending the text or when they perceive they are failing to work toward their goal, the reading slows down and the reader deliberately engages specific strategies to overcome the obstacle (Afflerbach et. al, 2008). In an effort to capture the complexity of expert readers' strategic reading processes, Pressley & Afflerbach

(1995) catalogued the many reading strategies that expert readers exhibited before, during and after reading. The resulting framework exploring the nature of Constructively Responsive Reading, provides insight into the sophisticated strategic reading processes.

Pressley & Afflerbach (1995) characterized the strategic processes or deliberate strategy use into three groups: 1)identifying and learning text content, 2) monitoring, 3) evaluating. Strategies related to identifying and learning text content were primarily related to gaining meaning from the text. Monitoring strategies were those employed deliberately by students when they encountered struggles associated with the text or goal. Strategies related to the evaluation of the text, either as a whole or in component pieces, were incorporated into the evaluating category. The strategies in identifying and learning text content occur before, during and after reading, while those in monitoring and evaluating were primarily observed during and after reading only.

The following description provides examples of the complex strategic processes and strategies that expert readers might employ before, during and after reading (Pressley & Afflerbach, 1995). Prior to reading, expert readers promote understanding of the texts by setting reading goals, previewing the text, and determining which sections to read or not read based on the goals. Skilled readers also active their prior knowledge of the topic and the text genre to further facilitate reading goals. During reading, expert readers continue to activate prior knowledge and adjust their understanding of the ideas based on new information in the text. While reading they identify main ideas, acquire vocabulary/key words, ask questions, and make inferences. They monitor their reading to ensure that they understand what they are reading, and they slow down to employ specific strategies such as rereading, asking questions, using context clues, and examining their own reading processes. They also evaluate the alignment of the text

with their goals, the author's intent, the style of the text, and the accuracy and reliability of the content in the text. After reading, expert readers may reread for particular information, construct a cohesive summary, self-question, and reconstruct meaning. They again monitor their understanding and progress toward the reading goal and evaluate the text.

Overall, skilled readers employ these strategic skills and strategies in a constructively responsive manner, constantly shifting and adjusting strategies as they monitor and evaluate their reading (Pressley & Afflerbach, 1995). These readers possess a vast strategy knowledge base at the declarative, procedural, and conditional level (Paris & Hamilton, 2009; Paris, Lipson, & Wixson, 1983; Pressley, Symons, Snyder, & Cariglia-Bull, 1989). For example, they know many specific reading strategies to fix-up comprehension (declarative), how to use the specific strategies (procedural), and when and why to use them (conditional). They also engage metacognitive strategies to assess their performance toward a goal and to monitor their comprehension, making adjustments in their reading processes or specific texts (Baker & Brown, 1984). The detailed findings about reading comprehension in expert readers then also provided a point of reference for examining the strategies and processes of at-risk readers.

Reading strategies of at-risk readers in traditional print-based texts. A substantial research base has highlighted the struggles of students with reading disabilities and students considered at-risk readers. Struggling readers have limited declarative, procedural and conditional knowledge about specific reading strategies (Gersten et al., 2001; Gersten, Matropieri & Scruggs, 2003; Swanson, 1999). They do not seem to have a deep knowledge base of strategies to draw upon when reading (declarative), they struggle to employ the strategies they do have appropriately (procedural), and they have difficulty assessing under when and why they might employ a specific strategy when compared to skilled readers (conditional). For example, a

body of research examining the reading processes of students with disabilities reading expository texts revealed that students fail to recall information from the text, identify relevant from irrelevant information, ask relevant questions, recall vocabulary, make inferences, and summarize information (Baumann, 1984; Englert & Thomas, 1987; Johnson, Graham, & Harris; 1997; Scruggs, Mastropieri, Levin, & Gaffney, 1985). Furthermore, unlike skilled readers, students with disabilities fail to recognize variations in expository text structure and are therefore unable to apply specific reading strategies required for unique text structures (Englert & Thomas, 1987). At-risk readers also struggle in reading, as well as writing, with metacognitive and self-regulatory strategies necessary to select, execute, and sustain strategy use. They struggle to monitor their own thinking processes and to generate, monitor, and evaluate plans that might guide strategic processes (Englert et al., 1989; Gersten et al., 2001; Johnson, Graham & Harris, 1997).

In contrast to their peers, at-risk readers fail to learn key strategies for making sense of text without explicit instruction (Englert & Thomas, 1987; Conley, 2008; Gersten et al., 2001; Williams, 1993; Williams, 2003). However, promisingly, when students are provided with explicit strategy instruction targeting content area text they have the ability to learn and apply reading strategies and self-regulatory strategies thereby increasing their performance in content area literacy tasks (Baker, Gersten, & Scanlon, 2002; Duke & Pearson, 2002; Edmonds et al., 2009; Englert et al., 2008; Englert, Wu, & Zhao, 2005; Gajria, Jitendra, Sood, & Sacks, 2007; Gersten et al., 2001; Mastropieri & Scruggs, 2001; Pressley, 2000; Wong et al., 2003). In science specifically, research endeavors like Concept-Oriented Reading Instruction (CORI) (Guthrie, Mcrae, & Klauda, 2007), Seeds of Science – Roots of Reading (Seeds & Roots) (Pearson, Moje, & Greenleaf, 2010), and Guided Inquiry Supporting Multiple Literacies (GIsML) (Palincsar,

Magnusson, Cutter & Vincent, 2002; Palincsar, Magnusson, Marano, Ford, & Brown, 1998), have consistently demonstrated the importance and effectiveness of teaching literacy strategies integrated within the science curriculum for all students, including at-risk readers (Guthrie et al., 2007; Palincsar & Magnusson, 2001). To date though, the largest body of research specifically addressing content area reading processes and strategies has focused on print-based, not online texts. While this can inform research related to online reading comprehension, there is a need for new research agendas examining reading comprehension on the Internet.

Reading strategies in Internet hypertexts. With the increasing proliferation of Internet-based reading, Afflerbach & Cho (2009) have extended the model of Constructively Responsive Reading to incorporate the strategic process that expert readers employ when reading online. While there are many strategies that are common among both print-based and hypertext reading, there are also new strategies that are specific to reading on the Internet. Again, the model integrates strategies before during and after reading. The model also continues to incorporate three original organizing groups, but adds an entirely new category: 1) identifying and learning text content, 2) monitoring, 3) evaluating, and 4) realizing and constructing potential texts to read. The additional category of realizing and constructing potential texts include numerous strategies related to locating and finding webpages to read, including using search engines, hyperlinks, menus, and built-in search tools. In essence, these strategies merely help a skilled reader navigate to a site where they hope to gain meaning that aligns with their reading goals, the act of locating information. The steps immediately following the location like reading, viewing, and listening to the text presented on a webpage is still encapsulated under the category of identifying and learning text content.

The following is only a sample of the complex strategies that expert readers might engage before, during and after reading on Internet-based texts. Common to both traditional and hypertext, expert readers set reading goals prior to reading. In a search for texts relevant to the goal, they might use search engines employing a key word search, revise search terms, examine webpage menus, and select menu links or hyperlinks. Prior to reading any webpage, expert readers might evaluate the credibility and reliability of websites based on their inferences from search engine results (ex. entry titles) or URLs (ex. .com vs. .edu). During reading, students engage in strategic processes of making meaning from the text. In Internet-based texts readers might use the minimal textual information in or related to hyperlinks to gain meaning. For instance, they may read short descriptive entries on the search engine results under the titles, a series of links, groups of menu links, or descriptions in mouse-over text to gain meaning. Skilled readers then also engage in constructing meaning from within webpages themselves. They continue to engage many strategies and processes evident in traditional print-based texts like activating prior knowledge, adjusting their understanding, identify main ideas, seeking vocabulary/key words, asking questions, and making inferences. However, they also examine the organizational structures of websites, use web searches to continue or extend reading toward the goal, and synthesize information from print, images, videos, tables, and other visual or auditory modalities. Skilled readers construct meaning from within and across websites using non-linear linking, back browsing, and searching. Throughout the process, they are monitoring their reading path, their understanding, and their progress toward the goal. For instance, skilled readers change search engines and key words while reading, examine hypertext organization and structure in determining whether sites are helpful in working toward the goal, and monitor for overload of information. While monitoring, they also evaluate the specific webpages or website

as a whole in consideration of the reading goal and the results of a navigational move in a search for information (ex. clicking on a link). After reading, skilled readers may revisit webpages to reread, expand their search beyond the specific reading goal to related yet extraneous information, and save Webpages or information from a page (ex. bookmarking, clipping). They continue to monitor their overall comprehension and progress toward the goal and evaluate the webpages, websites, and the effectiveness of their search overall. Overall, the readers continue to engage in constructively responsive reading, but the process is now characterized more dramatically by the non-linear processes of searching and reading, the rapid cycles of searching for webpages with high levels of inferencing from minimal textual information, the highly intertextual meaning making within and across webpages, and the integration of multiple modes of information.

The Constructively Responsive Reading model provides a theoretical framework for methodological decision-making in this research. In particular, the depth and specificity of strategies emerging from the model offer a foundation for the deductive coding schemes in the data analysis process. While the model provides an excellent foundation for examining readers' strategies, another relevant framework provides an alternative perspective and related body of research for examining online reading comprehension. It is commonly referred to as the new literacies of online reading comprehension and will be examined in the following section beginning with an overview of the new literacies perspective and transitioning specifically into the research findings emerging about students engaging in the new literacies of online reading comprehension (Leu et al., 2004).

Reading Comprehension: New Literacies of Online Reading Comprehension

A new literacies perspective provides an additional lens for examining online reading comprehension. A new literacies perspective also advances the idea that reading and comprehending online texts naturally draws on some of the skills and strategies necessary for offline, print-based reading, but acknowledges there is also an entire set of novel skills, strategies, and dispositions that students must master to effectively read and comprehend online texts (Duke & Carlisle, 2011; Leu, Zawilinski, Castek, Banerjee, Housand, Liu, & Oneil, 2007). There are numerous definition for the new strategies and skills necessary for reading, writing, and communication on the Internet (e.g., digital literacies, ICT literacies, informational literacies) and each has been framed from a unique theoretical perspective and field of study, yet among the numerous definitions a set of four commonalities has emerged (Coiro et al., 2008). These four commonalities also inform this research.

First, new technologies require new social practices, skills, strategies, and dispositions if they are to be used effectively. It is this first claim that justifies the importance of researching online reading comprehension, given that relatively little is known about online reading comprehension in general and even less is understood about online reading comprehension for students with disabilities (Castek et al., 2011). Second, new literacies are key foundational components to civic, economic, and personal participation in a global community. Therefore, understanding how students read online texts and what strategies are essential to effective online reading comprehension will inform instruction, ensuring that students with disabilities are equipped with the strategies and dispositions necessary to engage fully and actively in a digital world (Castek, Zawlinski, McVerry, O'Byrne, & Leu, 2011). Third, as new technologies continue to change, so will new literacies. Fourth, new literacies are complex and multi-modal. The reality that new literacies are shifting, complex, and multi-modal justifies research informed

by multiple theoretical perspective and multiple methods to fully explore and understand online reading comprehension (Kulikowich, 2008; Livingstone, Van Couvering, & Thumim, 2008).

The new literacies perspective shapes the definition of online reading comprehension for this study. Leu et al. (2004) suggested that the *new literacies of online reading comprehension*:

> … allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others. (Leu et al., 2004, p. 1571).

Within the context of this study, *online reading comprehension* will refer to the following five practices: 1) identifying important questions, 2) locating information, 3) critically evaluating the usefulness of information, 4) synthesizing information to answer questions, and 5) communicating the answer to others (Leu et al., 2007).

Asking questions. As students prepare to read information on the Internet, they must begin by asking questions. The initial questions students formulate generate a purpose for reading online and begin to frame the parameters of online searching (Leu et al., 2007). The clarity and focus of the questions help guide students in the processes of locating and then evaluating digital text (Leu et al., 2007); thereby facilitating effective online reading comprehension. Students who search the Internet with a clear purpose or goal, articulated through appropriate questions, spend less time browsing and more time engaging in reading that is relevant to the topic at hand (Eagleton & Dobler, 2007; Henry, 2006; Wallace, Kupperman, Krajcik, & Soloway, 2000). However, many students struggle with generating a topic-appropriate question, reformulating a question when their initial question fails to generate a

reasonable answer, and recognizing that a single website may not provide a single, definitive "answer" to their question (Wallace et al., 2000; Bilal, 2000; Bilal, 2001).

Locating information. Locating information is crucial due to the staggering amount of information available on the Internet (Guinee, Eagleton, & Hall, 2003; Henry, 2006; Lawless & Schrader, 2008). If a student can not locate information, their overall ability to carry out the remaining functions of evaluating, synthesizing, and communicating findings effectively is nearly impossible (Henry, 2006). The sheer importance of locating information online has led Henry (2006) to call it the "gatekeeper" function, ultimately the key to successfully reading and comprehending information from the Internet.

Multiple strategies and processes must occur for student to successfully locate information. When asked to search for information, students must recognize what tools are available to initiate a search (e.g., search engine, social media platforms, etc.) (Leu et al., 2007). If starting with a search engine, students must decide which search engine to use and which key words or phrases to enter into the search engine (Guinee, Eagleton, & Hall, 2003; Henry, 2006). They must employ strategies to select from among the search engine results in an attempt to locate the most relevant information (Eagleton & Dobler, 2006; Henry, 2006). Furthermore, students must know how to adjust keywords or phrases when the initial search terms do not provide them with appropriate answers to their questions (Guinee, Eagleton, & Hall, 2003; Wallace et al., 2000). Students must then navigate through a maze of links and Websites, applying strategies for dealing with unique website organizational features, broken links, loops, multiple viewing windows, and distracting games and advertisements (Bilal, 2000; Coiro & Dobler, 2007, Henry, 2006, Leu et al., 2007). Students must also make inferences about where information is located

within the infrastructure of a webpage based on the available menus and links (Afflerbach & Cho, 2009; Coiro & Dobler, 2007; Leu et al., 2007).

Research has revealed that without instruction, nearly all adolescents struggle with strategies involved in locating information. In several studies (Bilal, 2000; Bilal, 2001; Hirsh, 1999), students struggled with constructing search terms that maximized topic-relevant results, failing to use features built into search engines to increase search relevance (e.g. Boolean operators, advanced searches, prioritized results lists). Upon receiving search engine results, students were quick to click, but slow to read, choosing the first results on the page and then working their way down a the page one-at-a-time until they found a page they believed matched their search agenda (Henry, 2006). Research by Bilal (2000), also revealed that students frequently navigated inefficiently, spending extended time browsing or looping through websites in a manner that resulted in the failure to locate relevant information (Bilal, 2000). Students' relative success or failure at employing strategies related to locating information was dependent upon several contextual factors, including the type of searching task, personal interest or motivation in the task, prior knowledge about the topic, prior knowledge about searching on the Internet, and features of the search engine (Bilal, 2000; Bilal, 2001; Kuiper, Volman, & Terwel, 2005).

Although the research clearly reveals that adolescents struggle with the online reading comprehension skills of asking questions and locating information, intervention research demonstrates that when students are provided with strategies for locating online information, their ability to search for and find relevant information increased (Castek et al., 2005; Hoffman, Wu, Krajcik, & Soloway, 2003). This research demonstrates the imperative for teaching students strategies for locating information online and reveals that strategy instruction does

increase searching performance. This study further seeks to contribute to the literature base by examining detailed case studies of specific students, examining specific strategic processes, or a lack thereof, as they locate information within and across websites.

Evaluating information. Evaluating the information located is the next crucial component of online reading comprehension. After locating a source of information online, students must engage in evaluation at multiple levels. Students must evaluate: (1) their understanding of the information presented, (2) the relevance of the information to the search question or purpose, (3) the accuracy of the information, (4) the reliability of the information, (5) the bias that an author or organization infuses into the information (Coiro, 2007), (6) the coherence and completeness of the answer they are constructing as they synthesize information (Leu et al., 2007). Students' evaluation of informational sources online is critical due to the vast quantities of information available and the unregulated nature of the Internet. Evaluation is particularly relevant in science, a discipline that privileges accuracy and reliability.

The ability to evaluate the relevancy of search engine results and websites is a key factor in completing online searches in a time efficient manner. When comparing seventh-grade students who successfully completed an online searching task to students who failed, Bilal (2000) noted that the unsuccessful students were unable to quickly identify the relevancy of a search engine result or information on a webpage and they spent significantly more time browsing ineffectually. Compared to their peers who failed the task, students that appeared to be skilled at evaluation spent less time navigating and looping back to the search engine page and more time navigating and clicking links within websites themselves (Bilal, 2000). These findings were also supported by research from Wallace et al. (2000), who discovered that unskilled searchers spent nearly 70% of their time navigating search engine pages and only 30% of their time engaged

with websites that provided content. The results of these studies clearly demonstrate that evaluating search engine results for relevancy is crucial to completing tasks involving online reading efficiently.

However, simply evaluating the search results to find a potentially relevant website is only an initial step in reading online. Once students find the page, they must then examine the content and contextual clues on the webpage to determine if the site provides reliable information relevant to their search. Studies of secondary students revealed that while they had emergent strategies for evaluating reliability and accuracy, they tended to place high value in website appearance and the presence or absence of spelling and grammar errors (Agosto, 2002; Lorenzen, 2001). Furthermore, the very presence of a name or affiliation on the page was taken at face value for a sign of reliability or credibility; students did not expend time investigating whether the name or organization was real or reputable (Lorenzen, 2001). In another study, Leu et al. (2007) provided students with a hoax website entitled "Save the Northwest Pacific Tree Octopus". The result revealed that even when students were explicitly reminded not to believe everything they read on the Web, nearly 90% of the participants believed the website was credible and reliable. The consequences of the lack of evaluation strategies was evidenced in another study by Coiro (2006) who demonstrated that students' inability to accurately evaluate the relevance of information provided on websites led to excessive reading or browsing unrelated to the initial question or purpose.

Evaluating the coherence and completeness of an answer based upon the information compiled from online sources also appears to be a struggle for adolescents. Wallace et al. (2000) reported that students were unable to construct comprehensive answers because they were too focused on finding an immediate answer from a single source. Students appeared to be

skimming for the one page within a website for the definitive answer. The very fact that they did not know how to compose an answer from information on multiple websites, or even multiple pages within a single website, precluded them from even applying strategies that would allow them to evaluate the quality or coherence of an answer. The growing body of literature clearly calls for a more comprehensive examination of students' evaluation strategies with a more detailed examination of how the varying levels of evaluation, the nature of the online task, and student characteristics affect students' overall online evaluation skills. Based on these recommendations, this study will contribute to the current research base by uncovering how students evaluate their understanding of the information presented, relevancy of the information and coherence and completeness of the answer they are constructing.

Synthesizing information. Synthesizing information requires students to summarize and integrate meaning within sites and between sites (Leu et al., 2007; VanMeter & Firetto, 2008). Students construct meaning online based on the sites, pages, links, and features they choose to read (Hoffman et al., 2003; Leu et al., 2007). As a result, every student will create a distinctive path through the available online resources, thereby uniquely constructing, synthesizing, and comprehending information even when guided by the same original question (Leu et al., 2007; VanMeter & Firetto, 2008). When compared to synthesizing information from traditional, print-based texts, students that use the Internet as a major source of information must place even greater importance on synthesis. This is due in part to the vast quantities of information available online, the varying degrees of content coverage in the information presented, and the variety of modalities in which information is presented (Hoffman et al., 2008; Leu et al., 2007).

Unfortunately, the research about the synthesis of online information is extremely limited. Leu et al. (2007) contend that we know very little because researching how students

synthesize text, a task that occurs in the mind, is difficult. The research that does provide a preemptive glimpse at students' strategies for synthesizing information, demonstrates that as with the other online reading comprehension components, students struggle to synthesize online information into comprehensive answers or understandings. Wallace et al. (2000) reported that students did not seem to recognize that an answer might be synthesized from multiple sources. Instead, students looked for one right answer or one specific website that would provide all the information they were seeking. Research by Bilal (2001) and Wiley, Goldman, Graesser, Sanchez, Ash, & Hemmerich (2009) also confirmed the tendency for students to search for a "specific answer," either not wanting to put forth the effort to construct an answer from multiple sources or not recognizing that they could construct an answer from multiple sources. Based upon the limited research about the synthesis of online texts, it is evident that more extensive and rigorous research must explore students' synthesis of information during online reading tasks. This study seeks to address this gap in the literature, exploring at how students synthesize information when provided with a limited number of high-quality, reliable, and topic-appropriate websites as starting points.

Communicating information. Communicating information is the final component included in online reading comprehension and is included in a new literacies definition of online comprehension due to the interconnected nature of reading and writing on the Internet. Communication tools like chats, blogs, wikis, social network sites, email, and video conferencing are some of the tools that can be forums for disseminating information, but are also sources of information themselves (Leu et al., 2007, Leu et al., 2011). The Internet offers varying mediums of communication and degrees of interactivity within the communication process (Sweeny, 2010). There is a limited body of empirical evidence however about the

interconnected nature of communication integrated with the online reading process (Kuiper et al., 2005; Leu et al., 2007). This research seeks to examine the integrated nature of online reading with communication by exploring students' strategy use and navigational profiles as they read for the purpose of communication using Internet tools.

At-risk readers and the new literacies of online reading comprehension. Nearly the entire body of research into students' online reading comprehension strategies has included participants that are skilled or average readers in general education classrooms. Some research has examined the online reading comprehension skills of students labeled at-risk, and a handful of studies have examined the skills of students with learning disabilities (Castek, Zawilinski, McVerry, O'Byrne, & Leu, 2011).

Perhaps the most noteworthy finding emerging from research of online reading comprehension by students who are at-risk or labeled with a learning disability is the fact that "we should not assume that low achieving offline readers are necessarily low achieving online readers, or vice versa" (Leu et al., 2007). More specifically, the research revealed that some of the students that struggled with reading traditional text, either labeled with a disability in the area of reading or demonstrated reading levels significantly below grade level, were sometimes among the most proficient students at online reading comprehension (Castek et al., 2011; Leu et al., 2007). For example, Leu et al. (2007) profile "Thomas," a student with an identified learning disability who received support in reading, but who demonstrated successful strategies for locating, synthesizing, and communicating information, resulting in an online reading comprehension score that placed him within the top 15% of students in the study. While Thomas was "slow" at completing the tasks, needed extra time to decode and comprehend information, he was still strategic and successful in completing all of the online reading comprehension tasks,

except for evaluation. Conversely, some of the students that were the most proficient at reading comprehension in traditional printed or offline text faired poorly on measures of online comprehension.

These preliminary findings demonstrate that reading comprehension on the Internet does differ in some ways from reading comprehension in traditional print-based texts. These results are supported by another study in which Leu et al. (2005) reported that there were no significant correlations between students' online and offline reading comprehension performance. Consequently, the findings also establish that students with learning disabilities in reading, who perform poorly with reading comprehension in printed texts, may not necessarily perform poorly at reading comprehension in online texts.

This research is still in its infancy, and clearly there is the need for a better understanding of the online reading comprehension of students with learning disabilities. Additional research is needed to examine the correlations between online and offline reading comprehension. Whether they are correlated or not though, some specific academic weaknesses for students with learning disabilities exhibited in print-based texts will likely continue to affect online reading comprehension. For example, a student with reading decoding weaknesses in print-based text will probably still continue to struggle with decoding text on the Internet, as evidenced in the case of Thomas (Leu et al., 2007). Studies of assistive technologies designed to support struggling readers (e.g., see Anderson-Inman & Horney, 2007; Lange, McPhillips, Mulhern, & Wylie, 2006) suggest for example, that students with decoding difficulties will still struggle with decoding words whether they appear in printed text or online. However, these studies also point out that the Internet provides unique avenues for scaffolding struggling readers through accessible supported electronic text (Anderson-Inman & Horney, 2007). For example,

hyperlinks can provide pronunciations, definitions, synonyms, and examples for technical science vocabulary, images and videos can be presented with text to present information in multiple formats or enrich the words on the page, and text-to-speech readers can read the text aloud. Research has demonstrated that supported electronic text does increase students' academic performance (Anderson-Inman & Horney, 2007), but the majority of studies have focused either on student performance using a specific assistive technology (e.g., text-to-speech software, online graphic organizers) or on student performance in a controlled, closed-system website with particular supported eText features (e.g., hyperlinks with dictionary definitions). Yet, due to the ill structured nature of the Internet, every website will vary with the extent to which the text may be supported, and students expected to effectively read and comprehend on the Internet must flexibly adapt their reading process for every page they encounter (Spiro, 2004). Therefore, the field needs a deeper understanding of how at-risk readers and students with learning disabilities engage in online reading comprehension in open systems where students must adapt their reading processes according to the structure and support (or lack-thereof) on the websites they do encounter.

Ultimately, the new literacies framework of online reading comprehension and related empirical research provide a second substantive foundation for this research. They provide a rationale for a research agenda that examines at-risk readers engagement with online texts. They further operationalize specific components of online reading comprehension from a perspective beyond Constructively Responsive Reading. Most importantly, the new literacies framework and related research contribute to new methods for exploring online reading comprehension, which significantly influenced the design of this study.

Summary of Theoretical Frameworks

The frameworks of scientific literacy, social semiotic theory, Constructively Responsive Reading, and new literacies have provided a rich foundation for understanding and exploring the complexity of reading comprehension. As Livingstone et al. (2008) suggest, it is only through the convergence of multiple theoretical perspectives that research will understand the complexities of online reading comprehension, which is necessary if educators are to begin to support strategies for reading in this digital age (Livingstone et al., 2008). Together, these literatures have outlined (1) how reading is specific to the disciplines of science, (2) what constitutes science text, (3) the unique characteristics of online text, (4) the complexity of reading comprehension understood through the interactions of text, reader, and context, (5) the comprehensive and integrated strategic reading processes necessary for comprehension, (6) the components of the new literacies of online reading comprehension, and (7) the empirical research that examines the reading strategies and processes of skilled readers and their at-risk peers. They have provided a conceptual base that has informed both the design and methods of this research.

Current Study

As previously discussed, few studies have examined how students with learning disabilities engage in online reading comprehension in science. This study will contribute to the current research base in three specific ways. First, the study will uncover how at-risk and average-achieving readers locate, evaluate, and synthesize information found on high-quality, reliable, and topic-specific science websites that are incorporated into the general education science curriculum. The choice to preselect websites stems from the recognition that the body of research into new literacies has demonstrated that most students struggle to locate accurate,

reliable, and topic-appropriate websites. Yet, little research has identified how students actually locate, evaluate, and synthesize information within and across quality websites once they are found or provided for students (Leu, Zawilinski et al., 2007).

Second, the study will provide a new understanding of how specific contexts, texts, and reader characteristics shape online reading comprehension for students with and without learning disabilities, filling a hole in the research. This study will examine online literacy within the context of a complete science unit incorporated into the general education science curriculum. Specific attention will be paid to the varying representations of information on the websites and the nature of the science task itself. The study will also consider factors previously demonstrated to influence online reading comprehension in normally achieving students, including prior content knowledge, technology use at home and school, engagement, and self-regulation strategies (Coiro & Dobler, 2007; Leu, Reinking et al., 2007).

Third, the study will provide insight about how students construct meaning as they integrate information presented through multiple representations available on the Internet. The very nature of the Internet encourages students to construct meaning by navigating through a series of links, creating a unique path, or "traversal," through online text connecting words, images, animations, and sound (Lemke, 2002). Virtually nothing is known about how or why students create particular traversals through science websites during synthesis tasks. Therefore, the study will uncover how and why at-risk and average-achieving students construct the traversals they do, with an emphasis on the frequency, duration, and sequential construction of specific types of online representations.

Chapter Summary

Four literatures informed the conceptual framework and design of the current study:

scientific literacy, social semiotic theory, Constructively Responsive Reading, and a new literacies perspective. The convergence of knowledge from these literatures combined with the existing research about how at-risk and average-achieving readers engage in print-based and online reading comprehension, provide the grounding and rationale for the design and methods in this study. While a growing body of research is exploring online reading for skilled or average readers, there remains a lack of research about how at-risk readers engage in online reading comprehension. Unless there is a body of research about how struggling readers engage in online reading comprehension in content area classrooms that can inform and direct classroom interventions, they will be marginalized. The tragedy, as Leu points out, would be to allow students who may need the most preparation for the online age of information to be those who receive the least (Leu, 2007). Therefore, this study will help inform the field about online reading comprehension for at-risk and average-achieving readers in science classrooms, filling a gap in the research, and influencing a future trajectory of research.

CHAPTER 3

METHODS

Participants

Participants in this study included six ninth-grade students enrolled in a general education biology course. The participants (n=6) were sampled from a larger population of 51 ninth-grade students enrolled in one of the two general education biology classes offered Spring 2011 that included students with disabilities. Of the 51 students enrolled in the biology classes, only 25 students had the necessary student and parental consents to participate in the study. The following section will begin with descriptive statistics about the school, teacher, and the pool of 25 consenting participants. Next, it will outline the sampling procedures that led to the selection of the final six participants. Finally, it will provide descriptive statistics about the six participants.

Participants were enrolled in a large, public, suburban high school in the Midwest United States, which had a total enrollment of 1,325 students and 359 ninth grade students. The school population was 86% White/Caucasian, 8% African American, 3% Hispanic, 2% Asian/Pacific Islander, and 1% American Indian/Alaskan Native (National Center for Education Statistics, 2010). During the trimester of the study, participants were selected from two sections of general biology with a total of 51 students. Both classes were taught by the same female teacher, a teacher with 12 years of experience teaching science, a Master's of Education degree, and more than 30 hours of additional education in biology and science technology.

Of the original 51 students in the biology classes, 25 students and parents consented to participate. In the group of 25 students, 32% were male and 68% were female. The students' self-reported race/ethnicity was 80% Caucasian, 16% multiracial, and 4% African American.

Six students with disabilities received special education support in the biology classroom. One female and one male both had a specific learning disability in basic reading and reading comprehension and one additional female had a specific learning disability in mathematics calculation and reasoning. The remaining three students were all males and labeled with a disability in the category of Other Health Impairments. Within that group of males, one student had Individualized Education Program goals related to reading comprehension.

The Nelson-Denny Reading Test administered in the spring trimester of the study revealed the consenting population's (n=25) mean reading comprehension scaled score was 203.6 (SD=27.683), which converted into a grade equivalent of 12.133 (SD=4.37). The students' MEAP reading scores from the fall of the previous academic year revealed a mean scaled score of 825.52 (SD=25.469) with 34.00% of students receiving a score equivalent to advanced (PL=1), 50.00% scoring proficient (PL=2), 8.00% scoring partially proficient (PL=3), and 8.00% scoring not proficient (PL=4).

The following section describes the sampling procedures used to identify six participants from the potential pool of 25 consenting students. The research initially sought to sample two different groups of readers: (1) average-achieving readers, and (2) readers with learning disabilities in the area of basic reading or reading comprehension. However, while three students with learning disabilities in reading or reading comprehension consented to participate in online reading, note taking, and brochure creation, only one had consented to the second and more extensive level of participation in the study. The more extensive participation included students engaging in verbal protocols one-on-one with a researcher while they completed the research tasks and performed additional assessment measures. For this research, the verbal protocol data and additional assessment measures were of primary importance; therefore the research subgroup

that was to include three students with learning disabilities in reading, had to be expanded to include a broader range of at-risk readers, a process explained below.

Six participants were selected using data about special education services and two standardized reading assessments: the Michigan Assessment of Educational Progress (MEAP, 2010) and the Nelson-Denny Reading Test (Brown, Fishco, & Hanna, 1993). First, a pool of potential at-risk readers was established by including all students identified with a learning disability. Following this, students with Nelson-Denny reading comprehension scores at or below the 25th percentile compared to their 9th grade peers and with 8th grade MEAP reading scores falling below the normed level established as proficient, were included in the pool of at-risk readers. This process resulted in a potential pool of six students considered at-risk.

Next, a pool of potential average-achieving readers was established by identifying students with: 1) with Nelson-Denny reading comprehension scores between the 25th and 75th percentile compared to their 9th grade peers, and 3) with 8th grade MEAP total reading scores falling at or above proficiency. The identification resulted in a potential pool of 13 students considered average-achieving readers.

To form the final groups of low-achieving and average-achieving readers, three students were selected randomly from the at-risk pool and three from the average-achieving reader pool. This created two comparison groups consisting of three students each for a total of six participants.

Table 1 shows the demographics, disabilities, and standardized reading scores of the six participants. In the group of three average-achieving readers, there were two females and one male, all Caucasian. The spring Nelson-Denny reading comprehension scores ranged from 9.7 to

14.4 with scaled scores from 190 to 219. A Mann Whitney U test was used to determine whether the reading scores of the selected average-achieving readers were similar to the median of the sample of 19 students not selected as participants. The non-significant results of the test (z = -.432, p = .666) revealed that the average-achieving readers' Nelson-Denny scaled scores were similar to the median score of the larger sample of all students, and were thus appropriate to consider "average-achieving readers." On the 8th grade MEAP, one student achieved the level of proficient (PL = 2) with a scaled score of 822, and two students achieved advanced proficiency (PL = 1) with scaled scores of 839 and 844.

The at-risk readers included two females and one male, two who self-identified as Caucasian and one as Multiracial. Their spring Nelson-Denny reading comprehension scores all fell significantly below the mean of the full sample, with grade equivalent scores less than 5.9 and scaled scores less than 167. A Mann Whitney U test was used to determine whether the reading scores of the selected at-risk readers were significantly different from the median of the sample of students not selected as participants. The significant results of the test (z = -2.442, p = .015) revealed that the at-risk readers' Nelson-Denny scaled scores were significantly lower than the rest of the sample, and they were therefore appropriately identified as "at-risk readers" for the purpose of this research. The MEAP reading scores for two students fell below the level of proficiency (PL = 3, and PL =4) with total scaled scores below 784. However one student's scores was atypical of the other members of the group. Allison, who was included in the group because she had an identified disability in math but reading goals in the IEP, scored advanced proficiency (PL = 1) with a total scaled score of 839. However, further examination of prior standardized reading scores dating back two years, including the Nelson-Denny reading comprehension scores administered in the fall of her 8th and 9th grade year, revealed a pattern of

lower reading scores than her peers. Her Nelson-Denny reading comprehension scores in the fall of her 8th grade year fell below the 15th percentile of all 8th grade students at her school, and her scores at the 9th grade year fell below the 20th percentile of all 9th grade students at the school. A Mann Whitney U could not be used to examine significance due to the loss of students' individual standard scores in the school's database of Nelson-Denny scores. Based on the data available though, Allison's performance on her 8th grade reading scores appears to be an anomaly and the decision was made to continue to include her in the at-risk group.

Table 1. Participant Demographics, Disability, and Standardized Reading Scores

	Gender	Ethnicity	Disability*	ND Read. Comp.**		MEAP Read.***	
Student				SS	GE	SS	PL
Average-achieving							
Hannah	F	Caucasian	n/a	190	9.7	844	1
Leanne	F	Caucasian	n/a	212	13.5	839	1
Adam	M	Caucasian	n/a	219	14.4	822	2
At-Risk							
Tameca	F	Multiracial	LD Reading	146	4.1	772	4
Levi	M	Caucasian	OHI	153	4.1	784	3
Allison	F	Caucasian	LD Math	167	5.9	839	1

*LD Reading= Specific Learning Disability in Basic Reading and Reading Comprehension; OHI = Other Health Impairment; LD Math = Specific Learning Disability in Math Calculation and Computation

** ND Read. Comp. = Nelson-Denny Reading Test Comprehension Scores for Spring 2012; SS = scale scores; GE = grade equivalent

***MEAP Reading = Michigan Educational Assessment Program Reading Scores 2010; SS = scale scores; PL = proficiency level

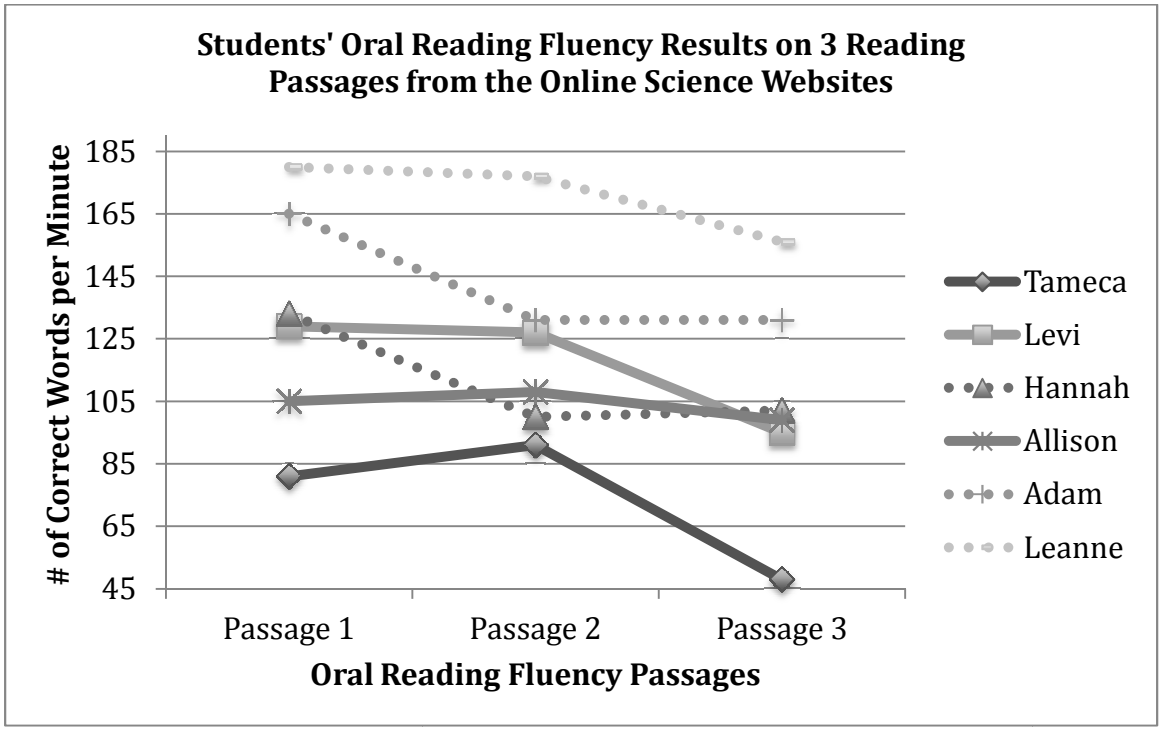
Figure 1 reveals students' oral reading fluency scores. Although the data for oral reading fluency was measured as part of the research, but not gathered prior to the research, the results will be reported here because they provide highly relevant information about the individual students' reading levels in a study where reading was the primary task. The oral reading fluency scores for the average-achieving readers ranged from 100 to 180 words per minute over three passages. The oral reading fluency rate for 9th graders at the 50th percentile is expected to be 151 correct words per minute (Hasbrouck & Tindal, 2006).

Among the average-achieving readers, Leanne had the highest oral reading fluency (156 to 180 wcpm), Adam had the second highest oral reading fluency (131 to 165 wcpm), and Leanne had the lowest oral reading fluency (100-133 wcpm). Leanne's oral reading fluency scores placed her, on average, between the 50th and 75th percentile; while Adam's scores placed him between the 25th and 50th percentile. Leanne's scores fluctuated around the 25th percentile (124 wcpm) sometimes above and sometimes below.

Among the at-risk readers, Levi had the highest oral reading fluency rate (95-129 wcpm). His scores were relatively similar to the lowest average-achieving reader, Leanne, placing him just above to just below the 25th percentile (124 wcpm). Allison had the second highest rate among the at-risk readers (99-108 wcpm), placing her between the 10th (97 wcpm) and 25th percentile (124 wcpm). Tameca had the lowest oral reading fluency rate (48-91 words) placing her below the 10th percentile. While reading passages from the UCSB and MBG websites, Tameca's scores fell within approximately 20 words read correctly below her peers, with the third WC passage proved significantly more challenging. Passage three had the greatest density

of word difficulty and the highest number of multisyllabic science terms and the highest average Dale-Chall word level per page (see Table 2). On this passage Tameca had a dramatically lower oral fluency rate (48 wcpm) than the student with next lowest score (95 wcpm), a fact that holds relevance for her actual online reading performance on the day of online reading with a verbal protocol.

Figure 1. Oral Reading Fluency Results for Students in the VP Condition



Design

An embedded mixed-methods design was used in this study, in which both quantitative and qualitative data were analyzed with the purpose of enhancing and enriching findings (Collins, Onwuegbuzie, Sutton, 2006; Creswell, Plano Clark, 2011). This was relevant for the study because quantitative analysis of several sources of data provided results about factors that may influence online reading comprehension (e.g. oral reading fluency, self-efficacy about

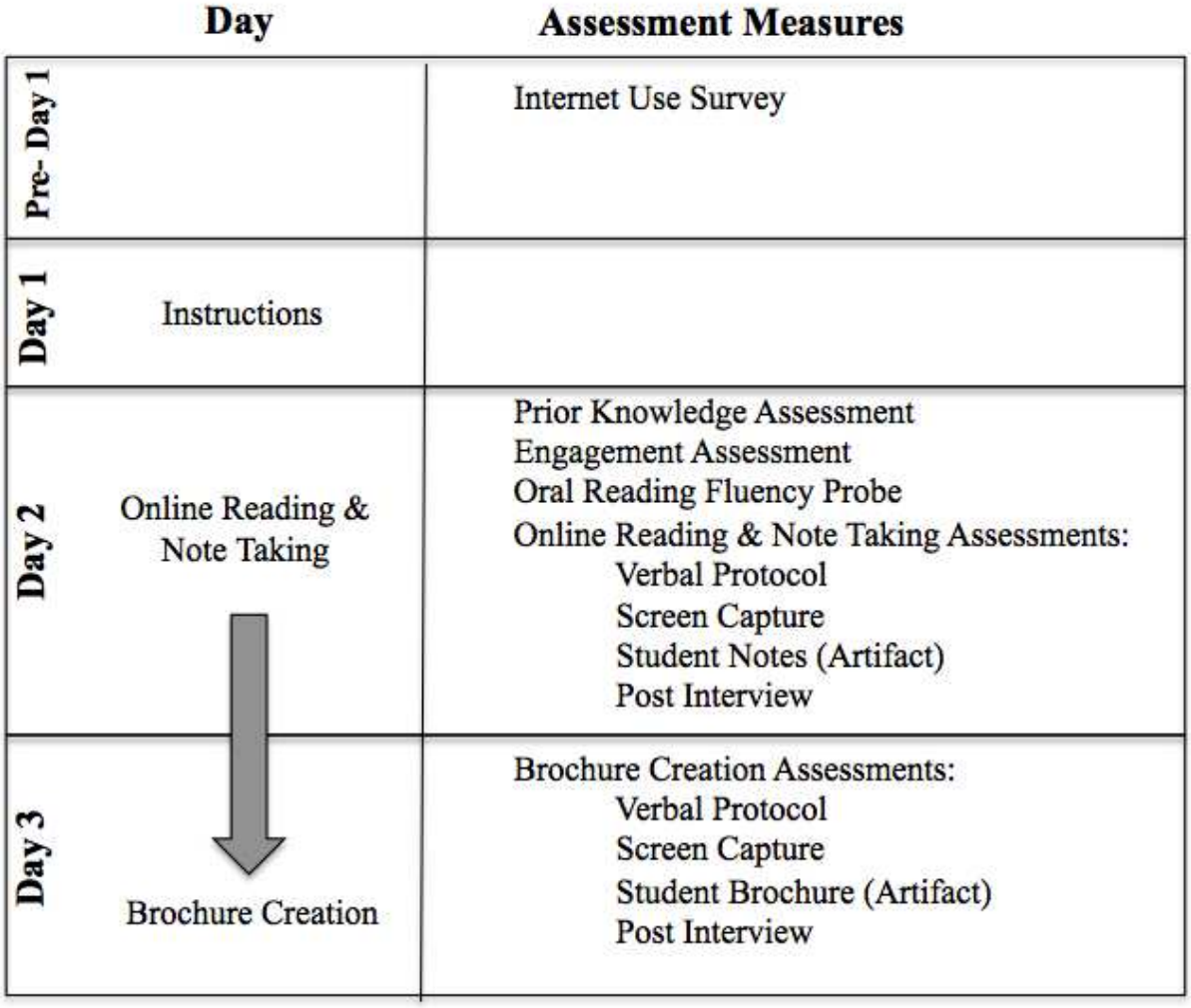
Internet skills, etc.) and information about navigational profiles, but did not provide a lens for examining students' cognitive processes. An understanding of students' cognition as they read, select, evaluate, and synthesize online information was achieved by adding a qualitative verbal protocol component to the research (Afflerbach, 2000). Therefore, it was the combination of quantitative and qualitative data that supported a comprehensive examination of students' online reading processes while also examining diverse contextual and individual variables that influenced online reading comprehension (Afflerbach, 2000; Deshler, Hock, Ihle, & Mark, 2011).

The design incorporated the use of multiple assessment measures. An overview of the procedures will be provided first to offer a context of the study as a whole; then detailed descriptions of the procedures and measures will follow. Prior to the start of the study an Internet Use Survey was administered to students. A week later, students engaged in a three-day project of online reading, note taking, and creation of an informational brochure for tourists about a specific terrestrial or aquatic biome.

On Day 1 of the 3-day project, students received instructions from the teacher. On Day 2, students were administered an oral reading fluency probe, an assessment of prior knowledge, and an assessment of engagement in the topic. They then observed a sample verbal protocol and practiced a verbal protocol for five minutes. For the next 20 minutes, students engaged in a verbal protocol while reading about their biome online and taking notes. Day 2 concluded with a post-interview about their online reading and note taking. On Day 3, students engaged in a verbal protocol while creating their brochure. They were still allowed to read online and take notes if they chose, but they were instructed to begin the brochure. On both Day 2 and 3, a screen

capture software recorded student's actions on the computer. An overview of the measures is depicted in. These will be described in the section that follows.

Figure 2. Overview of Study Measures by Day



Procedures and Assessments for the Research Project

In this section, the Internet use survey, which was administered prior to the start of the main study, will be introduced first. This will be followed by specific procedures and assessment measures outlined by day of administration. Next, the methods section will outline procedures that ensured the fidelity of implementation for the administration of the verbal

protocol during the online reading task, selecting the two science websites, and ensuring comparable classrooms. The section will conclude with the data analysis procedures.

Preassessment: Internet use survey. The Internet Use Survey was administered at the start of the study and subsequent online reading comprehension task (See Appendix B). It was administered prior to the final selection of the six participants, therefore all 25 students that consented to participate in the research took the survey. The survey measured students' Internet use characteristics at home and school, self-efficacy about their Internet skills, and their online reading comprehension skills. The survey was adapted in part from surveys created by the Pew Internet & American Life Project (http://pewinternet.org/) and surveys created by Leu, Reinking et al. for the project Teaching Internet Comprehension to Adolescents. Measuring students; Internet use characteristics, perceived self-efficacy about their Internet skills, and their online reading comprehension skills was relevant because research must explore how online reading comprehension might be influenced by these factors (Coiro & Dobler, 2007). Therefore, collecting data about these variables provided a foundation for contextualizing the research results to specific profiles of students.

The subsection of the survey that assessed Internet use explored students' perceived use "at school" and "outside of school." Three multiple choice questions asked students to report how many total hours per week they spent on the Internet, the technology tool they are most likely to use to access the Internet, and whether they preferred to gain new information from a book or the Internet. These were followed by eight likert-scale questions in which students were asked to report how often they engage in certain online tasks (e.g., work on school-related assignments, Facebook, watch or post videos, etc.). They six point scale ranged from never to *10 or more times a* day. The three multiple choice and eight likert-scale questions were first asked

about students Internet use “at school” and then the same questions were asked in the next portion of the survey about students Internet use “outside of school.”

The next subsection of the Internet use survey examined students’ perceived self-efficacy on certain Internet tasks. Six likert-scale items asked students to rate how good they were at specific tasks (e.g., I am good at using the Internet to find information for school assignments and projects, I am good at reading and understanding information on the Internet, etc.) on a five-point scale ranging from *not good at all* to *extremely good*.

The subsection of the survey that assessed basic online reading comprehension skills included four multiple choice questions and one short-answer question associated with one of the multiple choice questions. The short-answer questions examined whether students could identify the best options on a website menu for certain tasks (e.g., what to click on to find out who created the website), identify what a software pop-up prompt was telling the student to do, and which website from a list of search engine results would be best for writing a report about a topic. The short-answer questions asked students to justify why they choose a specific search engine result for writing a report. The five questions combined were a very basic pre-assessment of some of the necessary skills for successful online reading comprehension.

The teacher administered the Internet use survey to all students that consented to participate in the research during class time seven days prior to the start of the main study. The teacher read each item aloud as students completed the survey to support students that may have had difficulty reading the text. Students then received an additional five minutes to review their answers and to allow individual students to ask for a section or question to be reread.

Day 1: Introduction to the research project. On Day 1, the teacher presented the assignment, the rubric, and examples of brochures from previous years to both biology classes.

For both classes, the teacher presented the same directions about online reading and brochure creation both visually and orally. Appendix D provides the teacher script for Day 1, but due to difficulty obtaining the laptop cart, the instructions were responsively revised during the class period to reflect the reality that online reading and note taking would not begin until the following day. During the instructions, the teacher informed students which biomes they were assigned. The biomes were randomly assigned for all students in the class except for the six participants in the research condition (n=6), who were assigned the rainforest biome. The majority of the instructions focused on the brochure rubric used to guide students' construction of the brochure (see Figure 3). The teacher used student brochures from previous years to provide examples for each of the subcategories in the rubric. Using the Elmo projector, she displayed 2-3 student examples from previous years for of each "informational requirements" on the brochure rubric.

Figure 3. Travel Brochure Rubric for Students

TRAVEL BROCHURE MINI-PROJEC

Directions: Create a brochure that teaches people about your biome and entices them to visit your biome. Use the table below to complete the requirements for the brochure. Use color, pictures, and creative font choices to enhance your brochure.

My Biome: _____

Informational Requirements:	Self-Check:	Teacher Comments & Feedback:
Climatic (weather) and Seasonal Information for your biome		
Map of where your biome is located in the world		
Plants in your biome		
Animals in your biome		
Items tourists should pack if they visit your biome		
Activities tourists might do while they visit your biome		
A website tourists might visit to learn about your biome		
Design Requirements:		
Your brochure is organized and neat		
Your brochure includes a combination of words and images		
Your brochure is creative		

On Day 2, the students were told that they were only allowed to read online and take notes. They were not allowed to start the brochure until Day 3. Furthermore, students were informed that, on Day 2, "You must take notes. You are allowed to take notes in whatever format you prefer. You may take notes on paper, in Microsoft Word, in Evernote, or any other manner you choose."

Next, the teacher demonstrated how students could access their "starting website." The starting website was researcher-created and listed three high quality, reliable biomes website links that the teacher recommended students use to begin their search. There were two starting websites (A and B) that each included the same three biomes websites, but they were counterbalanced for order. So students in group A saw the websites listed in a different order than students in group B. The researcher randomly assigned students to group A and B prior to Day 1. During Day 1, the teacher demonstrated how students could find their specified starting website on the class website. The teacher informed each class, "I recommend you start with these websites that have reliable and appropriate content. You can find most of the informational requirements on these websites. You may use other websites if you need to find additional information." Finally, the teacher provided each class with 10 minutes to individually walk around the room and examine brochures from the previous year.

Day 2: Online reading and note taking. The task of online reading and note taking began on Day 2. Each student worked one-on-one with a researcher for the entirety of Day 2. The following section will introduce the measures and procedures chronologically. It will begin with the oral reading fluency, prior knowledge, and engagement measures. Then it will introduce the online reading and note taking with the verbal protocol and screen capture. It will end with the post interview measure.

Oral reading fluency probe. Students' ability to read is an important concern of the research, and oral reading fluency is a common measure used to gather information about students' overall reading competence (Fuchs, Fuchs, Hosp, & Jenkins, 2001). Therefore, a measure of oral reading fluency was given to the participants in the verbal protocol condition to acquire information about their reading skills. The oral reading fluency measures, administered prior to the online reading and note taking task, were conducted based upon research-based recommendations (Fuchs, Fuchs, Hosp, & Jenkins, 2001). The recommendations supported the use of curriculum-based measures of oral reading fluency to identify differences between readers and their peer groups. They suggested assessment with multiple texts each administered at one-minute intervals.

Initially, the oral reading fluency measures were to consist of two randomly selected sections of text from the three preselected websites, for a total of six . First, the researcher assigned numbers to each page within the preselected websites. In the case of the University of California Santa Barbara (UCSB) site, that was one long page, each heading was assigned a number. The researcher then used a process of random selection to identify webpages. In examining the randomly selected webpages, the text on the page had to range from 200-255 words. Two hundred was established as the minimum word level based on the oral reading fluency norms established by Hasbrouck and Tindal (2006) which revealed that in the spring of 8^{th} grade, students in the 90^{th} percentile of oral reading fluency were reading 199 words correct per minute. On the selected webpages, texts had to meet the minimum word count. Only one of the initial webpages on the Missouri Botanical Garden (MBG) website was rejected based on word count. The researcher then randomly selected one additional webpage and that page met the text requirements.

To examine the effectiveness of the oral reading fluency probe, a pilot assessment of oral reading fluency was administered with two eighth grade students prior to the research. The pilot revealed that students' oral reading fluency fluctuated dramatically as a result of the wide variety of reading difficulty, vocabulary, and word count on pages even within the same website. This fact, combined with the reality that pilot students reported being cognitively fatigued after the oral reading and even before the verbal protocol began, led the researcher to reduce the number of oral reading fluency texts from six to three, one from each of the three preselected websites.

On Day 2, researchers administered three oral reading fluency probes using standardized directions (see Appendix C). The oral reading fluency probes were counterbalanced by order across participants. Participants were timed for one minute per passage and the researchers or research assistants recorded the number of the total number of words read correctly per minute and the number of errors per minute.

Prior knowledge measure. Students' prior knowledge of a topic has been an individual factor that has influenced traditional, print-based reading performance as well as online reading comprehension (Coiro & Dobler, 2007; Ericsson & Simon, 1993; Pressley & Afflerbach, 1995). Therefore, Pressley & Afflerbach (1995) assert that methods that capture detailed characteristics of the subject are essential to the interpretation of the results. The procedures for measuring these variables and adapted for this study were based on procedures created by the Teaching Internet Comprehension to Adolescents Project (TICA), funded by the Institute of Education Sciences and led by principal investigators Donald Leu and David Reinking. In this study two questions were used to probe prior knowledge. Following the oral reading fluency probe on Day 2, the interviewer asked the student, "What do you know about biomes?" and "What do you know about the rainforest biome?" The interviewer continued to ask "What else do you know?"

and “Is there anything else?” until the students stopped responding to the open-ended question. The answers were recorded using an audio recorder and through researcher notes.

Engagement measure. Students’ personal engagement in a topic has been another individual factor that influenced print-based and online reading comprehension (Coiro & Dobler, 2007; Pressley & Afflerbach, 1995). A basic measure of personal engagement, based on students’ reported interest in the topic of the research, was developed based on procedures created by the Teaching Internet Comprehension to Adolescents Project (TICA). To quickly assess personal engagement on Day 2, the interviewer asked students, “How much does X interest you?” on a scale of 1-10, with 1 representing *no interest* and 10 representing *extremely high interest*. The answers were recorded using an audio recorder and researcher notes. These likert-scale ratings could then be compared across research participants.

Verbal protocol with screen capture. The following section will describe the rationale for using a verbal protocol and screen capture and then describe the procedures on Day 2 for the online reading and note taking with verbal protocol and screen capture (See Appendix C).

On Day 2, students were asked to think aloud as they completed the task of reading the three websites and constructing notes because verbal protocols provide valuable insight into students’ cognitive process as they read and construct meaning online (Kucan & Beck, 1997; Ericsson & Simon, 1993; Pressley & Afflerbach, 1995). Although verbal protocol protocols are an advantageous method for exploring online reading comprehension, there is a pressing methodological constraint that must be considered and addressed as it affects this study. Adding a verbal protocol component to the online reading comprehension task may affect any student’s performance due to increase cognitive demands and the interruption of reading processes as students pause to reflect on what, how and why they are reading (Ericsson & Simon, 1993;

Afflerbach, 2000). This effect on performance may be amplified for at-risk readers who already struggle with the cognitive demands of reading comprehension tasks. For these reasons, research employing verbal protocols have often focused on expert readers (Afflerbarch, 2000). However, by judiciously constructing the verbal protocol task and additional measures to minimize task interference, the potential contribution of verbal protocols to the study and to the field of special education will hopefully outweigh the constraints (Pressley & Afflerbach, 1995). The verbal protocol was limited to two prompts, described in detail in the next section, designed to minimize the cognitive demands to the greatest extent possible. The verbal protocol itself was limited to 20 minutes. The post-interview provided an opportunity for students to provide greater detail about their thoughts and actions after the online reading comprehension task was completed.

Combined with the verbal protocol was a screen capture software, Morae (Techsmith, 2011), designed to record all student actions on the computer screen. Screen capture software has become a particularly useful tool when examining students' actions in online environments (Asselin & Moayeri, 2010; Coiro & Dobler, 2007; Leu et al. 2008). The software captured students' actions down to every click, keystroke, and cursor movement on the screen. The screen capture software used in this study, Morae, also recorded audio. This allowed for in-depth analysis of verbal protocol responses aligned precisely with online actions. In an online environment, where multiple student actions can occur rapidly, the ability to return to the screen capture video and analyze the actions and verbal prompts provides data that is accurate to the second. Therefore, the use of Morae combined with the traditional literacy methodology of verbal protocols, enhanced the rigor of the study methods.

On Day 2, after completing the measures of oral reading fluency, prior knowledge, and engagement, the researcher prompted students to direct their attention to the text-to-speech reader (NaturalReader) positioned in the bottom right hand corner of the screen. The research or research assistant described the purpose of the text-to-speech reader, how it might support their online reading, and demonstrated how the text-to-speech reader worked. They then asked the student to demonstrate the use of the text-to-speech reader on two samples of text. Next, he students viewed an example of a verbal protocol (http://youtu.be/Ug6L_GvuMPE). The example reveals a 9th grade student solving an algebra problem while thinking aloud. Students then practiced engaging in their own verbal protocol for three minutes on a biomes website that was not used in this study (http://www.cotf.edu/ete/modules/msese/earthsysflr/biomes.html). Appendix C provides detailed instructions for the practice verbal protocol. The researcher or research assistants provided feedback to all students during the verbal protocol. A review of the audio recordings of each student's practice session revealed that all students received feedback in the form of the specific prompts listed for researchers in the detailed instructions (e.g., what are you thinking while you read this page, what are you thinking now). In addition, feedback beyond the suggested prompts included in the instructions included prompts about increasing the amount of verbalization during specific reading or navigational actions (e.g., tell me what you are thinking while you are scrolling over the menu, tell me why are you using the back button, what are you looking at on the page).

After the practice verbal protocol, student engaged in the online reading and note taking task with verbal protocol for approximately 20 minutes. The researcher or research assistants pointed students to the computers where their starting webpages were already open on the

desktop. The researcher or research assistant reread the directions provided on the students' brochure rubric on Day 1 (See Figure 3).

Students then began the online reading and note taking task. In the event students were not thinking aloud during the task, the researcher or research assistants used two specific prompts to promote thinking aloud (See Appendix C). First, student were prompted with, "Can you tell me what you are thinking?" when they were about to click on any link that would transfer them to new information (e.g. a new page, a definition, a video) or when they were typing information into a search box. If the researcher or research assistant was too slow anticipating the click, then the question was asked after the mouse click. The researcher also voiced the prompt if one minute had passed without verbal input from the student. Second, students were provided with a verbal prompt, "Can you tell me why you chose to write (type, or cut & paste) that?" when they were adding information into their notes. After 20 minutes, the research ended the verbal protocol and began the post interview.

Post-reading interview. The post-reading interview provided a series of retrospective questions designed to further examine students' online reading comprehension strategies and processes during their 20 minute reading and note taking session and to probe their knowledge of what "good" online readers would do. The interview included six questions, one likert-scale question and five open-ended questions. The first question asked students to rank their enjoyment of the assignment from 1 (*no enjoyment)* to 10 *(extremely high enjoyment)*. The first open-ended question asked students to describe how successful they were at the task. Two open-ended questions asked students to think about their day's online reading and respond to, "what worked best for you to find the information for completing your task?" and, "how did you decide which information was important to include in your notes?" Another open-ended question asked

students to look at the starting website and describe what strategy they used to start their search. Finally, one open-ended question probed students' predictions about skilled readers by asking, "what do good readers do when they are reading for information on the Internet?"

The post-interview questions were administered immediately after the online reading and note taking verbal protocol session. Answers were captured using an audio recording device and through researcher notes. The time students engaged in the post-interview varied based upon the depth of a student's verbal answers. However, at the completion of the post-interview, if there was time remaining in the class period, students were instructed to return to the computer and continue the online reading and note taking until the end of the task. They were informed that there was no verbal protocol, but that the screen capture would still be recording their actions on the computer. Four participants (Tameca, Hannah, Allison, and Adam) had time remaining to continue the online reading and note taking with screen capture only. Two participants (Levi and Leanne) did not have time remaining. The lack of time remaining at the end of the verbal protocol session for these two participants was due to time research assistants spent resolving minor technology issues with starting the screen capture software at the beginning of Day 2.

Day 3: Brochure creation. On Day 3, students resumed their work on the computer, beginning the creation of their informational brochure for tourists. Students continued to work one-on-one with a researcher while engaging in a verbal protocol with screen capture. The following section will introduce the measures and procedures chronologically.

Verbal protocol with screen capture. The initial research plan for Day 3 included no verbal protocol, just a screen capture, and at the end of the Day students were to engage in a post-interview for approximately 15 minutes (Appendix C, Section X). However, due to the loss of time on Day 1 when the laptops were not acquired, the researcher adjusted the plan for Day 3

to include the original post-interview questions into a loose verbal protocol during the class period to ensure that all students would at least begin the brochure creation within Day 3. The researcher informed the research assistants to use the post-interview questions as prompts during the students' work on Day 3. Research assistants were not to prompt students in the first 10 minutes, a time limit reinforced by setting their timers when the student began working. After 10 minutes, they were asked to select points during the student's brochure construction that they felt appropriate for the question. For example, when adding a picture or graph to the brochure, asking, "Can you tell how you decided which pictures should go in the brochure?" Researchers were instructed to maintain a minimal engagement with the student to minimize the cognitive load devoted to the verbal protocol on Day 3. All student work on the computer continued to be recorded using the screen capture software Morae.

Students worked for approximately 50 minutes on Day 3 using the computers, with the exception of Adam who finished everything in 46 minutes. The researcher and research assistants reread the directions at the top of the brochure rubric to students (see Figure 3), and instructed them to begin. Some students began with the continuation of online note taking and reading, while other immediately started constructing the brochure. All participants used either Microsoft Publisher or Microsoft Word to construct their brochure, therefore Morae was able to capture the online reading actions for all students during brochure creation.

Brochure and note taking artifacts. At the end of Day 3, the researcher copied all students' notes and brochure for data. All participants chose to handwrite their notes, so photographs of the notes were taken at the end of Day 3 to permit students to retain their notes for continuing work on their brochure at home. The saved files of all students' brochures were compiled at the end of Day 3.

Procedures for Training, Selection, and Fidelity

Training for the verbal protocol task. Training all research assistants to employ the verbal protocol assessment ensured the reliability of the administration of the measure. The training consisted of an initial 2-hour introduction and practice session with the researcher followed by one 2-hour period of trial verbal protocols with peers playing the role of students. During the trials, the primary researcher used a rubric to assess the research assistants' fidelity of implementation (See Appendix E). The research assistants engaged in subsequent trials with actual peers, until they reach 90.00% reliability.

Science website selection. The researcher selected three science websites that corresponded to the unit of study. Websites played a central role in the study as a form of science text, and choosing the specific websites was undertaken based on a detailed procedure that analyzed potential sites based on their content alignment with the biomes unit, reliability, readability, and visual qualities. First, the researcher and one research assistant executed a broad sweep of the Internet using Google, Bing, and two science education databases for quality websites to find websites that covered at a minimum all the terrestrial biomes in the classroom science unit. The search terms included *biomes, terrestrial biomes*, *aquatic biomes*, and the names of individual terrestrial biomes (e.g. *rain forests, tundra).* Websites were excluded if they covered fewer than all the terrestrial biomes or if they were specifically targeted at post-secondary or college students (e.g. Introductory Ecosystems lecture notes for undergraduates). The initial search resulted in a pool of 18 websites.

Second, the researcher reviewed the 18 websites for content validity, website reliability, and evidence of active website maintenance (e.g. last date of revision/update) and functional contact information (e.g., email address). In addition, the researcher analyzed the websites for a

reasonable degree of age-appropriateness for the 9th grade students, ruling out websites that were geared to early elementary students (e.g., cartoons and clip art), or websites that did not contain a sufficient depth of content coverage. Websites were also ruled out if they covered only terrestrial or only aquatic biomes. The analysis of websites yielded a final pool of 5 websites.

Third, the researcher randomly selected 5 pages from each website and calculated the readability level using the Dale-Chall readability formula, which also calculates for word difficulty, a necessity when considering the dense vocabulary of science expository text. The Dale-Chall was calculated on words that appeared in sentences or paragraphs on the page, since readability formulas are not well-designed to consider variations in text structures like expository text (Zakaluk & Samuels, 1996). The calculation did not include isolated words or phrases located throughout the page, which would decrease the Dale-Chall reading index. The reading levels ranged from below 5th grade, the floor of the scale, to 12th grade. The researcher eliminated websites if their average readability score across 5 pages was greater than a 9-10 readability range. One website exceeded the readability score with an average score of 11-12, and was eliminated.

Fourth, since the variability in the expository text and the presence of multimedia is highly relevant to this research, the researcher also counted the number of static pictures, dynamic pictures, maps/graphs, tables, lists, videos, audio (unassociated with video), and external links to provide a more complete portrait of some of the expository features of the webpages. Using this information, the researcher eliminated three additional websites. One webpage was eliminated due to its extremely linear presentation, with pages ranging from 2,082 - 8,729 words per page and an average of 5,227 words per page, and only 3 static pictures. The website resembled print text book pages, as if information was cut and pasted directly onto the site. Therefore, the

remaining three websites were valid, reliable, and content-specific with coverage of both aquatic and terrestrial biomes.

The final three websites represented various textual features within and across websites. This variability illustrates how online reading can vary dramatically from reading printed texts, and justifies the need to examine online reading comprehension. Every page within a single website may vary on multiple levels including word count, readability, quantity of specific types of multimodal representations of information, and links to outside webpages. The characteristics of the individual pages from the three final websites is presented below (See Table 2).

Table 2. Characteristics of Selected Websites

	Website Characteristics						
Website	Word Count	Dale-Chall GE	Pictures	Maps/ Graphs	Tables	Videos	External links
UCSB							
Pg. 1	169	9-10	3	0	0	0	8
Pg. 2	900	5-6	1	0	0	0	6
Pg. 3	889	7-8	2	0	0	0	6
Pg. 4	1486	7-8	3	0	0	0	5
Pg. 5	1009	5-6	4	0	0	0	5
MBG							
Pg. 1	155	7-8	2	0	0	0	0
Pg. 2	104	5-6	1	1	1	0	1
Pg. 3	319	5-6	6	0	0	0	0
Pg. 4	237	7-8	1	0	0	0	0
Pg. 5	132	5-6	5	0	0	0	0

Table 2 (cont'd)

Website	Word Count	Dale-Chall GE	Pictures	Maps/ Graphs	Tables	Videos	External links
WC							
Pg. 1	756	7-8	0	0	0	1	0
Pg. 2	765	11-12	3	0	0	1	4
Pg. 3	544	7-8	5	3	0	0	0
Pg. 4	205	11-12	0	0	0	0	0
Pg. 5	1540	7-8	0	4	0	3	0

Although variation occurred across pages within an individual site, each website can be analyzed and characterized as a whole. The three final websites selected for this research are analyzed below based on their organizational (structural) features, range of readability, range of word count per page, type and quantity of textual features, and external links.

The University of California Santa Barbara website (UCSB) (http://kids.nceas.ucsb.edu/biomes/index.html) is organized with a navigational menu on the left-hand side of the page that remains consistently visible across the pages (See Figure 4). Links to each of the terrestrial and aquatic biomes are then located at the bottom of the main "biome homepage," but are only present on this single page. The information on each specific biome (e.g., rainforest) is then represented on a long scrolling page, with shifts between categories of information distinguished by bold headings. At the top of the specific biome page (e.g., rainforest), there are within-page anchor links (e.g. location, weather, plants, animal) that direct a reader to a fixed position further down the page. Each specific biome page typically incorporates greater than 800 words per page. Pages range in readability from $5^{th}/6^{th}$ to $9^{th}/10^{th}$ grade. Most pages include a range from 1-4 static pictures. A large majority of pages include links to outside

sites, positioned at the bottom of each page on the site. The UCSB site includes more external links than MBG Net or the WC combined. There are virtually no maps, graphs, tables, lists, or videos on the UCSB biome pages.

Figure 4. Screenshot of the University of California Santa Barbara (UCSB) Website

Note: Text in the figure is not meant to be readable but for visual reference only.

The Missouri Botanical Gardens website (MBG) (http://www.mbgnet.net/) is organized with a series of three menus (See Figure 5). A fixed position menu at the top of the page remains visible throughout the website, and provides thumbnails of pictures that represent each specific biome. Once a biome is selected from the main menu (e.g. rainforest), a fixed vertical menu appears on the left-hand side of the page and remains visible as long the reader remains within the specified biome. The menu is specific to a single biome and the menu topics vary depending on the biome selected. Occasionally, a third subordinate menu appears on the left-hand side of the page, but located to the right of the fixed vertical menu. The sub-menu signals additional pages of information. For example, clicking on "Rainforest Plants" prompts a sub-menu of different plants. The multi-level organizational structure appears to support pages with limited printed text, with word counts typically less than 300 words. This is a significant variation from the UCSB website, which trends towards covering entire biomes on one long page. MBG tends to segment information into smaller chunks on each page. This creates a significantly increased number of links readers must click on to continue reading information when compared to UCSB and the WC websites. The readability scores range from 5^{th} /6^{th} to 7^{th} /8^{th} grade. The pages rely on pictures ranging from 2-5 per page on average, with occasional maps, graphs, or tables, but with almost no links that direct readers outside of the MBG Net website.

Figure 5. Screenshot of the Missouri Botanical Gardens (MBG) Website

Note: Text in the figure is not meant to be readable but for visual reference only.

The Wild Classroom Biomes (WC) website (http://www.thewildclassroom.com/biomes/) authored by a non-profit orginazation with the mission to provide quality science websites for educators is organized with 4 menus (see Figure 6). A series of fixed menu links appear in tabs at the top of the page (e.g. Biomes) with a submenu are presented in a horizontal header line right beneath the tabs. Once within the Biomes unit, a small group of color-coded thumbnail pictures representing each biome represent a second menu that is fixed and present on every page within the biomes unit. A third fixed menu comprised of words is present on the left-hand side of the page, color coded to match the biome colors from the thumbnail pictures at the top of the page, also represents each biome. A fourth menu is a small group of white images in an oval of black background, sometimes accompanied by text, which is present on nearly every page, although it is not fixed and shifts location and size depending on the page. The website incorporates more maps, graphs, and videos than UCSB and MBG. The website also has the greatest fluctuation in readability level and word count from page to page within the site. Readability ranges from $7^{th}/8^{th}$ to $11^{th}/12^{th}$ grade and word counts vary dramatically with a low of 205 and a high of 1540. The WC is the only website that appears to still be in highly active development. Some links do not work and some sites are still under construction. Yet, the site is evolving from month to month and there are active users and site administrators working on the site. This is a contrast to UCSB and MBG Net, which appear to have reached a point of stability with limited updates.

Figure 6. Screenshot of the Wild Classroom Biomes (WC) Website

Note: Text in the figure is not meant to be readable but for visual reference only.

Comparable classroom conditions. To ensure that the two classrooms were comparable in relation to the online reading task, the researcher observed the instructor and classrooms in the website synthesis condition during the directions and then debriefed after the class period with a brief interview about the support provided during the class period. For the verbal protocol condition, the researcher captured all communication that occurred one-on-one between the researcher and the student using an audio recorder and the Camtasia voice capture. Subsequently, all conditions were compared with one another to ensure there were no anomalies between class periods.

Data Analysis

Data analysis proceeded in two major stages. The first stage involved data analysis that occurred prior to the main study. This included the analysis of data from the Internet Use Survey. The second stage involved data analysis that occurred after the primary study. The analysis involved both quantitative and qualitative analysis of the note taking and brochure artifacts, oral reading fluency probe, assessment of prior knowledge, assessment of engagement, verbal protocol, screen capture, and post-interview.

Analysis Prior to the Research Project

In the first stage of analysis, data from the Internet Use Survey was explored using descriptive statistics and univariate analysis. The data analysis provided descriptive statistics for individuals including frequencies and measures of central tendencies for whole class and individual data regarding: 1) number of hours spent on the Internet at school, 2) number of hours spent on the Internet at home, 3) specific type of Internet use at school with related frequency (e.g. frequency using search engines at school), 4) specific type of Internet use at home with

related frequency, 5) self-efficacy about using the Internet, and 6) online reading comprehension skills.

For the online reading comprehension skill component of the Internet use survey, the multiple choice answers were scored with 1 point for correct answers and 0 points for incorrect answers. A composite score was also calculated for each student's overall online reading comprehension score by adding the total points received on that section of the survey. The results of the survey data were also revisited during the second stage of analysis as a means for thoroughly characterizing the sample population and to support pattern seeking in the verbal protocol analysis.

Analysis After the Research Project

The second stage of analysis, completed after the online reading comprehension task, combined multiple analysis techniques. First, the following section will begin with analysis of the measures assessed on Day 2 prior to the beginning of the online reading task including the: assessment of engagement measure, assessment of prior knowledge, and oral reading fluency. Second, the section will examine the development of scoring measures and subsequent analysis of the note taking and brochure artifacts. Third, the transcription process for the screen captures and verbal protocols will be provided. Fourth, the section will examine the coding process and introduce coding schemes. Fifth, the section will examine the measures to ensure rigor and reliability in the data analysis process.

Engagement, prior knowledge, and oral reading fluency. The data from the Likert-scale engagement measure was analyzed using descriptive statistics. The data from the prior knowledge measure, which included the two open-ended questions, was coded by two raters based upon quantity and quality of idea units within each student's response. Each student's

answer was broken down into idea units. For example a student's response to the rainforest concept (e.g., rainforests "are ecosystems filled with organisms and plants") was broken into 3 idea units, denoted by the underlined sections. The total idea units were calculated for each student according to their prior knowledge about *biomes* in general and then about *rainforests*. Next, each idea unit was coded for quality from 0 (low) to 2 (high). A score of a 0 represented an inaccurate idea or an idea unrelated to biomes or rainforests (e.g. our ecosystem is a dominant forest). A score of 1 revealed an accurate idea related to either biomes or rainforest (e.g. birds live there). A score of 2 was reserved for idea units consisting of rich vocabulary or a mastery-level idea not stated by other students (e.g. canopy layer in the trees). The inter-rater reliability for the coding was 93.45%.

The oral reading fluency measures were scored and analyzed by three raters using a curriculum-based measure model (Fuchs et al., 2001) calculating the number of words read correctly per minute. Descriptive statistics were used to compare the ORF scores between students on each passage.

Note taking and brochure artifacts. Scoring measures were developed for the note taking artifact produced by the students on Day 2 and Day 3 (Appendix F). The scoring measures for note taking were adapted from note taking rubrics devised by Englert, Mariage, Okolo, Shankland, et al. (2009). The rubrics were designed to assess the specific component traits necessary for students to engage in the successful use of note taking as a strategy. The rubrics assessed five primary traits of note taking: (1) organization of notes, (2) breadth of content, (3) depth of content, and (4) reduction. First, *organization of notes* focused on the visual organizational features of notes including hierarchical structures and evident organizational patterns. Second, *breadth of content* addressed the coverage of main ideas encapsulated in the

notes. Third, *depth of content* attended to the coverage of relevant supporting details represented from the text. Fourth, *reduction* focused on the extent of summarization by identifying key ideas and meaningfully reducing the ideas into succinct phrases or words. Finally, the score of the five components were combined to create a composite score identified as *potential usefulness of tool*. The adaptations in the note taking rubric from those devised by Englert et al. (2009) were reviewed by Dr. Englert and one additional graduate student previously trained and experienced in content area literacy.

The rubric for each note taking trait ranged with scores from 1 to 5. Students demonstrating *Undeveloped or No Knowledge* received a score of 1. Students who revealed an *Emerging* but very limited knowledge of a particular trait of note taking received a score of 2. Students exhibiting a *Developing* knowledge of a trait, but not yet consistently proficient received a score of 3. Students who were *Mostly Proficient* and clearly demonstrated a trait consistently throughout their notes but still retained minor errors received a score of 4. Students who exhibited a sophisticated and *Highly Proficient* use of a particular trait consistently throughout 100.00% of their notes received a score of 5. The researcher and one graduate student each trained using the scoring protocol scored 2 test students with an inter-rater reliability of 89.00%. The notes for students in the verbal protocol were then independently scored with an inter-rater reliability of 88.00%.

Scoring measures were also developed for the brochure artifact produced by the students on Day 3 (Appendix G). The scoring measures were rubrics informed by writing research and researchers who identified key components in writing or devised writing assessments (De La Paz, 1999; Englert et al., 2009; Harris, Graham, & Mason, 2003; Graham, 2006; Troia & Graham, 2002). The rubrics assessed five primary traits of the brochure: 1) content alignment

with the rubric, 2) depth and accuracy of content, 3) brochure organization and aesthetics, and 4) voice. *Content alignment with the rubric* examined the extent to which the brochure covered the required content components outlined by the teacher (e.g. climatic and seasonal information, map, plants, etc.). *Depth, accuracy, and cohesion of content* assessed the depth of supporting details within each category or main idea and whether they were cohesive as a group. It also considered the accuracy of those details. *Brochure organization and aesthetics* examined the organization of information within the brochure in consideration of the specific brochure text structure and the aesthetic appeal of the brochure. *Voice* assessed the students' use of a writing voice that was appropriate for the topic, purpose, and audience of the brochure. The final score was a composite total of the prior four scores to provide an *overall score*. The scores on the brochure rubric, ranging from 1 to 5, were exactly the same as those used on the note taking rubric described in the previous paragraph.

Screen capture and verbal protocol transcription. The six students' screen captures and verbal protocols were analyzed using qualitative methods. Initially, the data from the verbal protocols was transcribed. The process of transcription cycled through five iterative stages: 1) viewing the screen capture and recording student and research dialogue; 2) viewing the screen capture in 10 second increments and recording students' actions on the computer (e.g. opening new web pages, entering terms in a search engine, typing in the brochure) using a transcription code influenced by similar research (Coiro & Dobler, 2007; Cho, 2011); 3) refining the transcription code after a collective review of all students initial transcriptions (Table 3) ; 4) viewing the screen captures a third time in 10 second increments to review steps 1 & 2 for accuracy and to add time increments to each student action or dialogue. To assess reliability of the measure, a research assistant reviewed a randomly selected portion (20.00%) each

participant's screen capture using the transcription code. Inconsistencies were recorded for inter-rater reliability, discussed and revised. The inter-rater reliability was 89.40%. The most common inconsistencies were apparent in the recording of time, an inconsistency caused by the flow of each online action into the next. The Morae software allowed for precision of time identification to the tenth of a second, but the inconsistencies resulted from researcher decisions about action. For example, the researcher coded actions when students hovered over specific items on a page (menus, links) but did not click. In these cases discrepancies in start time were due to whether to start the time when the mouse began the scroll toward the item or when the mouse actually hovered over the item. While discrepancies like these may have been resolved with another step in the transcription process, the time necessary to do so was not feasible or necessary for the purposes of this research. Therefore, an acceptable range of time required a cushion of plus or minus .5 seconds at the beginning of an action or dialogue. Fifth, the researcher then reviewed the remaining 80.00% of the transcriptions while viewing the screen captures to revise one final time. For initial transcription, prior to coding, the data was parsed into the smallest units of action or dialogue (e.g. 58:55 [closes the directories window by clicking on X], 58:56 [clicks on the IE icon at the bottom of the screen and opens the bat image website]). The parsing of units was revised at times during the coding process.

Table 3. Transcription Codes for the Screen Capture and Verbal Protocol Data

Code	Meaning	Example
minute:second	Start time of action or dialogue	2:45
R: S:	Speaker - R: researcher speaks Speaker - S: student speaks	S: Uh, I went to this one cuz it tells me the plants.
?	Speaker asks a question	S: How do you make this a little bigger?

Table 3 (cont'd)

Code	Meaning	Example
…	Omitted words	S: delete these and then…OK
-UN-	Undecipherable words	S: I think -UN-.
[ ]	Actions (activity on the computer, looking at the rubric, etc.)	[clicks on introduction in the left hand menu]
[notes]:	Writes notes - followed by the notes written on the paper	[notes]: Animals like to eat alot of fruit.
[types]:	Types into the brochure - followed by the words typed on Word or Publisher	[types]: and plants like Frogs/
[types " "]	Types into a search engine	[types "rainforest" in the searchbar]
italics	Icons in toolbars	[clicks on *Word* icon in the toolbar at the bottom of the page].
_____	hyperlink words hyperlink menu items hyperlink icon hyperlink image	[clicks on temperate oceans] [clicks on plants menu link] [clicks on MBG net icon] [clicks on rainforest image]

The final transcripts were then analyzed using descriptive statistics to examine: 1) number of websites visited, 2) number of webpages visited, 3) time per website, 4) time per webpage, 5) number of hyperlinks clicked, 6) the primary website that students used to collect information (TR websites or other websites), 7) time spent on the computer vs. time spent taking notes or other non-computer activities on Day 2, and 8) time spent on the Internet vs. time spent creating the brochure on Day 3. Webpages (e.g., individual pages within the MBG website) were distinguished from websites (e.g., MBG, WC) during the analysis to provide more detailed data about students' use of the Internet sources. For example, one student may have visited 12

webpages and all of those pages were within one websites, while another student may have visited 12 webpages, but they were within 4 separate websites. Although the students visited the same number of webpages, their use of the websites varied dramatically.

Furthermore, as qualitative coding began and themes and patterns emerged, additional descriptive quantitative variables were examined including: 1) the number of different types of hyperlinks students clicked on (e.g., menu links, non-menu links, etc.), 2) number of keyword searches in a search engine, and 3) number of single-step keyword searches (e.g., students located a result after their initial keyword search), and 4) number revised keyword searches (e.g., students revised their keyword before locating a relevant result). These quantitative results were used to triangulate and further enhance qualitative themes and patterns.

Coding process and schemes. Next the transcripts were coded using an abductive coding method employing constant comparison (Strauss & Corbin, 1998). The specific coding process was informed by similar coding procedures used in the analysis of verbal protocols of skilled readers in online environments (Coiro & Dobler, 2007; Cho, 2011). There were multiple steps to the coding process. First, the data were transcribed using prepositional clusters as the unit of analysis, with a decision and paired explanation functioning as the unit of analysis (Coiro & Dobler, 2007). The coding began with deductive codes derived from the current body of research. Two significant bodies of research established the initial foundation for coding. The coding drew on the extensive catalog of constructive Internet reading strategies, drawing upon an extended model of constructively responsive reading strategies (Pressley & Afflerbach, 1995). Next, the coding drew upon results from research about online reading comprehension stemming from work by the New Literacies Research Team (Coiro, 2006; Coiro, 2011; Coiro & Dobler, 2007, Leu, Zawilinski et al., 2007). Second, the transcripts were read two complete times to code

for deductive codes. The initial readings provided an overview of the data and revealed emerging questions and patterns. Third, the transcripts were read two additional times with the intention of adding emergent codes during iterative readings of each transcript. Fourth, a generative and iterative process of coding cycled through two to four additional stages of identifying idea units, applying and refining codes for idea units, searching for patterns and potential categories, coding categories, and refining categories through constant comparison (McMillan & Schumacher, 2009). During the process, a detailed catalogue of strategies was composed and these strategies were categorized into larger groups of strategies that ultimately became the primary coding scheme. The detailed catalogue provided a comprehensive list of strategies that also recorded which students used the strategy on Day 2 during the verbal protocol, Day 2 after the verbal protocol, and Day 3. The detailed catalogue informed the search for patterns and potential categories and supported the primary coding scheme. At the second and fourth stages of the coding process, the researcher collaborated with a doctoral candidate and the dissertation chair to critique emerging codes and patterns.

The primary coding scheme that emerged from the deductive codes drew significantly upon two initial frameworks. During the coding process, components of the frameworks were collapsed into one another. The two frameworks were (1) constructively responsive reading strategies for print-based and Internet texts, (2) the new literacies of online reading comprehension. Each framework's central constructs are reviewed below and then the coding scheme is explained. Constructively responsive reading strategies in traditional and Internet-based reading included 1) realizing and constructing potential texts to read, 2) identifying and learning text content, 3) monitoring, and 4) evaluating. The new literacies of online reading comprehension as defined by Leu et al. (2007) incorporated 1) identifying important questions,

2) locating information, 3) critically evaluating the usefulness of information, 4) synthesizing information to answer questions, and 5) communicating the answer to others (Leu et al., 2007). Within the new literacies of online comprehension, a subset of research that focused on self-regulatory strategies while engaging in locating and evaluating information became integral to the coding as well. Coiro & Dobler (2007) suggested that self-regulatory strategies might play a more significant role for students engaging in reading in online texts than in print-based texts due to the many choices they must make when locating online texts. From their research, they highlighted 4 self-regulatory strategies that were evident within online reader's profiles: planning, predicting, monitoring, and evaluating. While Coiro & Dobler's (2007) work was the primary influence of self-regulatory strategies used in the deductive coding, additional research related to self-regulatory strategies was utilized to flesh out additional strategies that have been documented in a variety of literacy tasks (De La Paz, 1999; Harris, Graham, & Mason, 2003; Graham, 2006; Massey, 2009 in HRRC; Palincsar & Brown, 1984). The following section outlines a brief summary of the codes, both deductive and emergent, which are outlined in more detail in Table 4.

Primary Coding Scheme

Online reading strategies.

1. **Realizing and constructing potential texts to read [RC]** involves strategies necessary for searching and locating information using the Internet. This code subsumes the new literacies of online reading comprehension concept of *locating information*. All strategies related to RC involve the actual location of information using web tools (e.g. search engines, browser buttons, hyperlinks, etc.), the navigation required to find information, but do not incorporate strategies

used to gain meaning from the text. The strategies related to RC influence the construction of students' reading paths, or traversals, while searching for information online.

2. Identifying, evaluating, and constructing meaning from text [IECM] involves strategies necessary for constructing meaning from the text. These include a wide range of strategies used before, during, and after reading to comprehend the text, whether it is print-based or on the Internet. The Constructively Responsive Reading construct *identifying and learning text content* and the new literacies constructs of *identifying important questions, evaluating the usefulness of information,* and *synthesizing information to answer questions* were subsumed under identifying, evaluating, and constructing meaning as they also incorporate various strategies necessary for learning text content.

Online communication strategies: Brochure creation.

3. **Publishing content [PC]** includes strategies necessary for the communication and publication of ideas for an audience. The variety of formats for communication are inclusive of multimodal formats (visual, oral, auditory) and thus include information that was typed, written, video taped, photographed, recorded, etc. Modes of communication, like note taking or generating graphic organizer while gaining and constructing meaning for one's own self, are not publishing content strategies because the content is not disseminated to an audience. In this study, Publishing Content incorporates strategies used in the construction of a final product, the brochure. The new literacies construct incorporated into this code is *communicating the answer to others*.

Landscaping strategies.

4. **Landscaping the screen [L]**, an entirely emergent category, includes strategies that alter the aesthetics or arrangement of elements on the screen of personal technology devices

(computers, laptops, phones). Landscaping strategies are not those that occur when students are directly constructing or communicating meaning, but are rather peripherally associated to the construction of meaning from a text or the communication of meaning. For example, prior to use a search engine for the purposes of finding information, a student may alter the theme, page style, or size of font on the search engine or they may personalize the search engine by adding a unique icon or personal picture to represent themselves. Another example includes the arrangement of active windows on the desktop, like switching between Microsoft Word and Internet Explorer windows. In both instances, the student is not yet reading text to gain meaning nor explicitly constructing content for an audience, thus landscaping strategies are peripherally associated to meaning construction.

Table 4. Overview of the Primary Qualitative Coding Scheme with Examples

Code	Summary of Meaning
RC	Realizing and Constructing Potential Texts to Read Strategies within the scope of RC include activities most commonly associated with locating information on the Internet. These strategies typically occur when a student is about to construct a reading path, or traversal, *on the Internet*. It includes planning, monitoring, and evaluating the reading path. Common examples include planning what search engine to use, planning what hyperlinks to click, using search engines, navigating between different websites with the web browser toolbar (back, forward, bookmarks, etc.) or within a single website (menus, search bars, etc.), using hyperlinks to continue moving toward more useful information or a deeper knowledge of the text, monitoring the resulting reading path, redirecting the reading path, detecting problems in the reading path, etc.
IECM	Identifying, Evaluating, and Constructing Meaning From Text Strategies within the scope of IECM include activities related to constructing meaning from a text. These strategies support meaning making in the Internet or in print-based texts (e.g. textbooks, notes, etc.). Common IECM strategies include creating a reading plan, identifying main ideas, skimming the text, summarizing text, note taking, making inferences about the meaning of the text, connecting the text to prior knowledge, constructing meaning from multiple texts, monitoring the reading plan, monitoring comprehension, evaluating the usefulness of the text, evaluating a students' personal strategy use, etc.

Table 4 (cont'd)

Code	Summary of Meaning
PC	Publishing Content Strategies within the code of CC include those related to the communication of ideas, whether written, typed, oral, or visual output that communicate content to others. Typical CC strategies might include generating a plan for communicating information, monitoring and evaluating the plan for communicating, summarizing ideas, recording questions, drawing on prior knowledge, reporting information in a print-based artifact (e.g. brochure, paper, book, etc.), sharing information in a web 2.0 communication format (e.g. blog, tweet, comment, YouTube, podcast, etc.), editing, and revising the product. When on a technology platform, the CC strategies also include cutting and pasting, editing font (size, color, alignment, etc.), editing images or videos, using a spell-check tool, etc.
LAND	Landscaping the Screen Landscaping strategies include activities that negotiate the aesthetics of personal technology devices (computers, laptops, phones) that are associated peripherally to the construction of meaning from a text or the communication of meaning. Strategies include arranging application windows on the screen, resizing windows on the screen, searching for applications, zooming in or out of the screen, personalizing the aesthetics of the screen (e.g. changing theme image of a search engine, altering the settings of a search engine, adding a personalized profile, etc.), moving a toolbar on the screen, adjusting the page style, planning how to negotiate windows on the screen for effective use, monitoring and evaluating the plan to navigate windows.

After the fourth stage of coding, as the researcher explored patterns and themes and received feedback from colleagues in the literacy field, an additional two stages of coding were added. An emerging theme related to self-regulatory strategies prompted the need to reanalyze the transcripts a second time with a specific focus on all of the self-regulatory strategies. In the initial rounds of coding, the self-regulatory strategies of planning, predicting, monitoring, evaluating were strategies that were embedded within the strategy groups for realizing and constructing potential texts to read [RC], identifying, evaluating, and constructing meaning [IECM], Publishing Content [PC], and Landscaping [L]. For example, a student might construct

a plan to use a specific set of keywords to search for online information and then also monitor and evaluate the plan to use those specific keywords. Each of these strategies would have initially been coded under RC because they were directly incorporated into the task of locating information. Yet once the thematic analysis revealed the importance of the self-regulatory strategies in influencing each major strategy group (RC, IECM, CC), a more specific examination of the specific self-regulatory strategies was necessary. So while the strategies still retained original codes, a second coding process was employed at the fifth and sixth stages of coding.

In the fifth stage of coding the researcher reexamined the self-regulatory strategies already present in the coding and constructed the secondary coding scheme described below. The researcher read through the transcripts two additional times to code specific strategies of planning, predicting, monitoring, and evaluating for all student transcripts. In the sixth stage of coding, the researcher again collaborated with two peers and one dissertation committee member to critique codes. After the feedback, the researcher made minor modifications to the code and revisited each transcript to confirm coding one last time. The secondary coding scheme, which was employed in addition to, not in place of, the original coding scheme is outlined below first with a general overview of the codes and then in more detail in Table 5.

Secondary Coding Scheme

Self-regulatory codes.

4. **Planning [PLAN]** strategies involve identifying purpose and establishing goals for locating information online, reading and gaining meaning from the text, Publishing Content in the brochure, and landscaping the desktop. Planning strategies might occur at a meta-level (across multiple tasks) or a micro-level (within a specific task). In the context of complex

research tasks, the comprehensive goals, or meta-level goals, require identifying the purpose, audience, topic, and genre of the brochure and then establishing plans to achieve the goals. Effective plans then consist of subgoals, or micro-level goals, that support progress toward a primary goal. For example, a student may recognize the audience of the final brochure is tourists and the primary goal is to make the brochure to inform and attract tourists. The student will then establish subgoals for what type of information they want to locate when they search online, how they want to create and organize the brochure, and what they want to include in the brochure based on the primary goal.

5. **Predicting [PRED]** strategies are related to the inferences about the text structure, content, or student generated plans. Predicting strategies were primarily evident in realizing and constructing potential text to read and identifying, evaluating, and constructing meaning. Predicting strategies were evident at a micro-level. However, the skill at generating inferences, particularly when locating text online influenced students' progress toward their meta-level goals. For example, at a micro-level, students predicted the content and usefulness of hyperlinks prior to clicking on them. These inferences about hyperlinks then influenced the actual webpages students accessed and therefore the information available to support their reading plan and overall construction of meaning.

6. **Monitoring [MON]** strategies refer to the reader's perception of and cognition about the goals, the website structure, the text structure, and their own knowledge and strategy use. When carrying out plans to realize and construct potential text, identify and learn text content, communicate content, and landscape the screen, monitoring strategies are critical for ensuring students are progressing according to their goals, identifying problems, and generating fix-it strategies. Monitoring strategies, just like planning strategies, may occur at both a meta-level or a

micro-level. For example, at a micro-level a student may monitor the website structure to generate a plan for locating information on that specific site or they may monitor their comprehension of a section of text they read. At a meta-level, student may monitor their overall progress locating and recording information for the appropriate audience.

4. **Evaluating [EVAL] s**trategies refer to students evaluation of characteristics of websites, texts, their own developing construction of meaning, and the product they are creating to communicate content. As with all the other self-regulatory strategies, evaluating can occur at a meta-level or a micro-level. For example, evaluation at the subtask level included readers' evaluation of a specific navigational choice like clicking on a hyperlink or the usefulness of a portion of text in relation to the reading goal. Evaluation strategies at the meta-level and driven by research task impressions included evaluating the overall use of time, the extent to which the product appealed to the appropriate audience, the success of online reading and note taking on Day 2 in goal of the final objective of creating the brochure. This coding scheme incorporates the new literacies construct of *critically evaluating the usefulness of information*.

Table 5. Overview of the Secondary Qualitative Coding Scheme with Examples

Code	Summary of Meaning
PLAN	Planning Strategies in the scope of planning involve establishing goals and plans. Goals and plans may be comprehensive and function at a meta-level (e.g. setting an overarching reading goal based on guidelines in the rubric, planning how to spend their time over the research days). Planning strategies may be micro-level and subtask specific to locating, reading, communicating text, or landscaping the screen (e.g. planning what link to click on next, planning how to read a specific web page, planning what topic to include in the brochure next, or planning how to arrange windows on the screen). These micro-level plans may contribute to a meta-level goal or plan as well. Typical planning strategies include developing a navigational plan for searching a website based on any number of factors (e.g. prior knowledge of the topic, text structure, teacher expectations, etc.), developing a reading plan, establishing goals for when to alternate between reading and communicating, articulating a plan for the construction of the brochure, identifying the target audience for the final product to guide the component steps of locating information online, reading text, generating content by writing or typing, etc.
PRED	Predicting Strategies in the predicting code refer to inferences generated in the process of locating text online or gaining meaning from the text encountered. Common predicting strategies include making inferences about where a link will go when they click on it, how well a specific search term might produce useful information, the type and quality of information that can be found on a website, how much time it will take to construct the brochure, etc.
MON	Monitoring Monitoring strategies are related to the reader's perceptions of the text characteristics, the micro- and meta- level goals (e.g. goals for reading the text, goals for the brochure), and their own knowledge and strategy use. Common strategies include monitoring the online reading path, the structure of websites in relation to the goal, progress toward the reading goal, personal strategy use in relationship to the goal, progress toward the communication product (e.g. brochure), and formatting in the product itself (e.g. spelling, grammar, etc.). Monitoring strategies frequently involved monitoring for problems such as ineffective online reading paths, not understanding text, failing to find content relevant to goals, prior knowledge conflicting with the information read, challenging vocabulary, etc.

Table 5 (cont'd)

Code	Summary of Meaning
EVAL	Evaluating Strategies within this code include readers' evaluation of their navigational choices, their effectiveness of their reading and communication choices, and the overall usefulness of value or quality in the text. Evaluating frequently occurs hand-in-hand with monitoring. Common evaluating strategies include evaluating the success of a web search, the usefulness or quality of information encountered, evaluating the effectiveness of the brochure content and aesthetics, and evaluating a student's overall progress toward the comprehensive goals.

After all the data had been coded for individual students, the themes and patterns once again compared across all students and between at-risk readers and average-achieving readers as separate groups. During this process, the quantitative data captured in the screen capture (e.g., number of websites and webpages visited, use of a menu for navigation, keyword searches in Google, etc.) were compared and contrasted with the emerging qualitative themes. These quantitative results provided a deeper analysis and synthesis of themes and patterns, particularly in the category of realizing and constructing potential texts to read where student actions online provided substantial insight into potential strategy use.

Procedures to ensure validity and reliability. Throughout the data analysis process, multiple steps were included that ensured the validity and reliability of the analysis, informed by guidelines for high-quality qualitative research (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005; Collins, Onwuegbuzi, & Sutton, 2006). First, raters provided inter-rater reliability on multiple procedures throughout the qualitative coding process. First, the researcher and a research assistant engaged in a practice coding session. Second, the researcher and research assistant coded three ten-minute sections of transcripts, selected randomly, from three different participants verbal protocols. The codes were compared, the inter-rater reliability was

73.00%, discrepancies were discussed and the coding scheme was further clarified until agreement was reached. Third, an additional three ten-minute sections were randomly selected from the three participants whose verbal protocols were not previously coded. The researcher and research assistant coded the sections and compared scores for an inter-rater reliability of 86.11%. The researcher then independently coded all participants' verbal protocols. The research assistant coded an additional two ten-minute segments from each student's Day 2 and Day 3 verbal protocol and screen capture transcripts respectively. Inter-rater reliability was 86.43%.

Second, external auditors (members of the dissertation committee and doctoral peers) reviewed emerging data analysis to critique the emerging codes and patterns and the theoretical grounding. The coding scheme was clarified and extended for theoretical and empirical alignment. Further recommendations led to the collapse of categories into one another, the reorganization of some individual strategies within codes, and reexamination of the levels of codes.

Third, the researcher triangulated themes across the multiple data sources (concurrent verbal protocol, screen capture, post-interview, and student artifacts). The majority of triangulation occurred through examining of the qualitative themes across the verbal protocol, screen capture data, and post-interview questions. The researcher explored codes and themes by frequency, examining both codes and themes that occurred multiple times across data sources as well as those which were anomalies, occurring only within a single data source or only within a particular time frame. The analysis provided confirming and disconfirming evidence for the themes examined in the results.

CHAPTER 4

RESULTS: QUESTION 1

Average-Achieving and At-Risk Readers' Online Reading Comprehension Strategies

This chapter will answer the original research question: What strategies and processes do students with and without learning disabilities use as they locate, evaluate, and synthesize information on science websites? However, the question must be revised. While the question was informed by research and remains central to the research, the qualitative nature of the work, particularly the influence of the emergent coding and themes revealed a necessity for reframing the constructs "locate, evaluate, and synthesize." These terms were too narrow and a broader examination of the literature and the coding process led to a broader question that is related but more appropriate. Therefore the question is rephrased as: *What strategies and processes do at-risk and average-achieving readers use as they locate information and generate meaning from science websites?*

In this chapter, the focus is on the strategies that three at-risk (AR) and three average-achieving (AA) readers employed while locating information and generating meaning from science websites while engaged in the online reading, note taking, and brochure construction task. First, the chapter begins with strategies for realizing and constructing potential texts to read [RC]. Second, the chapter introduces the strategies students used while identifying, evaluating, and constructing meaning [IECM]. Third, the strategies for landscaping the screen [L] are introduced. Fourth, the chapter will examine the self-regulatory strategies of planning [PLAN], predicting [PRED], monitoring [MON], and evaluating [EVAL] that influenced the online reading and note taking. Fifth, the chapter will examine the shift in self-regulatory strategies [PLAN, PRED, MON, EVAL] that occurred when the research task shifted to brochure

construction and dramatically altered students' strategies for locating and gaining meaning from the text.

It is relevant to note that this section only examined strategies related to locating and generating meaning from the website are revealed in the results. There are many strategies, particularly within the category of publishing content that were not relevant to the question. For example, students use of spell checker did not provide evidence for how they located online information or gained meaning from the website. While these strategies are certainly worth examining in future research, the comprehensive examination of publishing content strategies were not relevant to the question or within the scope of this study. The strategies from the coding category of publishing content that most impacted the location of information and generation of meaning from science websites were the self-regulatory strategies, and they are discussed in the final section of this chapter.

Realizing and Constructing Potential Texts to Read

It is important to preface this section on the strategies that students employed while locating information with an acknowledgement that the results were influenced by the study methods, particularly the fact that students were provided with three reliable and accurate websites with strong content-alignment to the topic. They were not excluded from the use of additional websites, but they were strongly encouraged to begin with the three teacher-recommended [TR] websites. Therefore, the design restricted the need for students to engage in a broader search to locate and evaluate potential goal-related websites unless they chose to expand their search beyond the three provided websites. Nonetheless, evidence of strategies for realizing and constructing potential texts to read were still evident. The following section will examine student strategy use related to: locating goal-relevant websites, locating goal-related

information from within a website, and generating inferences about hyperlinks. Table 6 provides a general overview of strategy use for realizing and constructing potential text to read for each student. The table reveals each student's specific strategy use on Day 2 while reading online and taking notes both during the verbal protocol and after the verbal protocol as well as on Day 3 when students began brochure construction. The table also organizes individual students by whether they were identified as average-achieving or at-risk readers in the study. Each strategy identified in the table will then be examined in more detail in the text that follows.

Table 6. The Use of Strategies for *Realizing and Constructing Potential Texts to Read* [RC] by Student and Task.

	Average-Achieving Readers								
	Hannah (AA)			Leanne (AA)			Adam (AA)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Locating Goal-Relevant Websites									
Generating keyword searches using search engines		x	x		n/a	x			x
Revising keyword searches in search engines	x		x		n/a	x		x	x
Selecting teacher-recommended websites	x	x	x	x	n/a	x	x		x
Using browser tools (e.g. navigation buttons, toolbar)	x	x	x	x	n/a	x	x	x	x
Locating Goal-Relevant Information from within a Website									
Selecting useful menu links	x		x	x	n/a	x	x	x	
Selecting useful non-menu links	x		x		n/a	x	x	x	

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue)

Table 6 (cont'd)

Average-Achieving Readers

	Hannah (AA)			Leanne (AA)			Adam (AA)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Using navigation buttons	x		x	x	n/a		x		
Generating inferences about usefulness, relevance, possible path of hyperlinks	x				n/a	x	x		

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue)

Table 6 (cont'd)

At-Risk Readers

	Tameca (AR)			Levi (AR)			Allison (AR)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Locating Goal-Relevant Websites									
Generating keyword searches using search engines	x		x		n/a	x			x
Revising keyword searches in search engines					n/a	x			x
Selecting teacher-recommended websites	x	x	x	x	n/a	x	x	x	x
Using browser tools (e.g. navigation buttons, toolbar)	x	x	x	x	n/a	x	x	x	x
Locating Goal-Relevant Information within a Website									
Selecting useful menu links	x		x	x	n/a	x	x	x	
Selecting useful non-menu links					n/a	x	x		x

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue

Table 6 (cont'd)

At-Risk Readers

	Tameca (AR)			Levi (AR)			Allison (AR)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Using navigation buttons	x	x	x	x	n/a	x		x	x
Generating inferences about usefulness, relevance, possible path of hyperlinks				x	n/a		x		

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue

Locating Goal-Relevant Websites

Students located goal-relevant websites by using search engines and selecting from a recommended list of websites. Student patterns of strategy use for locating websites varied across participants and research subtasks, as described below.

Generating keyword searches using a search engine. Students initiated keyword searches using a search engine for two completely different purposes. First, three students initiated keyword searches to locate information that would help them gain meaning from the text. Second, all students initiated keyword searches to locate images for inclusion in the brochure. Both purposes will be examined in this section.

On the initial day of online reading and note taking, only Hannah (AA) and Tameca (AR) accessed search engines at all. When students started brochure construction on Day 3, one additional student, Levi (AR), also initiated a keyword search to gain meaning from online websites. The strategies they used for generating keyword searches were 1) enter entire questions into the search bar (e.g., is the Pacific Ocean salt water) or 2) appropriate language from the student brochure rubric (e.g., activities tourists might do in rainforest). All three used single-step keyword searches, clicking on a result from their initial keyword search and never revising their search terms to refine search results. Furthermore, when students did select a result, they always clicked on a result within the first four search engine results listed.

On Day 3, when brochure construction began, all six students engaged in keyword searches using Google to find images. The keyword searches were again appropriated from the language of the brochure rubric or from their notes. Students typically scrolled their mouse over images in the results row, quickly identifying a target image within the first page of results. An example is provided in Levi's (AR) search for a parrot image.

50:04 [types “parrot” in the Google search bar]

50:10 [clicks on images in the toolbar above the Google logo to open all images of parrots]

50:12 [hovers over the 4th parrot image]

50:12 S: This one. So I will go here.

50:13 [clicks on the image]

Levi (AR) scanned the image results within two seconds, selecting the image and then incorporating it into their brochure. Some students then clicked on the results image to take them to the image’s website where they copied the image and returned to paste it in the brochure, while others simply copy and pasted the image from the results page. Students’ strategies for locating images were typically executed with less than 30 seconds, much more rapidly than their strategies for locating text to generate meaning.

Revising keyword searches using a search engine. All students except for Tameca (AR) demonstrated strategies for revising search terms on Day 3 while locating images for the brochure. All students refined search terms to redirect the search to more specific information or to correct spelling errors in their initial search term. For example, Allison (AR) initially sought an image of a howler monkey using the search term “monkey,” but after skimming the results and concluding they were not specific enough to her goal she revised her search term to “howler monkey.” Two students, Leanne (AA) and Allison (AR), refined search terms using the autocomplete search engine suggestions to compare results while searching for images. For example, after initially searching for “map of the rainforest,” Leanne (AA) returned to the searchbar, deleted the word rainforest and the autocomplete suggestions appeared, from which she selected “map of the tropical rainforest.”

Overall on Day 3, there was limited use of revision of search terms (see Table 7). Hannah (AA), Leanne (AA), and Allison (AR) used revised searches the most, and even they only revised between 20-25% of their searches. So when students did utilize Google, they predominantly engaged in a single-step keyword searches, using the single-step keyword strategy greater than 75.00% of the time they used search engines.

Table 7. Frequency and Percentage of Single-Step and Revised Keyword Searches on Day 3

Student	Total Keyword Searches	Single-step Keyword Searches		Revised Keyword Searches	
	n	n	% of Total	n	% of Total
Average-achieving					
Hannah (AA)	9	7	77.78%	2	22.22%
Leanne (AA)	4	3	75.00%	1	25.00%
Adam (AA)	6	5	83.33%	1	16.67%
At-Risk					
Tameca (AR)	3	3	100.00%	0	0.00%
Levi (AR)	9	8	88.89%	1	11.11%
Allison (AR)	4	3	75.00%	1	25.00%

These results must be examined in consideration of the fact that students were provided with three websites that were high in content alignment. Therefore, students who utilized the three provided websites and located information using those sources first likely had less need to search broadly for information using the Internet. Instead, students were more frequently engaged in seeking out specific goal-related information that was not covered completely in their previous day's reading or in seeking out images.

Selecting teacher-recommended [TR] websites. All participants on both days of research used one or more of the three TR websites (MBG, UCSB, and WC). The websites were introduced on the "starting" webpage created by the researcher. On this page, websites were identified by their title, the title generated by the authors of the site, followed by the word

biomes, with no provided description. Students saw the following three titles: MBG Net Biomes, World Biomes - KDE Santa Barbara, and The Wild Classroom Biomes. Five of six students simply selected the first site to begin the search. The TR websites were counterbalanced for order, so three students started with the UCSB site and two started with the MBG site. When two students did verbally report their reason for selecting one of the three sites they simply referred to "starting with the first one" and then proceeding from there. Based on these statements and students' online actions, the students did not appear to use textual clues in the titles to guide their initial choice.

Leanne (AA) was the one exception; she chose a website that was not listed first on the TR site. She used the textual clues in the titles to generated inferences about which of the three websites to select. She explained her choice not during the selection itself, but later in the post-interview when asked to describe her strategy for initiating the search from the "starting" website.

> Leanne (AA): Just go with the one that looked like it looked the most professional. The one that said MBG biomes I figured just cuz it said biomes it would probably have something created so I just went there. Nothing like the wild classroom biomes which sounds like a little kid thing.

Although both titles she referred to actually included the word biomes, she inferred that the website with the acronym MBG would be more professional than Wildclassrooms and therefore offer information that aligned with her reading goals.

All students returned in both Day 2 and Day 3 to use the "starting" webpage to locate a previously visited TR website. It is relevant to note though, that all students except for Tameca (AR) eventually used the "starting" webpage to choose a new TR website as well. Tameca may

have forgotten there were additional TR websites to visit, or she may have also simply not had enough time to proceed to the next website due to extensive reading and note taking on every webpage.

Using web browser tools. All students used navigation buttons in web browsers to locate websites on Day 2 and Day 3. All six students used the navigational forward and back arrows in the web browser to locate a previously encountered website. An example is evident as Adam (AA) planned to leave the UCSB website and return to the WC website for additional information.

> 23:33 [S clicks on the IE back arrow and returns to the researcher created biomes homepage]
>
> 23:35 [S clicks on Wild Classroom biomes link and opens homepage]

Only two students, Hannah (AA) and Adam (AA), used a bookmark in the Internet Explorer favorites toolbar, located at the top of the browser, to quickly locate the "starting" page with the TR websites. The researcher had bookmarked the "starting" page on all students Internet Explorer browser toolbars prior to Day 2. Hannah (AA) used the strategy of clicking on the bookmark three times on Day 2 and four times on Day 3. Adam (AA) used the strategy one time on Day 2 and one time on Day 3. This strategy use was relatively limited compared to other strategies Hannah (AA) and Adam (AA) used for locating websites.

Locating Goal-Relevant Information Within a Website

Some strategies for locating information online occurred once students were within an individual website. These strategies examined below include: using the menu, selecting useful non-menu hyperlinks, and using within-site navigation buttons.

Using the menu. All six students used menus to locate additional webpages or information within a website on Day 2 and Day 3. However, the sophistication of students using the menu as a strategy for locating information varied across participants. Hannah (AA), Leanne (AA), Allison (AR), and Adam (AA) demonstrated greater skill with the strategy than the remaining two at-risk readers Tameca (AR) and Levi (AR).

Over the course of both research days, students verbally articulated using the menu to locate informational requirements outlined in the brochure rubric. A transcript excerpt from Allison's (AR) verbal protocol and screen capture revealed the use of the menu as a strategy. After accessing the UCSB website, Allison (AR) started hovering over menu links.

17:18 R: Tell me what you are thinking.

17:19 S: What one to click.

17:22 [S scrolls down page of menu hyperlink options]

18:00 S: Mmm. Well, I'm clicking on rainforest because my topic is rainforest.

18:01 [S clicks on rainforest menu link and opens page]

Allison (AR) verbalized that she was considering her potential reading path by examining the menu hyperlinks on the home page and comparing them to her topic-related requirements for the brochure. Much like Allison (AR), as all students scrutinized the menu they predicted that a potential menu link would provide access to a site related to their topic-related requirements based on near literal matches between the menu link and their specific goal for locating information (e.g., to locate a potential goal-relevant site about the topic rainforest a students clicks on the rainforest menu link).

Despite the fact that all students demonstrated the strategy of using the menu to execute a specific search for information at various points in their research, it is relevant to note that the

quantitative data reveals varying patterns of menu use. Table 8 provides a quantitative display revealing how many total webpages students located on Day 2 and 3. It also reveals the percent of pages students located with the menu versus other strategies (e.g., navigation buttons) on both days. Individual students are organized by whether they were identified as average-achieving or at-risk readers in the study.

Table 8. Frequency and Percentage of Teacher-Recommended Webpages Located with Menu vs. Non-Menu Strategies on Day 2 and 3

	Day 2: Online Reading and Note Taking			Day 3: Brochure Creation		
Student	Total Pages Located (n)	Pages Located With Menu (%)	Pages Located With Other Strategies (%)	Total Pages Located (n)	Pages Located With Menu (%)	Pages Located With Other Strategies (%)
Average-achieving						
Hannah*	8	75.00%	25.00%	10	70.00%	30.0%
Leanne	8	12.50%	87.50%	4	75.00%	25.0%
Adam*	21	52.38%	47.62%	1	100.00%	0.0%
At-Risk						
Tameca	8	25.00%	75.00%	41	12.20%	87.8%
Levi	6	33.33%	66.67%	4	100.00%	0.0%
Allison*	10	40.00%	60.00%	7	85.71%	14.3%

Note. * = students that started their websearch on the UCSB website.

The quantitative analysis revealed that on the first day of online reading and note taking (Day 2), once students started navigating within a TR website (e.g., MBG), Hannah (AA) and Adam (AA) located more than 50.00% of their webpages using a menu strategy. The third average-achieving reader, Leanne (AA) located only 12.50% of pages using a menu. Leanne (AA) instead used internal navigation buttons, discussed in more depth in the upcoming navigation button strategy section. The three at-risk students used menus to locate from 25.00% to 40.00% of the webpages.

When constructing the brochure on Day 3, all students except for Tameca (AR) used the menu as a strategy for locating 70.00% or more webpages within the TR sites. The results on Day 3 when student began constructing their brochures revealed a dramatically different picture of student strategy use for locating webpages, with the exception of Hannah (AA). For example, Leanne (AA), Levi (AR), and Allison (AR) all increased their use of the strategy between Day 2 and Day 3, with Leanne (AA) locating 75.00%, Levi (AR) locating 100.00%, and Allison (AR) locating 85.71% of webpages using a menu. Tameca (AR) used the menu to locate even fewer webpages (12.20%) on Day 3 than Day 2. While most students appeared to use a menu strategy more on Day 3, a deeper examination of the screen captures revealed that the quantitative results do not reflect the level of sophistication with which students use the strategy.

The screen capture data revealed that Allison (AR), Hannah (AA), Leanne (AA), and Adam (AA) did appear to use the menu effectively to seek out specific goal-related information. However, even when Tameca (AR) and Levi (AR) did use the menu, they lacked sophistication in their use of menus. On Day 2 when reading and taking notes, both at-risk readers failed to use menus to proceed beyond the second page in a website. They used the homepage menus to locate an introduction page to the topic they were studying (e.g., rainforest), but they never

navigated beyond the 2nd page, the introductory page, in a website. This pattern occurred on multiple websites. For example, Levi (AR) first began locating information using the MBG website. From the homepage, he clicked on the rainforest menu link and proceeded to the MBG rainforest introduction page (see Figure 7). He took notes and then clicked on the back button to return to the MBG homepage. Later in his search he switched to the WC website. From the homepage, he clicked on rainforest menu link and proceeded to the WC rainforest introduction page. He again took notes and then clicked on the back button to return to the MBG homepage. Even when provided with content-relevant websites, rich with information about the rainforest, both at-risk readers appeared to lack strategy knowledge related to the use of the menu as a tool for locating information within the site.

Another example, this one from Tameca's (AR) web search, demonstrated her lack of strategy knowledge about how to locate new or additional information using the menu, or any other feature of the website. Tameca's (AR) transcript is accompanied by a screenshot to provide context for the example (Figure 7).

Figure 7. Screenshot of the MBG Rainforest Homepage

23:22 R: Yep, tell me what you are thinking.

23:28 [S mouse scrolls up the page]

23:30 S: Mmm. Do I go back?

23:34 R: That's a great question. Why don't you try to figure that out.

23:37 [S mouse scrolls to bottom center of page, then back up to the top in one motion.]

23:42 [S clicks on the back arrow on the IE browser and opens the MBG homepage]

Even though there were three internal menus and hyperlinked images directly below the sentences she had read, Tameca (AR) never scrolled over any possible options for moving further into the website. Instead she decided to use the back button to return to the MBG homepage. So while Tameca (AR) and Levi (AR) did demonstrate a strategy for using a website menu to navigate to a broad topic-related introduction webpage, they lacked either declarative or procedural knowledge of menus as a strategy to effectively seek additional and related goal-specific information within the websites.

Selecting useful non-menu hyperlinks. Students used the strategy of selecting useful non-menu links to navigate both within the website and also to explore hyperlinks leading beyond the TR website. Non-menu hyperlinks were defined in this study as any hyperlinks that: 1) were not included in fixed position menus or 2) were fixed on the page and acted as anchor links jumping students within a single webpage but never to another webpage within or outside of the site. Two examples are provided in Figure 8, an additional example is evident in Figure 9. On the left of Figure 8 are links listed at the bottom of the UCSB rainforest page to direct students to additional information outside the website, and on the right are links within the MBG rainforest introduction page.

Figure 8. Screenshots of Non-Menu Links on the UCSB and MBG Websites

Hyperlinked images

First, this section will provide details about the use of the strategy to locate information within the website using 1) hyperlinked images, 2) hyperlinked interactive maps, and 3) anchor links or "jump links" within a page. Next, the section will describe the use of external hyperlinks that directed the student outside of the current website. When only reading and note taking (Day 2), the three at-risk readers never selected non-menu hyperlinks. On the same day, Leanne (AA) used the strategy to locate 10.00% of the webpages or sections of the webpage, Hannah (AA) used it to locate 12.50%, and Adam (AA) used it to locate 23.80%. All three of these students utilized the anchor links provided at the top of the UCSB rainforest page, allowing them to quickly jump to a section further down the page (see Figure 9). Hannah (AA) also selected a hyperlinked image and Adam (AA) selected hyperlinks within an interactive map.

On Day 3, all students except for Tameca (AR) and Adam (AA) used non-menu hyperlinks that directed them to webpages with a single website. Adam (AA) stopped using non-menu hyperlinks within sites due to the fact he almost exclusively used Google search engine queries rather than the TR websites for locating information. The remaining four students used between

one and two non-menu hyperlinks each. All but one of the non-menu hyperlinks students clicked were anchor links on the UCSB rainforest page (see Figure 9). Hannah (AA) also accessed one hyperlink within an interactive map.

Figure 9. Screenshot of Anchor Links in the UCSB Rainforest Page

Only two average-achieving readers, Hannah (AA) and Adam (AA), used the strategy of selecting external hyperlinks to find additional goal-relevant information on Day 2. External hyperlinks directed students to new websites for additional information. Hannah (AA) used the strategy four times and Adam (AA) used it one time. No at-risk readers used external links. Both Hannah (AA) and Adam (AA) explored groups of hyperlinks that were listed as "links" for additional information within the current TR websites they were reading. On Day 3, no students used external hyperlinks. External hyperlinking may have been influenced by the fact that students were provided with three content-aligned websites and therefore students needed very little additional information beyond what was provided on the three websites already.

Using navigation buttons. All students used navigation buttons *on the web browser* to locate webpages. The strategy of using the forward and backward buttons on the Internet Explorer web browser was introduced in the previous section related to finding websites, but in this section navigation buttons were specific to locating webpages within a website. In addition, four students, Tameca (AR), Levi (AR), Leanne (AA), and Adam (AA), demonstrated strategy use of navigation buttons *provided within the TR webpages*, specifically with the MBG website, to navigate forward or backward to the next page (see Figure 10).

All six students demonstrated the strategy of using the navigation buttons *on the web browser*. An example was evident in Tameca's (AR) screen capture.

6:01 [S clicks the IE browser back button to return to "Vine Snake" page]

6:06 [S scrolls up page]

6:08 [S clicks IE browser back button to return to "Slow Loris" page]

6:10 [S clicks IE browser back button to return to "Orangutan" page]

Tameca (AR) used the back button to return to a previously encountered page to locate specific information about the Orangutan for her brochure. Overall, students used the navigation buttons to return or advance to a specific topic-related website they had already skimmed or read. All students demonstrated greater use of the browser navigation buttons on Day 3 when utilizing search engines.

Two students, Tameca (AR) and Leanne (AA), demonstrated strategy use of navigation buttons *provided within webpages*, specifically with the MBG website, to navigate forward to new pages. These navigation buttons were provided at the end of webpages grouped within a specific topic (e.g. a group of pages each providing information about "types of rainforest plants") and were devoid of any textual references that suggested where they might lead (see Figure 10). Leanne (AA) used this strategy while on the MBG website to locate 75% of the pages she visited. Leanne (AA) was only on the MBG site on Day 2, but after she had progressed only two pages (or links) into the website and the navigation arrows appeared at the bottom of the screen, she then remained on the MBG site the remainder of Day 2 (18 min and 21 sec) using only the forward navigation button to locate the next webpage. The use of the forward navigation button strategy became Leanne's (AA) predominant strategy for locating webpages. Tameca (AR) used this strategy to locate 48.21% of the pages she visited in the MBG website on

both Day 2 and 3. Interestingly, she used the back arrow navigation button in the Internet Explorer rather than at the bottom of the page to navigate to a previously encountered page. Compared to the remaining students who did not use the within site navigation buttons at all, both Leanne (AA) and Tameca (AR) used this as a primary strategy for locating websites within the MBG website. Students never clicked on the back button or central compass figure, a button linked to the introduction page, as navigation tools.

Figure 10. Screenshot of MBG Navigation Buttons

Generating Inferences About Usefulness, Relevance, and the Possible Path of Hyperlinks.

The following section examines students' strategy use of inferential reasoning about hyperlinks when students were within individual websites and when they used search engines. All students except Tameca (AR) generated verbal inferences about the usefulness, relevance, or possible path of hyperlinks in a menu within a website. As discussed in the previous section examining results related to the use of menus as a strategy, the inferential reasoning was employed on menu terms that had high literal alignment with students' goals for locating information (e.g., to locate a potential goal-relevant site about the topic rainforest a students clicks on the rainforest menu link).

Only two students, Hannah (AA) and Adam (AA), generated inferences about non-menu hyperlinks within a website. The students both generated inferences about the content and relevance of potential external sites based solely on the title of the links, which was the only information provided to the students. The following example demonstrates Hannah's attempt to locate information while selecting from a list of 10 external links.

35:03 [S clicks on National Geographic: Rainforests at Night and opens a new page which displays an error message]

35:04 R: Can you tell me what you are thinking?

35:08 S: I'm thinking that National Geographic might be a school safe place, but apparently not because it doesn't give me information about

35:22 [clicks on the IE back arrow and returns to UCSB rainforest page]

Cont.

35:49 [clicks on Teachers: get a free rainforest PowerPoint show and opens a new page that displays a PPT on the web]

35:54 R: Can you tell me what you are thinking?

35:55 S: I'm thinking that if the teacher has a PPT, then they should show me some notes and good pictures on the rainforest, but apparently not. Well, teachers.

Hannah's (AA) selection of the National Geographic link revealed a connection to her prior knowledge about National Geographic and her inference therefore that the link should provide content that was "school safe." Next, she made inferences about the possibility that a site with teacher Power Points were likely to provide both information and pictures about the rainforest. These inferences were based on minimal textual information. Both students generated inferences about the potential usefulness of external hyperlinks based on only textual clues in the title and more than 95.00% of the time the results were unsuccessful, leading to non-goal-relevant websites. This pattern suggests that students struggled to generate inferences based on the minimal textual clues in titles and that these specific website structures which lacked detailed descriptions of external hyperlinks did not support effective hypertextual external linking.

No students verbally generated inferences about selecting hyperlinks from a search engine result. It is relevant to note that generating inferences about any hyperlink, within a website or provided in a search engine result, was not coded unless a verbal prompt accompanied a student's actions. In this study, most inferences were evident during Day 2 when students were within the TR websites during the verbal protocol. On Day 3, with a limited verbal protocol, there were fewer verbalizations. However, as previous research suggests, students are likely making forward inferences nearly every time they encounter and prepare to click on hyperlinks on a page (Coiro & Dobler, 2007). Therefore, it is likely that all students were engaging strategies of inferential reasoning about hyperlinks as they located online information, but without a verbal explanation of their actions, little information could be gathered about the types of inferences being generated.

In summary, students used a variety of strategies for locating goal-relevant websites and locating information within websites. However, the frequency and sophistication of the strategy use varied across students and across days. The results for realizing and constructing potential texts to read revealed the complexity of strategy use when locating online information to read. An examination of how the dynamic interactions of these strategies revealed patterns that could generate navigational profiles will be examined in chapter 5.

Identifying, Evaluating, and Constructing Meaning

The following section discusses student strategy use while identifying, evaluating, and constructing meaning. These were the strategies utilized as students began to construct meaning from the text. The following section will examine student strategy use including: note taking, skimming and searching for key words, summarizing, asking questions, synthesizing information within a single webpage, synthesizing information across webpages, purposefully returning to

previously encountered information, and generating inferences. Table 9 provides a general overview of strategy use for identifying, evaluating, and constructing meaning for each student. The table reveals each student's specific strategy use on Day 2 while reading online and taking notes both during the verbal protocol and after the verbal protocol as well as on Day 3 when students began brochure construction. The table also organizes individual students by whether they were identified as average-achieving or at-risk readers in the study. Each strategy identified in the table will then be examined in more detail in the text that follows.

Table 9. The Use of Strategies for *Identifying, Evaluating, and Constructing Meaning from Texts* [IECM] by Student and Task.

Average-Achieving Readers

	Hannah (AA)			Leanne (AA)			Adam (AA)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Note Taking	x	x		x		x	x	x	
Skimming & Searching for Keywords	x	x	x		n/a	x	x	x	x
Summarizing	x	x	x	x	n/a	x	x	x	x
Asking Questions	x		x	x		x	x	x	
Synthesizing Information within a Page	x		x	x	n/a		x	x	
Synthesizing Information across Websites			x	x	n/a	x	x	x	x
Returning to Previously Encountered Information			x						
Generating Inferences About Text	x			x	n/a	x	x		

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue)

Table 9 (cont'd)

At-Risk Readers

	Tameca (AR)			Levi (AR)			Allison (AR)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Note Taking	x	x		x	n/a	x	x	x	x
Skimming & Searching for Keywords			x		n/a	x			x
Summarizing	x	x	x	x	n/a	x	x	x	x
Asking Questions	x		x	x		x	x		x
Synthesizing Information Within a Single Webpage					n/a			x	
Synthesizing Information Across Websites	x		x		n/a	x	x		x
Returning to Previously Encountered Information			x		n/a	x	x	x	x
Generating Inferences About Text				x	n/a		x		x

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continue

Note Taking

Note taking is a specific strategy for identifying important ideas and actively manipulating and constructing meaning from the text. It can therefore be coded as one strategy among many necessary for making meaning from the text. However, in this study, the notes themselves served as a mediational tool that fostered student verbalizations and provide a unique lens for the researcher to examine multiple other strategies. As students responded to the prompt, "Can you tell me why you chose to write that?" they revealed strategies like summarizing main ideas, generating inferences to extend the meaning of the text, and more. In addition, the assessment of the notes themselves using a rubric, provided data about other strategies. Therefore, the note taking section will precede the sections related to other strategies.

All students engaged in note taking on Day 2. While given the option to take notes in any format they preferred, including any digital tools (e.g., Microsoft Word, Evernote, etc.), all participants chose pencil and paper. On Day 3 only Leanne (AA) and Levi (AR) continued to take notes, the other students only constructed information on the brochures. Students' note-taking scores were assessed in the categories of organization, breadth of content, depth of content, and summarization (see Table 10). A final composite score denoted the overall usefulness of the notes as a tool. Scores ranged from *undeveloped* (1) to *highly proficient* (5).

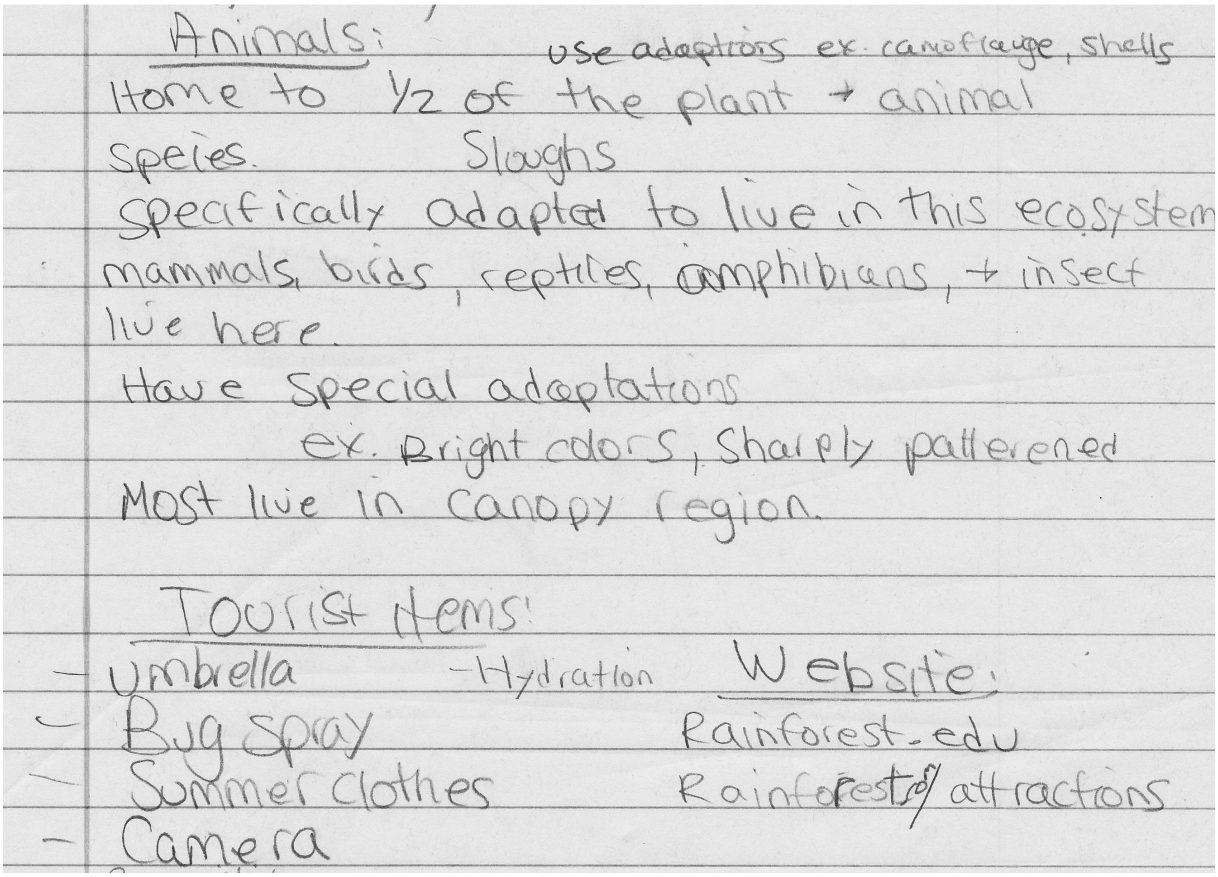
Table 10. Students' Note Taking Scores Assessed by the Rubric

Student	Organization	Breadth	Depth	Reduction	Usefulness as a Tool (20)
Average-achieving					
Hannah	3	4	4	4	15
Leanne	4	4	5	4	17
Adam	4	4	4	4	16
At-Risk					
Tameca	1	2	2	1	6
Levi	2	2	2	1	7
Allison	3	3	3	4	13

* Note taking score ratings: (1=undeveloped, 2=emergent, 3=developing, 4=mostly proficient, 5=highly proficient)

As a whole, all three average-achieving readers outperformed the at-risk readers on note taking. Hannah (AA), Leanne (AA), and Adam (AA) received composite scores ranging from 15 to 17. Across all note taking traits, the average-achieving students predominantly received scores of mostly proficient, demonstrating their overall proficiency at taking notes. A section of Adam's (AA) notes provide an example that represents the average-achieving readers' performance (Figure 11).

Figure 11. A Sample from Adam's (AA) Notes

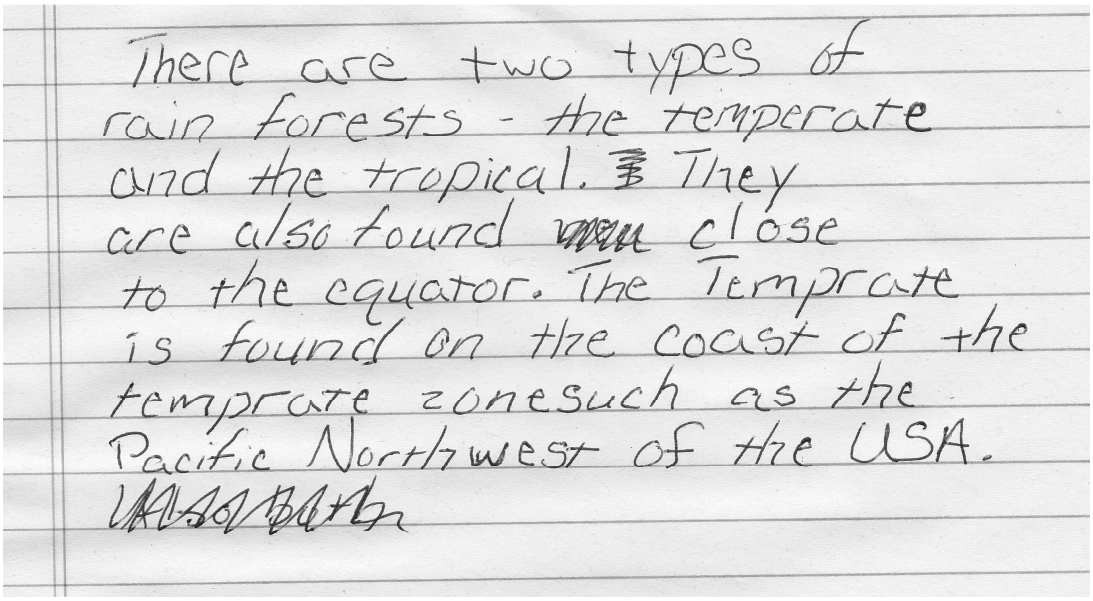


In this section of notes, it was evident that Adam (AA) was predominantly organizing at two levels, categories and supporting details, although occasionally including a third level when providing examples of adaptations. While the supporting details contained repetitions and had some internal organizational issues, they were still proficient overall when examining the entire set of notes. He generated meaningful summarizations from the text including accurate information. Overall his notes cover a breadth of categories necessary for the brochure with proficient depth. This sample is representative of the average-achieving readers' notes.

On the other hand, the at-risk readers Tameca (AR) and Levi (AR) scored 6 and 7 respectively and Allison (AR) scored a 13. Tameca (AR) and Levi (AR) achieved scores ranging from undeveloped (1) to emerging (2) on the note taking traits assessed, while Allison (AR)

performed slightly better with scores ranging from developing (3) to mostly proficient (4). Based on these scores, Tameca (AR) and Levi (AR) had very limited knowledge about how to construct notes from the online reading while Allison (AR) at least had developing knowledge about how to take notes. A sample from both Tameca (AR) notes will be provided below (see Figure 12).

Figure 12. A Sample from Tameca's (AR) Notes



Tameca (AR) constructed the notes in paragraph format, with no organizational plan. She copied a significant amount of information nearly word for word with limited summarization. Even when copying nearly directly from the text, there were errors. For example, Tameca (AR) wrote "they are also found close to the equator," however the text stated that only the tropical rainforest is found close to the equator. Tameca (AR) did not incorporate a breadth or depth of topics in her notes. While this sample is representative of Tameca (AR) and Levi (AR), it is not representative of Allison (AR) whose performance in note taking was neither as undeveloped as the other at-risk readers nor as proficient as the average-achieving readers. A further

examination of notes for all students will be included in results related to other strategies for identifying, evaluating, and constructing meaning upcoming sections.

Skimming & Searching for Key Words

On Day 2, only Hannah (AA) and Adam (AA) explicitly used the strategies of skimming and searching for key words to locate information within the page. On Day 3 during brochure construction, all students demonstrated these strategies.

Hannah (AA) and Adam (AA) demonstrated skimming for information while engaging in online reading and note taking. Skimming was predominantly evident in the rapid scrolling up and down pages as students sought important or goal-relevant information within the page before pausing to read typed text or examine other text modalities (e.g., images, graphs, etc.). For example, in searching for tourist activities, Adam (AA) rapidly skimmed up and down the page seeking goal-relevant information.

32:50 [S scrolls down page]

32:53 [S scrolls up page]

32:56 [S scrolls down page]

33:28 R: What are you thinking?

33:30 S: Um, I think I just need to find a few more activities for tourists and then after that, I can um, start on the brochure.

The rapid scrolling in this section suggested the strategy of skimming and the explanation revealed the goal of the skimming, to locate activities for tourists. Hannah (AA) and Adam (AA) infrequently explained their strategy for locating information within the text, but when they did the limited verbalizations demonstrate that they were skimming with purpose, typically searching for keywords (e.g., “I’m looking for plants”). However, in the Day 2 post-interview Adam (AA)

did reflect on strategies good readers would use when reading on the Internet, he immediately responded, “Um, they skim.” When asked anything else he responded, “Look for key words, like, or key links that will help you.” He embodied these strategies in his own online reading. For Hannah (AA) and Adam (AA), the skimming appeared effortless and automatic, perhaps not a conscious strategy, but rather an automated process in reading online texts.

On Day 2 while reading online and taking notes, the remaining four readers, Leanne (AA), Tameca (AR), Levi (AR), and Allison (AR), appeared to use no evident skimming strategies once within a single webpage. In fact, they all appeared to read the nearly the entire text on the webpage in a linear manner from top to bottom, spending significant time on every page. Tameca (AR) and Levi (AR) read every section and spontaneously encountered information that may or may not have been relevant to the brochure goals. They took notes on every webpage. Leanne (AA) and Allison (AR) also read every section in a linear manner with no evident skimming, but unlike Tameca (AR) and Levi (AR), they did so with a plan to identify information that would support the informational requirements in the brochure. For example, Allison (AR) read an entire section on weather and then included information in her notes specifically related to weather, “because we need to know the weather for our brochure.”

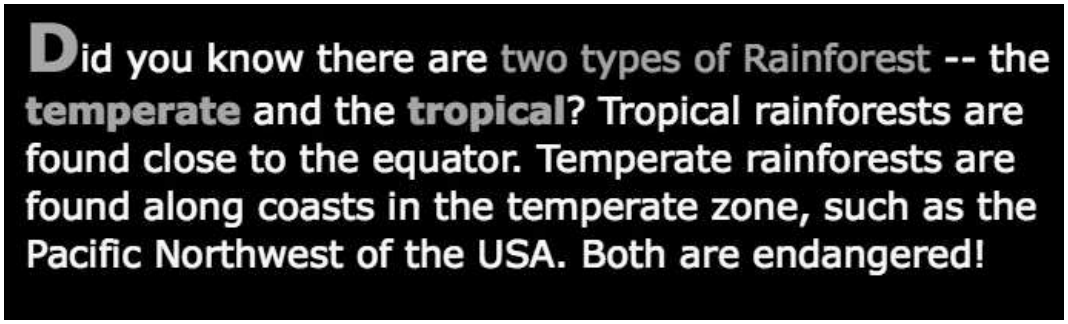
When constructing the brochure on Day 3, all students demonstrated online actions, specifically the rapid scrolling and searching for keywords that suggested skimming websites at least some of the time. For example, when Tameca (AR) was constructing her “plants” section in the brochure she returned to the MBG website and scrolled up and down pages multiple times within less than 15 seconds, pausing at a particular section in the page to then record information about plants back into her brochure. This was in contrast to Day 2 when she started reading at the top of a page and only scrolled down when she finished reading an entire visible section. So,

as the research task shifted to the construction of the brochure, students' patterns in skimming and searching for keywords shifted.

Summarizing

All students summarized information on both days of research. Summarization was evident in the verbal explanations during the verbal protocols and also in the note taking and brochure artifacts. Although all students summarized, the sophistication with which they summarized the text varied. Hannah (AA), Leanne (AA), Adam (AA), and Allison (AR) summarized information more effectively than the two remaining at-risk readers Tameca (AR) and Levi (AR). The note taking scores in particular reveal that Hannah (AA), Leanne (AA), Adam (AA), and Allison (AR) received a score of proficient (4) on their reduction, or summarization, in the notes. Tameca (AR) and Levi (AR) received scores of undeveloped (1) (see Table 10). An example of the varying success of the use of summarization is evident by comparing three students that took notes and verbally described that process on the same webpage. The examples will begin with a screenshot of the page (Figure 13), followed by a section of Leanne's (AA) transcript, then Tameca's (AR) transcript, and finally Levi's (AR) transcript.

Figure 13. Screenshot of the MBG Rainforest Introduction Webpage



Leanne's (AA) summarization of the information in her notes revealed a reduction of information to focus exclusiely on the main ideas from the text. She also explained the rationale for why she incorporated the information into her notes, recognizing the importance of the first facts for shaping a schema to support further information gained about the rainforests.

23:00 [S notes]: • Temperate and tropical

23:12 S: I'm writing down the two types of rainforests because it would be useful to know which one is which because there's probably different parts of it, each one that the other one doesn't have.

23:22 [S notes]: o tropical - closer to equator

o temperate - along coasts

23:40 S: I am writing where they are because it's their specific location cuz one has to be in one place and one has to be in the other.

24:03 [S notes]: o both endangered

In comparison, Tameca (AR) failed to summarize main ideas, paraphrasing nearly the entire text. In her verbal explanations, she referred to her lack of prior knowledge about the information as a reason for incorporating it into the notes. She did not appear to distinguish relevant from irrelevant information.

19:38 [S notes]: There are two types of rainforests - the temperate and the tropical.

19:48 R: Can you tell me why you choose to write that?

19:50 S: Because I actually didn't even know that there was a temperate and a tropical in the rainforest. Like I know that there was a tropical but I didn't know that about the temperate.

20:03 R: OK

20:05 [S notes]: They are also found close to the equator.

20:46 [loud noise in background]

20:46 S: oops, sorry

20:46 R: Can you tell me why you chose to write that?

20:49 S: Mmm, because I thought that, um, that they were really close to the equator. Like a little far back but I didn't think they were like actually close.

21:00 [S notes]: The Temprate is found on the coast of the temprate zones

21:52 S: Mm, I chose to write this because, mm, it would actually be in the temprate zone, but actually its found along the coast. Mmm

22:07 [S notes]: such as the Pacific Northwest of the USA.

22:58 S: I decided not to put both are endangered cuz, um, I kind of figured that they're. mmm

While Tameca (AR) paraphrased nearly everything, Levi (AR) reflected a different struggle with summarization. He summarized too little, verbally referring to or taking notes on one to two facts on a page, but failing to notice or record all the main ideas.

25:08 [S notes]: Tropical are found close to the equator.

25:30 R: Can you tell me why you chose to write that down?

25:31 S: I wrote it down because in order to have a tropical it has to be close to the equator.

Overall, Leanne's (AA) summarization was reflective of Hannah (AA), Adam (AA), and Allison's (AR) use of summarization. As they encountered online text, whether they read it all or skimmed, they identified and recorded main ideas and relevant supporting details. Their verbal protocols often revealed articulated rationales for incorporating information into their

notes. They reduced out irrelevant information. They summarized information into categories on their notes, reflecting the use of an organizational schema for constructing meaning. On the other hand, Tameca (AR) and Levi (AR) struggled with the summarization strategy. They both struggled to identify main ideas and their strategy was to paraphrase entire sentences or paragraphs. They used virtually no organization framework or strategy to construct meaning from the text.

Asking Questions

All students asked questions during online reading and note taking (Day 2), and all students except for Adam (AA) asked questions during brochure construction (Day 3). Students generated questions as they monitored and evaluated the meaning they were constructing from the text. An overview of the types of questions will be provided here. First, all students asked questions about ideas in the text that prompted the next plan in the search for information. For example, Tameca (AR) asked, "mmm, Isn't the Pacific a saltwater?" The question resulted in locating information that answered the question and supported her comprehension. Second, the three average-achieving readers and Allison (AR) asked questions to activate their prior knowledge. For example, while considering tourist activities, Adam (AA) was struggling to locate more possible activities so he asked, "Um, what else they could do in the rainforest is, besides view wildlife is, uh, I do not know." He was attempting to generate inferences based on both the online reading and his prior knowledge to construct more ideas about tourist activities. Third, all students asked questions when they encountered reading comprehension problems. This was evident in Hannah's (AA) struggle with the vocabulary word epiphyte.

23:53 S: -UN- plants in here

23:56 S: Ĕp-ĭ-fē-tē. What the?

24:00 [S notes]: 2 - epiphyte, bambusa

24:07 R: Can you tell me what you are thinking?

24:08 S: Um, I am thinking that I don't know what this plant is. And I don't know how to spell it and I'm confused and I better look.

She monitored the meaning of the word exclaiming her confusion with a question, followed by an inferred question about what the plant is. This type of questioning resulted in comprehension fix-up strategies. Overall, the self-questioning evident in all students' verbal protocols were prompts that encouraged students to initiate additional strategies (e.g., generating inferences, strategies for fixing comprehension, synthesizing additional information within or across websites).

Synthesizing Information Within a Single Webpage

As students constructed meaning from individual webpages, they examined different parts or modalities of the text to synthesize information. In other words, after gaining meaning from one modality (e.g., the typed paragraph), students then also constructed meaning from a different modality (e.g., images or charts). Or alternately, after gaining meaning from one section in the page (e.g., a section on "tropical rainforest adaptations") they then purposefully scroll to another section of the text on the same page to make sense of the initial text (e.g., a section on "other adaptations"). In the latter case, students sometimes gained meaning from the same modalities while at other times from different modalities. Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR) demonstrated the strategy at least one time. They demonstrated synthesis for two purpose: 1) to accumulate additional information in a category, and 2) to enhance comprehension.

All four students used synthesis to accumulate information. Students most commonly synthesized information from typed text and a visual mode of information (e.g., image, chart, or graph). For example, three seconds after scrolling down to the animals heading on UCSB, Hannah (AA) exclaimed, "Hm, whoa, monkeys" after seeing the photograph of the monkey, the only image in the section. She wrote "monkeys" in her notes to start the category on animals. She then read the paragraph accompanying the picture for 49 seconds before adding the next animal, "parrot," to her notes. She was constructing intertextual meaning within the page using the image under the category of animals and then the typed text. Hannah (AA), Adam (AA), and Allison (AR) generated this intertextual meaning using typed text and images. Adam (AA) and Leanne (AA) also constructed meaning using typed text and graphs or tables. They are the only two students that appeared to pay explicit attention to the information-rich modalities of graphs and tables specific to science texts. The other students simply skipped over these graphs and tables when they encountered them.

Only Leanne (AA) and Allison (AR) engaged the strategy of synthesizing information within the website to enhance comprehension for better understanding. Each student used the strategy only one time and they both used it when they monitored the meaning they had previously constructed and recognized a comprehension problem. For example, after reading only the typed text under the third and final heading in a webpage, Leanne (AA) spent over one and a half minutes searching different parts of the text to reconstruct a more coherent understanding of the text.

48:44 S: I got confused so I am kind of reading back, cuz I read ahead, and now I'm reading back to try to see what was going on.

49:00 [S scrolls back up the page to the beginning of the paragraph]

49:40 [S scrolls further up to the beginning of the section]

50:24 [S scrolls down the page to the final section]

It may be possible that students were synthesizing information within a website more than the results revealed in the verbal protocol, but without verbalizations, it was not evident.

Synthesizing Information Across Multiple Webpages

All students constructed meaning for the research by synthesizing information across websites when examining the entire macrostructure of the notes or brochure. However, the intertextual construction of meaning was more of a collection of topic-related facts from one website for one category and then a collection of different topic-related facts from a second website for a different category rather than a deep integration of meaning. For example, a student would collect all the plants from one website and all the animals from another website. Although this was a strategy for integrating information, it was not highly sophisticated and promoted no intertextual construction of meaning within smaller units of information. Only Hannah (AA), Adam (AA), Tameca (AR), and Allison (AR) used the strategy with greater sophistication. Therefore, the following section will examine their use of synthesizing across multiple web sources to 1) accumulate information and 2) enhance comprehension.

Hannah (AA), Adam (AA), and Allison (AR) synthesized information across websites to accumulate information within a specific category or topic. For example, Allison (AR) initially incorporated information about weather into her notes from the UCSB website. She then recognized she needed "more about weather" and located the MBG website to continue adding supporting details within her category for weather. Adam (AA) was the only student to synthesize information across websites using a video. In fact, he was the only participant to actually use a video at any point in the research task. When he did, he returned to four

previously constructed category headings within his own notes and added new supporting details generated from the video.

Only one reader, Tameca (AR), an at-risk reader, used multiple websources to construct meaning to enhance comprehension. After reading the rainforest introduction page that discussed temperate rainforests on the "Pacific Northwest," Tameca (AR) asked herself "mmm, Isn't the Pacific a saltwater?" She then sought out the answer on ask.com by searching for "is the Pacific ocean saltwater." She skimmed the search engine results, and constructed an answer based only on the titles and descriptions on the result page, saying, "So it is saltwater." Tameca (AR) generated a question based on her initial reading, she then gathered information by skimming the descriptions provided under the titles in the search engine results page to generate an answer. This was a sophisticated use of multiple websites to construct intertextual meaning.

Purposefully Returning to Previously Encountered Information.

Four students, Hannah (AA), Tameca (AR), Levi (AR), and Allison (AR), revealed the strategy of purposefully returning to information they had encountered previously in the search. This strategy did not include students that returned to websites accidentally or for a completely different topic, rather students that were specifically seeking out information they had previously skimmed or read. Students engaged in this strategy by either returning to a webpage they had previously visited. During brochure construction Hannah (AA), Tameca (AR), Levi (AR), and Allison (AR) all articulated plans to return to previously visited webpages for specific information related to their goal. For example, while locating animals for her brochure, Tameca (AR) returned to a specific page that she had previously encountered.

4:02 [S scrolls down page]

4:02 [S clicks the next arrow and opens "Common Tree Shrew" page]

4:03 S: I wanted to go back to that little squirrel thing.

4:04 S: There it is. That's awesome.

4:09 S: That's the name? Common tree shrew?

Upon finding the common tree shrew webpage, Tameca (AR) added the animal to her brochure. These four students typically returned to previously visited webpages during the process of brochure construction to add additional information to their notes or brochures.

Generating Inferences

Multiple strategies for generating inferences were evident while students gained meaning from the text. On Day 2, all readers except for Tameca (AR) generated inferences as they constructed meaning. On Day 3 with limited verbalizations due to the loose verbal protocol, only Leanne (AA) and Allison (AR) verbalized the use of inferential reasoning. The following section will first examine the purposes for generating inferences. Next, the section will identify the sources for generating inferences.

Purposes for generating inferences. Students appeared to generate inferences to 1) support their comprehension and 2) determine the relevance of the information. All the students that actually generated inferences used it to support comprehension at least once. For example, after reading that tropical rainforest soil gains nutrients from organisms like decaying plants and animals, Leanne (AA) interpreted and inferred, "so it is often sort of like a recycling thing. It kind of decays and then gives back to the soil and the soil can grow more that will eventually give back to that, which is always good to know that the soil won't be gone some day." She interpreted the text, drawing on the idea or recycling, and inferred that this process regenerated the soil, thus maintaining nutrient rich soil for the lifetime of the rainforest.

Four students, all except for the at-risk readers Tameca (AR) and Levi (AR), also generated inferences about which information would be relevant for the brochure based on topic, informational requirements, or the audience for the brochure. Allison's (AR) verbal explanation of why she incorporated information in her notes provided an example.

32:30 [S notes]: -rainforests are important because they provide oxygen.

32:54 R: Can you tell me why you chose to write it?

32:56 S: Um, because people should know that rainforests are very important because they provide oxygen and without oxygen we wouldn't live.

Allison (AR) inferred that "people" would find the information about oxygen in the rainforest important, therefore prompting the inclusion of the fact in her notes. She considered the audience as a rationale for identifying and recording important information during the online reading task. Students used their evaluation of the usefulness of the information to either include information in their notes or brochure or to exclude it.

Sources for generating inferences. Students generated inference by: 1) examining a single modality within a page (e.g., words in a paragraph), 2) integrating multiple modalities within a single webpage (e.g., images and words in a paragraph on the same page), and 3) drawing almost exclusively upon prior knowledge. No students verbally indicated that they generated inferences across multiple webpages (e.g., images on two or more pages, or images from one page and words from a second page). In many cases, inferencing was supported by not only the text, but also prior knowledge.

Inferences from a single modality within a page. All students except for Tameca (AR) generated inferences from a single modality. The majority of inferences using a single modality were evident while students were reading typed text, particularly paragraphs of information. For

example, Allison (AR) generated inferences about what tourists might be able to do based on the information from the paragraph about the deforestation of the rainforest.

35:45 [S notes]: -thirty acres of trees are cut in tropical rainforests every minute

36:24 S: I kind of want to put that on my brochure because it um, cuz it's um, kind of a bad thing because they are killing habitats for animals and plants.

36:49 S: Um, I'm thinking about an idea I have for the brochure because it says activities tourists might do while they're there visiting it. I was thinking that maybe they could like um, plant a tree, like if they are there. They can plant tree seeds.

After reading the text and adding information to her notes, Allison (AR) inferred that tourists might enjoy planting seeds to counteract the impact of deforestation. This inference drew upon knowledge gained from the text, her prior knowledge, and her recognition of the audience of the brochure.

Adam (AA), Leanne (AA), Levi (AR), and Allison (AR) also generated inferences from images and groups of hyperlinks. For example, Adam (AA) used inferential reasoning when searching for tourist activities. Adam (AA) clicked on the Cool Planet link provided inside the UCSB website for further information about rainforests and skimmed the page, which provided no typed text that might be valuable, but did have a picture of a waterfall. Adam (AA) used the picture to infer a possible activity stating, "I see a waterfall, so I'm thinking they can swim." This inference drew upon his prior knowledge that people can swim in the pools or rivers that generate the waterfalls and the image encountered online.

However, not all students that generated inferences did so correctly. Levi (AR) and Allison (AR) both generated inferences that were incorrect within their reading process. An example is evident in Levi's (AR) use of a group of hyperlinks to generate inferences. The

example below reveals a screenshot of the group of hyperlinks (Figure 14) along with Levi's (AR) resulting inference.

Figure 14. Screenshot of Grouped Hyperlinks

31:49 R: Can you tell me what you are thinking?

31:53 S: That terrestrial biomes are on land and aquatic biomes are like in freshwater.

After reading the list of hyperlinks, presented in a table format, Levi (AR) inferred correctly that terrestrial biomes are on land, but inferred incorrectly that aquatic biomes are in freshwater. While Levi (AR) was the only student to demonstrate inferencing with a group of hyperlinks, a strategy that no other participant utilized, he did so in a way that did not support accurate comprehension.

Inferences from multiple modalities within a page. Hannah (AA), Adam (AA), and Allison (AR) generated inferences from multiple modalities within a page. An example of generating inferences while constructing meaning from multiple modalities on a website was evident in Hannah's (AA) online reading and note taking. She engaged in examining multiple modalities as a strategy for clarifying the meaning of an unfamiliar word, epiphyte. In the process, she generated inferences about the text.

23:53 S: -UN- plants in here

23:56 S: Ĕp-ĭ-fē-tē. What the?

24:00 [S notes]: 2 - epiphyte, bambusa

24:07 R: Can you tell me what you are thinking?

24:08 S: Um, I am thinking that I don't know what this plant is. And I don't know how to spell it and I'm confused and I better look.

24:19 [S scrolls down page to the Epiphyte picture (there is no caption on the picture)]

24:20 S: And I'm pretty sure that is what the E plant, the Ē-fē-tā

24:50 [scrolls down page to see the information under the epiphyte picture]

Hannah (AA) was aware of her lack of comprehension and she devised a plan to "look" and try to clarify her understanding. Hannah (AA) scrolled down to the picture on the page, but due to the limitations in the design of the website, with no captions or title to accompany the image, she could only make an inference that the picture represented an epiphyte. She then moved on to read additional text positioned below the picture. Much like Hannah (AA), the students that did integrate modalities within a webpage frequently combined the typed text with a visual modality like images, charts or graphs.

Inferences from prior knowledge and previously encountered text. Allison (AR), Adam (AA), and Hannah (AA) demonstrated a strategy for generating inference about topics almost exclusively from prior knowledge. Adam (AA) and Allison (AR) generated these inferences during note taking, and Allison (AR) and Hannah (AA) generated them during brochure construction. For these students, the use of this strategy occurred when students were taking notes or constructing brochure categories related to what tourists should pack and activities tourists could do. The students first looked briefly for the information online, but when they did

not find it, they all started generating inferences about facts that might be appropriate for the categories. For example, on Day 3 while constructing the brochure, Allison (AR) began generating information in her brochure that was not included in her notes.

37: 48 R: How are you coming up with these ideas for what to bring?

38:02 S: Um, I'm thinking up what you would need if you were walking in a rainforest.

The inferences may have been generated in part from the general comprehension of text over the course of online reading, but the items generated were primarily from the students' prior knowledge.

In summary, students used many different strategies for identifying, evaluating, and gaining meaning from text. However, the frequency and sophistication of the strategy use varied across students and across days. Overall though, the at-risk readers Tameca (AR) and Levi (AR) demonstrated the fewest and most ineffective strategies for identify, evaluating, and gaining meaning from the text, significantly impact their ability to produce cohesive and useful notes to be used during brochure construction.

Landscaping the Screen

The following section discusses student strategy use while landscaping the screen. These were the strategies utilized as students altered the aesthetics or arrangement of elements on the computer screen. These strategies did not result in the direct construction or communication of meaning, but were peripherally associated to the construction of meaning from a text or the communication of meaning. The strategies were afforded by the technology itself, allowing users to manipulate, personalize, organize, and play with visual elements on the screen. The following section will examine student strategy use including: personalization of a search engine and managing application windows. Table 11 provides a general overview of strategy use for

landscaping the screen for each student. The table reveals each student's specific strategy use on Day 2 while reading online and taking notes both during the verbal protocol and after the verbal protocol as well as on Day 3 when students began brochure construction. The table also organizes individual students by whether they were identified as average-achieving or at-risk readers in the study. Each strategy identified in the table will then be examined in more detail in the text that follows.

Table 11. The Use of Strategies for *Landscaping the Screen* [L] by Student and Task.

Average-Achieving Readers

	Hannah (AA)			Leanne (AA)			Adam (AA)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Personalizing Search Engines					n/a				
Managing Application Windows			x		n/a	x			x

At-Risk Readers

	Tameca (AR)			Levi (AR)			Allison (AR)		
	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3	D2:VP	D2:NoVP	D3
Personalizing Search Engines	x				n/a				
Managing Application Windows			x		n/a	x			x

Note: x denotes the presence of a strategy at least one time
D2:VP = Day 2 online reading and note taking during the verbal protocol, D2:NoVP = Day 2 online reading and note taking after the verbal protocol, D3 = Day 3 brochure creation (online reading and note taking continued)

Personalizing Search Engines

One student, the at-risk reader Tameca (AR), revealed the strategy of landscaping during the process of realizing and constructing online texts to read. On Day 2, she personalized a search engine prior to a search for information. Tameca (AR) decided to select the search engine ask.com to search for an answer the question "Is the Pacific Ocean salt water?" Prior to any searching however, Tameca (AR) altered the aesthetic appearance of the search engine.

24:37 [S clicks on right hand page corner image and opens the ask.com themes page.]

24:43 [S scrolls down the page]

24:44 [S clicks on sea buddies image and the current page changes to display the sea buddies theme.]

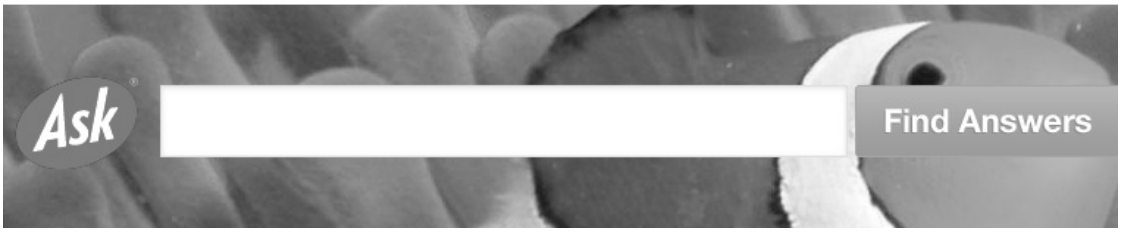
24:46 [S scrolls over a popup box that asks S to like it, love it, or try again.]

24:48 [S clicks like it]

24:50 S: I'm sorry but I have to change the background. I always do it cuz it's so cute.

Rather than using the search engine with the basic template, Tameca (AR) altered the background aesthetics, the theme (Figure 15). Furthermore, she reported always changing the aesthetic appearance when using ask.com. This personalization of the search engine page was a strategy that was not directly associated with finding, reading, or communicating content, but was a precursor that she felt compelled to complete. Although this was secondary to the direct construction of meaning, questions arise about the impact of landscaping strategies on the construction of meaning, questions examined in more depth in the discussion.

Figure 15. Screenshot of Sea Buddies Theme on ask.com



Managing Application Windows

All students engaged in strategies of managing application windows in Day 3 while constructing the brochure. These strategies included navigating between active windows, zooming in or out of the screen on active windows, resizing active windows, and managing software pop-up windows.

The strategies for navigating between windows were apparent as students shifted from the Word application window and the Internet Explorer window. All students worked with only one active window on the desktop at a time while other windows were still active but minimized to the task bar. All students used the Windows' task bar, located at the bottom of the computer screen to switch between active windows. An example is evident in Hannah's (AA) construction of the weather category in the brochure, during which she was using the UCSB website to add more information to the category.

12:07 [S clicks on the Word icon at the bottom of the screen (task bar) and opens brochure]

12:09 [S types]: High humidity 77% to

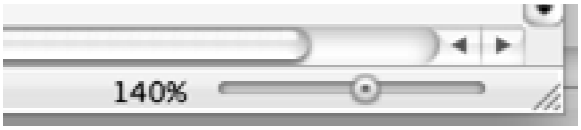
12:23 [S clicks on the IE icon at the bottom of the screen (task bar) and opens the UCSB rainforest webpage]

12:26 [S clicks on the Word icon at the bottom of the screen (task bar) and opens brochure]

All students except for Leanne (AA), demonstrated this strategy frequently on Day 3 while constructing the brochure. The students listed in order from highest number of clicks between active windows to the lowest are as follows: Levi (AR) (42), Hannah (AA) (40), Allison (AR) (32), Adam (AA) (27), Tameca (AR) (22), and Leanne (AA) (3). Leanne (AA) is the exception because she spent the beginning of Day 3 locating online information to complete her notes and then constructed the brochure almost wholly from her notes. All other students were actively using several online websites and webpages to construct their brochure.

Both average-achieving readers Adam (AA) and Leanne (AA) used the strategy of zooming into and out of text in the Microsoft Publisher window using the zoom button in the toolbar one time each (see Figure 16). Hannah (AA), Tameca (AR), and Levi (AR) never used a zoom strategy. Allison (AR) did not demonstrate the strategy of zooming, but instead after a period of silence asked the research, "How do you make it bigger?" The researcher verbally directed her to the zoom tool after she sat in silence without any action for over one minute.

Figure 16. Screenshot of Zoom Button



Only Leanne (AA) used the strategy of resizing the active window on the screen. When the Microsoft Publisher window appeared covering approximately three-fourths of the screen, she dragged the corners of the window until it covered the entire screen. She did not verbally explain this strategy. All other students worked with windows that were not fully expanded on their screen resulting in more navigational moves within the document to view sections of their brochure. Only Adam (AA) encountered a software pop-up textbox and he quickly engaged strategies to close the textbox using the close button at the top right corner of the window.

Although overall the landscaping strategies were demonstrated infrequently, with the exception of navigating between active windows, these strategies raise questions about the frequency and efficiency with which students can manage and manipulate features on the screen to their benefit. This is further examined in the discussion.

In conclusion, one student demonstrated landscaping strategies within a search engine. All students demonstrated landscaping strategies for navigating application windows on the screen. However, in general the landscaping strategies students used were limited. Given the possibilities for technology to provide multiple ways to represent information especially for struggling learners (Rose & Meyer, 2002), there was limited customization of the technology to support individual learners.

Self-Regulatory Strategies During Online Reading and Note Taking (Day 2)

The self-regulatory strategies for realizing and constructing potential texts to read and identifying, evaluating, and constructing meaning from text were highly interconnected. They frequently occurred in conjunction with one another. The primary strategies evident within these cycles were planning, predicting, monitoring, and evaluating, although not all students used every strategy. The following section will introduce each strategy and reveal how students engaged the strategies during online reading and note taking. However, before that detailed examination of strategies, it is important to recognize that the self-regulatory strategies occurred as subroutines within specific tasks, at a micro-level, but those subroutines also supported or sometimes failed to support a meta-level self-regulatory process. The meta-level processes supported the entire project and helped students coordinate the strategies in each of the subroutines to ultimately support brochure construction. Figure 17 and 18 will provide evidence of how micro-level self-regulatory strategies supported or failed to support the meta-level goal.

Figure 17 reveals how Hannah (AA) engaged in a 20 second self-regulatory strategy cycle while locating and gaining meaning. The cycle of strategies supported her meta-level goal to locate information and gain meaning according to the informational requirements to support brochure construction the following day. Figure 18 reveals how Tameca (AR) engaged in planning at the micro-level while locating text, but failed to monitor or evaluate her hyperlink selection. As a result, she failed to continue online reading to support her goal to gain information about the general topic of the rainforest.

Figure 17. Hannah's (AA) Micro-level Self-Regulatory Strategies Successfully Supported the Meta-level Plan

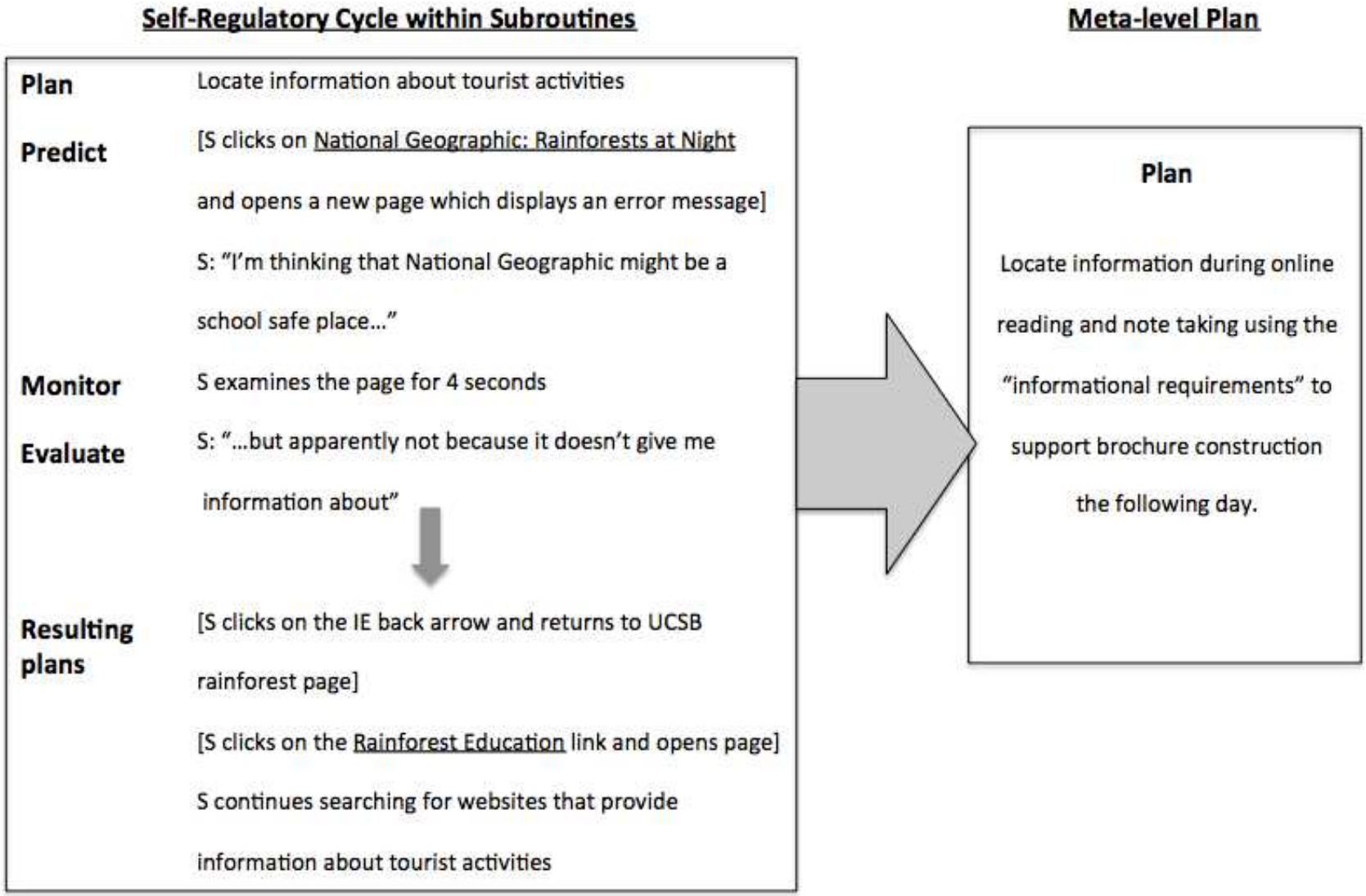
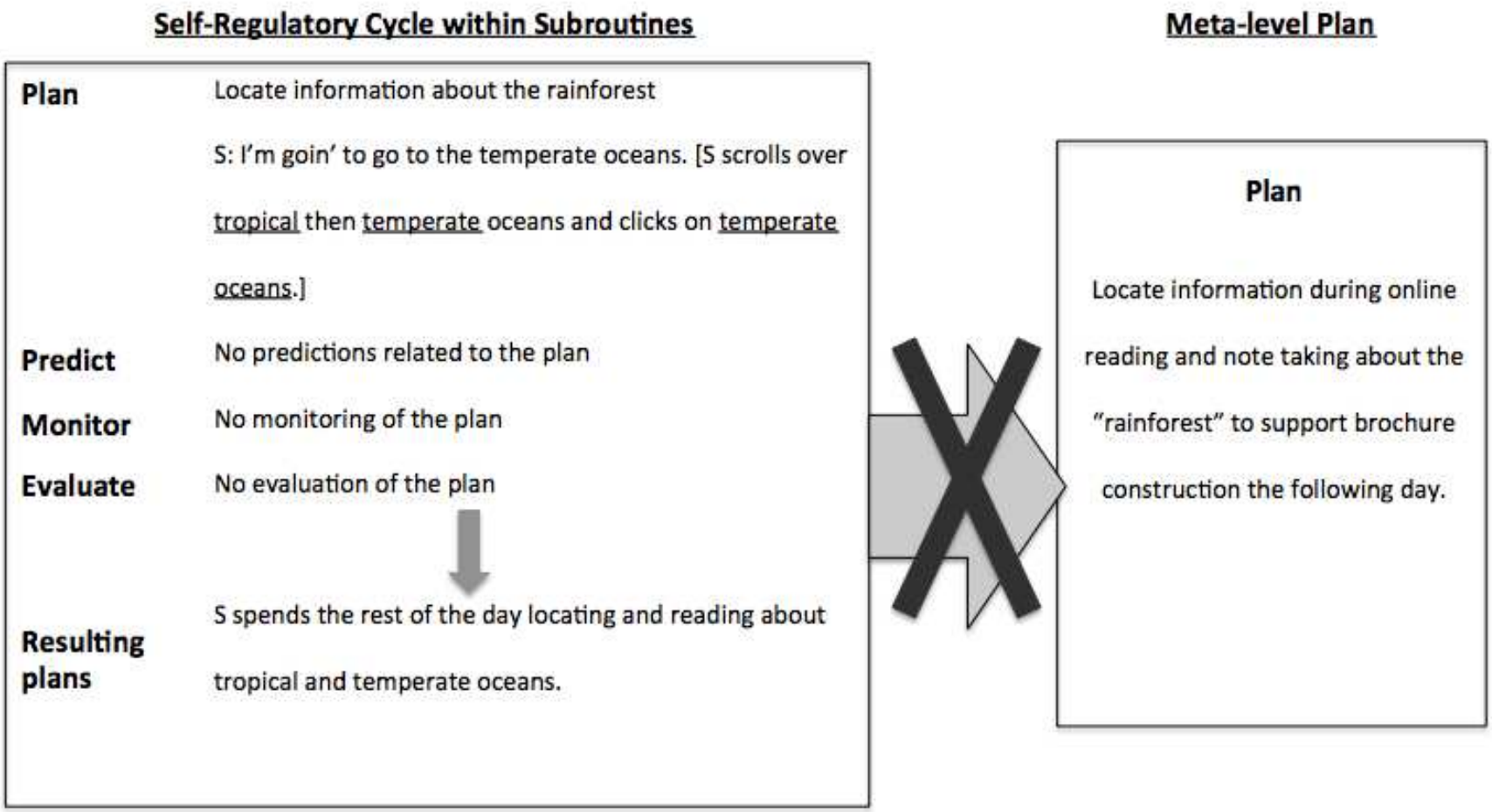


Figure 18. Tameca's (AR) Micro-level Self-Regulatory Strategies Failed to Support the Meta-level Plan



Planning

All students engaged in planning strategies for realizing and constructing potential texts to read and identifying, evaluating, and gaining meaning during online reading and note taking. Students' plans involved 1) locating texts and constructing meaning about goal-relevant information 2) determining what to read and what to ignore, 3) revising the reading path, 4) resolving comprehension problems. Only one student, Tameca (AR) revealed planning strategies for landscaping the text. The following section will examine students' plans as well as the extent and effectiveness of those plans.

Locating texts and gaining meaning about content-relevant information. At some point during online reading and note taking on Day 2, every student initiated a plan to initially locate online texts and construct meaning about the general topic (rainforest) or the informational requirements (e.g., plants, animals). However, the extent of the plan and the way each student carried it out varied.

Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR) consistently articulated plans that were guided by goals aligned with the brochure rubric (e.g. finding specific rainforest animals). These goals influenced their strategies for locating online texts as well as gaining meaning from text. When locating online texts, these students navigated to a specific hyperlink, or group of hyperlinks, because they might be topic-relevant and useful. For example, when about to click on a hyperlink titled Tropical Rainforests What it's Like Where You Live, Hannah (AA) explained, "I'm thinking that this site might help me with the other two of the check marks that I need." She was referring to the self-check portion of the rubric where she was checking off information requirements as she completed them. These students used goals to locate topic-relevant websites and webpages.

The plans to locate topic-relevant information helped these four students locate the website, but then as students engaged in reading the online text, their plans to construct meaning using the goals varied. Hannah (AA) and Adam (AA) initiated active plans to skim within webpages for the informational requirements, move on to additional webpages within the site or new sites as they directly sought information for the specific goal (e.g., finding information about plants). Leanne (AA) and Allison (AR) initiated more passive plans for gaining meaning related to their goals. Once they located websites that were relevant to the topic rainforest they did not actively search and locate additional topic-relevant information within the website using the informational requirements. Instead, they read nearly everything within the site, spontaneously encountering information rather than searching directly for topic-relevant websites or hyperlinks. Their plans involved finding relevant information on every single page, accumulating the information in their notes. An example of Leanne's (AA) plan to gain information from each page was evident when she responded to the researcher's prompt.

40:22 R: Tell me what you are thinking

40:23 S: To go to the next page because I feel like there is going to be a lot of pages ahead so I just want to get through them to get as much information as I quickly can.

Leanne's (AA) goal was to continue to move sequentially through each page, constructing meaning and recording it into her notes. In this way, both students' strategies for constructing meaning were more passively goal-directed compared to the students that actively engaged strategies to locate and gain meaning from information within websites. As a result, Leanne (AA) and Allison (AR) visited fewer total webpages (9 and 2 respectively) than Hannah (AA) and Adam (AA) (20 and 13 respectively) during the online reading and note taking with the verbal protocol.

The remaining two readers generated ineffective or inefficient plans for locating texts and constructing meaning. Levi (AR), an at-risk reader, planned around the general reading topic (rainforest), only referring to an informational requirement one time. He also generated plans to examine interesting information that may or may not have been useful for the purposes of the brochure. For example, Levi (AR) detoured to tropical oceans stating he picked it because it "looks cool." He then read and took notes about tropical oceans. Tameca (AR) demonstrated minimal planning according to the goals aligned with the brochure, reading toward the goal of rainforest on the first website she located, but never again, a finding discussed further in Chapter 6. For a significant period of Day 2, Tameca (AR) located websites that were not relevant to the topic rainforest and as a result read information unrelated to the rainforest. She failed to continue using a plan related to the brochure rubric for locating texts or gaining meaning from texts.

Locating texts and gaining meaning about audience-relevant information. On Day 2, it is worth noting that no students verbally indicated plans to initially locate audience-relevant information. However, Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR) demonstrated monitoring or evaluative judgments of the websites they encountered that suggested they were indeed planning for audience-relevant information. For example, Hannah evaluates a website stating, "I'm thinking that I found a good place for tourists…" which suggests that she was planning to locate both topic- and audience-relevant information. These students' actions suggested they were likely planning for audience-relevant information.

Plans to move to a new goal-relevant category. All students generated plans about when to move on to another category or when to construct more meaning by continuing with online reading. All students verbally noted that their plans were based on reaching a certain quantity of

information that they believed was "enough." For example, when finishing his last category, Adam (AA) planned to gain more information about tourist activities from a new website.

32:44 [S clicks on Cool Planet link and opens cool planet page]

32:47 S: Go to that, maybe it has tourist attractions.

32:50 [scrolls down page]

32:53 [scrolls up page]

32:56 [scrolls down page]

33:28 R: What are you thinking?

33:30 S: Um, I think I just need to find a few more activities for tourists and then after that, I can um, start on the brochure.

Adam (AA) was locating additional potential sources by clicking on a hyperlink and opening a new page. He articulated that he was still looking for "more" activities to add to the category before he could move on to the next stage in the process. Tameca (AR) described the plan to gain a certain amount of information in her post-interview.

S: First I went to the one I was assigned for [clicks on rainforest menu link].

R: OK.

S: The Rainforest. And I found out some really good information. And I know that that wasn't really enough. So then I just went back and then I went to the next one. [clicks on back button and returns to MBGnet homepage]

When students reached the threshold for "enough" information, they then moved on to the next category, sometimes remaining within the current website and sometimes navigating to a new webpage. Unfortunately, no students articulated how they determined the quantity for what was "enough."

Revising the reading path. Two students, Adam (AA) and Hannah (AA), revealed plans to revise the online reading path, a plan that occurred after they had monitored and evaluated the website. They did not articulate their plans, but they were evident through the students' online actions, as evident in Hannah's (AA) search for additional online sources.

35:03 [S clicks on National Geographic: Rainforests at Night and opens a new page which displays an error message]

35:04 R: Can you tell me what you are thinking?

35:08 S: I'm thinking that National Geographic might be a school safe place, but apparently not because it doesn't give me information about

35:22 [clicks on the IE back arrow and returns to UCSB rainforest page]

So while Hannah (AA) had planned to gain information about tourist attractions from the National Geographic website, she rapidly monitored and evaluated the site resulting in a revised plan to go back to a TR website. Adam (AA) and Hannah (AA) revised reading paths when websites were not related to their reading goal and when they encountered broken links (e.g., sites that failed to load, or sites with "construction in progress").

Resolving comprehension problems. All students except for Levi (AR) articulated plans to resolve comprehension problems. These plans were generated after students monitored their comprehension and recognized either a struggle in decoding a word, comprehending the meaning of a sentence or paragraph, or interpreting an image or graph. Four students, Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR), resolved comprehension problems by navigating within the website, examining other sections of the current webpage and a variety of modalities on the page. An example of a plan was Hannah's (AA) recognition that she was struggling to understand the term epiphyte. Hannah (AA) stated, "Um, I am thinking that I don't know what

this plant is. And I don't know how to spell it and I'm confused and I better look." She then generated a plan to look at other sections of the page including other modalities (e.g., images) to resolve her understanding. It is relevant to note that not all students carried out the plans toward a successful understanding of the meaning. Both Hannah (AA) and Leanne (AA) demonstrated instances where they began fix-up strategies and then moved on to new plans before resolving their struggle with comprehension.

Tameca (AR) was the only student to resolve a comprehension problem by navigating to a search engine and then engaging in a keyword search. After reading the rainforest introduction page that discussed temperate rainforests on the "Pacific Northwest," Tameca (AR) asked herself "mmm, Isn't the Pacific a saltwater?" She then initiated a plan to use a keyword search on ask.com, searching for "is the Pacific ocean saltwater." While going to the site, she stated, "This is the best website that I go to ask for information." She generated her plan based on prior knowledge and familiarization with the search engine and ultimately answered her initial question.

Landscaping the screen. Tameca (AR) revealed plans to landscape the ask.com search engine background rather than using the template. She articulated, "I'm sorry but I have to change the background. I always do it cuz it's so cute." She generated her plan based upon her prior knowledge and familiarization with the search engine. No student articulated their plans for managing active windows although their actions suggested that they did in fact have plans. These plans may have been subconscious routines, or skills, that students simply did not articulate.

Predicting

Students engaged in predicting while generating the reading path and while determining what information might be appropriate for the brochure based on topic, informational requirements, or the audience for the brochure. First, all students except for Tameca (AR) verbally articulated predictions or inferences about the path of hyperlinks. They predicted the usefulness or relevance of hyperlinks within the reading path. For instance, Hannah (AA) predicted that the National Geographic link should lead to content that was "school safe." Students predicted the possible path a hyperlink may lead to, the usefulness of information that may be encountered, or the relevance of the information that may result.

Second, four students, all except for the at-risk readers Tameca (AR) and Levi (AR), also predicted which information would be relevant for the brochure based on topic, informational requirements, or the audience for the brochure. For example, Allison (AR) predicted tourists would want to know about deforestation. The predictions about relevant or irrelevant information led students to either continue reading the text to confirm their predictions, resulting in the inclusion of the information in their notes, or to abandon the current reading and link to a new webpage or a different section of the webpage.

Monitoring

Monitoring was evident throughout students' online reading process. All students verbally described monitoring while realizing and constructing online texts to read and identifying, evaluating and constructing meaning in Day 2. They demonstrated monitoring of 1) the reading path in relation to their goals and what meaning had already been constructed, 2) specific problems in the reading path, and 3) comprehension problems. Although all students demonstrated strategies at some level, the frequency and sophistication of the monitoring strategies varied across participants. Both will be discussed in the following section.

Monitoring the reading path in relation to goals and previously constructed meaning. Students monitored their reading path in relation to the reading goals. Monitoring the reading path required that students were also monitoring the meaning they were constructing while reading online texts. While monitoring strategies were most clearly evident when students articulated explanations for their online actions (e.g., "now I need to look for more animals"), students' online actions alone also provided evidence of unarticulated monitoring strategies (e.g., a student persisting to search for specific goal-related information through multiple hyperlinks when the first link does not provide the information sought).

During online reading and note taking, Hannah (AA) and Adam (AA) frequently demonstrated monitoring strategies related to their plans to gain meaning specifically related to the informational requirements of the brochure. An example was evident in Adam's (AA) online search with the goal of locating tourist attractions.

29:18 S: Let's see if they have anything about it on this website.

29:19 [S scrolls to the top of the rainforest page]

29:23 S: people

29:24 [S clicks on the people anchor link which scrolls the page down to the heading "people"]

29:26 S: cuz I'm looking about people

29:38 [S scrolls to the bottom of the page]

In Adam's (AA) search, he continued on to another website recognizing that he needed to locate additional information about the topic. He quickly skimmed and monitored the page with his goal for locating information about tourists in mind. Both students that demonstrated

monitoring strategies during online reading and note taking frequently paired their monitoring with evaluation, discussed in the following section.

The four remaining students, Leanne (AA), Allison (AR), Tameca (AR), and Levi (AR), either monitored inefficiently or infrequently for reading goals aligned with the requirements of the brochure. Leanne (AA) and Allison (AR) monitored their goal for locating information, noting information they encountered that aligned with their goals and recording it in their notes. However, their monitoring did not result in a revised and more effective plan for searching for information. Levi (AR) monitored the reading goal, but only infrequently. He spent nearly the first five minutes reading about tropical oceans before he monitored his meaning in relation to the reading goal for the rubric and shifted to reading about the rainforest. Then once within a topic-relevant websites, he never actively monitored the reading path again. Tameca (AR) was an example of both infrequent and ineffective goals for locating information. Approximately eight minutes into her search for information about her topic the rainforest, Tameca (AR) clicked on a link to tropical oceans. She never monitored her initial goal of locating information about the general topic of the rainforest and she never redirected her search back to the rainforest for the remainder of the day. Overall, Leanne (AA), Allison, (AR), Tameca (AR), and Levi (AR) struggled to engage effective monitoring strategies, which in turn affected their ability to direct or redirect their plans to effectively locate information for the purposes of the research.

Monitoring specific problems in the reading path. During online reading and note taking, Adam (AA) and Hannah (AA) monitored for problems in the reading path related to 1) broken links and 2) previously encountered information. The verbalizations related to monitoring for these types of problems were limited, but the online actions revealed monitoring

had occurred because students redirected their reading path. An example of monitoring broken links was demonstrated by Adam (AA).

34:46 [S clicks on the home menu link and website is loading (spinning counter) but nothing happens]

35:09 R: What are you thinking?

35:11 S: Um, right now I'm just waiting for it to load.

35:18 [webpage is still loading]

35:35 [webpage opens that says "server error"]

35:40 [S clicks on the IE back arrow in the browser and returns to the Cool Planet webpage]

35:45 [S hovers mouse over menu items]

35:48 [S clicks on the facts and figures menu link and opens a new page]

Adam's (AA) actions revealed that he was monitoring the broken reading path and readjusting his plan for locating the information. Adam (AA) and Hannah (AA) only encountered broken links when navigating to external links, and every time this occurred they monitored their reading path and took actions to renegotiate a navigational path to goal-relevant information.

An example of monitoring for previously encountered information was evident in Hannah's (AA) search.

37:42 [S clicks on rainforests link and opens page]

37:47 S: Ohhh. What the?

37:51 R: What are you thinking?

37:51 S: I'm thinking that I just went back to this place and now I'm confused so I am going to click on Sarah's.

37:59 [S clicks on Sarah link and opens page]

Hannah (AA) monitored her reading path, recognizing that she had previously visited the site, and subsequently redirected her reading path by clicking on a new hyperlink. Both Hannah (AA) and Adam (AA) were quick to notice unintentional returns to sites they had previously visited and responded by redirecting their online reading path by either clicking on a new hyperlink within the page or using the back arrow to navigate to the previous webpage.

Monitoring comprehension problems. All students except for Levi (AR) monitored for comprehension problems while engaging in online reading and note taking. For example, Allison (AR) monitored her understanding of a passage she had skimmed, noting a struggle with comprehension, and engaging a fix-up strategy.

48:08 [S scrolls down the page]

48:44 S: I got confused so I am kind of reading back, cuz I read ahead, and now I'm reading back to try to see what was going on.

49:00 [S scrolls back up the page to the beginning of the paragraph]

49:40 [S scrolls back up to the beginning of the section]

Two students, Hannah (AA) and Adam (AA), monitored specific challenges with content vocabulary. For example, Hannah (AA) monitored her comprehension while reading about plants recognizing that she had encountered an unfamiliar word, epiphyte. She stated, "Ĕp-ĭ-fē-tē. What the?" and then she explained, "Um, I am thinking that I don't know what this plant is. And I don't know how to spell it and I'm confused and I better look."

Despite monitoring and noting comprehension problems, not all students then engaged effective plans to resolve their problem. Hannah (AA), Tameca (AR), and Allison (AR) all demonstrated at least one instance of not resolving their lack of understanding. For example, Allison (AR) spent time examining a graph about the effects of altitude on vegetation. After nearly one minute on the same webpage examining the graph and reading the accompanying text, the researcher prompted her to share what she was thinking.

> 37:41 S: That I'm kind of confused about this map because it says stuff about snow and mountains on it and it really doesn't have anything to do with the rainforest. And sea level. So I'm not sure how altitude really did have to do with the rainforest now.
>
> 37:58 [S clicks on the next arrow at the bottom of the page and opens "why are forest people well-adapted to living in the tropical rainforest?"]

Rather than resolving her struggle to comprehend the graph, she simply clicked on the next arrow at the bottom of the page and advanced to the next topic, beginning a new section in her notes related to people in the rainforest. None of the students that abandoned a plan to fix-up comprehension ever resolve the comprehension issue later in their reading.

Evaluating

Evaluating strategies frequently followed monitoring strategies as students sought to evaluate the usefulness of an online source. Students evaluated their plans for realizing and constructing potential texts and identify, evaluating, and constructing meaning. For all students, the results of monitoring and then evaluating reading paths and the constructed meaning led to either reading the text for meaning, continuing the plan for locating information, or creating or revising a new plan for locating information. Students evaluated 1) the usefulness or relevance

of information within a website and 2) the usefulness of a website based on its URL. Both will be examined in the following section.

Evaluating the usefulness or relevance of information on a website. Evaluation could occur within seconds of clicking on hyperlink and examining the resulting page or after a longer period of reading portions of the text on the website. The patterns in the use of evaluation strategies mirror the patterns seen in the monitoring strategies. That is, on Day 2, the same two readers that monitored the most frequently (Hannah (AA) and Adam (AA)) also evaluated text most frequently.

Hannah (AA) and Adam (AA) evaluated the usefulness and relevance of websites within seconds of entering the new website. An example was evident in Hannah's (AA) online reading.

35:49 [S clicks on Teachers: get a free rainforest PowerPoint show and opens a new page that displays a PPT on the web]

35:54 R: Can you tell me what you are thinking?

35:55 S: I'm thinking that if the teacher has a PPT, then they should show me some notes and good pictures on the rainforest, but apparently not. Well, teachers.

Hannah (AA) and Adam (AA) used this strategy most frequently when hyperlinking to external links. On the other hand, evaluation of the usefulness or relevance of the website could also occur after students spent more significant time on the site. Four students, Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR), evaluated the usefulness or relevance of the webpage after spending time skimming or reading sections of the text. This was evident in Adam's (AA) attempt to locate information about tourist attractions.

29:18 S: Let's see if they have anything about it on this website.

29:19 [S scrolls to the top of the rainforest page]

29:23 S: people

29:24 [S clicks on the people anchor link which scrolls the page down to the heading "people"]

29:26 S: cuz I'm looking about people

29:38 [S scrolls to the bottom of the page]

29:38 S: This is kind of talking about why people need rainforests though, not tourist attractions.

After clicking on the people hyperlink, he monitored the reading path and then rapidly evaluated the usefulness of the page in relationship to his reading goal. He recognized that while the section was discussing people, it did not appear to discuss information pertinent tourist attractions.

Evaluating the usefulness of a website based on its URL. Only one student, Hannah (AA), evaluated the usefulness of a website based on the URL. After monitoring a new website in her reading path she stated, "I'm thinking that I found a good place for tourists if they visit the rainforest, that they could use this website, cuz it looks like a safe site, cuz it has net, dot net on it, instead of dot com." She evaluated the credibility of a site that had .net as better than .com and therefore more appropriate for the audience of tourists.

In conclusion, during online note taking and brochure construction, students used a variety of self-regulatory strategies. If arranged on a continuum of self-regulatory strategy use while online reading and note taking, Hannah (AA) and Adam (AA) would be have demonstrated the most frequent and effective strategies related to planning, predicting, monitoring, and evaluating. Leanne (AA) and Allison (AR) would be in the middle of the continuum, demonstrating some self-regulatory strategies with varying levels of effectiveness. Tameca (AR) and Levi (AR)

would be on the lower end of the continuum having used the fewest self-regulatory strategies with limited effectiveness. When examining these patterns in self-regulatory strategy use in relationship to the note taking product students created, Hannah (AA) and Adam (AA) had high total composite note taking scores (15 and 16 respectively). Leanne had the highest total composite score (17), but she was also the only student that continued to take extensive notes on Day 3. Therefore, the high score is not a result of self-regulatory strategy use, but rather a result of spending an extra twenty minutes more on notes than any of her peers. Allison had a total composite note taking score (13) near the group mean of 12.3. Tameca (AR) and Levi (AR) received the lowest composite note taking scores (6 and 7 respectively). Therefore, students with more frequent and effective strategy use received higher scores on the note taking artifact than students that used fewer strategies and did so ineffectively. Ultimately, the students' abilities to engage in effective self-regulatory cycles also supported the meta-level plan for the brochure, as revealed in the next section examining self-regulatory strategies during brochure construction.

Self-Regulatory Strategies During Brochure Creation (Day 3)

Self-regulatory strategies related to brochure creation influenced students' strategies for realizing and constructing potential texts to read and identifying, evaluating, and constructing meaning from text, and landscaping on Day 3. The following section will examine students' self-regulatory strategies evident during brochure construction and examine how those strategies influenced all other strategies for locating and gaining meaning from text.

Planning

Students' plans for the brochure affected their strategies for realizing and constructing potential text to read, identifying, evaluating, and constructing meaning from online text, and landscaping on Day 3. The following section will examine students' plans and their impact on

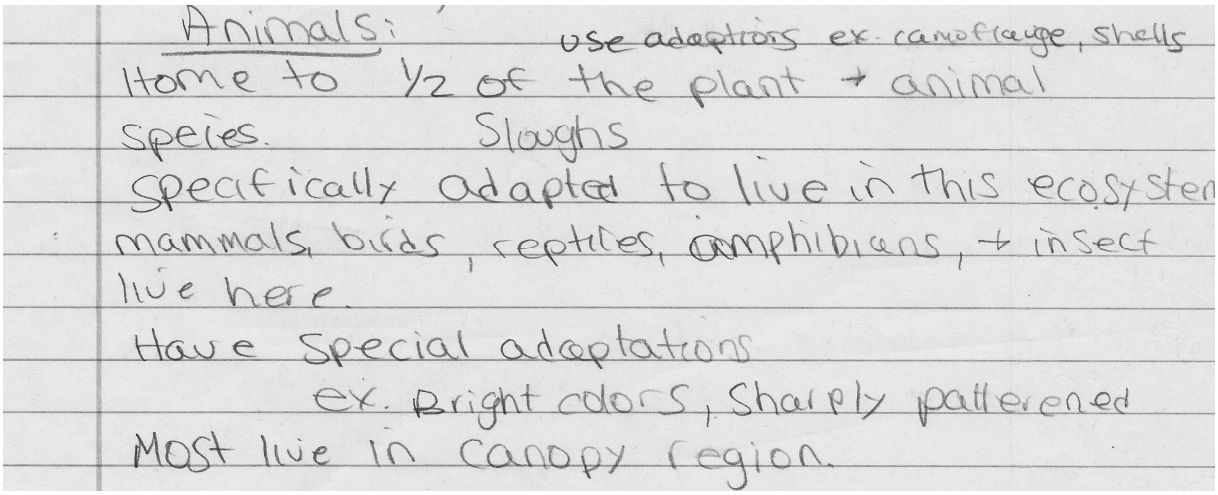
resulting strategies. The section will reveal the results about students' plans to 1) construct topic-relevant content in the brochure, 2) construct audience-relevant content in the brochure, and 3) organize the brochure.

Constructing topic-relevant content in the brochure. All students engaged in planning to accumulate information related to the content requirements of the brochure. The general topic (rainforest) and the specific informational requirements (e.g., plants, animals, a map, etc.) were drawn specifically from the students' brochure rubric. Prior to discussing the planning strategies noted on Day 3 during brochure construction, it is relevant to point out that variations in strategy use on Day 3 were influenced by whether or not students had a meta-level awareness and plan for the research project that supported collecting topic-relevant information on Day 2. Four students, Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR), revealed evidence of planning for the more specific informational requirements necessary for the brochure on Day 2 while engaging in online reading and note taking. It appears that they had a meta-level goal during the entire research project; therefore, they used the brochure rubric to guide their online reading and note taking beginning on Day 2. The two remaining at-risk readers, Tameca (AR) and Levi (AR), did not plan for the specific informational requirements until Day 3 when actually constructing the brochure. As a result, the timing affected the way students generated plans to incorporate content requirements into the brochure using 1) the notes, 2) the Internet, and 3) inferences generated from prior knowledge and previously constructed meaning.

Using notes. When students began constructing their brochures on Day 3, Hannah (AA), Leanne (AA), and Adam's (AA) high content-alignment of the notes with the requirements for the brochure led to the use of a large portion of their notes from the previous day. Hannah (AA) used 45.00% of the idea units from her original notes, Adam (AA) used 60.50%, and Leanne

(AA) used 61.38%. Their attention to the planning for the topic and audience requirements while online reading and note taking the previous day supported their plan for the construction of the brochure. An example of Adam's (AA) notes about animals and his resulting brochure section on animals are displayed in Figure 19.

Figure 19. A Sample of Adam's (AA) "Animal" Category in the Notes and Brochure



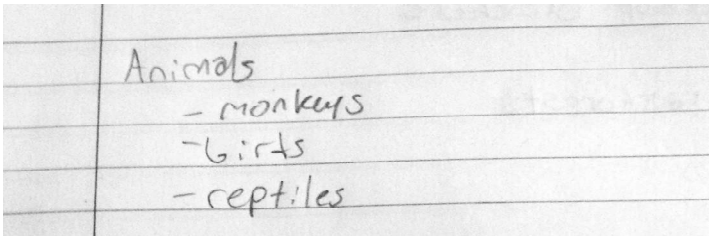
Animals

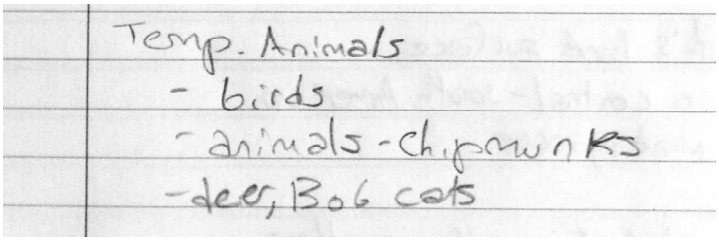
The Rainfores biome is home to over half of the plant and animal species. animals are specifically adapted to this environmnet. There are mammals, birds, reptiles, amphibians, and insects that live in this ecosystem. Most of them live in the canopy region. They all have their own special adaption to survive and reproduce.

Adam (AA) used over 80.00% of the ideas from his notes in his brochure for the animal category. As the average-achieving readers planned to use their note to construct information in their brochure, they primarily transferred information directly from their notes to the brochure with limited transformation of the information.

The at-risk reader Allison (AR), who had also articulated a plan to collect information on Day 2 related to the informational requirements on the brochure actually used only 11.00% of her notes in the brochure on Day 3. While Allison (AR) had accumulated information in her notes that supported the content required for the brochure, her pattern of use varied from the average-achieving readers because she spent significant amounts of time transforming her original notes for the purpose and audience of the brochure. An example of Allison's (AR) notes and then resulting brochure section are provided in Figure 20, followed by a section of transcript revealing her process for transforming the original notes.

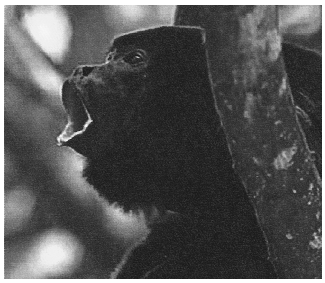
Figure 20. A Sample of Allison's (AR) "Animals" Category in the Notes and Brochure





Fun loving Animals:

- Howlin' Monkeys
- Perty Birds
- Fierce Bob Cats
- Scaley Reptiles



14:44 [S types]: Animal

14:46 [S deletes “Animal”]

14:47 [S types]: Fun loveing animals [autocorrect changes loveing to “loving”]

14:54 [S places mouse in front of plants and types]: Pretty

15:07 [S clicks on the bullet icon at the top of the screen]

15:30 [S looks at notes]

15:34 [S types]:

*Howlin’ Monkeys

*Perty Birds

16:26 [S types]:

*Fierce Bob Cats

*Scaley

17:13 [S deletes “ey” and types]: ie

17:14 [S deletes “ie” and types]: ey

17:15 [S types]: Repstiles

17:23 [S deletes “s” in middle of Repstiles]

17:26 S: I’m trying to put adjectives in there so it looks more interesting.

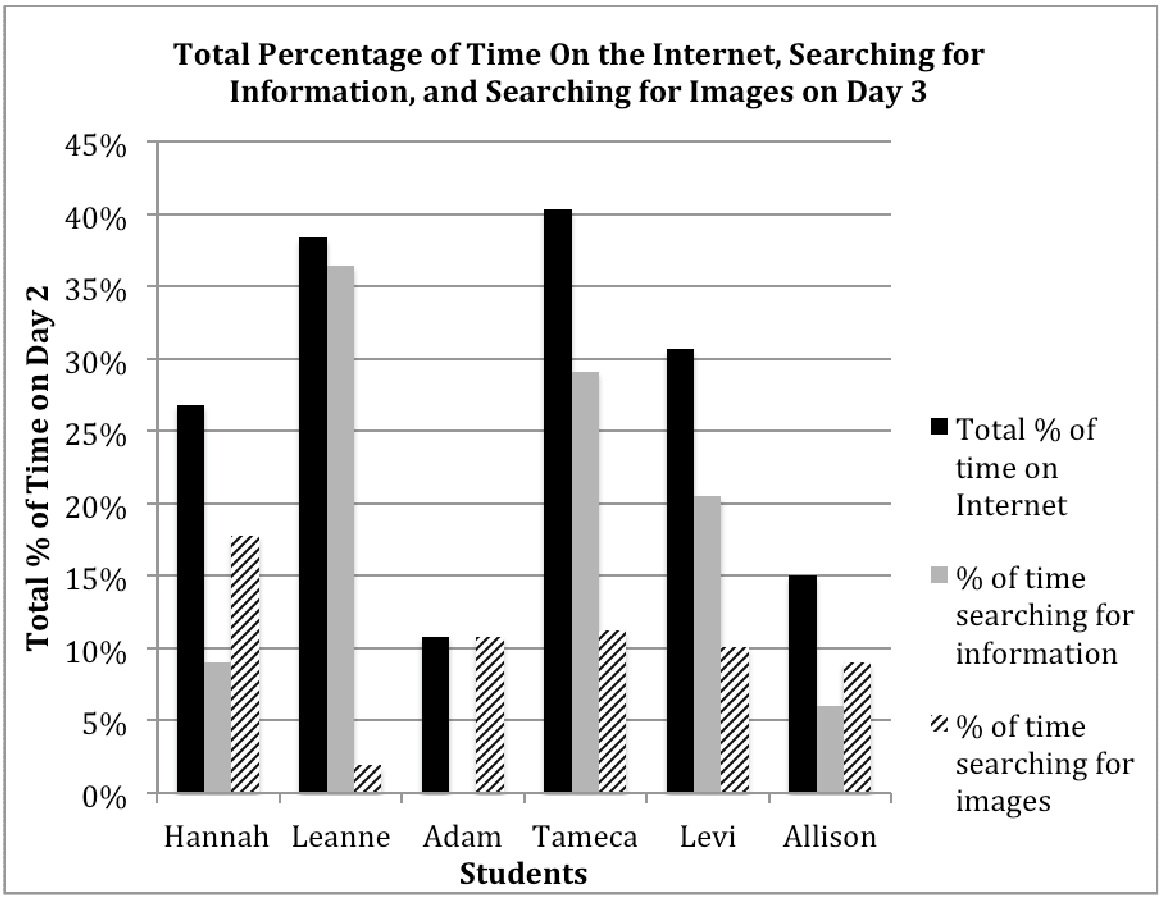
17:28 R: OK

In this example, while Allison (AR) unfortunately failed to attend to the distinction between tropical and temperate animals, she nonetheless spent time considering the audience and transforming the information for the audience. Allison (AR) spent more time transforming the notes than her peers; as a result she recorded fewer ideas from her notes into her brochure than the three-average achieving readers that also had content-relevant notes from the previous day.

When brochure construction began for Levi (AR) and Tameca (AR), they had limited information in their notes from the previous day that would contribute to their brochure. Again, this was due to the fact that they did not engage in planning strategies or engaged in inefficient planning strategies related to the informational requirements until brochure construction on Day 3. At the beginning of brochure construction both students asked questions like, "What kind of stuff do I put in the brochure?" As a result of planning only during brochure construction, Tameca (AR) used 0.00% of the ideas from her notes in her actual brochure and Levi (AR) used only 18.00%. Levi (AR), who had some information in his notes, frequently transferred notes into sections of text he was constructing word for word. Both students then had to spend significant time revisiting the web to locate information and gain meaning from online websites while constructing the brochure, discussed in the next section.

Using the Internet. All students initiated plans to return to the Internet for two primary purposes while constructing the brochure: 1) to gain more information about a topic, and 2) to locate images for their brochure. Both will be discussed in this section. Figure 21 provides information about the total percentage of time students spent on the Internet, time they spent searching for information about a topic, and time they spent searching for images on Day 3.

Figure 21. Students' Use of the Internet as a Percentage of Total Time on Day 3



First, students used the Internet to gain more information. All students except for Adam (AA) returned to the Internet to locate and gain meaning from online texts, although each student's plans varied. Leanne (AA) initiated a plan to return to the Internet at the beginning of Day 3 to continue to gain specific information about the topics she had not covered in her notes the previous day. Unlike all other students her plan involved recording the information in her notes before beginning brochure construction. She spent nearly 20 minutes (38.36% of her total time) on Day 3 simply constructing her notes. Therefore, she continued using similar strategies for locating and generating meaning as the previous day. After the completion of her notes, she then used the notes as the primary source for the brochure.

Two students, Hannah (AA) and Allison (AR) generated a plan to return to the Internet for content only when they first exhausted their notes. Altogether, Hannah (AA) spent only five minutes revisiting the Internet for information, 17.76% of her total time on Day 3. Allison (AR) spent approximately three minutes revisiting the Internet, 6.03% of her total time on Day 3. In each case of returning to the Internet, they returned to TR websites engaging multiple strategies for realizing and constructing potential texts to read and identifying, evaluating, and constructing meaning from the text related to specific informational requirements. Both students skimmed and searched for keywords, synthesized information across websites, generated inferences, summarized information, and asked questions. While the flexible use of multiple strategies to locate specific information during brochure construction was similar to Hannah's (AA) previous strategies on Day 2, for Allison (AR), they demonstrated a shift in strategies. Both students also engaged in more frequent landscaping strategies while navigating back and forth between open windows. They appeared to jump back and forth between open windows as they memorized small units of information, transferred them to the brochure, and then returned to the Internet for more.

Two students, Tameca (AR) and Levi (AR), predominantly generated plans to search for entirely new information on the Internet. While Levi (AR) did sometimes incorporate his notes into a category on the brochure, both students initiated new categories within the brochure by starting with a plan to locate online information and gain meaning from that online source. As a result, these two students, aside from Leanne (AA) who continued note taking in Day 3, spent the greatest percentage of time on the Internet during the day of brochure construction. Tameca (AR) spent 29.12% of her total time and Levi (AR) spent 20.52% of his total time during brochure construction to locate and gain meaning from goal-relevant websites. As Tameca (AR)

and Levi's (AR) plans were now directly correlated with the informational requirements on the rubric, their strategies for locating and gaining meaning from text altered. Their search became goal-directed and then started locating webpages that were specifically relevant to informational requirements on the brochure. They still engaged in a linear progression through sections and pages of the websites, but they monitored and evaluated their reading path more frequently and initiated more strategies for redirecting their reading path if the information was not useful or relevant. They also revealed far more strategies for navigating between active windows, shifting from the Internet to their brochure. Therefore, their new plans to use the Internet to locate goal-relevant information also altered all their other strategies for realizing and constructing potential texts to read, identifying, evaluating, and constructing meaning, and landscaping.

Second, students returned to the Internet not to gain meaning, but instead to locate images. All students engaged in a new strategy of locating images specifically for the purpose of adding them to the brochure. It is important to note that students never articulated or engaged in actions that gave any indication that they were gaining meaning from the image. They simply planned to get a specific image and then carried out the plan. An example of the strategy was evident in Hannah's (AA) return to the Internet for a cover page image while constructing the brochure.

2:25 S: OK

2:28 S: Alright, I will think of monkeys

2:28 [S selects "snake" in search bar and types "monkeys"]

2:31 [S hits enter and opens search results page]

2:35 [S places cursor after "monkeys" and adds "in the rainforest"]

2:40 [S hits enter to open the search results page]

2:45 S: Aww. Look at you.

2:52 S: I like that

2:52 [S clicks on 4th image result and opens monkey image]

2:59 [S right clicks on image and clicks copy]

3:00 [S clicks on the Word icon and opens brochure]

3:08 [S right clicks and pastes image into brochure]

3:09 [S resizes and adjusts image location by dragging corners and edges]

Hannah (AA) examined the initial results page from "monkeys" for only four seconds before revising her search term. Once the results for monkeys in the rainforest appeared, she scanned the images and identified a specific image within seven seconds. She then incorporated the image into her brochure. Students typically carried out their plans, monitored, and evaluated the images for their usefulness within less than 30 seconds. The only search engine students used to locate images was Google images.

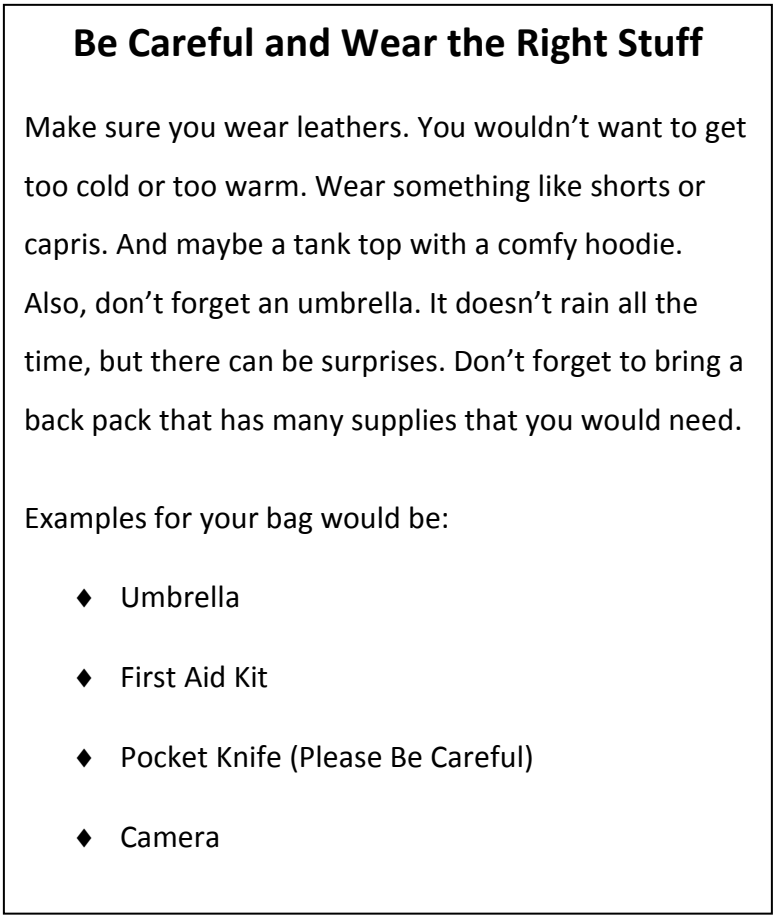
Again, students' initiation of plans to locate and gain meaning from content-relevant websites impacted their search for images during brochure construction. Adam (AA), Hannah (AA), and Allison (AR), who already had goal-relevant information in their notes, spent a greater percentage of their time online locating images than locating additional information online (100.00%, 66.24%, and 59.93% respectively). In fact, Adam (AA) never planned to return to the Internet for anything besides images. Leanne (AA), Tameca (AR), and Levi (AR) spent less time locating images than information (5.03%, 27.78%, and 33.04% respectively). Leanne (AA) was engaged in completing her notes, while Tameca (AR) and Levi (AR) had to reconstruct almost entirely new online searches for information, leaving limited time for locating images.

Using inferential reasoning based on prior knowledge and tex*t.* While constructing the brochure, two students, Hannah (AA) and Allison (AR) initiated plans to construct content-

relevant information in the brochure primarily through inferences about the topic. They either generated inferences about a topic by examining one section of a webpage (e.g., an image of a waterfall) or without returning to any source of information at all. However, it is likely they were drawing upon the knowledge gained the previous day and their prior knowledge to construct meaning.

Plans to generate inferences for the primary source of information did not always result in accurate or cohesive sections in the brochure. For example, Allison's (AR) resulting category for what tourists should pack revealed both accurate and inaccurate information (see Figure 22). Allison (AR) started the paragraph with "Make sure you wear leathers. You wouldn't want to get cold or too warm." The inference about what to wear based on her knowledge about the rainforest, gained either from reading or prior knowledge, was inaccurate. Yet, her inclusion of items like an umbrella revealed that at times in the paragraph her inferences were accurate. These errors in construction will be examined in more detail in the monitoring section.

Figure 22. A Screenshot of Allison's (AR) Brochure



Be Careful and Wear the Right Stuff

Make sure you wear leathers. You wouldn't want to get too cold or too warm. Wear something like shorts or capris. And maybe a tank top with a comfy hoodie. Also, don't forget an umbrella. It doesn't rain all the time, but there can be surprises. Don't forget to bring a back pack that has many supplies that you would need.

Examples for your bag would be:

- Umbrella
- First Aid Kit
- Pocket Knife (Please Be Careful)
- Camera

Constructing audience-relevant content in the brochure. Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR) revealed a strategy of planning for the audience of the brochure beginning when they read and took notes prior to brochure construction. The plans carried through to Day 3. The at-risk readers Tameca (AR) and Levi (AR) never verbally indicated they were aware of the audience tourists. The students that planned for the audience beginning with the online reading and note taking the previous day drew upon that information while constructing the brochure. For example, Allison (AR) had previously noted that tourist "can plant tree seeds" to counteract deforestation. She then incorporated that into the brochure as an activity for tourists.

When these four students had to revisit the Internet for additional information during brochure construction they continued to plan for tourists. For example, Allison (AR) verbally explained why she chose a simple version of a rainforest map to incorporate into her brochure. She stated, "Um, cuz like it basic for people who aren't very good with maps." She inferred that tourists did not need a technically detailed map, but instead would benefit from a simple map that a general audience could interpret. Therefore, the plan to construct the brochure for an audience of tourists continued to influence students' plans for locating information on Day 3.

One student, Adam (AA), recognized that tourists were an artificially constructed audience and the actual audience was the teacher. He also generated plans based on the teacher as the audience. This was evident when during construction he commented, "I just looked at the information from my notes, like, information that looked most like important and what looks good to the teacher." As he only verbally commented on the teacher as audience one time during the construction of the brochure, it is uncertain to what extent his plans for locating and gathering information were influenced by the reality that the teacher was the audience.

Organizing brochure construction. All three average-achieving readers revealed plans on to organize their brochure in order of the informational guidelines of the rubric. These students articulated their plans for organization at points throughout the construction. Leanne (AA) explained part of her organization plan as the researcher questioned her about the plan for organizing the brochure near the end of the class period on Day 3.

53:44 S: I'm ending with the whole tourist thing. I was just going to give everything up front that's going to be there so it is going to be like no surprises and then, um, kind of sort of how this order is going [holding rubric] I kind of want to put it in.

53:58 R: OK, so you kind of wanted to use the order from the direction sheet?

54:00 S: Yeah. So this will probably be on the inside and stuff, saying what it is, what's going to be there, the animals, the plants they'll see, and what's going on in the rainforest

All three students followed their articulated organizational plan. As they did so, they all referred initially to their notes to construct the information. Although they did not verbally explain it, all three students' actions suggested they returned to the website to initiate an online search for additional information only after they had exhausted their notes or after monitoring the need for a different type of information, discussed further in the monitoring section.

Allison's (AR) actions constructing the brochure suggested she was following the informational requirements list on the rubric, although when the research assistant asked her for specific details about her plan, she struggled to articulate it. An example is evident in the following transcript.

10:18 R: Is there a specific reason why you chose plants and animals.

10:20 S: Cuz it is on my brochure thing [pointing at rubric].

10:24 R: But for that side I mean [pointing to the cover of the brochure]?

10:25 S: Yeah, cuz I'm kind of, I don't know.

Allison (AR), like the three-average achieving readers, would initiate the brochure construction from her notes and then either 1) reinitiate a search for information online or 2) generate categories from prior knowledge. However, she appeared less certain about her overall plan when asked to articulate it.

Levi (AR) and Tameca (AR) did not have an effective plan for the organization and construction of the brochure. Levi (AR) provided a dramatic example of how the lack of an effective plan affected his strategies for locating information online and constructing meaning from the information. He spent nearly 15 minutes trying to construct a plan for how to organize

the brochure, including what contents to include in the brochure. However, even once Levi (AR) started constructing the brochure, he could not articulate his plan and regenerated a new plan midway through the construction of the brochure. The result was an entirely new and unnecessary online search for information and a new construction of meaning, as revealed in the following example.

Levi (AR) spent approximately 19 minutes constructing the following sentence in his brochure: "There are a lot of different animals and plants like Frogs, Snakes, Birds, Monkeys, etc. And the plants there are Bromeliads, Butter roots, Lianas, etc." While not rich and detailed content, it did reflect content required for the brochure as outlined in the rubric. After the construction of the sentence the research assistant prompted Levi (AR) with a question about how he was organizing his brochure.

39:38 S: Mmm, like a section could talk about each one? (pointing to rubric)

39:46 S: Like this could talk about the forest and the animals, and then plants here… (pointing to two different columns)

39: 53 R: Ok then, so you are thinking each panel will kind of approach one different part.

39:57 S: Mmhm, cuz I am going to fix this right here. [hovering mouse over paragraph 1 in brochure].

39:59 R: OK.

40:12 [S highlight and deletes "There are a lot of different animals and plants like Frogs, Snakes, Birds, Monkeys, etc. And the plants there are Bromeliads, Butter roots, Lianas, etc."]

Levi (AR) began to articulate a plan and then decided to edit the work he had already completed to align with his organizational plan. However, rather than pasting the sentences into

a new column in the brochure or using a strategy to save the information for later, Levi (AR) simply deleted them all together. He then began an entirely new search for plants and animals and spent the remainder of the period recreating information that had already established in the brochure before it was deleted. Levi's (AR) lack of a cohesive plan and inability to carry the plan out, combined with the lack of a strategy for reserving previously typed information (e.g. copy and paste), led Levi (AR) to engage in an entirely new online search locating information and reconstructing almost entirely new information into the categories of plants and animals. Tameca (AR) also revealed a similar deletion of information as she reconstructed her organizational plan for the brochure. In both cases Tameca (AR) and Levi (AR) had to reinitiate strategies to locate and generate meaning from online text about categories that they had already completed. At the end of Day 3, it is no surprise that Tameca (AR) and Levi (AR) had the least information in their brochures.

Monitoring and Evaluating

Due to the limited verbalizations on Day 3 with the loose verbal protocol monitoring strategies were only evident because they were followed by students' articulated evaluations. Unlike the previous day, it was nearly impossible to demonstrate monitoring without evaluation. Therefore, the two strategies were combined for this section. Several monitoring and evaluation strategies were evident during brochure construction. Students devoted significant time to monitoring and evaluating plans about the 1) construction of topic-relevant content in the brochure, 2) construction of audience-relevant content in the brochure, and 3) organization of the brochure. All will be examined in the following section.

Construction of topic-relevant content in the brochure. All students monitored and evaluated the construction of information that was relevant to the topic and informational

requirements of the brochure during Day 3. This was a shift from the previous day when not all students were planning or monitoring for the content necessary within the brochure. Even Tameca (AR) and Levi (AR), the students that demonstrated the most limited monitoring and evaluation strategies on the previous day increased their strategies during brochure construction. For example, while beginning brochure construction, Levi (AR) examined his notes and crossed lines through the first three facts. He monitored and evaluated the meaning he constructed from the previous day as he considered to topic-relevant information that was required for the brochure. Levi's (AR) explanation of his action demonstrated his strategy use.

12:09 R: Can you tell me, like you made little marks there, why you made those marks? (referring to the lines crossing off the first words in the first three notes he took yesterday)

12:16 S: Cuz um, I mighta went on the wrong thing and it doesn't go with the rainforest. I think I went on freshwater.

All students except for Levi (AR) and Leanne (AA) also monitored and evaluated their reading paths in relation to the goal when they returned online for information. This was mainly evident in their online actions. For example, Allison (AR) visited the MBG website to find climate noting, "I don't know where like the climate would be." She then clicked through six different webpages, spending less than fifteen seconds on each, and finally located the UCSB website where she located the heading weather. She continued to monitor and evaluate each site until she reached a website she believed was topic-relevant.

Interestingly, only Tameca (AR) verbally reported monitoring her comprehension while returning to the Internet to construct meaning. For example, she stopped to monitor a decoding struggle when encountering the "common tree shrew." Tameca (AR) stated, "What is that? Oh,

a shrew? I thought it said shoe." Compared to the prior day, far fewer students verbally reported monitoring comprehension about information gained from the online science websites.

Even though students engaged several monitoring and evaluating strategies that resulted in their use of or location of topic-relevant information for the brochure, all students except for Allison (AR) unfortunately failed to effectively monitor and evaluate their construction of meaning when they synthesized sources from the Internet and their notes. This was evident in Hannah's (AA) climatic weather category.

Climatic weather

- Temperate Rain forest have short drier summers but long wet winters
- Temperatures at 70-80 degrees (Temperatures don't change at night)
- Rainfall 80-400 cm
- High humidity 77% to 88%
- Tropical Rainforest have lush warm weather all year round

In the climatic weather category, Hannah (AA) did not clearly distinguish the information related to the temperate and tropical rainforest even though she had done so in her notes. The facts showed no evidence of cohesive grouping within the category. She transferred facts into the brochure, but did not monitor or evaluate the category as a whole. When comparing the final brochure to notes, some students' notes reflected more coherence, depth, and clarity than the categories in her final brochure. Therefore, the intertextual process of constructing meaning in the brochure by drawing upon multiple sources did not support the creation of content in the brochure that would be considered *proficient* because they failed to monitor and evaluate the content they incorporated. This must be examined with consideration that this was only the first day of brochure construction, monitoring and evaluating may have occurred on subsequent days

if they edited their brochure, however that work was unexamined in this study for reasons discussed in the limitations section.

Construction of audience-relevant content in the brochure. Four students, Hannah (AA), Adam (AA), Leanne (AA), and Allison (AR), monitored and evaluated their construction of content while considering the audience of tourists. These strategies for monitoring and evaluation were evident when they were typing text and even more frequently when they were locating and incorporating images for the brochure. The frequency with which they monitored and evaluated the content in relation to the audience varied.

Hannah (AA), Adam (AA), and Leanne (AA) revealed strategies for monitoring and evaluating as they typed information into categories. For example, after describing the location of the rainforest, Hannah (AA) added an additional sentence: "Exploring them can be very fun and I hope to make this an exciting trip for you." Although she did not verbally describe the reason for adding the sentence, the fact that she added it after constructing the rest of the category revealed her consideration of the tourists. These three students appeared to transfer information from their notes or online and then monitor and evaluate the text to make the adjustments after the fact. However, it is important to recall that these students were also locating information on the prior day with attention to the audience.

Allison demonstrated the most frequent monitoring and evaluation strategies related to the audience. Allison's (AR) approach to the brochure was to monitor and evaluate the information gathered through her notes and additional online searches and construct audience-relevant information by transforming the information as she typed information into the brochure. This was evident in the example of Allison's (AR) transformation of text using adjectives.

14:44 [S types]: Animal

14:46 [S deletes “Animal”]

14:47 [S types]: Fun loveing animals [autocorrect changes loveing to “loving”]

Cont.

17:26 S: I’m trying to put adjectives in there so it looks more interesting.

She was monitoring and evaluating the text as she constructed the brochure to make sure that the content appealed to tourists. Allison (AR) revealed monitoring and evaluating strategies in consideration of the audience during the construction of all but one category, the most frequent monitoring of any student.

One student, Adam, revealed he was monitoring and evaluating the text for the actual audience of the teacher. After typing information into his brochure, the researcher asked how he decided what to incorporate since he had not incorporated all the facts. Adam (AA) replied, “Um, I just looked at the information from my notes, like, information that looked most like important and what looks good to the teacher.” Adam (AA) selected audience-relevant information by monitoring and evaluating whether they would be appropriate for the teacher.

All students demonstrated strategies of monitoring and evaluating images with tourists in mind. For example, after selecting a parrot for his image, Levi (AR) says, “I chose this one cuz it’s, it just shows the bird it is colorful. And it can tell the people what it looks like.” All students search for images appeared to be regulated by whether the image appealed to tourists. They frequently used phrases like Levi’s (AR) including, “it stands out,” “tourists will like it,” “it will show them (tourists) what it is like.” So while they initiated a search for images based on the topic or category, they then monitored and evaluated images in consideration of the audience.

Organization of the brochure. All students except for Levi (AR) monitored and evaluated the organization of the brochure. All five readers monitored and evaluated their

organizational plan and continued to organize according to their original plans. For example, as Tameca (AR) was returning to the Internet to add more source to the current category she was working on, she stated, "Oh, I should've looked up for plants first cuz that is what I have on here [appears to be looking at her paragraph typed in the brochure]." She was monitoring her original plan to start with plants and evaluating the fact that the information she was seeking was not relevant to the category plants. She then returned to the Internet to find information about plants to add to the current category. Each student only articulated evaluation of the brochure organization from one to three times over the course of the entire day of brochure construction. It is likely that they may have been monitoring and evaluating their plans for organization of the brochure more frequently, but that was not evident without frequent verbalizations.

In conclusion, students engaged in multiple self-regulatory strategies. Once again, the strategy use was varied among individuals. Most notably, as students engaged in planning, monitoring, and evaluating on Day 3, their plans influenced how they located and gained meaning from online texts. Therefore patterns or profiles of strategy use on Day 3 were different that profiles of strategy use on Day 2, discussed in more detail in the next chapter. Furthermore, the at-risk students that used the fewest self-regulatory strategies on Day 2 began to demonstrate more self-regulatory strategies on Day 3, and therefore their strategies for locating and gaining meaning from text became relatively more effective in comparison to the previous day.

CHAPTER 5

RESULTS: QUESTION 2

Average-Achieving and At-Risk Readers' Navigational Profiles

This chapter answers the original question: What navigational profiles emerge as students with and without learning disabilities construct traversals (unique online paths of information) while they locate, evaluate, and synthesize information on science websites? As with the first research question, the influence of the emergent coding and themes revealed a necessity for reframing the constructs "locate, evaluate, and synthesize." These terms were too narrow and a broader examination of the literature and the coding process led to a broader question that is related but more appropriate. Therefore the question is rephrased as: *What navigational profiles emerge as at-risk and average-achieving readers construct traversals (unique online paths of information) they locate information and generate meaning from science websites?*

Navigational Profiles

The following section will examine the students' navigational profiles as they constructed traversals, or unique online reading paths. The navigational profiles reveal the common themes evident in students' online actions while locating and gaining meaning from text while engaging in online reading and note taking during the verbal protocol and after the verbal protocol (Day 2), and during brochure construction (Day 3). Student profiles are overviews of student strategy use. Reporting simply the frequency or type of strategy for each student would not provide a cohesive picture of students' navigational profiles as a whole. Therefore, multiple data collected from the verbal protocols and screen captures was reexamined to construct a comprehensive profile. This data included: 1) number of webpages visited, 2) time per webpage, 3) primary source for collection information (TR websites, other websites), 4) number of different strategies

used in each strategy group (RC, IECM), 5) sophistication of strategy use (RC, IECM), 6) whether or not the search was directed toward a goal that would support the brochure (self-regulatory strategies), 7) the modalities for constructing meaning, and 8) sequential vs. non-sequential patterns in searching. Upon examining the trends in the collected data, four navigational profiles emerged. Three profiles occurred while students sought to gain meaning from the online science websites and these included: 1) flexible knowledge-seekers, 2) sequential knowledge-seekers, and 3) inefficient knowledge-seekers. The fourth, image-seekers, was revealed as students sought to locate images, but not gain meaning from them. Within each category, the knowledge- or image- seeker were also distinguished by a) their goal orientation (goal-directed, partially goal-directed, or not goal-directed), b) the primary source they used to gain information (TR websites, websites from search engine results), and c) the primary modalities they gained meaning from. Table 12 will provide an overview of navigational profiles, whether their navigation was goal-directed, the primary modality students used to construct meaning (e.g., image, typed text, chart), and the primary source students used to construct (e.g., TR websites, Search engine). The table is organized by profiles revealed while students engaged in online reading and note taking during the verbal protocol, online reading and note taking after the verbal protocol, and brochure construction. The individual students are grouped by average-achieving and at-risk readers. The table will be followed by a narrative description of the categories and the results.

Table 12. Students' Navigational Profiles, Modalities and Sources for Constructing Meaning by Student and Task.

	Day 2: During the Verbal Protocol			
	Goal Orientation	Navigational Profile	Primary Sources to Construct Meaning	Primary Modalities to Construct Meaning
Average Achieving				
Hannah	Goal-directed	Flexible Knowledge-seeker	TR sites	typed text, images
Leanne	Goal-directed	Sequential Knowledge-seeker	TR sites	typed text, graphs, tables
Adam	Goal-directed	Flexible Knowledge-seeker	TR sites	typed text, images
At-Risk				
Tameca	Not Goal-directed	Inefficient Knowledge-seeker	1) TR sites 2) Search Engine	typed text
Levi	Partially Goal-directed	Inefficient Knowledge-seeker	TR sites	typed text
Allison	Goal-directed	Sequential Knowledge-seeker	TR sites	typed text, images

Table 12 (cont'd)

Day 2: After the Verbal Protocol

	Goal Orientation	Navigational Profile	Primary Sources to Construct Meaning	Primary Source to Construct Meaning
Average Achieving				
Hannah	Goal-directed	Flexible Knowledge-seeker	Search Engine	typed text
Leanne	Goal-directed	n/a	n/a	n/a
Adam	Goal-directed	Flexible Knowledge-seeker	TR sites	typed text, videos, graphs, maps
At-Risk				
Tameca	Not Goal-directed	Inefficient Knowledge-seeker	TR sites	typed text
Levi	Partially Goal-directed	n/a	n/a	n/a
Allison	Goal-directed	Sequential Knowledge-seeker	TR sites	typed text

Table 12 (cont'd)

Day 3: Brochure Creation

	Goal Orientation	Navigational Profile	Primary Sources to Construct Meaning	Primary Modalities to Construct Meaning
Average Achieving				
Hannah	Goal-directed	1-Flexible Knowledge-seeker 2-Image-seeker	1 - TR sites 2-Search Engine	1-typed text 2-image
Leanne	Goal-directed	1-Sequential Knowledge-seeker 2-Image-seeker	1-TR sites 2-Search Engine	typed text
Adam	Goal-directed	Image-seeker	Search Engine	images
At-Risk				
Tameca	Goal-directed	1-Sequential Knowledge-seeker 2-Image-seeker	1 - TR sites 2-Search Engine	1-typed text 2-image
Levi	Goal-directed	1-Sequential Knowledge-seeker 2-Image-seeker	1 - Search Engine 2-Search Engine	1-typed text 2-image
Allison	Goal-directed	1-Flexible Knowledge-seeker 2-Image-seeker	1 - TR sites 2-Search Engine	1-typed text 2-image

Flexible Knowledge-Seekers

Flexible knowledge-seekers were those that flexibly navigated the webpages and websites effectively using a variety of strategies while realizing and constructing potential texts to read [RC] and identifying, evaluating, and constructing meaning [IECM]. They demonstrated self-regulatory strategies that directed and redirected the search toward goal-relevant information [PLAN, PRED, MON, EVAL]. They located information following goal-related conceptual ideas rather than the linear structure of websites [RC]. For example, while seeking information about rainforest plants, they would visit multiple webpages and websites until they located the relevant information. As a result they typically visited the greatest number of websites [RC]. They generated inferences about what hyperlinks would lead them to goal-relevant information [RC] and what information on a webpage would be important to attend to or dismiss [IECM]. When a page appeared to lack information related to the students' goals, they quickly moved on to the next webpage [RC].

While online reading and note taking during the verbal protocol (Day 2:VP), the average-achieving readers Hannah (AA) and Adam (AA) were flexible knowledge-seekers using multiple strategies effectively. They constructed meaning primarily from typed text and images. After their verbal protocol ended (Day 2: No VP), they continued to demonstrate the same navigational profile. However, Adam's (AA) source for constructing meaning shifted. He began constructing meaning from a wider variety of modalities including typed texts, videos, graphs, and maps. On the other hand, Hannah (AA) completely shifted the primary source for constructing meaning. She left the TR websites altogether and initiated her search using sources identified through a Google keyword search. When students began constructing the brochure (Day 3), the average-achieving reader Hannah (AA) and the at-risk reader Allison (AR) revealed flexible knowledge-

seeker profiles, using primarily text as the modality for constructing meaning and referring to the TR sites as their primary source for constructing meaning.

Sequential Knowledge-Seekers

Sequential knowledge-seekers were students that located a webpage and once on that webpage proceeded in a linear fashion from top to bottom or left to right through entire sections of the webpage [RC]. They visited the fewer total websites than flexible-knowledge-seekers [RC]. They typically spent the most time on webpages, reading or skimming significant portions of the webpage [RC]. They predominantly navigated by locating the "next" webpage within the websites (e.g., internal navigation buttons, menus), although occasionally they used menus to skip to new sections of a website [RC]. They still maintained a reading goal, but they passively encountered goal-related information as they read or skimmed through entire webpages or sections of webpages rather than actively seeking it out directly [IECM]. They still constructed meaning by generating inferences between the text and prior knowledge [IECM]. They demonstrated self-regulatory strategy use, but less frequently than the flexible knowledge-seekers [PLAN, PRED, MON, EVAL].

While online reading and note taking during the verbal protocol (Day 2:VP), the average-achieving reader Leanne (AA) and the at-risk reader Allison (AR) were sequential knowledge-seekers. They both used the TR websites as their primary source for constructing meaning. Leanne (AA) constructed meaning using typed texts, graphs, and charts while Allison (AR) used typed text and images. After their verbal protocol ended (Day 2: No VP), Allison (AR) maintained the same profile of a sequential knowledge-seeker. Leanne (AA) did not have time remaining to engage in online reading after the verbal protocol. As students engaged in brochure construction (Day 3), Leanne (AA) remained a sequential knowledge-seeker. This is

unsurprising as she continued with online reading and note taking for nearly an additional 20 minutes before moving on to brochure construction. In addition, Tameca (AR) and Levi (AR) also revealed profiles of sequential knowledge-seekers. All three students predominantly constructed meaning from the TR websites using the typed text. While Leanne (AA) and Tameca (AR) continued to use the TR websites as their primary sources for information, Levi (AR) used the websites located through the Google search engine as his primary source.

Inefficient Knowledge-Seekers

Inefficient knowledge-seekers were students that demonstrated limited, non-existent, or non-relevant self-regulatory strategies to locating online sources of information and to gain meaning from those sources [PLAN, PRED, MON, EVAL]. They demonstrated the fewest and least sophisticated strategies for locating text [RC] and for identifying, evaluating, and constructing meaning from text [IECM]. For example, when locating text they may use the menu to navigate to the second page of the website but never beyond that. Once on the websites, they failed to decipher relevant from irrelevant information, and read nearly everything on the webpage [IECM].

During online reading and note taking during the verbal protocol (Day 2: VP) both at-risk readers Tameca (AR) and Levi (AR) were inefficient knowledge-seekers. Although they used strategies for realizing and constructing potential texts to read and identifying, evaluating, and constructing meaning, they used them relatively ineffectively for the purpose of the brochure. They predominantly constructed meaning from typed text. They were either partially goal-directed or not goal-directed at all. After the verbal protocol ended (Day 2: No VP) Tameca (AR) continued to reveal a profile of an inefficient knowledge-seeker. Levi (AR) did not have time to continue the online reading and note taking after the verbal protocol.

Image-Seekers

Image-seekers were students that demonstrated a unique profile for locating images using search engines. These students did not gain meaning from the images for their notes, but instead they sought out images to complement information already constructed on their brochure. As a result, as students shifted to brochure construction and occasionally sought out the images to incorporate into the brochure, they demonstrated a different profile than their previous searching to construct meaning from text. Image-seekers used search engines, specifically Google images, to rapidly locate images specific to a goal [RC]. They used goal-relevant keyword searches [RC]. For example, a student would search for images of monkeys by typing "howler monkeys" in the search engine. Students used the results page to rapidly scan images and locate a target image [RC].

All students except revealed profiles as image-seekers during brochure construction (Day 3), although Leanne (AA) demonstrated this only once, far fewer than all other participants. These students demonstrated keyword searches in Google as their primary strategy for locating images. They spent relatively limited time (typically fewer than 30 seconds) selecting their image from the results page. While Adam (AA) was exclusively an image-seeker on Day 3, all other students revealed image seeking in conjunction with another profile for gaining meaning from online science websites.

Profile Correlations with Note Taking and Brochure Artifacts

There appeared to be a correlation between reading profiles and students' performance on their note taking and brochure artifacts. When examining the results from the note taking assessment, flexible-knowledge-seekers scored the second and third highest scores. Their notes were among the best in the study (Adam (AA)=16, Hannah (AA)=15). Interestingly Leanne

(AA), a sequential knowledge-seeker who had the highest note taking composite score (17), only did so because she continued to take notes for nearly 20 minutes on Day 3 when other student were starting their brochures, thus deepening the breadth and depth of her notes. Had her notes been scored at the end of Day 2 when most other students stopped taking notes, her composite score would have been lower. Therefore, she took notes longer than any other student, using strategies that were goal-directed, and as a result her eventual final result received the highest score. The other student that was a sequential knowledge-seeker, Allison, had the fourth highest composite note taking score (13). The two inefficient knowledge-seekers revealed the lowest composite note taking scores (Levi (AR)=7, Tameca (AR)=6). Therefore, students that were inefficient knowledge-seekers revealed the weakest notes.

The results from the brochure assessment revealed that the students that revealed the flexible-knowledge seeker profile over the most days and research conditions, had the best overall scores on the brochures at the end of Day 3 (Hannah (AA)=13, Adam (AA)=13). The students that were sequential knowledge-seekers during the day of online reading and note taking performed near the median of the participant group on their brochures (Leanne (AA)=10, Allison (AR)=11). The students that were inefficient knowledge-seekers during the day of online reading and note taking and then shifted to sequential knowledge-seekers on the day of brochure construction had the worst overall scores on the brochures (Tameca (AR)=6, Levi (AR)=9).

Navigational Profiles Are Individual, Complex, and Responsive

Profiles Vary Across Individuals

When examining students' strategy use for online reading comprehension, it is evident that although navigational profiles may be evident, every student's profile was also uniquely individual. The students revealed differing navigational profiles as they dynamically integrated

strategies for realizing and constructing potential texts to read [RC], identifying, evaluating, and constructing meaning [IECM], publishing content [PC], and landscaping [L]. Comparing the intricate strategy use of any two students at the beginning of Day 3 revealed the individuality and complexity of profiles. The following section will examine Leanne (AA) and Hannah's (AA) profiles and strategy use at the beginning of Day 3 when students were allowed to begin constructing the brochure.

Leanne (AA) revealed the profiles of a sequential-knowledge seeker and image-seeker while locating and gaining meaning from online text on Day 3. Leanne (AA) began Day 3 by physically checking off informational requirements on her brochure rubric and monitoring the categories she had not yet covered in her notes [IECM]. She then initiated a plan at to search for specific information in order to complete the research project [RC, ILC]. Unlike all other students, Leanne (AA) spent a full 20 minutes simply searching for information, reading and skimming webpages in a sequential manner, and constructing notes [RC, IECM]. She did not move onto brochure creation until the notes were complete [IECM]. She visited 11 webpages, all within two different TR websites, to gather information [RC]. She used the key words "plants," "animals," and "weather" to skim pages or to click on anchor links associated with the key words typically navigating her in a sequential trajectory through webpages [RC, IECM]. Upon finding a section of text relevant to the subcategory she was searching for, she summarized key ideas into her notes [IECM]. When she completed her notes, Leanne (AA) began the construction of the brochure [PC]. Leanne (AA) returned only once to the Internet was to find a map to include in the brochure [RC, IECM], but after that she used her notes as the primary source of information [PC]. As a result, she had the fewest number of negotiations between active windows (e.g. Word to Internet Explorer) compared to her peers [L].

On Day 3, Hannah (AA) exhibited two profiles. When searching for information to add to her brochure, she revealed the profile of a flexible knowledge-seeker. However, nearly half of the time on the Internet was spent searching for images, during which time she revealed the profile of an image-seeker. Hannah (AA) began Day 3 with a plan to construct the title page of her brochure, starting with an image [PC]. She decided first to search for an image and focused her search on monkeys [RC]. Hannah (AA) used a keyword search for "monkeys" in the Google search engine to specifically locate monkey images [RC]. She rapidly skimmed the initial results page and realized that her search results were too broad incorporating more than rainforest monkeys [IECM]. She then narrowed the search for locating relevant monkey images by revising her search terms to "monkeys in the rainforest" [RC, PLAN]. Within three seconds of opening the results page, she appeared to have skimmed the first visible results and selected the 4th image that she "likes" [IECM]. Hannah (AA) used a right click copy strategy to copy the image [PC], then navigated between active windows [L], to paste the image into the brochure [PC]. She then resized and adjusted the image to edit the visual layout of the image in the brochure [PC]. Next, Hannah (AA) used her notes to transfer the first three facts into the brochure, adding bullets to denote separate units of information [PC]. Rather than using all of her notes, she navigated between active windows back to the Internet and located additional information online [L, RC, IECM]. The information was added to the brochure [PC].

Both students revealed different profiles on Day 3 and they both initiated different plans to approach the work on Day 3. Leanne (AA) focused on completing her notes first, therefore engaging in multiple RC and IECM strategies for the entire first 20 minutes. As Leanne (AA) then moved on to brochure construction, the majority of her work consisted of dynamic interactions of PC strategies, she had only limited need to return online and therefore

demonstrated only minimal RC, IECM, and L strategies. Therefore, her navigational profile was that of a sequential-knowledge seeker. On the other hand, Hannah (AA) immediately began constructing the brochure. Within the first 10 minutes, she cycled through various RC, IECM, L, and PC strategies. Hannah (AA) continued to cycle through the various RC, IECM, L, and PC strategies for each category of information she constructed in the brochure. She engaged strategies that revealed her profile on Day 3 as a flexible knowledge-seeker and image-seeker.

In conclusion, these students serve as examples of the individual navigational profiles comprised of highly complex integrations of strategies. Online reading profiles may provide valuable information about students' online reading processes, but the highly individual nature of strategy use even within common profiles must be noted.

Profiles Shift in Response to Task

The results revealed that every student significantly altered their patterns of strategy use in response to the task. Profiles of strategy use shifted in response to 1) alternating between online reading and note taking (Day 2) to active construction of the brochure (Day 3), and 2) alternating between locating information from typed text and specifically locating images. An example of each shift in strategies and resulting profiles will be examined in the following section.

First, all students shifted or added navigational profiles between Day 2, when only engaging in online reading and note taking during the verbal protocol, and Day 3, when allowed to begin brochure construction. All the at-risk readers completely altered their navigational profiles for locating information to gain meaning from text. Tameca (AR) and Levi (AR) shifted strategies that categorized them as inefficient knowledge-seekers to sequential knowledge-seekers. The remaining at-risk reader Allison (AR), shifted from a profile of sequential knowledge-seeker to a flexible knowledge-seeker. All three at-risk readers also added strategies

that classified them as image-seekers. Two average-achieving readers, Hannah (AA) and Leanne (AA), retained their previous profiles for locating information to gain meaning from text, but added strategies that also classified them as image-seekers. The remaining average-achieving reader, Adam (AA), stopped locating information to generate meaning and only searched for images, resulting in a navigational profile as an image-seeker.

Allison (AR) provided a specific example of how the strategies and resulting profiles shifted between online reading and note taking with the verbal protocol (Day 2) and brochure construction (Day 3). On Day 2, Allison (AR) profile for locating and generating meaning from text was that of a sequential knowledge-seeker. She progressed in a linear fashion through only two websites, reading or skimming nearly everything on the pages she visited [RC, IECM]. During the reading, she took notes as she spontaneously happened upon information that aligned with the informational requirements in the brochure rubric [IECM]. As brochure construction began on Day 3, Allison (AR) revealed a much more focused and flexible set of strategies for locating online text, thus profiling her as a flexible knowledge-seeker. Allison (AR) used more strategies and located more websites than on Day 2 [RC]. Once on the website, she rapidly scrolled down pages searching for keywords in headings [IECM]. She quickly moved to new webpages to find information that she perceived she did not have in her notes, but which was required for the brochure [RC, IECM]. The difference in profiles was confirmed in the fact that on Day 2 Allison (AR) spent 31.06 minutes on the Internet, visited 14 webpages and spent more than 15 seconds on nearly 60.00% of the web pages she visited, while on Day 3 she only spent 8.21 minutes on the Internet, visited 22 separate webpages, and spent more than 15 seconds on only 31.82% of the websites she visited.

These profile shifts may have resulted for multiple reasons, two of which were suggested in an overview of students' verbal explanations of their strategies. First, as some students were constructing the brochure, they became more aware of the meta-level goal (e.g., informational requirements that must be included in the brochure, audience, etc.). So students like the at-risk readers Tameca (AR) and Levi (AR) who appeared to have limited reading goals related to the brochure requirements on Day 2 were now more aware of the goals because they were constructing the brochure using the rubric handout. For example, when Levi (AR) started constructing the brochure on Day 3, he returned to his notes and crossed out the first three facts. When the research assistant asked him to explain what he was doing, he replied, "Cuz um, I mighta went on the wrong thing and it doesn't go with the rainforest. I think I went on freshwater." The brochure construction prompted them to more closely examine the comprehensive project goals and they then planned to locate and construct meaning from texts on Day 3 based on those goals. Second, students may have shifted profiles as they accumulated more knowledge about the topic. The initial online reading strategies may have supported the broad accumulation of information about the topic and informational requirements, helping students construct a schema for the topic and accumulate an initial foundation of information in their notes. However, once that was established, students may have then altered their strategies and resulting profiles because they now needed specific information to fill in gaps or extend knowledge gained the previous day. For example, Allison (AR) started constructing the weather section on her brochure and then returned to the website for more specific information. After skimming the webpage she stated, "There is weather, but all it talks about is rain." She then skimmed further down the page and said, "Tropical…It's right here." Allison (AR) was seeking

out specific information to complement the information she had already gained about climate the previous day.

Second, every student shifted navigational profiles when searching specifically for images. All students became image-seekers, using the Google images search engine to quickly locate online images for their brochure. Students used the search engine results to skim over the images, selecting the image from the results page [RC]. Students were highly goal-directed during these searches.

Profiles Shift in Response to Research Methods

The results suggested that students also shifted their profile in response to research methods. Two students, Hannah (AA) and Adam (AA), revealed shifts in profiles. In particular, this shift was evident with one student, Hannah (AA), who engaged strategies for locating and constructing meaning from text differently on Day 2 during the verbal protocol and then after the verbal protocol.

While engaged in the verbal protocol, Hannah's (AA) profile for locating information consisted of strategies that revealed a flexible knowledge-seeker with multiple strategies that gained meaning from TR websites. Hannah (AA) would first locate a TR webpage relevant to the topic rainforest [RC]. Then, using the informational requirements on the rubric, she skimmed and searched each page for information related to a specific informational requirement, taking notes on goal-relevant information [IECM]. At the end of Day 2, Hannah (AA) was one of four students with time remaining after the verbal protocol so she was allowed to return to the Internet to continue the online reading and note taking. At that point, Hannah (AA) changed the primary source she used for constructing meaning. Hannah (AA) immediately left the TR websites and went to the search engine Google for the remaining six minutes of the period. She used keyword

searches in Google to locate information [RC]. She would directly type questions like, "what to pack for rainforest?" [RC] She typically clicked on the 1st, 2nd, or 3rd result in the search engine list, and recorded both relevant and irrelevant information in her notes from those sites [RC, IECM]. While she was still a flexible knowledge-seeker, her profile was altered due to the use of the search engine. Without a verbal protocol, there was no more that could be gained from the screen capture about strategy use or about why she altered sources for constructing meaning. Overall, three students demonstrated different navigational profiles on Day 2 when the verbal protocol ended. The profile deviations raises questions about how the research method, particularly the verbal protocol, influenced students' impression and execution of the research task. It also raises questions about how the shift in methods from a structured verbal protocol on Day 2 to a loose verbal protocol on Day 3 may have influenced strategy profiles.

In conclusion, navigational profiles are evident in students' online reading. Students strategy use revealed profiles of flexible knowledge-seekers, sequential knowledge-seekers, inefficient knowledge-seekers, and image-seekers. These could be further classified by their goal orientation, the primary sources they used to construct meaning, and the primary modalities used to construct meaning. These navigational profiles were highly individual, complex, and dynamic. The navigational profiles varied across individuals, across tasks, and across research methods. Although the profiles provide valuable frameworks for examining students' online reading, it is important to note that within the profiles there are complex and dynamic interactions of strategies for realizing and constructing potential texts to read [RC], identifying, evaluating, and constructing meaning [IECM], publishing content [PC], and landscaping [L].

CHAPTER 6

RESULTS: QUESTION 3

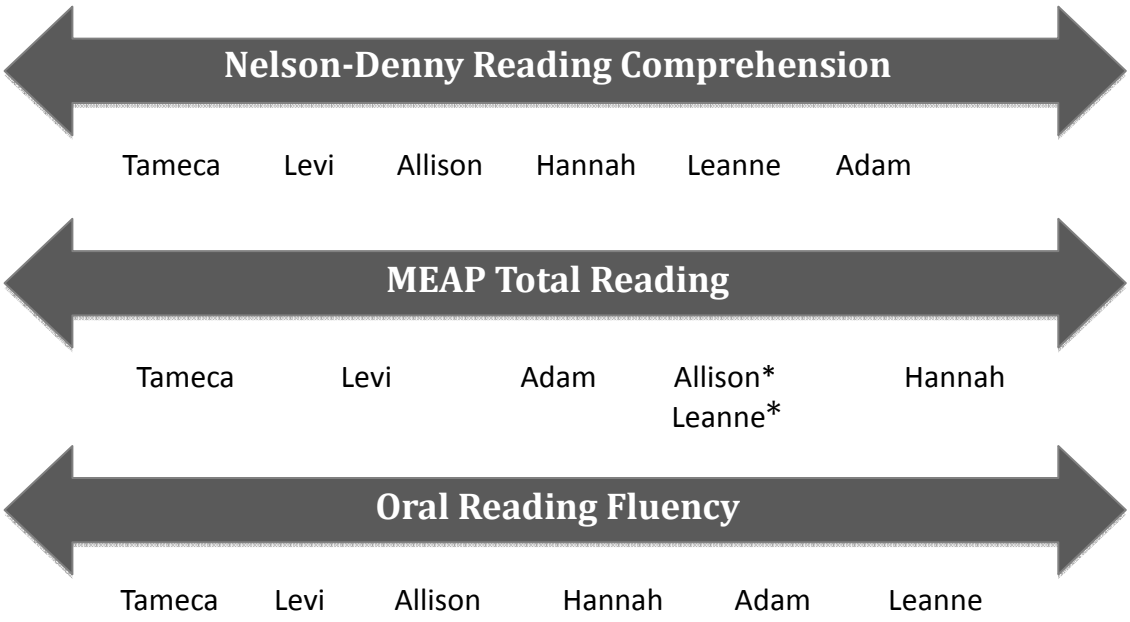
Individual Characteristics that Influenced Online Reading Comprehension

This chapter will answer the original research question: What individual characteristics influence student choices as they locate, evaluate, and synthesize information on science websites? As with the other two questions, the third was also shifted in a similar manner to now ask: *What individual characteristics influenced students' strategies as they locate information and generate meaning from science websites?* First, the chapter will examine how individual reading levels influenced the location and generation of meaning from online science websites. Second, the influence of students' prior knowledge on locating and generating meaning will be explored. Finally, the chapter will review the results of the self-efficacy and Internet use measures, which in this study did not reveal specific influences on locating and generating meaning from online texts.

Reading Levels

Students reading levels, assessed by the oral reading fluency measure, the Nelson-Denny Assessment, and the MEAP, influenced students performance as they located and generated meaning from science websites. The specific assessments reporting the reading comprehension and oral reading fluency scores are reported in the Methods section and will not be revisited here. However, Figure 23 will reveal students' performance on a continuum compared to their peers on each of the reading achievement measures. The resulting ways in which the students' individual reading levels impacted the locating and generation of meaning from texts will follow.

Figure 23. Continuum of Students' Performance on Reading Achievement Measures



Note: * represents students scores that were exactly the same on the MEAP Total Reading assessment.
The standard scores for the Nelson-Denny and MEAP and the median oral reading fluency score were used to arrange students on the respective continuum.

Within the online reading, note taking, and brochure creation tasks students with the lowest reading levels consistently demonstrated a lower frequency and less sophisticated use of strategies for both realizing and constructing online texts and identifying, evaluating, and constructing meaning from text than their peers at the upper ends of the continuum. The pattern is evident throughout the results in chapter 4.

In part, some of the overall ineffective or inefficient strategy use may have been due to the struggles with decoding and comprehension. All at-risk students verbally revealed struggles with decoding at least twice during the research project. For example, after reading a paragraph about orchids, Levi (AR) restated, "There are a lot of orchards in the forest." Although all six students revealed challenges decoding at some point in the online reading, the decoding struggles for

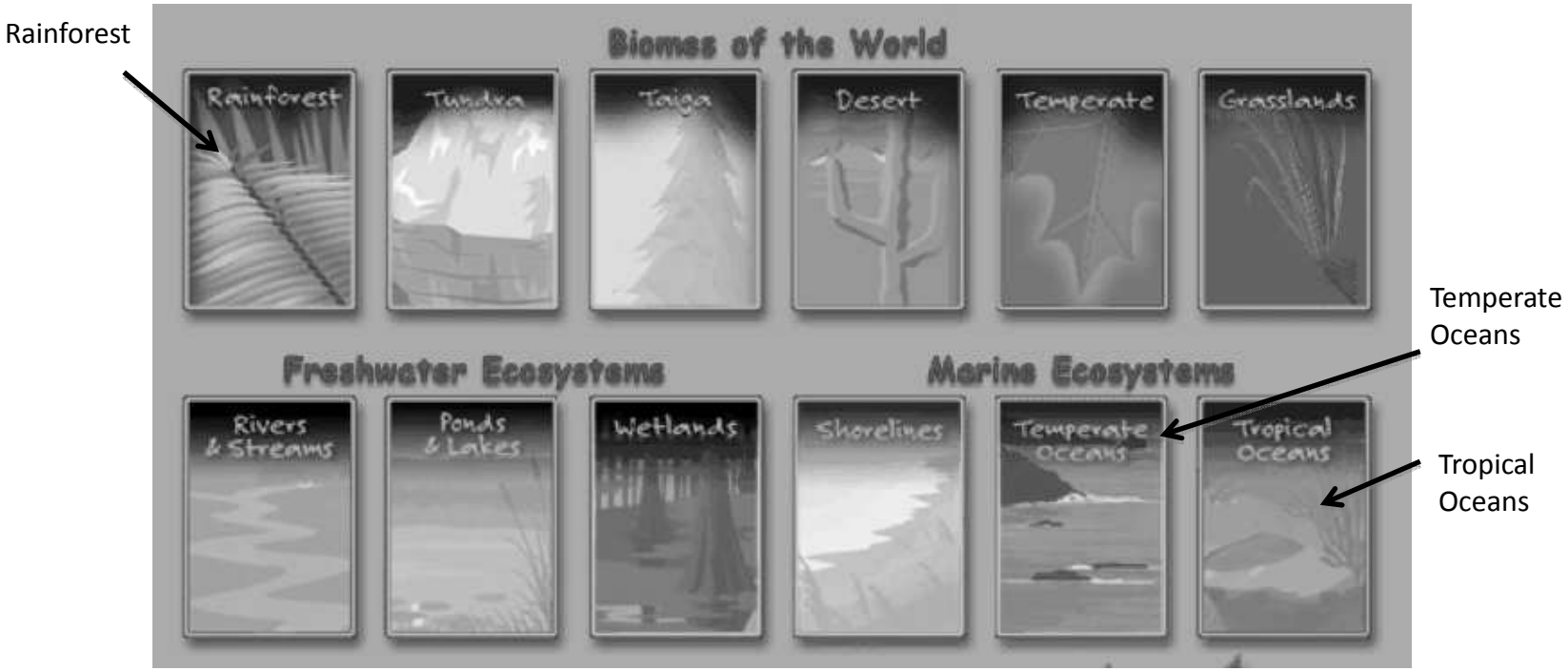
average-achieving readers were observed as they monitored their errors and then employed fix-up strategies. The at-risk readers did not appear to notice their errors. Allison (AR) was the exception, noting a decoding error and employing a fix-up strategy one time.

Tameca (AR) and Levi (AR) in particular also struggled with comprehension. Their lower reading comprehension skills at times appeared not to impact the overall meaning generated from the text, but at other times impacted it significantly. This is most evident in Tameca's (AR) comprehension struggles as she navigated to an entirely new topic on Day 3. Tameca (AR) had just completed reading about tropical and temperate rainforest, she then returned to the MBG homepage and decided to click on a link to temperate oceans (see Figure 24).

25:55 [S scrolls over tropical then temperate oceans and clicks on temperate oceans.]

25:59 S: I'm goin' to go to the temperate oceans.

Figure 24. Screenshot of the MBG Homepage



Note: Text in the figure is not meant to be readable but for visual reference only.

While reading the previous page, Tameca (AR) failed to attend to the association of *temperate* and *tropical* in relationship to the topic rainforest. Her struggle with comprehension led her to alter the entire search to center around *temperate* and *tropical* oceans. This initial off-topic detour might have been relatively quickly noticed and reversed for a student that was also employing strategies to monitor and evaluate the reading goals related to the research task, but this was not the case for Tameca (AR). Her struggle with reading comprehension significantly impacted her strategies for locating online information and gaining meaning from the text for the remainder of Day 2. While these instances of struggles were evident in limited glimpses of the data, it is still likely that several of the decoding and comprehension issues persisted throughout the research impacting students' performance in online reading comprehension.

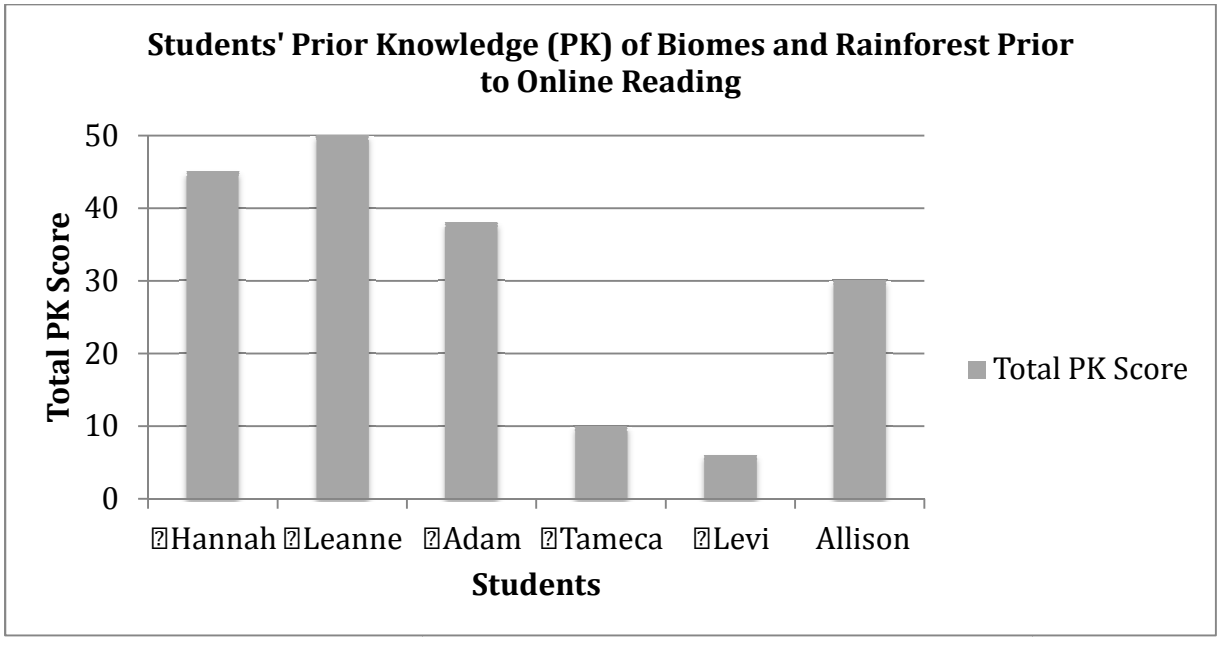
On the other hand, the readers that were on the higher end of the reading achievement continuums (Adam (AA), Leanne (AA), and Hannah (AA)) were the ones that consistently demonstrated a greater frequency and more sophisticated use of strategies for both realizing and constructing online texts and identifying, evaluating, and constructing meaning from text. An examination of results from chapter 4 suggest that Adam (AA) and Leanne (AA), the students on the highest end of the reading achievement continuums, were the students that exhibited the greatest variation in strategies as well as the most sophisticated strategies for monitoring and adjusting their plans for locating online information or gaining meaning from text. Therefore, the research appears to suggest that individual reading levels impact students' performance as they locate and gain meaning from texts. In this study, low reading levels in traditional print-based reading were indicative of lower levels of strategy use and poor performance on the note taking and brochure artifacts than students with higher reading levels.

Furthermore, it may be likely that students' reading levels also influenced the webpages that all students visited and remained on to gather information. All students spent more total time on the MBG (71 min 14 sec) and UCSB (82 min 16 sec) websites than the WC website (37min 22 sec). These websites had the lowest reading levels (see Table 2). Another possible alternative is that it was the website design rather than the reading level that influenced the choice of websites.

Prior Knowledge

Students' prior knowledge about biomes and rainforest influenced individual strategies for realizing and constructing potential reading paths and identifying, evaluating, and constructing meaning. Higher scores on prior knowledge influenced strategy use positively and lower scores on prior knowledge influenced it negatively. Figure 25 reveals the results from the assessment of prior knowledge on Day 2, in which students were asked to tell researchers everything they knew about biomes and then the rainforest.

Figure 25. Students' Prior Knowledge (PK) Scores



The results of the prior knowledge assessment revealed that Levi (AR) (6), Tameca (AR) (10), and Allison (AR) (30) had the lowest prior knowledge scores and Adam (AA) (38), Hannah (AA) (45), and Leanne (AA) (50) had the highest prior knowledge scores. The impact of prior knowledge on strategies for realizing and constructing potential reading paths and identifying, evaluating, and constructing meaning were particularly evident when comparing the students with the highest scores (Hannah (AA) and Leanne (AA)) to those with the lowest scores (Levi (AR) and Tameca (AR)). The individual influences were evident when examining the online traversals students constructed while locating text. The students with the highest prior knowledge generated the most inferences about which hyperlinks might lead them to the next useful site. The students with the lowest prior knowledge rarely generated inferences about the potential path of hyperlinks that might lead them to goal-relevant information. As a result the students with the lowest prior knowledge also spent the most time navigating to sites that were not useful or relevant for the purposes of the brochure.

The individual influences of prior knowledge were also evident when students generated inferences and drew upon prior knowledge to gain meaning. Two examples comparing students' use of prior knowledge to gain meaning from the text will reveal the differing levels of sophistication with which students used their prior knowledge. Leanne (AA) encountered a graph of the effects of altitude on vegetation. She then inferred why that would be important stating, "I'm thinking the effects of altitude and climate and vegetation are probably an important thing because it is saying how dropping in temperature is going to occur with every altitude rise and that totally changes how plants are going to grow and how they are going to get food and what they are going to be." Leanne (AA) used her prior knowledge to identify why the information would be important and then continued to examine the chart to gain meaning. The prior

knowledge about the rainforest and biomes in general support Leanne (AA) and Hannah (AA) in making inferences that supported the effective location of online information and provided fewer detours to irrelevant sites or sections of webpages.

On the other hand, Tameca's (AR) lack of prior knowledge led her to record nearly everything she read in her notes. Her plan, articulated in the post interview, was to add information to her notes if she did not already know it. When asked why she wrote information in her notes, she responded with statements like "Mmm, because I thought that, um, that they were really close to the equator. Like a little far back but I didn't think they were like actually close." She revealed that she "didn't know" about nearly every fact she encountered on the web, and she then wrote nearly every fact into her notes. The lack of prior knowledge for both Tameca (AR) and Levi (AR) hindered their inferences about which websites and sections of webpages would provide relevant information and which information within a webpage was relevant or irrelevant. Therefore, it appears that individual prior knowledge played a substantial role in students ability to generate inferences that would support strategies for realizing and constructing potential texts to read and identifying, evaluating, and gaining meaning from text.

Self-Efficacy and Internet Use Measures

The measures of self-efficacy and Internet use did provide contextualizing information about the participants, but they did not appear to suggest any individual influences on students' online reading comprehension. It is likely that perhaps with a larger sample, these measures would in fact suggest individual characteristics that influence online reading comprehension, but they did not in this study. Nonetheless, a brief overview of the results will be provided below beginning first with the self-efficacy results and followed by the Internet use results. Table 13 reveals the students' reported self-efficacy about four different online skills, and then about their

skills overall (in general). To assess self-efficacy about Internet skills students were asked students to rate "how good" they were at a variety of skills, answering on a scale of 1-5 (1 = not good at all, 2 = a little bit good, 3 = moderately good, 4 = very good, and 5 = extremely good).

Table 13. Self-efficacy about Internet Skills as Reported by Readers

Student	Info. for School Assignments	Info. for Topics of Interest	Answering Questions	Reading and Understand-ing	In General
Average-Achieving					
Hannah	3	4	2	3	3
Leanne	4	4	3	4	5
Adam	2	2	3	3	4
At-Risk					
Tameca	5	4	5	2	3
Levi	2	2	1	2	3
Allison	4	4	3	4	5

* Likert scale ratings: (1 = not good at all, 2 = a little bit good, 3 = moderately good, 4 = very good, and 5 = extremely good)

When asked about Internet skills in general, three students reported being moderately good (3), two students reported being very good (4), and one reported being extremely good (5). Leanne (AA), Adam (AA), Levi (AR) and Allison (AR) all reported higher score at using the Internet "in general" than their mean scores in the other self-efficacy categories. Hannah's (AA) scores for all Internet skills ranged from a little bit good (2) to moderately good (3). Leanne's (AA) scores ranged from moderately good (3) to very good (4) on the individual skills and then extremely good (5) on her skills "in general." Adam's (AA) scores ranged from a little bit good (2) to moderately good (3) on the individual component skills and then very good (4) on his skills "in general." Tameca (AR) rated herself as only a little bit good (2) at reading and

understanding information online. She then rated herself from very good (4) to extremely good (5) on the remaining component skills, and then rated herself as moderately good (3) "in general." Levi (AR) on the other hand, rated himself from not good at all (1) to a little bit good (2) on the component skills, with a final score of moderately good (3) "in general." Finally, Allison's (AR) self-efficacy scores ranged from moderately good (3) to very good (4) on the component Internet skills, and extremely good (5) "in general."

As a whole, students appeared to have a higher self-efficacy in rating their skills using the Internet for personal rather than school-related activities.

Next, the results for students' reported total time on the Internet inside of and outside of schools will be reported along with the activities that students reported engaging in most frequently during that time (Table 14).

Table 14. Students' Reported Hours Per Week on the Internet and Most Frequent Online Activities Inside and Outside of School

	Inside of School		Outside of School	
	Hours	Most Frequent Activities	Hours	Most Frequent Activities
Average-Achieving				
Hannah	1-4	work on school related assignments	1-4	work on school related assignments
Leanne	5-10	search the Internet, play games	1-4	search the Internet, play games
Adam	1-4	search the Internet	1-4	work on school related assignments, search the Internet
At-Risk				
Tameca	10-15	play games, watch videos, search Internet	> 15	Facebook
Levi	1-4	work on school related assignments	1-4	work on school related assignments
Allison	5-10	work on school related assignments, search the Internet	1-4	work on school related assignments, search the Internet

When in school, four students reported spending 1-4 hours per week on the Internet, two reported spending 5-10 hours, and one reported spending 10-15 hours. The most common activities were working on school related assignments and searching the Internet. When outside of school, five students reported spending 1-4 hours per week on the Internet, and one reported spending more than 15 hours. The most common activities were working on school related assignments. It is important to note that the student who reported the most hours in both settings, Tameca (AR) may have inaccurately reported total time. In fact, when Tameca's (AR) total hours are added up for the individual activities she reported engaging in, the hours do not total up to 10-15 hours at school or more than 15 at home.

The data for all measures described above were examined for patterns that associated with results from the previous questions. No patterns were evident. However, to further ensure that there were no associations that were not evident, the researcher also used chi-squared tests of association among the aggregated data from the self-efficacy assessment and the frequency of Internet use and related activities. No associations were significant. Therefore, the data provided no additional evidence of individual characteristics that influenced students' online reading comprehension.

In summary, students' reading levels and the prior knowledge influenced students' strategies as they located and gained meaning from online science websites. The students with the lowest reading levels and prior knowledge about the rainforest demonstrated struggles with locating relevant websites, decoding and comprehending text, and identifying relevant information from the science websites. They also performed lower on the note taking and brochure artifacts than students with higher reading levels and prior knowledge. Students' self-

efficacy and Internet use results did not reveal data that suggested an influence on students' strategies while reading or gaining meaning on science websites.

CHAPTER 7

DISCUSSION

This study represents a mixed-methods study of three average-achieving and three at-risk readers' online reading comprehension strategies and profiles while engaged in a research project using online science websites. The study examined what strategies students used while locating and gaining meaning from online texts, what navigational profiles emerged, and what individual characteristics influenced the online reading comprehension. The findings suggest that students employed a variety of online reading comprehension strategies in complex and dynamic ways, that patterns of strategy use could be examined as unique navigational profiles, and that individual characteristics influenced online reading comprehension. Each will be examined in the following section. The section will then examine implications for practice, future research directions, limitations of the study, and finally the significance of this study.

Online Reading Comprehension Strategies

The results suggest that the online reading comprehension strategies students employed in this study were highly individual and complex. However, four primary categories of strategy activities emerged. Each of these categories of strategies was influenced by students' self-regulatory strategies both within individual research tasks (e.g. online reading, note taking) and across the research project as a whole. First, students engaged strategies for *realizing and constructing potential text to read*, the strategies necessary for locating information in an online environment, similar to strategies noted in previous research with skilled Internet readers (e.g., Afflerbach & Cho, 2009; Bilal, 2000, Cho, 2011; Coiro & Dobler, 2007; Leu et al., 2007). Collectively, students located goal-relevant websites by generating keyword searches, revising those searches, and selecting teacher-recommended websites. Once within the sites students

located information by selecting useful menu links, useful non-menu links within the webpage, and using navigation buttons. As students engaged in the location of websites and webpages, they generated inferences about the usefulness, relevance, and possible path of hyperlinks. While these strategies were similar to strategies noted in previous research with skilled Internet readers (e.g., Afflerbach & Cho, 2009; Cho, 2011; Coiro & Dobler, 2007), one average-achieving reader and all three at-risk readers in this study used the strategies relatively with only limited effectiveness or sometimes not at all. This finding was significant given the fact that the students were provided with three reliable, valid, content-relevant websites to initiate their search to reduce the problems locating online information noted in previous research (e.g., Bilal, 2000, Bilal, 2001, Henry, 2006). But even when using the three provided websites, which was where students spent the majority of their online time, the four students were still unable to consistently engage strategies to locate information effectively and efficiently. Therefore, even though the task demands reduced the openness of the Internet space and guided students' initial location of information, some students still demonstrated significant struggles integrating strategies for effectively realizing and constructing potential texts to read.

Second, students engaged strategies to gain meaning from the online texts they located, a group of strategies called *identifying, evaluating, and constructing meaning.* These strategies were evident as students read and took notes prior to brochure construction. Collectively, students gained meaning from the text by note taking, skimming and searching for keywords, summarizing, asking questions, synthesizing information within a single page, synthesizing information across webpages, and generating inferences about text. Again, nearly all of these strategies were anticipated by research from research about online reading comprehension strategies in both print-based and online texts (e.g., Baumann, 1984; Englert & Thomas, 1987;

Gersten et al., 2001; Johnson, Graham, & Harris; 1997; Pressley & Afflerbach, 1995). Similar to the previous research, specifically with students considered at-risk or with a learning disability in reading (e.g., Englert & Thomas, 1987; Gersten et al., 2001), all the at-risk readers and one average-achieving reader in this study demonstrated limited or ineffective declarative, procedural, and conditional knowledge about strategies that would support their comprehension of the texts. Even the two average-achieving readers with the most frequent demonstration of strategy use still appeared more focused on accumulating a certain quantity of information than a deep and cohesive understanding of the text. The intertextual meaning skilled readers generated across multiple online texts noted in previous online reading comprehension research (e.g., Cho, 2011; Coiro & Dobler, 2007) was only evident briefly and typically within just one brochure category for any of the students in this study.

A specific examination of students' generation of meaning from the multiple modalities specific to online expository science texts (e.g., charts, graphs, videos, diagrams, etc.) reveals that in this study students paid only limited attention to these rich modalities. Students predominantly used text as a source for gaining meaning, followed by images. Only two students substantially sought meaning from charts, graphs, and videos multiple times throughout the online reading process. The remaining students typically skipped over these highly detailed science-specific modalities that could have provided substantial opportunities for generating meaning. As a result, four of the six students failed to construct intertextual meaning through the integration of these multiple modalities, a necessary strategy for gaining a deeper and broader conception of science texts (Lemke, 2002; Norris & Phillips, 2003; Tang & Moje, 2010).

Third, this research identified an emergent category of strategies that influenced how students located and gained meaning from text. The strategy *landscaping the screen* included

the strategies students used as they negotiated the arrangement and the aesthetics of the visual elements on the screen. In this study, the collective group of landscaping strategies students used included: personalizing search engines and managing application windows. While the strategies for landscaping the screen are certainly highlighted in the multiliteracies perspectives on reading (e.g., Kress, 2003, New London Group, 2000), the strategies were not examined specifically in the research emerging from the new literacies of online comprehension (e.g., Leu et al., 2007) or constructively responsive reading (Afflerbach & Cho, 2009). Yet, these landscaping strategies are particularly important in online reading comprehension given the affordances of technology to manipulate, personalize, organize, and play with visual elements on the screen (Kress, 2003; Lawless & Schrader, 2008, Unsworth, 2008). For at-risk readers in particular, the ability to engage in strategies to landscape the screen potentially allow them to support reading comprehension by manipulating the representation of textual features to make the text more accessible (Rose & Meyer, 2002). For example, students may highlight key features, zoom into text to make it larger, and more. In this study though, only two average-achieving students took limited advantage of specific landscaping strategies (zooming and adjusting the size of the window) that would have supported comprehension. One at-risk reader employed a strategy of personalizing a search engine, and although she only personalized the theme, it raises questions about the type of personalization that might further support online reading comprehension and provides suggestions for future research. Ultimately, while these landscaping strategies play only a supporting role to locating and gaining meaning from online texts, research suggests they have the potential to significantly influence online reading comprehension (Rose & Meyer, 2002; Rose, Meyer, & Hitchcock, 2005).

Fourth, the final category of online reading comprehension strategies was *publishing content*. *Publishing content* plays a unique role in online reading comprehension because of the highly interconnected nature of online reading and the communication of the ideas (Leu et al., 2007, Leu et al., 2011). This research reveals the extent to which the communication or publication of ideas impacted the other strategies for locating and gaining meaning from online science websites. In particular, the self-regulatory strategies of planning, monitoring, and evaluating the construction and publication of the final product, the brochure, significantly influenced students' strategy use and resulted in different patterns of strategy use, or different navigational profiles, for all students both within and across research tasks. This will be discussed more fully in the next paragraph. However, it is important to note that multiple strategies for publishing content that were not directly associated with locating or gaining meaning from the science website were not fully explored in this study (e.g., use of the auto spell-checker, editing paragraphs, arranging the textboxes in the brochure), but they should be examined more fully in future research. They played a significant role in how the meaning gained from online texts was transformed for an audience.

Perhaps most importantly, the self-regulatory strategies of planning, predicting, monitoring, and evaluating influenced all of the strategies students exhibited for locating and gaining meaning from science websites. The two average-achieving readers with that frequently and effectively used self-regulatory strategies demonstrated the most varied and flexible use of strategies for locating and gaining meaning from text compared to the two at-risk readers with infrequent and most ineffective self-regulatory strategies. Furthermore, they also performed better on their notes and final brochure than their two at-risk peers with the most infrequent and ineffective use of self-regulatory strategies. This corresponds with research from traditional

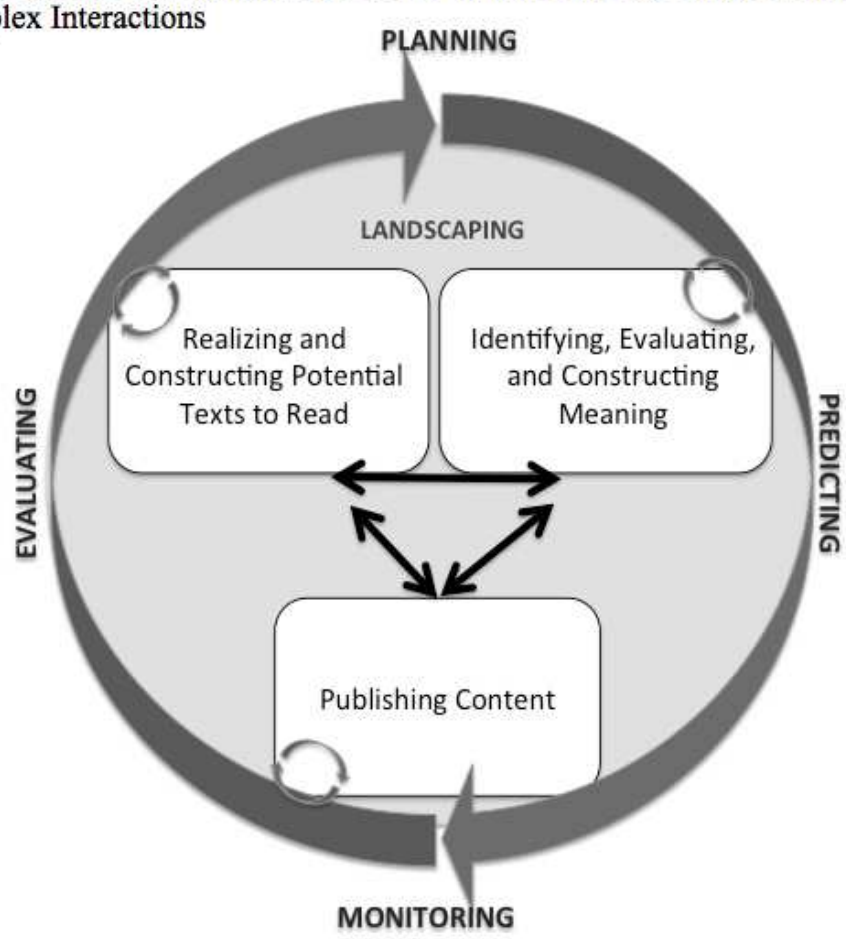
print-based reading and writing tasks that suggests that skilled readers are goal-directed and actively engage in monitoring and evaluating their plans, while at-risk readers struggle to monitor their own thinking processes and to generate, monitor, and evaluate plans that might guide strategic processes (De La Paz, 1999; Englert et al., 1989; Harris, Graham, & Mason, 2003; Gersten et al., 2001; Graham, 2006; Johnson, Graham & Harris, 1997; Massey, 2009; Palincsar & Brown, 1984). Interestingly, all three at-risk readers began to demonstrate completely different patterns of strategy use when they engaged in brochure construction on the third day of research. During online reading and note taking, when they were not permitted to construct the brochure, their strategies for realizing and constructing potential texts to read, identifying, evaluating, and constructing meaning, and the self-regulatory strategies were less frequent and ineffective. Yet, when they were allowed to begin brochure construction on the third day, all at-risk students began using more strategies and doing so more effectively as they returned to the Internet to locate information and gain meaning. The actual construction of the product, the brochure, increased their awareness of the goals and influenced all other strategies they exhibited. These types of goals were essentially meta-level goals, stemming from the brochure product but influencing students' strategy use in all other subtasks of the research. However, there were also micro-level self-regulatory strategies within the subtasks of research as well and these either supported or hindered progress toward the meta-goals.

Within each subtask of research, multiple recursive cycles of self-regulatory strategies either supported or hindered online reading comprehension. As Coiro and Dobler (2007) noted rapid and recursive cycles of self-regulatory strategies appeared necessary for making choices about the online reading path that supported the construction of meaning from texts. These rapid, recursive cycles were also evident in this research and they directed the online reading

path either toward or away from the meta-goals. Deviations in the reading path away from the meta-goal were frequently the result of students' struggles to effectively engage in the self-directed, self-regulatory strategy cycles necessary for navigating the open space and multiple possibilities of Internet texts.

A visual depiction of the intricate interactions between the online reading comprehension strategies evident in this study is provided in Figure 26. Three primary strategy categories are central to locating and generating meaning from online texts. These are realizing and constructing potential texts to read, identifying, evaluating, and constructing meaning, and publishing content. However, the possibility of landscaping the perceptual features of online texts may play an influential role in supporting students within each of the primary strategy categories. Students may or may not engage in landscaping strategies, but if they do, there is the potential to support online reading comprehension. Furthermore, the success of the locating and generating meaning during online reading comprehension tasks is directly affected by a students' self-regulatory strategy use. These self-regulatory strategies of planning, predicting, monitoring and evaluating occur within subtasks of the research, at a micro-level, as well as across the entire research project, at a macro-level. This conceptualization of online reading comprehension extends previous models of online reading comprehension by emphasizing the role that publishing content, or communicating content to an audience, plays in online reading comprehension and incorporates the influence of landscaping strategies, a key feature to be considered when examining how at-risk readers gain meaning from online texts.

Figure 26. A Visual Conceptualization of the Online Reading Comprehension Strategies and their Complex Interactions



Navigational Profiles Are Dynamic and Responsive

The results of the research, particularly the examination of the patterns of strategy use for each student, also suggest that navigational profiles are evident. Similar research from others examining online navigational profiles (e.g., Bilal, 2001; Horney & Anderson-Inman, 1994, MacGregor, 1999), this research suggests students demonstrate varying navigational profiles. However, and perhaps more importantly, this research also suggests that students' navigational profiles do not remained fix, but rather shift in response to the task and research methods. This responsive nature of navigational profiles is influenced by the multiple contextual variables of the online reading task in much the same way that students vary their reading comprehension

strategies based in the context of traditional print-based texts (RAND, 2002). The students in this study that revealed the most significant shifts in navigational profiles in response to the task were the at-risk readers. While locating information and gaining meaning from texts, they all exhibited more sophisticated and effective navigational profiles when engaged in the construction of a product meant to communicate their ideas. Therefore, the end-goal, the product intended to communicate meaning to an audience, substantially altered students' navigational profiles.

In addition, the navigational profiles for two average-achieving readers shifted in response to the research methods. Although both students were still engaged in the task of online reading and note taking, when the verbal protocol ended, both students altered their navigational profiles. These results reflect the reality of the concerns that verbal protocols may affect reading performance (Ericsson & Simon, 1993; Afflerbach, 2000). In this research, as the students were released from the verbal protocol, they indeed altered their strategies and processes for locating and gaining meaning from text. Due to the lack of verbalizations though, there was no way to ascertain why students altered their profiles.

Individual Characteristics Influence Online Reading Comprehension

This research also suggests that online reading comprehension, much like traditional reading comprehension, is influenced by reader characteristics (e.g., engagement, prior knowledge, etc.) (e.g., Coiro & Dobler, 2007; Coiro, Knobel, Lankshear, & Leu, 2008; Lawless & Kulikowich, 1996). Specifically, students' reading decoding and comprehension abilities in traditional print-based texts and their prior knowledge about the topic rainforests influenced their strategies for locating and gaining meaning from online science websites. The at-risk readers with the lowest reading comprehension and oral reading fluency scores were more likely than the

average-achieving readers to encounter comprehension issues that resulted in constructing ineffective traversals, or online reading paths, and spending significant time investing in online reading that was irrelevant to the research project. Even when within goal-relevant webpages, they still failed to locate the main ideas and summarize information into their notes or brochure with accuracy and cohesion. Therefore, the reading skills and processes that students struggled with in traditional print-based texts appeared to persist and sometimes even produce more substantial reading comprehension struggles in online tests.

Prior knowledge played a significant role in students' location of goal-relevant websites. Realizing and constructing an online reading path requires a high level of forward inferential reasoning (Coiro & Dobler, 2007). Students must generate inferences while constructing online traversals as they anticipate how to progress to the next online text, often using minimal textual information. In this study, students with a high level prior knowledge about the rainforest generated more useful inferences about how to traverse using hyperlinks, menus, and navigation tools compared to students with a lower level of prior knowledge. As a result, they navigated most effectively to useful websites, wasting minimal time visiting and exploring irrelevant webpages. Furthermore, the students with the highest prior knowledge of the topic were able to synthesize information within and across websites more effectively than students with low prior knowledge, a finding similar to research in traditional print-based texts (e.g., Afflerbach, 1990; Carr & Thompson, 1996; Williams, 1993).

Implications for Practice

There are several implications that can be drawn from this study. In the 21st century, scientifically literate citizens must know how to navigate and read online science texts. This research reveals that in order to engage in successful online reading comprehension, students

must employ a wide range of strategies in flexible and dynamic ways. So first, students must have declarative, procedural, and conditional strategy knowledge that they can employ flexibly as they navigate the ill-structured, open, and vast possibilities of text on the Internet. Teachers must explicitly teach these strategies, modeling their use in various contexts and with a variety of tasks. In addition, teachers must help students become self-regulated online readers, establishing online reading goals and then frequently monitoring and evaluating their goals. The self-regulation necessary to engage in online reading is perhaps even more critical than reading in print-based texts because failure to execute a plan or to monitor and evaluate progress toward that plan will lead students to construct irrelevant traversals, leaving students lost in hyperspace, failing to construct any goal-relevant meaning (Coiro & Dobler, 2007). Second, teachers must recognize that simply providing students with content-relevant websites, reducing the necessity for relying on search engine queries, does not ensure that students can locate or generate effective meaning from within those websites. Third, teachers must help students learn how to read online science texts in disciplinary-specific ways, attending to both the multi-modal and hyper-modal nature of online science texts. Fourth, teachers must consider students' prior knowledge about the topic and website structures in general before starting an online search for topical information. Teachers may need to scaffold students' prior knowledge, particularly if it is weak to begin with, to support effective online reading comprehension both prior to and during the actual online activity. Fourth, the decoding and comprehension struggles that students reveal in print-based texts are likely to continue to impact students reading in online environments. Therefore, students must be taught about the affordances of online environments for supporting online reading comprehension in ways that are impossible in print-based texts. Teachers must

help students use online environments to support multiple means of representation, expression, and engagement (Rose & Meyer, 2002) that will enhance their online reading comprehension.

Future Research Directions

This study informs several possible future research endeavors in online reading comprehension. First, there are limited studies that have examined online reading comprehension with readers engaged in complex tasks. This research revealed that the strategies students exhibited even within the single research task varied based on the context of the subtask (e.g., online reading and note taking, brochure construction). Many of the current research studies examine students' online reading comprehension strategies in tasks with limited complexity (e.g., identifying a specific piece of online information, answering a limited number of isolated question about a topic). The impact of a complex research task where students engaged in online reading for the purpose of constructing meaning for an audience revealed the shifting nature of strategies and therefore, the complexity of assessing online reading comprehension. As a result, future research must continue to examine at-risk readers' online reading comprehension strategies in a variety of tasks and with varying levels of complexity. It should also consider how we might then assess online reading comprehension in light of the complex and dynamic nature of strategy use.

Second, future research must continue to examine how varying methods influence research about online reading comprehension. In this research the screen capture software provided a valuable tool to supplement the verbal protocol, as students' online actions sometimes conveyed strategies or processes that students did not verbally explain. Therefore, it provided an additional lens for examining online reading comprehension strategies that would not have possible for examining reading comprehension in print-based texts. This method therefore supports the

exploration of at-risk readers' strategy use in unique and promising ways. On the other hand, the verbal protocol did in fact completely alter the navigational profiles of two students in this study. Therefore, future research should continue to examine the affordance and constraints of varying methodological approaches to studying online reading comprehension with students of diverse ability groups.

Third, there remains a limited research base about how at-risk readers engage in online reading comprehension. This research sought to provide a detailed glimpse at a limited number of at-risk readers in comparison to average-achieving readers in hope that it will begin to reveal the online reading comprehension strategies that at-risk readers use in content-area classrooms. This study identified that questions must be raised about how at-risk students can engage the affordances of technology to support online reading comprehension. Furthermore, this study revealed that without scaffolding, at-risk readers and some average-achieving readers fail to effectively read and comprehend online texts. Research about what strategy instruction in online reading might look like for at-risk readers is an exciting new frontier. The future research directions for examining the at-risk readers' online reading comprehension is both timely in an era where growing research is drawing attention to new literacies and full of possibilities due to the limited research base.

Limitations

There are several limitations that must be addressed in this study. First, despite seeking to examine online reading comprehension for students with reading disabilities in addition to average-achieving readers, the design shifted based on students that consented to participate. There were eight students with specific reading disabilities within the two science classrooms, only three consented to participate in the research, but only one consented to the more intensive

condition where they would complete the work one-on-one with a researcher or research assistant. Therefore, the pool of participants had to be expanded to include "at-risk" readers, including students with other types of disabilities that still struggled with print-based reading according to standardized reading assessments. Therefore, the target participants for the research shifted.

Second, the proposed design and methods had to be altered in the field when the laptops could not be acquired on Day 1 for online reading and note taking. As a result online reading and note taking were shifted to the next day leaving only one day instead of two for the brochure creation. The methods only captured data about brochure creation on Day 3. Students then completed the brochures either at home or in a study support classroom where data collection could not occur. Upon questioning the teacher and students after they turned in the final brochure product, it became apparent that teachers and paraprofessionals supported significant amounts of work for all participants. The final products for some participants were significantly altered. As a result, the researcher decided to analyze the products at the end of Day 3, the last point of completion when students were independently creating the artifact to eliminate confounding methods.

Third, the level of cognitive demands in a complex research task with minimal scaffolding and being pulled out to work individually with a researcher or research assistant likely impacted student verbalizations during the verbal protocol as well as student performance. For example, the at-risk learners demonstrated fewer verbalizations overall than the average-achieving learners. Two at-risk readers asked the teacher if their paraprofessional could support them on Day 3 because the task was hard. Therefore, the factors of the design likely influenced the strategies students exhibited and their level of verbalizations.

Fourth, there was no way to distinguish between skills and strategies. In the reading process, students engage in both automatic, and subconscious reading actions (skills) and intentional, conscious reading actions (strategies) (Afflerback, Pearson, & Paris, 2008). All students' actions were identified as strategies within this research, but very likely many of the actions or descriptions of the actions were related to skills as well. There is no research or framework that yet addresses how to distinguish the two, and therefore it was not distinguished in this research.

Fifth, the generalizability of the results are limited due to the number of participants and the specific online reading task. Ultimately, this research focused on case studies of only six students in the context of a particular task. The online reading task, while complex in the integration of multiple informational categories, only required the accumulation of primarily factual information. The task was not designed to encourage students to engage with material that would have had multiple perspectives and required deeper analysis of author stance, credibility of arguments, and students' personal positions on ideas. Therefore, online reading strategies for engaging in different tasks may also vary. Future research must continue to examine online reading comprehension strategies with more students and a variety of tasks.

Sixth, there were limitations in the procedures to assure validity and reliability. The initial inter-rater reliability measures were employed for the primary and secondary coding schemes, yet a shift in the format of the results led to additional coding of specific individual strategies. While these individual strategies were incorporated into the primary and secondary codes, the nuanced detail to the individual strategies in the final round of coding have yet to be examined for inter-rater reliability by the research assistant. The coding for the individual strategies

themselves were examined by the discussed with the dissertation chair, but for this research to ensure greater rigor, the inter-rater reliability, which is currently in process, must be completed.

Significance of the Study

There is a pressing urgency for research that contributes to the knowledge of online reading comprehension for both average-achieving and at-risk readers. As new literacies gain growing attention in schools, a slow but steady process, a research-base must be established to begin to inform and direct classroom instruction and interventions for all learners. While significant research in online reading comprehension has examined the strategies of skilled online readers, only limited research has examined online reading comprehension with at-risk readers. Yet, research has revealed that at-risk readers are perhaps the furthest behind in online reading comprehension (Leu, Zawilinski et al., 2007) and research must examine both how at-risk students engage in online reading comprehension and how to help them develop these skills in school. Therefore, this study advanced the understanding about online reading comprehension for average-achieving and at-risk readers in science classrooms, contributing to a gap in the research, suggesting implications for practice, and promoting future research questions.

APPENDICES

Appendix A

Research Questions and Associated Assessment Methods

Table 15. Research Questions and Associated Assessment Methods.

Research Questions	Assessment Measures
Q1: What strategies do students with and without learning disabilities use as they locate, evaluate, and synthesize information on science websites?	Verbal Protocol Screen Capture Student Notes Student Brochures
Q2: In the screen captures, what navigational profiles emerge as students with and without learning disabilities construct traversals while they locate, evaluate, and synthesize information on science websites?	Screen Capture Verbal Protocol
Q3: What individual characteristics influence student choices as they locate, evaluate, and synthesize information on science websites?	Internet Use Survey Verbal Protocol Prior Knowledge Interview Topic Engagement Assessment Oral Reading Fluency Probes Cumulative File Review (Demographic Data & Special Education Data)

Appendix B

INTERNET USE SURVEY

You have been selected to take part in this survey of Internet use. We want to find out how much time students spend on the Internet and what kinds of things they do on the Internet. This information will help us to understand how high school students use the Internet in school and out of school. Your parents have already signed a letter saying it is okay for you to take this survey.

Participation in this survey does not involve any risks to you and will not affect your grade in any way. Participation in this study is entirely your choice. You may refuse to participate in this survey at any time.

If you have any questions regarding this study, you may contact the researcher at sevensma@calvin.edu.

1.) My age is: _____

2.) I am: (circle one)

MALE FEMALE

3.) I am: (circle one)

African American/Black

White/Caucasian

Hispanic

Asian

Multiracial

Other Please describe: _____

4.) I receive extra support in school (ex. special education classes, parapro support, accommodations, tutoring) because I struggle with reading or math: (circle one)

YES NO I DON'T KNOW

USING THE INTERNET: AT SCHOOL

FOR THE NEXT SECTION, PLEASE RESPOND TO ITEMS ABOUT HOW YOU USE THE INTERNET AT SCHOOL.

1.) When you must learn new information about a topic AT SCHOOL, would you prefer to: (circle one)

Read information from a printed book OR Read information from the Internet

2.) In the last week how many hours did you spend using the Internet AT SCHOOL? (circle one)

A. None **B.** 1-4 hours **C.** 5-10 hours **D.** 10-15 hours **E.** More than 15 hours

3.) What technology are you most likely to use when accessing the Internet AT SCHOOL? (circle one)

A. Computer **B.** Phone **C.** iPad/tablet **D.** Other _____

This is how often I use the Internet to do the following AT SCHOOL:

Table 16. Survey of Internet Use at School

	NEVER	A FEW TIMES EACH WEEK	ONCE A DAY	2-4 TIMES EACH DAY	5-9 TIMES EACH DAY	10 OR MORE TIMES A DAY
Search the Internet (Yahoo, Google, Bing)	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Facebook	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Tweet	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Download music	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day

Table 16 (cont'd)

Read about movies, music, or sports stars or other entertainment topics	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Watch or post videos	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Work on school-related assignments	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Play online games	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day

THE INTERNET: OUTSIDE OF SCHOOL

FOR THE NEXT SECTION, PLEASE RESPOND TO ITEMS ABOUT HOW YOU USE THE INTERNET OUTSIDE OF SCHOOL.

1.) In the last week how many hours did you spend using the Internet OUTSIDE OF SCHOOL? (circle one)

A. None **B.** 1-4 hours **C.** 5-10 hours **D.** 10-15 hours **E.** More than 15 hours

2.) Where are you most likely to use the Internet OUTSIDE OF SCHOOL? (circle one)

A. Home **B.** Friend's House **C.** Library **D.** Parent's Work **E.** Other: _____

3.) What technology are you most likely to use when accessing the Internet OUTSIDE OF SCHOOL? (circle one)

A. Computer **B.** Phone **C.** iPad/tablet **D.** Other _____

This is how often I do the following <u>OUTSIDE OF SCHOOL</u>:

Table 17. Survey of Internet Use Outside of School

	NEVER	A FEW TIMES EACH WEEK	ONCE A DAY	2-4 TIMES EACH DAY	5-9 TIMES EACH DAY	10 OR MORE TIMES A DAY
Search the Internet (Yahoo, Google, Bing)	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Facebook	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Tweet	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Download music	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Read about movies, music, or sports stars or other entertainment topics	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Watch or post videos	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Work on school-related assignments	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day
Play online games	Never	A few times each week	Once a day	2-4 times each day	5-9 times each day	10 or more times a day

HOW GOOD AM I AT USING THE INTERNET:

RATE YOUR SKILL LEVEL FOR EACH OF THE FOLLOWING BY SELECTING WHERE YOUR SKILL LEVEL FALLS.

Table 18. Survey of Internet Self-efficacy

	NOT GOOD AT ALL	A LITTLE BIT GOOD	MODERATELY GOOD	VERY GOOD	EXTREMELY GOOD
I am good at using the Internet to find information for school assignments and projects	Not good at all	A little bit good	Moderately good	Very good	Extremely good
I am good at using the Internet for find information for topics I'm interested in (ex. sports, music, movies)	Not good at all	A little bit good	Moderately good	Very good	Extremely good
I am good at using the Internet to answer a specific question (ex. How does global warming affect ocean currents?)	Not good at all	A little bit good	Moderately good	Very good	Extremely good
I am good at reading and understanding information on the Internet	Not good at all	A little bit good	Moderately good	Very good	Extremely good
I am good at typing	Not good at all	A little bit good	Moderately good	Very good	Extremely good
I am good at using the Internet in general	Not good at all	A little bit good	Moderately good	Very good	Extremely good

FOR THE NEXT SET OF QUESTIONS, PRETEND YOU ARE WORKING ON THE INTERNET.

Figure 27. The Alaskan Volcano Menu Bar (Left).

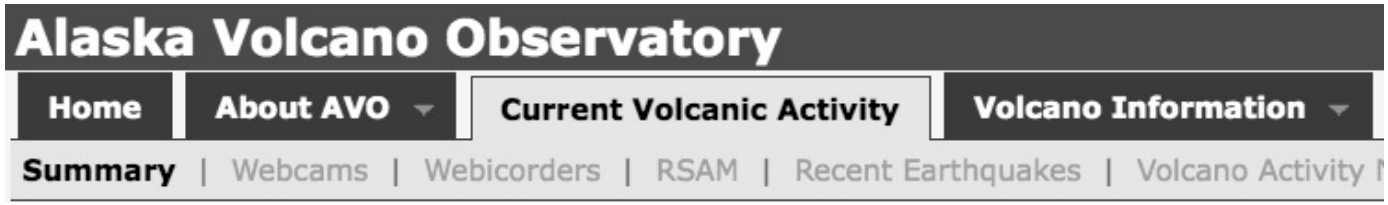
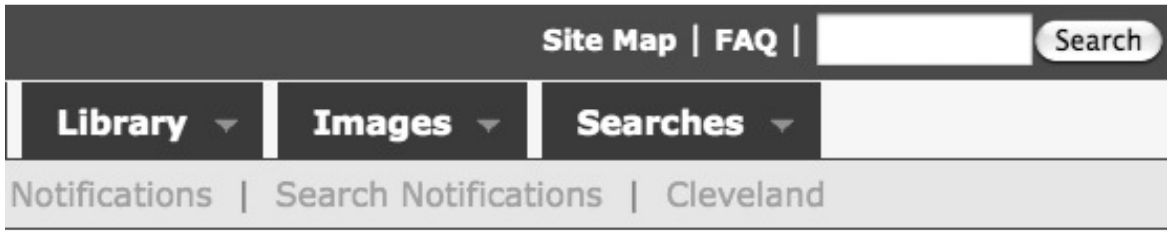


Figure 27 A. The Alaskan Volcano Menu Bar (Right).



1.) You are reading on this website (above) and want to get to the main page. What word would you click on? (circle one answer)

A. Home **B.** About AVO **C.** Library **D.** Searches **E.** FAQ

2.) You are reading on this website (above) and want to find out who created the website to see if it is a reliable and trustworthy source. What word would you click on? (circle one answer)

A. Home **B.** About AVO **C.** Library **D.** Searches **E.** FAQ

3.) This window appears on your computer screen. It is telling you…

Figure 28. Screenshot of Flash Plugin.

A. To answer a pop-up ad.

B. A security filter won't let you view information.

C. To download software.

D. To connect hardware to your computer.

E. I don't know.

4.) You are writing a report about ancient Egypt. You are looking for information that is useful and reliable. Which site would you go to first?

Figure 29. Screenshot of Search Results.

A. Tour Egypt Travel

B. Ancient Egypt Thematic Unit

C. The Ancient Egypt Site

D. Ancient Egypt Web

E. I Don't Know

4b.) Explain why you chose this answer.

5.) Rate how comfortable you would be explaining to an adult (or thinking aloud) about where you go and how you read on the Internet. (circle one)

A. Very Comfortable

B. Somewhat Comfortable

C. A little comfortable

D. Not at all comfortable

Appendix C

VERBAL PROTOCOL, ORAL READING FLUENCY, & INTERVIEWS FOR WEBSITE SYNTHESIS TASK

I. RULES FOR ASSISTANCE TO THE STUDENT

During the activity, you may clarify the task, itself, but you may not provide any information about how to complete it:

- You may ask the student to explain the task, to make certain they understand it.
- If the student is a poor reader and you think he/she might benefit from you reading the directions again, you should read these to the student. Do not read web sites or anything else.
- Do not provide any other assistance.
- Only respond with non-value laden comments to any think aloud responses. Use phrases like "OK," or "Keep going," or "Hm-hm," but don't do lots of head nodding, or excessive praise that would indicate to the student that we want them to "do more of that particular thing."
- If they ask a question, just say, "That's a great question. See if you can figure it out on your own."

II. PRE-TASK INTERVIEW & ORAL READING FLUENCY

(Push F9 to begin Morae recording. Verify that the red button on task bar is flashing to indicate recording.)

To Put Them at Ease by Positioning Them as an Important Informant to Our Research (1 min.)

1. "Hi XXXX. My name is YYYY. I work with the Michigan State University. We are studying how students read on the Internet. We would like you to help us learn how you read on the Internet. It will really help other students around the United States, and their teachers, if you can tell us how you use the Internet. We have some activities for you to do. They will help us learn how you use the Internet. Can you help us?"
2. (Following student response.) Today, we're going to spend time completing some tasks on the Internet. I am going to be recording where you are going on the computer, what sites you visit and how you get there so I can look back at it later and learn from you.

To Assess Oral Reading Fluency (6 min.)

1. Before we get to the computer, I am going to ask you to read out loud. These are pages that are printed from the webpages you will be reading later today. I am going to show you a page from a website and when I say start I want you to read the words out loud. You will read for 1 minute. I will say "stop" when the minute is finished. We will do this 3 times.

To Assess Prior Knowledge & Engagement (10 minutes)

(Record these answers by taking notes on the data collection sheet. Available for duplication at the end).

1. In a few minutes, I'm going to ask you to read some information about terrestrial biomes. Before you begin, can you…
    a. Tell me everything you know about biomes. What else do you know? Is there anything else? Anything else?

b. Tell me everything you know about the XX biome (at XX insert the name of 1 of the selected biomes for the study). What else do you know? Is there anything else? Anything else?

c. Tell me everything you know about the XX biome (at XX insert the name of 1 of the selected biomes for the study). What else do you know? Is there anything else? Anything else?

d. On a scale from 1-10 (with 1 being the lowest and 10 being the highest)…How much does the XX biome interest you?

III. INSTRUCTION ON HOW TO DO A THINK ALOUD (4 minutes)

1. You read on the Internet and I want to know how you do this. I'd like you to tell me what you are thinking while you are using the Internet. Let me show you how to do this.

   (Show video: http://ctell1.uconn.edu/thinkaloudvideo.mov)

2. Do you see how to think aloud while you do something? This is what we want you to do when you are reading. Do you have any questions about how to do this?

   (answer any questions)

IV. PRACTICE THINK ALOUD SESSION & INTRODUCTION TO TEXT-TO-SPEECH READER (3 minutes)

Warm-up activity

1. (Show students the text-to-speech reader): This is a text-to-speech reader. It is available to help you read the text. It can sound out words or read entire sentences for you. Let me show you. (Demonstrate with both a single word and entire paragraph). Now you try it. (Allow students to try demonstrate 2x or more if needed).

2. Let's do a quick warm-up to practice thinking aloud.

   We want you to read this site called COTF biomes. While you read, try to tell us what you are thinking as you read the website. Remember to tell us everything that you are thinking.

   During this task, you should encourage students to share their thinking with you. If they are not thinking aloud, remind them:

   a. What are you thinking while you read this page?

   b. What are you thinking as you are about to click on this link?

   c. What are you thinking now?

   (This is the one place where you may provide feedback to the student. Use the time to encourage them and offer feedback or examples.)

V. THINK ALOUD SESSION (20 minutes)

DIRECTIONS

Insert Directions from Website Synthesis Task

VI. DURING THE THINK ALOUD: PROMPT PROCEDURE FOR ELICTING ADDITIONAL THINKING ALOUD.

This is a *structurally prompted, think-aloud* session where we probe, inviting students to think aloud, at pre-selected locations, if they do not voluntarily share their thinking at these locations.

We will ask them one question at locations where we expect important thinking to take place:

Can you tell me what you are thinking?

Do not provide any other information in your question!

Ask this question at times <u>when they are about to click and choose an information route</u> (Try to anticipate the action as best as possible, so we get pre-click thinking, not post-click thinking.):

1. When they about to click on ANY link (or if you don't anticipate the click, then after they click on the link)

Ask this question at times <u>when they</u> <u>are not physically clicking</u> and choosing an information route, such as:

2. After they have clicked on any webpage item and more than 1 minute has passed without students' verbal engagement

We will ask them another question once they have written, typed or cut and pasted information into their notes:

<u>Can you tell me why you chose to type (write OR cut & paste) that?</u>

Do not provide any other information in your question!

VII. POSTREADING QUESTIONS (15 min)

(Record these answers by taking notes on the data collection sheet. Available for duplication at the end).

1. You just finished reading some information about terrestrial biomes. Now, can you…
   a. Tell me on a scale of 1 - 10 (with 1 being none and 10 being extremely high)…How much did you enjoy the task today?
   b. Tell me on a scale of 1 - 10 (with 1 being none and 10 being extremely high)…How successful were you at completing the task you did today?
2. In your opinion, what do good readers do when they are reading for information on the Internet?

3. As you were reading from the four websites today, what worked best for you to find the information for completing your task?
4. As you were reading from the four websites today, how did you decide which information was important to include in your notes?
5. (Show students the introduction page with 4 links to the information). Today, your teacher gave you four websites to start your search. What strategy or plan did you use to start your search from this page?

VIII. RELEASE THE STUDENT

1. Ask the students not to tell anyone about what they did. It is a study, and we want to see how each student does, without knowing what the activity is.
2. Release the student back to the classroom.

IX. END OF SESSION

1. Record the end time.
2. When student has completed the online assessment, stop the Morae recording (F10).
3. Save the Movie File As "[StudentCodeID]VP1date" (use the student's code)

X. POST-INTERVIEW (UPON COMPLETION OF THE FINAL DAY OF THE READING AND NOTE TAKING)

1. You just finished reading information about terrestrial biomes and making a brochure about a terrestrial biome. Now, can you…
    a. Tell me on a scale of 1 - 10 (with 1 being the lowest and 10 being the highest)…How much did you enjoy the entire assignment?
    b. How successful were you at completing the brochure?
2. Let's look at your brochure.

a. Can you tell me how you decided to make it? (What else did you do? Is there anything else? Anything else?)
b. Tell me how you decided which information should go in the brochure.
c. Tell me how you decided which pictures/graphs/(etc.) should go in the brochure.

3. (Upon reviewing the screen capture from the first day, they primary researchers may construct unique questions about specific features in the brochure and specific online reading behaviors. These interview questions are not to exceed 10 min. Hypothetical example: I noticed you wrote a lot of notes, but did not take out the notes when you were making your brochure. Why?)

DATA FORM: Field Notes for Verbal Protocol

Researcher: _____ Start time: _____ End time: _____

Student _____ Date _____

Filename: _____

Table 19. Field Notes Form for Verbal Protocol.

Time	Observations / Notes

Appendix D

Biome Project Teacher Script Outline for Day 1

Instructions: Read the italicized words verbatim as you provide instructions to the students about the brochure project.

1. Hand out biome rubric with students' assigned biomes
2. Teacher: *Today we are going to start a research project about terrestrial and aquatic biomes. You are going to create a brochure that educates people about your biome. Today we are going to discuss the brochure rubric and look at some examples of brochures from previous years. We are going to then start reading about your biome on the Internet while you take notes. The next day you will finish reading and taking notes and then begin to create your brochure.*
3. Review the brochure (have students follow along):
    a. Read the Directions aloud
    b. Review the Informational Requirements
        i. Use the Elmo to project student examples of each informational requirement from previous years
    c. Review the Design Requirements
4. Teacher: *You will be allowed to read on the Internet for information about your biome. I will provide three websites for you to start with. The link to the page with these websites is on the class blog.*

a. Demonstrate how to find the starting website and the difference between group A and group B. Tell students to examine their group listed on the top of their biome brochure.
b. Students are to open their laptops and find their starting site.
c. After students are to the starting webpage - Teacher*: I recommend you start with these websites that have reliable and appropriate content. You can find most of the informational requirements on these websites. You may use other websites if you need to find additional information.*

5. Teacher: *As you read, you must take notes. You are allowed to take notes in whatever format you prefer. You may take notes on paper, in Microsoft Word, in Evernote, or any other format you choose. You will use these notes to help you create the brochure. Tomorrow, when you are ready to start your brochure, you may use cardstock and art supplies* (point to the supplies), *Microsoft Publisher's brochure template, Microsoft Word, or any other format you choose. Any questions?*
6. Teacher: *Remember to use the brochure rubric to guide your reading. Go ahead and begin.*

Appendix E

Fidelity of Implementation Rubric for the Verbal Protocol

Table 20. Fidelity of Implementation Rubric.

Day 2 Task & Measures of Fidelity	Low *	Moderate*	High*
Pre-Task Interview & Oral Reading Fluency • Verbal Instructions • Non-verbals • Morae Start-up			
Prior Knowledge & Engagement • Verbal Instructions • Non-verbals			
Instruction on How to Do a Think-Aloud • Verbal Instructions • Demonstration Video			
Practice Think Aloud (VP) Session • Verbal Instructions • Non-verbals • Feedack (Quality/Quantity)			

Table 20 (cont'd)

Online Reading Think Aloud (VP) Session
• Prompts
  o Adherence to prompts
  o Timing of prompts
• Non-verbals			

Other (notes):			

* The general guidelines for low, moderate, and high fidelity are outlined below. Notes were recorded in the chart to document comments about the research assistant's performance.

Low Fidelity:

- 2 or more errors in verbal instructions or prompts
- 4 or more non-verbal cues (or verbal gestures, e.g. mmm-hmm) that directly answered students direct or indirect questions OR that were not neutral
- 2 or more errors with technology
- 2 or more inappropriate initiation of prompts during the VP

Moderate Fidelity:

- 1 errors in verbal instructions or prompts
- 2-3 non-verbal cues (or verbal gestures, e.g. mmm-hmm) that directly answered students direct or indirect questions OR that were not neutral
- 1 error with technology

- 1 inappropriate initiation of prompts during the VP

High Fidelity:

- 1 error in verbal instructions or prompts
- 1 non-verbal cues (or verbal gestures, e.g. mmm-hmm) that directly answered students direct or indirect questions OR that were not neutral
- No errors with technology
- No inappropriate initiation of prompts during the VP

Appendix F

Note Taking Rubric

Table 21. Note Taking Rubric

	Highly Proficient **ALL** **[5]**	**Proficient** **Mostly** **[4]**	**Developing** **Some** **[3]**	**Emerging** **None/No** **[2]**	**Non existent,** **Undeveloped** **[1]**

Table 21 (cont'd)

Organizational Structure (When scoring **focus on structure** of major and minor ideas NOT on the accuracy or amount of content included. This score is supposed to reflect the students' ability to CONSTRUCT a framework for notes.) A. Hierarchy of information B. Organization evidenced by visual features	A. Sophisticated Hierarchical structure and organizational pattern show a clear distinction between **major and minor ideas 100% of the time**. B. Organization is evident **all** of the time: **2 or more levels or groupings of ideas** are present throughout the notes. Notes may exhibit the following features: *Consistent use of the organizational strategy for distinguishing major and minor ideas.	A. Hierarchical structure and organization pattern is almost fully represented. **Major and minor ideas** are present and clear **most of the time**. B. Organization is evident **most** of the time; **2-levels or groupings of ideas** with a solid contingent of main ideas and details. Notes may exhibit the following features: * Distinction between major and minor ideas using labels *Distinction between different major and minor ideas besides labels (e.g. brackets,	A. Hierarchical structure and organizational pattern is partially represented, but slightly imperfect or inconsistent. Some **Major and minor idea**s must be present as indicated through labels OR physical groupings even if imperfect or very limited. B. Organization is evident as demonstrated by **2-levels or groupings of ideas**, but may be limited or imperfect**.** Notes may exhibit the following features:	A. Hierarchical structure is limited or mostly missing. B. Organization is limited as demonstrated by only **1-level or grouping of ideas (equal chunks)** OR extensive copying from source text. Notes may exhibit the following visual features: *Notes look like an essay with paragraphs to delineate a shift between major ideas OR *Notes may have a list-like structure, but no distinction between major and minor ideas (e.g. - a bulleted list of ideas but no distinction between major and minor ideas within list OR a list of vocabulary/keywords)	A. No hierarchical structure of major or minor ideas is evident. B. Notes look like a single paragraph or an essay with no visual distinction (eg. paragraphs) to delineate a shift between major ideas OR details are listed without any obvious associations D. There is not enough information to make a judgment.

Table 21 (cont'd)

	*Distinction between major and minor ideas uses labels OR a sophisticated visual stratey (e.g. web, chart, outline). *Evidence of grouping is evident **all** of the time even if there are errors in the accuracy or content of notes. (**2 main ideas with paired minor ideas is the minimum threshold to demonstrate the *consistent* use of organization and obtain the score of 5)	physically separated chunks, indentation, lines, etc.) *Organization is not evidenced 100% of time because notes may occasionally revert to 1 level or groupings of ideas. *Evidence of grouping is evident **most** of the time even if there are errors in the accuracy or content of notes. (**2 main ideas with paired minor ideas is the minimum threshold to demonstrate the *consistent* use of organization and obtain the score of 4)	*Distinction between different sets of major and minor ideas besides labels (e.g. brackets, physically separated chunks, indentation, lines, etc.) *Inconsistent use of labels or groups associated with major and minor ideas (e.g.. 2 levels present in only a small portion of the notes, the remainder reverts to 1 level).		

Table 21 (cont'd)

Content – Breadth A. Breadth: representation of major ideas in relationship to the requirements of the brochure rubric (see rubric for MI categories)	A. Covers ALL of the major ideas (7MIs) listed in the brochure rubric.	A. Covers most of the major ideas (5 MIs) listed in the brochure rubric OR covers all of the major ideas (6 MIs) but the information on 1 major idea is imperfect (e.g. states the major idea but the notes contain inaccuracies)	A. Covers some of the major ideas (4 MIs) listed in the brochure rubric OR covers most of the major ideas (5 MIs) but the information on 1 major idea is imperfect (e.g. states the major idea but the notes contain inaccuracies)	A. Inconsistent coverage of the major ideas (2 MIs) listed in the brochure rubric OR covers some of the major ideas (3 to 4 MIs) but the information on these major ideas is imperfect (e.g. states the major idea but the notes contain inaccuracies)	A. Covers none of the major ideas listed in the brochure rubric.
Content – Depth A. Depth: representation of supporting details for major ideas	A. Provides 6 or more relevant supporting details for EACH main idea presented in the notes. (*Exception for the "website" which may only have 1 fact)	A. Provides 4-5 relevant supporting details for each main idea -OR- Provides 6 or more supporting details for each main idea, but the details are slightly imperfect OR inappropriate for inclusion in the brochure	A. Provides 3-4 relevant supporting details for each main idea -OR- Provides 5-6 supporting details for each main idea, but the details are slightly imperfect OR inappropriate for inclusion in the brochure	A. Provides 1-2 relevant supporting details for each main idea -OR- Provides 3-4 supporting details for each main idea, but the details are slightly imperfect OR inappropriate for inclusion in the brochure	A. Provides no supporting details for the main ideas -OR- Provides 1-2 supporting details for each main idea, but the details are slightly imperfect OR inappropriate for inclusion in the brochure

Table 21 (cont'd)

		(e.g. inaccurate facts, confusion between facts for temperate and tropical rainforests) -OR- Provides 6 or more relevant supporting details for some main ideas, but 4-5 supporting details for other main ideas (*Exception for the "website" which may only have 1 fact) (**all main ideas must have at least 2 supporting details as a minimum threshold for determining a score of 4).	(e.g. inaccurate facts, confusion between facts for temperate and tropical rainforests) -OR- Provides 4-5 relevant supporting details for some main ideas, but 3-4 supporting details for other main ideas (*Exception for the "website" which may only have 1 fact)	(e.g. inaccurate facts, confusion between facts for temperate and tropical rainforests) -OR- Provides 3-4 relevant supporting details for some main ideas, but 1-2 supporting details for other main ideas (*Exception for the "website" which may only have 1 fact)	(e.g. inaccurate facts, confusion between facts for temperate and tropical rainforests)

Table 21 (cont'd)

Reduction A. Evidence of summarization as a strategy/skill B. Inclusion of key words and phrases C. Notes make sense	A. Nearly all of the important ideas are reduced and summarized succinctly (approx. 80-100%). There are few to no excess words. B. Student uses own words but also includes key words and phrases from the passage. C. Summaries include enough information to make sense. Information is relevant and important	A. The majority of the ideas in the notes are summarized (approx. 60-80%). Phrases, and groupings represent information with great success, but less than perfect B. Overall, shows good ability to summarize (in a meaningful way) by selecting key ideas/sentences *and* reducing the sentences into key words, concepts and phrases. Student summarizes most info with good success, but a few ideas may still be copied directly from the passage.	A. Some but not all ideas are summarized (approx. 40-60%). Many ideas may be paraphrased but not consistently or thoroughly. B. Overall, shows good ability to summarize (in a meaningful way) by selecting key ideas/sentences *and* reducing the sentences into key words, concepts and phrases. Student summarizes some info with success but many ideas may still be copied directly from the passage.	A. There is evidence that the student is beginning to select information, but notes closely parallel the language, structure, and ideas of the original websites. B. Reduces mainly in the sense of selecting sentences & key ideas C. Notes makes sense but there is a tendency to rely heavily on the source passage. D. Very little evidence that the student is independently arranging and summarizing the ideas to represent their meanings	A. There is no evidence of summarizing as a strategy or skill. Notes are nearly copied from the passage or notes are reduced too far to make sense. B. Student does not use her own words. Key information is included only because the student copied entire portions of the passage or no key words and phrases are included. C. Notes only make sense because they are copied. Notes are reduced too far to make sense.

Table 21 (cont'd)

		C. Most but not all of notes are reduced. Contains the gist of most of the important ideas. A few of the notes may be reduced too far to make sense.	C. Some of the notes make sense. Incomplete or extraneous or irrelevant wording may be present.		D. There is not enough information to make a judgment.

Appendix G

Brochure Rubric

Table 22. Brochure Rubric

	Highly Proficient ALL [5]	**Proficient Mostly [4]**	**Developing Some [3]**	**Emerging None/No [2]**	**Non existent, Undeveloped [1]**
Content – Alignment with Rubric A. Alignment: Coverage of the informational requirements (including images) presented in the brochure rubric	A. Covers ALL of the informational components/categories required by the brochure AND includes 5 or more relevant images.	A. Covers most of the informational components/categories required by the brochure (5-7 informational components) -OR- Covers ALL informational components/categories required by the brochure but includes 3 or less relevant images.	A. Moderate coverage of the informational components/categories required by the brochure (3-5 informational components) -OR- Covers 5-7 informational components/categories required by the brochure but includes 2 or less relevant images.	A. Inconsistent coverage of the informational components/categories required by the brochure (1-2 informational components) -OR- Covers 3-5 informational components/categories required by the brochure but includes only 1 relevant images.	A. Covers none of the informational components/categories required by the brochure and includes no relevant images. -OR- Covers 1-2 informational components/categories required by the brochure but includes no relevant images.

Table 22 (cont'd)

Content-Depth, Cohesion, & Accuracy A Depth - Representation of information that supports each category. B. Cohesion - The extent to which the supporting details connect with the category/topic. C. Accuracy - Factual accuracy of information presented.	A. Highly proficient depth of coverage in the categories/topics covered in the brochure (depth apparent in 100% of categoreis covered). B. The supporting details demonstrate high cohesion in every topic. C. All of the information presented in the brochure demonstrates factual accuracy. (**depth exculdes the rainforest map and website where 1 item fulfills the category requirement)	A. Proficient depth of coverage in the categories/topics covered in the brochure (depth apparent in 75% or more of categories covered). B. The supporting details demonstrate proficient cohesion with the topic (1 topic lacks cohesion). C. Most of the information presented in the brochure demonstrates factual accuracy (2 or less factual errors). (**depth exculdes the rainforest map and website where 1 item fulfills the category requirement)	A. Moderate depth of coverage in the categories/topics covered in the brochure (depth apparent in only 50%-75% of categories covered). B. The supporting details demonstrate some cohesion with the topic (2 topics lack cohesion) C. Most of the information presented in the brochure demonstrates factual accuracy (2 or less factual errors). (**depth exculdes the rainforest map and website where 1 item fulfills the category requirement)	A. Inconsistent depth of coverage in the categories/topics covered in the brochure (depth apparent in only 25-50% of categories covered). B. The supporting details demonstrate inconsistent cohesion with the topic (3 topics lack cohesion) C. Some of the information presented in the brochure demonstrates factual accuracy, yet some errors still exist (3-4 factual errors). (**depth exculdes the rainforest map and website where 1 item fulfills the category requirement)	A. No or almost no depth of coverage in the categories/topics covered in the brochure (depth apparent in less than 25% of categories covered). B. The supporting details demonstrate inconsistent cohesion with the topic (4 or more topics lack cohesion) C. Significant factual **innaccuracy** in the brochure (greater than 5 errors in factual accuracy). C. There is not enough information to make a judgment.

Table 22 (cont'd)

Brochure Organization & Aesthetics A. Organization of the information within the brochure. B. Aesthetic appeal appropriate for a brochure.	A. Organization is apparent in 100% of the brochure. (Ex. font consistency - size, alignment, colors; image presentation - borders, cropping; etc.) B. The brochure provides aesthetic appeal on ALL panels.	A. Organization is apparent across most of the brochure (75% of the brochure). (Ex. font consistency - size, alignment, colors; image presentation - borders, cropping; etc.) B. The brochure provides aesthetic appeal on 4 or more panels, but lacks aesthetic appeal on the remaining panels.	A. Organization is apparent across some of the brochure (50% of the brochure). (Ex. font consistency - size, alignment, colors; image presentation - borders, cropping; etc.) B. The brochure provides aesthetic appeal on 3 panels, but lacks aesthetic appeal on the remaining panels.	A. There is inconsistent organization throughout the brochure. (25% of the brochure). (Ex. font consistency - size, alignment, colors; image presentation - borders, cropping; etc.) B. The brochure provides aesthetic appeal on 1 panel, but lacks aesthetic appeal on remaining panels.	A. There is no apparent organization of the brochure. (Ex. font consistency - size, alignment, colors; image presentation - borders, cropping; etc.) B. The brochure reveals a lack of aesthetic appeal.

Table 22 (cont'd)

Voice A. Voice - the use of a voice appropriate for the topic (rainforest), the purpose (informative & persuasive), and audience (tourists).	A. The brochure demonstrates the appropriate voice for the topic, purpose and audience 100% of the time.	A. The brochure demonstrates the appropriate voice for the topic, purpose and audience most of the time (75% of the brochure).	A. The brochure demonstrates the appropriate voice for the topic, purpose and audience some of the time (50-75% of the brochure). -OR- The voice is occassionally inappropriate for the topic, purpose, and audience of the brochure (ex. the voice in 1 category is inappropriate but the remainder of the categories demonstrate appropriate voice)	A. There is inconsistent demonstration of appropriate voice for the topic, purpose, and audience throughout the brochure. May be evident in 25% of the brochure or 1 category, but not the remainder of the brochure. -OR- The voice is consistently inappropriate for the topic, purpose, and audience of the brochure.	A. There is no demonstration of an appropriate voice for the topic, purpose and audience.

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