ONLINE READING COMPREHENSION STRATEGIES AMONG GENERAL AND SPECIAL EDUCATION ELEMENTARY AND MIDDLE SCHOOL STUDENTS

By

Hsin-Yuan Chen

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ABSTRACT

ONLINE READING COMPREHENSION STRATEGIES AMONG GENERAL AND SPECIAL EDUCATION ELEMENTARY AND MIDDLE SCHOOL STUDENTS

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According to government reports, new Internet technologies present readers with new reading opportunities and challenges (National Institute of Child Health and Human Development, 2000; RAND Reading Study Group [RRSG], 2002). However, we are just beginning to understand the specific complexities that Internet text imposes on the reading comprehension process (Coiro, 2003; Leu, Kinzer, Coiro & Cammack, 2004), and we know even less about what these complexities mean for particular student populations who are reading texts in a variety of online environments. The present study purposefully targeted the online reading strategies of upper-elementary and middle school students with and without learning disabilities (LD), in the U.S. and in Taiwan, as they read expository text. Several aspects of the comprehension process were studied, including: (1) Internet navigation strategies and behaviors, (2) students' sensitivity to the organizational structure of hypertexts, (3) online search strategies, and (4) online reading strategies. Data collection involved surveys, structured metacognitive interviews, observations, reading comprehension activities, and online search tasks that were administered to 119 American and Taiwanese students in the fifth and sixth grades.

The results suggested that the fifth- and sixth-grade students in this study (1) had opportunities to use computers and use the Internet, but they were not taught sufficient online reading and search strategies; (2) were easily disorientated by the non-linear nature

and unfamiliar structure of online texts, especially when Websites or Web pages lacked appropriate tabs or organizational cues for informational passages; (3) did not employ recommended online search strategies; and (4) had weak before-reading strategies, and had difficulty distinguishing before- and during-reading strategies, although their after-reading strategies were often advanced. The study findings suggested that: (1) students needed to be taught necessary online reading and search strategies, and (2) educators and instructional Website designers needed to be mindful of the characteristics of non-linear and unclearly structured text when designing Websites and hypermedia for upper-elementary and middle school students.

To my family

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INTRODUCTION

Comprehending what is read presents significant challenges for many students, including students with learning disabilities (LD). Explicit and highly structured reading skills are required, and so is the application of strategy knowledge in support of reading comprehension, no matter whether students are reading in a conventional print or online digital environment. Indeed, most learning that results from reading, both with print and online, depends on the ability to read and understand informational text. Also, reading skills need to be highly structured and yet flexible in the different environments in which students read. However, there are many questions that have yet to be answered: How likely is it that students with and without LD will employ reading strategies when they are exposed to informational passages? Do readers with different disability status employ different reading comprehension skills and strategies when they read online texts? How do different types of text structures help or hinder students' reading in online environments? What characteristics do hypertext readers have when they search for and locate information on the Internet? Emerging from these questions, the purpose of this study is to investigate the online reading strategies elementary and middle school students actually use, with the larger goal of understanding how these students may optimize their reading comprehension with informational texts.

Rationale

A National Reading Agenda

The No Child Left Behind Act of 2001 (United States Department of Education, 2002) requires students from all subgroups, including students with disabilities in Grades 3 through 8, to make adequate yearly progress (AYP) and reach proficient levels in mathe-

matics and reading/language arts by the 2013-2014 school year. This means that reading will remain a primary subject in the school curriculum, and one of the most important academic skills and abilities that influence student learning across the curriculum.

One national report shows that more than eight million struggling readers in grades 4-12 in U.S. schools are not equipped with adequate literacy skills (NCES, 2003, 2007). Only 31% of fourth graders in 2004-2005 and 33% of fourth grade students in 2006-2007 scored at the proficient level in reading performance on the National Assessment of Educational Progress (NAEP), which defines proficiency as "solid academic performance" (NCES, 2007). Conversely, nearly 70% of students entering the fifth grade scored below this level, which means that they had only attained "partial mastery" of grade-level skills (Loomis & Bourque, 2001, p. 2).

Students who face difficulties in reading include students with learning disabilities (LD) who have been identified as having difficulties in literacy. They may have difficulty in reading words accurately; they may fail to comprehend what they read; they may lack the reading fluency needed to facilitate comprehension; or they may fail to use or acquire strategies to help them grasp the gist of a text, to recognize main ideas, to repair misinterpretations, and to change tactics based on the purpose of reading (Biancarosa & Snow, 2004). Such students with LD may not know how to activate relevant strategies to comprehend the informational passages in a particular subject, and they may fail to generalize the strategies they have learned in their reading or language arts class to the content-area literacy tasks they encounter in science, social studies, or mathematics (Biancarosa & Snow, 2004). In a nutshell, these students need to acquire the grade-level reading skills and strategies to support their reading comprehension performance, and they need

specific instruction that will help them generalize their strategy knowledge to the content areas of the informational curriculum.

Reading Strategies

Pressley and Afflerbach in 1995 (see also Gildroy & Deshler, 2006; Pressley & Wharton-McDonald, 1997) examined all extant think-aloud-based studies of reading and concluded that expert readers of print-based text actively employ reading strategies to increase their reading comprehension performance. Pressley (2000) pointed out that proficient readers know when and how to use a variety of comprehension strategies in different stages of reading, such as before, during, and after reading. The use of before, during, and after reading strategies has been shown to enhance readers' comprehension (Brown, Pressley, Van Meter, & Schuder, 1996) and recall from informational text (Anderson & Roit, 1993; Bereiter & Bird, 1985; Lytle, 1982; Pressley et al., 1992). Further, strategic readers set up reading purposes and actively engage in what is being read (Stahl & Vancil, 1986; Steffensen, Goetz, & Cheng, 1999), as well as attend to text organization and structure (Anderson & Armbruster, 1984; Meyer & Rice, 1984).

The prevailing literature has focused on print-based reading studies. Consequently, much less is known about how students use comprehension strategies in online reading environments (see Coiro & Dobler, 2007; Kamil & Intrator, 1998; Leu, 2000, 2002; Leu, Kinzer, Coiro, & Cammack, 2004; Reinking, 1998). Most of the research on online reading has focused on adults or college students (Lawless, Mills, & Brown, 2003), but there is little empirical data on the performance of adolescents (Coiro & Dobler, 2007) or upper-elementary school students. Of interest in this research is the nature of students' read-

ing processes and their cognitive strategies in non-linear online environments (Balcytiene, 1999), especially in reading and interpreting online informational (expository) passages.

Online Reading Comprehension

The Internet has transformed the nature of literacy learning, opening up virtually unlimited opportunities for users to further their academic knowledge, economic opportunities, and information circulation (Educational Testing Service, 2003; U. S. Department of Commerce, 2002). Most public schools in the United States provide their students with access to the Internet (National Center for Education Statistics [NCES], 2002, 2003). In fact, Internet technologies have become a part of school children's daily lives, especially in the area of informational texts (Lebo, 2003).

With its increasing capacity for access to online information (i.e., enriched hypertext, hypermedia, and multimedia), the Internet provides abundant resources and opportunities for students, and presents challenges for literacy educators (Spires & Estes, 2002). If students are to take full advantage of the informational possibilities afforded by the Internet, then it is essential to develop their digital literacy skills and strategies. According to government reports, new Internet skills are involved because Internet texts pose new reading challenges (National Institute of Child Health and Human Development [NICHD], 2000; RAND Reading Study Group [RRSG], 2002). For example, learners have to find solutions or make decisions about the suitability or usefulness of particular webpages from among the thousands listed on a search engine results page. They need new skills to face this new challenge (i.e., key word searching, selection, or organization) that will help them to manage these rich information resources as part of a learner-driven process involving investigation, research inquiry, and synthesizing meaning from many

sources of data. Learning becomes a real time exploration of dynamic world issues based on personal inquiry goals.

However, in comparison with research involving conventional print text, there is scarce empirical work to support the claim that hypertext poses additional complexities in the reading comprehension process (Coiro, 2003; Leu, Kinzer, Coiro & Cammack, 2004). In a meta-analysis study of 80 research articles that focused on comprehension and technology, only three of these studies focused on the Internet (Coiro, Leu, Kinzer, Labbo, & Teale, 2003). This gap in the research literature means that many educators may not be equipping their students with the comprehension skills and strategies they need to take full advantage of the opportunities for lifelong learning and reading that are available through the Internet. The purpose of this research is to examine elementary and middle school students' strategy use in reading comprehension and performance as they read hypertexts on the Internet.

LITERATURE REVIEW

The research described in this dissertation draws on three complementary conceptual frameworks. The first section of the literature review will focus on the informational reading comprehension strategies involved in reading conventional text. Two theoretical principles of reading processes and comprehension will frame the first section, including the literatures on cognitive theory and sociocultural theory. Within this section, the roles of texts, readers, and context in the reading comprehension process will be reviewed and discussed.

In the second section, online reading comprehension strategies will be reviewed, drawing on two theoretical frames: cognitive flexibility theory and new digital literacies. This section will explore the differences and similarities that exist between traditional print texts and hypertexts, as well as between readers of print and online readers in terms of their reading comprehension processes and strategy use.

In the third section, of special interest to the current research, the reading problems that students with learning disabilities face will be presented. The first part of this section will focus on the problems or difficulties that students with LD experience with traditional print passages. The concluding part then will highlight the need to explore the online reading comprehension strategies used by students with and without learning disabilities.

Reading Comprehension Strategies in Traditional Informational Texts

Reading comprehension includes several elements that allow readers to simultaneously process, extract, and construct meaning through written language (RAND Reading Study Group [RRSG], 2002, p. 11). Many researchers agree that the three elements interact to influence the reading comprehension process, and that this process is further

influenced by factors associated with the reader, text, and context (e.g., Paris, Wasik, & Turner, 1991; Pressley & Afflerbach, 1995; RRSG, 2002).

The skilled *reader* applies a broad range of processes and strategies designed to construct meaning. This skilled reader draws on and elaborates on the full range of processes and strategies related to the reader's prior knowledge and reading dispositions (e.g., vocabulary knowledge, decoding skills, meaning-making strategies) that help the reader to access and assign meaning to the *text*. In addition to reader-based factors, there are specific features of the *text* that influence the comprehension performance. For example, the reader's knowledge of common text structures influences the reader's literacy performance, including the reader's knowledge of narrative sub-genres (e.g., short story, autobiography, novel, etc.) and expository sub-genres (e.g., descriptive, persuasive, analytical, or procedural texts) and their respective text structures (Applebee, 2000; Englert, Mariage, Okolo et al., in press; Ogle & Blachowicz, 2002; Scardamalia & Bereiter, 1986). Finally, the reader and text interact in a broader sociocultural *context*, which entails learning and reading in a sociocultural environment that involves cultural tools and social agents. Figure 1 presents a visual representation of this literacy model, which is further explained in the following sections.

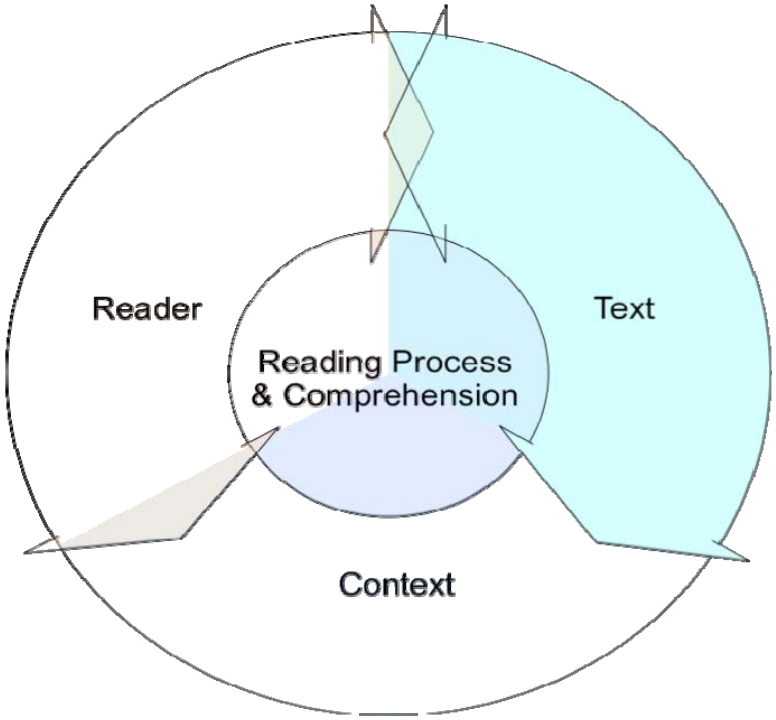


Figure 1. The roles of reader, text, and context in the reading process and comprehension

The Text, Reader, & Context in Reading Comprehension

The reader. "Comprehension" can be broadly defined as "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (RAND Reading Study Group [RRSG], 2002, p. 11). It encompasses a wide variety of skills and strategies, especially when comprehension entails reading. The central element of reading comprehension is a reader's ability to get the gist, point, or main ideas from a text (Pearson & Johnston, 1978; Williams, 2003). Without an ability to understand the meaning of a text, the reader is not able to make inferences, compare differences within and across the sections of a text, or engage in critical thinking about the textual ideas.

When processing a print text, the reader's prior knowledge plays a central role in the reading comprehension process (Carlisle & Rice, 2004; Duke, Pressley, & Hilden,

2004). For example, the reader has to make sense of the words based on what is already known (Goodman, 1967; Smith, 1971). Consequently, reading comprehension is influenced by the reader's knowledge of the reading topics and his/her familiarity with the central concepts of a passage. Prior knowledge helps the reader to predict words and particular types of information, and this knowledge in turn helps the reader to monitor the comprehension process (Anderson & Pearson, 1984). In addition, the reader uses prior knowledge to query the ideas in the text, ask questions, make inferences, construct meanings and images, and summarize what has been read in the text (Pressley & Afflerbach, 1995). These procedural actions that the reader takes are called "strategies," and prior knowledge influences the reader's employment of sense-making strategies in the planning and monitoring stages of the comprehension process.

Besides prior knowledge, some researchers also believe that reading comprehension is related to word recognition (e.g., word identification or decoding), which includes the reader's automaticity in identifying words and overall fluency in reading (Gough, Hoover, & Peterson, 1996). It is often assumed that once a reader is fluent, s/he will comprehend what is read. However, many researchers (i.e., Barnes, Faulkner, & Dennis, 2001; Buly & Valencia, 2002; Dewitz & Dewitz, 2003) have proven that even students who can read and recognize words on tests and in their textbooks can fail to comprehend. In one study of more than 400 children in a summer reading program, researchers found that there was no correlation between students' fluency in word recognition and their responses to a series of comprehension questions (Paris, Carpenter, Paris, & Hamilton, 2005). Other studies have corroborated the finding that oral reading fluency becomes more dissociated from comprehension after grade 3 (Kranzler, Miller, & Jordan, 1999;

Paris, Carpenter, Paris, & Hamilton, 2005; Stahl & Hiebert, 2006). These studies suggest that oral reading-rate assessments do not accurately measure or predict the comprehension performance of older students (Pressley & Hilden, 2005). In other words, lack of oral reading fluency correlates strongly with lack of comprehension among novice readers, but among experienced readers this correlation between fluency and comprehension does not exist (Paris, Carpenter, Paris, & Hamilton, in press).

Another explanation for the lack of correlation between word reading fluency and comprehension might be that readers' cognitive resources are finite and that the resources they can commit to performing the reading process are limited. When readers expend a large proportion of their attention to low-level processes such as word recognition, they do not have additional resources to devote to the comprehension process. For these readers, the cognitive load imposed by the lower-level processes hinders the executive functions that would allow them to monitor the higher-level processes of comprehension (LaBerge & Samuels, 1974). In this way, reader-based factors strongly impinge on reading comprehension. And as reader-based factors interact with the comprehension process, they are, in turn, supplemented or inhibited by other specific features associated with various aspects of the reader, text, and context.

A skilled reader also brings many abilities and characteristics to the reading activity. These characteristics involve critical thinking skills and dispositions, including the ability and inclination to analyze what has been read, interpret the meaning of the text, gather information from multiple sources, and solve confusing points while reading. A good reader must understand the purposes and goals for reading, how to achieve those reading goals, how to adjust the reading path, and what strategies to apply to maintain

good comprehension. Altogether these abilities encapsulate at least three reader-based aspects of reading comprehension: metacognitive knowledge, self-regulation, and motivational beliefs (Borkowski & Burke, 1996; Dickson, Collins, Simmons, & Kame'enui, 1998; Paris et al., 1991).

Metacognitive knowledge refers to when the reader has conscious knowledge of what is expected and what strategies to use to find a solution or a way forward. Metacognitive knowledge includes declarative knowledge (knowing what strategies to employ), procedural knowledge (how to employ the strategies), and conditional knowledge (knowing when and why the strategies should be employed) (Anderson, 1993; Enns, 1993; Paris, Lipson and Wixson, 1983; Smith and Ragan, 1999). Metacognitive knowledge is necessary for the reader to self-direct, self-monitor, and self-regulate reading performance, all of which are associated with the readers' executive control of the reading process and functions. When readers can employ strategies and understand the benefits of using particular strategies, they typically have higher motivational beliefs and self-efficacy (Westby, 2004). The following paragraphs and Table 1 further explain the three components of successful reading.

Table 1. Reader's Qualities and Abilities in Reading Activities

Component	Type of Knowledge	Characteristic
Metacognitive Knowledge	Knowledge of thinking Knowledge of different tasks Knowledge of strategies Knowledge of resources Knowledge of expected outcomes	Is the material too easy (or hard)? Which subjects or topics are interesting? What kind of testing formats will show up in the exams? What strategies or resource materials are used for comprehension or testing questions?
Self-Regulation	Coordinate metacognitive knowledge Set up realistic reading goals Monitor reading progress and comprehension Remediate reading confusions or failures Appreciate reading results	How do I read this task? First, second, next…? How do I know if I understand the text? What difficulties prevent understanding in this text? What actions should be taken to comprehend the task?
Motivational Beliefs	Competency, ability Belief, value Interest Attitude	Do I have the ability to handle the reading task? How do I explain this failure or success? Do I believe the reading strategy is worthy?

Metacognition consists of three components. The first component of metacognition was defined by Flavell (1976) as "one's cognition knowledge concerning one's own cognitive processes and products or anything related to them" (p. 232). The cognitive knowledge implicit in that definition refers to one's conscious awareness or knowledge of thinking, including knowledge of different tasks, knowledge of strategies, and knowledge of expected outcomes (Flavell, 1979). For example, the reader with metacognitive knowledge knows if the material is easy or hard; which subjects or topics are interesting; what kind of testing formats will show up in the exams, and how to comprehend or answer testing questions by selecting various strategies or acquiring resource materials. A good

reader also intentionally performs cognitive processes and metacognitive strategies to influence learning and cognition (Mayer, 2001), such as using a rehearsal strategy to memorize a paragraph through cognitive processes, or applying a representational strategy (i.e., map, notes) to comprehend a passage. The application of cognitive processes and metacognitive strategies helps the reader enhance reading comprehension and learning performance.

The second metacognitive component consists of executive functioning, or self-regulation. This component first appeared in Brown's (1980) descriptive study of reader-controlled strategies. The strategies identified by Brown (1980) included text selection, comprehension monitoring, corrective actions in the comprehension process, structure cues retrieval, and testing readiness estimation. Self-regulation may also be influenced by other personal variables, like self-concept (i.e., self-esteem, self-efficacy) or personal sentiments (i.e., anxiety, excitement, interest) (Westby, 2004). At the highest level, the self-regulated reader sets up realistic reading goals, monitors his/her progress, and appreciates the results. The reader may also regulate his/her knowledge-seeking process and evaluate his/her strategy use to ensure the comprehension of texts, in the present and also in the future (Mosenthal & Kirsch, 1991; Paris, Lipson, & Wixson, 1994).

The final component comprises motivation and motivational beliefs. Researchers believe that motivational and affective variables are also key elements that influence the cognitive reading processes and comprehension (Baker & Wigfield, 1999; Guthrie & Wigfield, 1997). These motivational and affective variables include beliefs, values, perspectives, perceptions, goals, interests, and attitudes that can affect strategy use with informational texts (Chapman & Tunmer, 1995; Guthrie & Alvermann, 1999; Horner &

Shewry, 2002; McKenna, Kear, & Ellsworth, 1995). These motivational beliefs may influence the reader's self-regulation and motivation in studying or searching for information. For example, the reader may only work for tangible rewards, rather than because of personal interest in or curiosity about the knowledge being sought. Such a reader may be quickly frustrated or anxious because of the external consequences. The focus on external factors will likely affect reading comprehension because the reader may not focus sufficiently on his/her reading goals, the features of the text, or the details that were read (Westby, 2004).

How does a good reader apply strategies when reading? What underlies the reader's metacognition, motivation, and executive functioning to assist reading? Researchers have shown that a good reader is usually a self-regulated learner who is intrinsically motivated; he/she reads for interest in or curiosity about knowledge and learning, not because of the exterior awards (Guthrie & Knowles, 2001). This reader sets up his personal goals before engaging in reading to get the gist and meaning. In addition, this kind of reader is usually a good comprehender who skillfully and effectively applies metacognitive strategies as tools to aid reading comprehension to a greater degree than a poor reader (e.g., Palincsar & Brown, 1984; Pearson & Fielding, 1991; Pressley, 2002; Tierney & Cunningham, 1984). The use of the strategies will aid the learning of reading comprehension skills, word recognition, and phonological decoding skills (Pinnell, Lyons, DeFord, & Bryk, 1994; Tunmer, Herriman, & Nesdale, 1988; Vellutino & Scanlon, in press).

Furthermore, the expert reader is active in applying a wide range of reading strategies and processes that are suitable for the different phases of reading, including before, during, and after reading (Pressley, 2002; Pressley & Afflerbach, 1995; Pressley & Whar-

ton-McDonald, 1997). These sub-processes help the reader remain actively involved in reading and interpreting the text to increase his/her reading comprehension. The left part of Table 2 illustrates these sub-processes of reading, and the right column indicates the reading strategies employed by the expert reader during each sub-process.

Table 2. Summary of Research Findings for Reading Strategies of Print Texts

	Expert-Level Print Reading Strategies
Before	1. Sets a purpose and goals for reading (e.g., to study, for entertainment) 2. Previews the text (e.g., title, introduction, headings, pictures/graphics, captions, summary, questions) 3. Plans how to read the text (e.g., front to back, or specific sections)
During	1. Thinks about what is already known about the topics 2. Anticipates and utilize text structures 3. Asks questions and seek answers 4. Predicts, confirms, or modifies predictions 5. Identifies important information and details 6. Relates important points across the text 7. Paraphrases and summarizes as a means to remember what was read 8. Infers, adds missing details, makes associations 9. Visualizes what is described 10. Monitors comprehension 11. Mends breakdowns in comprehension (e.g., re-reads, uses the glossary, consults graphics)
After	1. Summarizes 2. Reflects 3. Synthesizes 4. Writes

Before-reading strategies enable the reader to assess prior knowledge, define reading purpose, make predictions about the topic, and survey the material (Pressley, 2002; Pressley & Afflerbach, 1995; Pressley & Wharton-McDonald, 1997). For example, the reader may set up a goal to learn the material in depth, recall main ideas for a test, or look for specific information. Thus, the reader may skim or look through the text to get a

sense of the topics, its organizational structure, and the main parts to see if the text will meet his/her reading purpose. When surveying the text, the reader may also need to activate prior knowledge related to the text in order to make predictions or construct hypotheses about the covered topics. Through "text preview," the reader is motivated to read for understanding (Graves, Prenn, & Cooke, 1985; Graves et al., 2001).

During-reading strategies are employed by the reader to comprehend the important textual ideas, to monitor comprehension performance, and to make corresponding adjustments. The strategies employed by the reader while reading include utilizing text structures, asking questions and seeking answers, confirming or modifying predictions, identifying important information, relating important points across the text, paraphrasing and summarizing to remember what is read, inferring, and monitoring comprehension (Gildroy & Deshler, 2006; Pressley, 2002; Pressley & Afflerbach, 1995; Pressley & Wharton-McDonald, 1997). The reader may first skim some parts and focus on specific topics; then, re-read some sections to more deeply process the main ideas and details, or annotate the text by highlighting, note-taking, or coding the ideas through symbol-marking (Englert et al., in press). The good reader also makes inferences, interprets meanings, changes hypotheses, and pays attention to the causal relations implied in the text or author's intention. These strategies help the reader fill in the gaps of the text, make meanings more sensible, and increase the coherence of understanding from text (Duke et al., 2004; Pressley & Afflerbach, 1995). In addition, a good comprehender employs self-regulation during this sub-process (Westby, 2004). For example, the self-regulated reader may look back or jump ahead for clarification on a point that was confusing; the reader may read slowly when pondering specific points that relate to the reading goals; the read-

er may also try to solve the inconsistency because the reader expects a text to be consistent and coherent. Throughout reading, the good reader is very active in monitoring his text comprehension (e.g., relevance to reading goal, attention maintenance), in applying fix-up strategies when comprehension performance has been compromised, and evaluating the text information (creditability of the sources, quality of the passage).

After-reading strategies include the reader's interpretation or reaction to what is read while refining critical thinking skills. These strategies include summarizing, reflecting, synthesizing, interpreting, representing, and then integrating all of the above strategies within the reading or inquiry process (Pressley, 2002; Pressley & Afflerbach, 1995; Pressley & Wharton-McDonald, 1997). For example, the reader may reflect on ideas in the text, construct summaries based on what is read, consider confusing points, and check the coherence of the text. The reader may further interpret the meanings from the text that can be applied in the future as part of a reading-to-learn or writing-to-learn effort (Pressley, 2002).

The use of the before, during, and after reading strategies can result in increased comprehension, especially when the reader is reading independently (Brown, Pressley, Van Meter, & Schuder, 1996). The expert reader of informational texts is no exception to this general rule. Such a reader must be strategic and employ a range of strategies when engaged in reading informational text (Anderson & Roit, 1993; Bereiter & Bird, 1985; Lytle, 1982; Pressley et al., 1992): knowing *what* the strategies are (declarative knowledge), developing procedures for employing strategies (procedural knowledge), and making decisions about the right time to use the appropriate strategies (conditional knowledge). The strategic reader of informational text is purposeful and actively engaged in

what is read (Stahl & Vancil, 1986; Steffensen, Goetz, & Cheng, 1999), and also attends to the text organization and structure (Anderson & Armbruster, 1984; Meyer & Rice, 1984). These reading strategies help scaffold students' interactions with texts. In the next section, the specific features of texts are discussed.

The text. Broadly, *text* designates any print or electronic text which plays a central role in the comprehension process, and which requires that the reader construct representations from the text (RRSG, 2002, p. 14). No matter whether texts are printed or displayed electronically, they usually belong to one of two textual types: informational (expository) and narrative texts. These two genres are distinct in structure, content, and intent (Armbruster, 1984; Duke, 2000). In narrative texts, a successful reader knows that the story structure includes the story setting, characters, a sequence of events or actions, a climax, resolution, and conclusion (Fitzgerald, 1984; Mandler & Johnson, 1977). In informational texts, a skilled reader seeks the expository text structure and attends to the structural cues to identify the important ideas based on the reader's purpose. The reader's expectations and predictions guide the meaning-making and comprehension process (Duke et al., 2004) when engaged with expository text while reading. In this present study, informational texts will be the primary focus, and they are used to examine students' reading comprehension and strategy application as they read on the Internet.

Students have many opportunities to work with informational materials, such as in science and social studies, especially when they enter the fourth grades and up (Wilson & Rupley, 1997). At the same time, research studies and reports show that young readers usually experience more difficulty and face greater challenges in reading informational passages than in reading narrative texts (Biancarosa & Snow, 2004; Zabrucky & Ratner,

1992) because with an informational passage the reader has to simultaneously process several tasks, such as defining purposes, searching for related information, connecting to background knowledge, and synthesizing multiple soures of information within and between texts (Dreher, 2002; Hartman, 1995; Kristeva, 1986; Spivey & King, 1989). Furthermore, expository texts often contains unfamiliar content (Kucan & Beck, 1997) and technical vocabulary, and communicate abstract principles about expository concepts, which means that students have to employ more effective cognitive routines to organize, synthesize, interpret, or summarize the content (Lapp, Flood, & Ranck-Buhr, 1995). To complicate matters further, informational texts may simultaneously be comprised of a variety of text structures (i.e., *compare and contrast, cause and effect, problem and solution*) (Kucan & Beck, 1997), rendering the expository information more difficult and remote for the readers to access, organize, and to comprehend.

Infrequent exposure to expository texts is another factor that has a negative impact on the performance of upper-elementary students. Elementary students receive less exposure to informational than to narrative texts (Duke, 1998; Olinghouse, 2007; Stein & Trabasso 1982; Winograd & Bridge, 1986) which results in inadequate knowledge about informational genres, as revealed by reading and writing assessments (Chen & Englert, submitted; De La Paz, 1997; Hidi & Hildyard, 1983; Olinghouse, 2007; Pelligrini, Galda, & Rubin, 1984; Winograd & Bridge, 1986). Several studies have indicated that students display better-developed skills, and exhibit greater performance gains in reading and writing narratives than in reading and writing informational texts (Applebee, 2000; Englert et al., in press; Ogle & Blachowicz, 2002; Scardamalia & Bereiter, 1986). This may explain the achievement slump that researchers have observed in the fourth grade when

instructional emphasis on the independent comprehension and composition of expository texts increases at the same time that instruction in expository comprehension and composition processes remains generally sparse (Chall, Jacobs, & Baldwin, 1990).

The inadequate attention to exposition is unwarranted because informational texts reliably exhibit text structures and other features that can be described and taught. *Text structure* refers to the semantic and syntactic arrangement of ideas that are organized in particular ways to address specific purposes (Englert et al., in press; Vaughn & Klingner, 2004). The common text structures underlying informational text include: (1) cause and effect (reasons, causes, and effects), (2) compare and contrast (e.g., the similarities and differences between two or more people, animals, events, objects, settings, or topics), (3) problem and solution (statement of a problem and the presentation of solution), (4) order/sequence (timeline, chronological account, or steps: events in a sequence from beginning to end, typically signaled by keywords such as *first*, *then*, *next*, and *finally*, as well as specific dates and times), and (5) categories and details (e.g., classifications, enumerations or taxonomies consisting of hierarchical relationships among ideas that correspond to superordinate and subordinate ideas (Anderson & Armbruster, 1984; Englert et al., 2006, 2007, in press; Englert & Thomas, 1987; Gersten, Fuchs, Williams, & Baker, 2001; Meyer, 1975; Meyer, Brandt, & Bluth, 1980; Meyer & Freedle, 1984; Vaughn & Klingner, 2004; Weaver & Kintsch, 1991).

The five text structures are further defined as follows (see Table 3):

1. *Cause and effect*: a text structure tells the results of an event or occurrence and the reasons why it happened. Example: The cheetah is endangered. Why?

There are several causes that lead to this result/effect. First, they suffered from inbreeding. Second, they had high infant morality. Third, they lost habitat.

2. *Compare and contrast*: a text structure that compares the similarities and differences between two or more people, animals, events, objects, settings, or topics. Example: Although the cheetah is the oldest of the world's big cats, unlike other cats, the cheetah has a leaner body and longer legs. It is the only cat with short, blunt semi-retractable claws. Cheetahs' paws are less rounded than other cats', and their pads are hard, similar to tire treads.
3. *Problem and solution*: a text structure that states a problem and then presents a solution. Example: How can we protect the cheetah from extinction? Only human actions can save them. Farmers need to be more tolerant of cheetahs and should not kill any of them.
4. *Order/sequence*: a text structure that sequences events from beginning to end (specific dates and times might be mentioned); a text structure that orders steps in a process or in a series of events. Example: At the beginning of the 1990s, the total cheetah population was estimated to be 100,000. Today the population is between 12,000 and 15,000.
5. *Categories and details*: a text structure that categorizes objects in some taxonomy according to related details; items are put into categories or into some other system of classification. Example: The cheetah is in the family Felidae. It is the oldest of the world's big cats. It existed 4,000,000 years ago. It is also the world's fastest land animal. It can reach speeds of 70 mph.

Each text structure provides keywords that signal the location of answers to specific kinds of questions (see Table 3). For example, the *compare/contrast* structure addresses questions such as “What two things are being compared?” “How are they alike?” and “How are they different?” (Anderson & Armbruster, 1984; Englert & Thomas, 1987; Meyer, Brandt, & Bluth, 1980); the *cause-effect* structure suggests questions such as “What are the causes and effects of this event?” “What is the critical event?” “What caused the event?” “What are the effects?” and “What might happen next?” (Englert & Thomas, 1987; Meyer, Brandt, & Bluth, 1980); the *problem-solution* structure focuses on the answers to questions such as “What is the problem?” “What are the possible solutions?” “Which solution is best?” and “How will you implement this solution?” (Englert & Thomas, 1987; Meyer & Freedle, 1984). Table 3 provides more specific information about the types of questions occasioned by different text structures, and the keywords that signal the location of textual information.

Table 3. The description and keywords of text structures

Text Structure	Description	Keywords
Cause-Effect Structure	The result of an event or occurrence and the reasons it happened. Example: The cheetah is endangered. Why? First, they suffered from inbreeding. Second, they suffered from high infant morality. Third, they lost habitat.	*consequently, therefore, as* a *result, thereby, this leads to* What are the causes and effects of this event? What is the critical event? What caused the event? What are the effects? What might happen next?
Comparison/ Contrast Structure	The similarities and differences between two or more people, animals, events, objects, settings, or topics. Example: Unlike other cats, the cheetah has a leaner body and longer legs. It is the only cat with short, blunt semi-retractable claws. Cheetahs' paws are less rounded than other cats', and their pads are hard, similar to tire treads.	*however, unlike, like, by contrast, yet, in comparison, although, whereas, similar to, different from* What is different or alike between the two through comparison and contrast? What qualities of each thing correspond to one another? What two things are being compared? How are they alike? How are they different?
Problem-Solution Structure	Statement of a problem and then presentation of solution Example: How should we protect the cheetah from extinction? Only human actions can save them. Farmers need to be more tolerant of cheetahs and should not kill any of them.	*problem, question, solution, answer* What is the problem? What are the possible solutions? Which solution is best? How will you implement this solution?
Order/Sequence Structure (timeline, chronological sequence, or steps)	Events in a sequence from beginning to end (dates and times might be mentioned); the order or steps in a process or series of events. Example: At the beginning of the 1990s, the total cheetah population was estimated to be 100,000. Today the population is between 12,000 and 15,000.	*next, first, last, second, another, then, additionally* In what order did these events occur? What are the procedures of this occurrence? When did it happen?

Table 3. Continued

Categories-Details Structure (enumeration, taxonomy, classification) or	Objects are categorized in some taxonomy according to related details; items are put into categories/organization/classification Example: The cheetah is in the family Felidae. It is the oldest of the world's big cats. It existed 4,000,000 years ago. It is also the world's fastest land animal. It can reach speeds of 70 mph.	*categories, classification, organization, groups, chunks, main ideas, details* What is the main idea of this passage? What category does it belong to? What are its details?
List Structure	The passage is organized as an outline or list. Each section begins with a main idea, and then elaborates with subsections/details. Example: The cheetah is threatened with extinction for the following reasons. First, they suffered from inbreeding. Second, they experienced high infant morality. Third, they lost their habitat.	*as following/below, for example, for instance, specifically, in particular, in addition* What is the topic/main idea of this outline? What are the subsections/details? Why are these details grouped together?

Text structure is associated with reading comprehension performance (Bakken, Mastropieri, & Scruggs, 1997; Englert & Hiebert, 1984). A well-structured text presents information in a clear and logical order, which makes it easier for readers to predict and identify the textual elements that satisfy the structural requirements of the expository text structure. In turn, the reader's ability to apply knowledge about text structures in the reading process is associated with boosts in the reader's recall and comprehension since the text structure elements can be stored and retrieved based on organized networks that specify meaningful chunks and relationships (Baker & Brown, 1984; Pearson & Dole, 1987; RAND Reading Study Group, 2002). Taylor and Samuels (1983), for example, found that

fifth- and sixth-grade "good" readers[1] who made greater use of their text structure knowledge recalled more central information from well-organized expository passages than "poor" comprehenders at the same grade level. On the other hand, the text recall of the "good" and "poor" comprehenders was similar when they were given randomly organized passages because neither group could take advantage of the text structure. The differential performance of "good" and "poor" comprehenders suggested that the ability to use text organization had a significant impact on comprehension performance, because it permitted "good" readers to remember more chunks of organized ideas than the "poor" readers who tended to remember facts as though they were isolated and discrete. Similarly, McGee (1982) identified a similar relationship in a study with fifth-grade readers. In her research, she found that skilled readers recalled more main points that corresponded to the hierarchical ideas in an expository passage than the same-aged "poor" readers. Clearly, young readers' knowledge of text structure influenced the extent and organization of their comprehension performance and retellings.

Despite the fact that knowledge of text structure provides an important organizational framework for reading comprehension, text structure knowledge must be flexibly employed by students in the reading process. Many informational chapters include more than one text structure, which requires that readers navigate the shift in meanings as the texts flow seamlessly and dynamically from one text structure to the next. For example, when reading a chapter from a history textbook, students may need to identify multiple text structures. They may need to *compare and contrast* the *causes and effects* of a world war, for example, or identify a *sequence or timeline* of the events in the war, or describe

1 Good students were defined as identified as reading on or above grade level as indicated by teacher judgment and placement in the basal reading series used in the school.

the events that *caused or resulted* from the war. This might explain why the proficient reader who is sensitive to each text structure and uses these structures is more adept at building "internal connections" or making "logical connections among ideas from the text" and demonstrates greater literal and inferential comprehension (Mayer, 1984, p. 32). Likewise good readers who are aware of text structure can more successfully identify, reassemble, and synthesize information from different sources or from different locations in the text to address different interpretive questions, goals, or purposes. As an example, good readers know how to select and extract the necessary information to address questions requiring interpretation based upon *compare/contrast*, *problem/solution*, *sequence*, or *enumeration* text structures.

Several major findings emerge from the research reports and empirical literature that illuminate the relationship between readers' knowledge of text structure and their ability to apply effective reading strategies. The available research shows that text structure knowledge is developmentally acquired and can be used to distinguish readers with different performance levels of reading comprehension. Also, some text structures are easier to recognize and comprehend. These main findings are further explained in the following paragraphs.

First, the findings suggest that a reader's knowledge of text structure is developmentally acquired. Englert and her colleagues (1988) examined the differential text structure skills in reading and writing of learning disabled students and their regular class classmates. The results revealed that upper-grade students had a more developed knowledge of and sensitivity to text structure to guide them through the writing process. For example, upper-grade children could use initial text information to fill out appropriate

details from the text or their own prior knowledge. However, lower-grade students lacked such sensitivity to text structure, which then affected their ability to read and write coherent prose. These findings are also supported by the findings emanating from other research studies (Brown & Smiley, 1977; Brown, Smiley, & Lawton, 1978; Danner, 1976; Englert & Hiebert, 1984; Englert, Stewart, & Hiebert, 1988).

Second, awareness of text structure is differently developed by students with disabilities who exhibit different performance profiles. For example, students with LD have little awareness of text structures, which hinders their comprehension (Taylor & Williams, 1983). They cannot distinguish between important and unimportant ideas and have difficulties generating reasonable questions or hypotheses based on the text, as compared to their non-disabled peers (Englert & Thomas, 1987; Wilson & Rupley, 1997). Also, they do not develop expectations or predictions regarding the related details that follow a given text structure; nor do they look back to the initial text information to confirm the relationship between the text statement and its supporting details (Englert, Stewart, & Hiebert, 1988).

Third, some text structures are more obvious and easier to comprehend than others. Meyer and Freedle (1984) conducted a research study to examine the relationship between different text structures and students' recall. They found that high-ability students performed better on the *compare-contrast* and *enumeration* than low-ability students. In Englert and Hiebert's (1984) study, they found that third- and sixth-grade students comprehended and recognized the textual elements of the *sequence* and *enumeration* text structure to a greater degree than the *compare-contrast* and *description*. In another study by Englert and Thomas (1987), students were also more successful in ap-

plying the *sequence* text structure in predicting ideas from the text, and least successful with the *compare-contrast* structure. A study by Richgels, McGee, & Lomax et al. (1987) suggested that students were more capable of dealing with the *compare-contrast* than the *cause-effect* structure. Together these findings lead to the conclusion that the *sequence* text structure is easier than the *compare-contrast* or the *cause-effect* text structure inasumuch as students are more likely to notice and utilize it when they read and locate information in informational texts.

Sensitivity and the ability to use text structures are essential in reading comprehension of informational text. When children have the ability to use text structure, they are more able to predict what they will read based on initial text statements, and prompt themselves to fix up any missing information by rereading to find the supporting details. Therefore, students in earlier and later elementary grades should be equipped with knowledge of text structure in an appropriate, meaningful context that helps them understand the purpose and value of text structure in a read-to-learn process.

The context. Reading activities are practiced in the meaningful context of instruction. This context includes students' classrooms, schools, homes, and neighborhoods. Academic excellence often appears in a challenging and supportive context.

Recent sociocultural work focuses on the impact of communities on students' learning. For example, Lave and Wenger (2003) indicated that learning is situated within a "community of practice" (Wenger, 1998). This model of situated learning involves a process of engagement where learners are gradually involved in the performance of a cognitive process. Through apprenticeship with trained adults, parents or advanced peers, learners build increasing confidence and competence in more fully performing all aspects

of the process, while receiving responsible assistance on still unmastered aspects. Customizing for different personal needs is also addressed in this model. This personalization includes differentiated instruction, curricula, assessment, and learning methods that tailor the learning experiences to suit personal needs, and that scaffold performance to bring the performance endpoints forward. Therefore, meaningful context for learning and situated activity settings should be considered in students' learning.

Cognitive (Brown, Collins, & Duguid, 1989) or sociocognitive (Englert, Mariage, & Dunsmore, 2006) apprenticeship includes the idea of situated learning and communities of practice that help novice learners learn by observing experienced members' strategies and skills in situated problem-solving contexts. The apprenticeship process is enhanced through the use of instructional dialogues and think-alouds, which are first directed by the teacher and used to make visible the invisible thoughts and actions of skilled readers and writers (Englert, Mariage, & Dunsmore, 2006). In implementing think-alouds, teachers or experts first model what an experienced reader might be thinking or doing while reading. Teachers model the application of strategies, inner dialogues, cognitive actions, and interactions with texts to improve the reader's comprehension. Teachers or experts read one selection aloud and pause often to verbalize what they are reading and to explain how they make sense of the words or sentences, while students follow along silently. For example, the teacher may make comparisons and contrasts, make predictions, connect prior knowledge to new information, describe visual images, make conjectures about the author's intentions, ask questions, and clarify confusions.

To ensure that students master the inner dialogue and strategies, teachers release executive control of the cognitive routines to collaborative parters or small groups, who

share responsibility for directing, monitoring and evaluating the comprehension processes. Collaborative arrangements help students both externalize and internalize the dialogue, as they make decisions and select the reading strategy that is most suitable to maintain good comprehension as they participate in joint conversations and situated problem-solving activities with peers. Moment-to-moment, the teacher stands by to mediate and support performance using instructional scaffolds or prompts until students reach the point where they can independently direct and regulate the reading process. Even diverse readers with varied ability levels can participate in and benefit from the think-aloud activity (Migyanka1 et al., 2005). These dialogic activities can help such students be actively involved in the classroom talk in advance of independent performance. Through the practice of dialogues, educators may better understand students' cognitive work and comprehension of reading activities which can be shared, constructed, assessed, and compared to earlier and later efforts for improvement (Willhelm, 2001).

Instructionally, this body of literature suggests that an unsatisfactory apprenticeship may mean that students do not fully master the cognitive routines that support comprehension. For example, if teachers do not model and think-aloud the comprehension and search strategies for gathering and synthesizing information from print-based and online sources, then students may not have an opportunity to observe or acquire the skilled reading strategies and inner thinking of expert readers. Likewise, if teachers do not offer collaborative arrangements with the opportunity for students to assume gradual responsibility for the literacy discourse and strategies, then students may not have the full set of opportunities to develop greater metacognitive control that will allow them to di-

rect and regulate the reading comprehension process. These instructional problems will interfere with the ability of students to become skilled and successful readers.

Online Reading Comprehension in Informational Texts

One national statistic about the educational use of the Internet shows that 99% of U.S. public schools in 2001 had access to the Internet (National Center for Education Statistics [NCES], 2002). This statistic suggests that the Internet is fast becoming a major learning tool and an information resource in K-12 education.

Warschauer (2003) believes that the "digital divide" has intertwined technology (i.e., the Internet, equipment) and education and that this divide has influenced people's understanding of technology. Within the context of a digital divide, several questions have to be addressed. Does the use of the Internet provide support for the learning processes and comprehension of students in reading and writing? How do these students respond to the online texts and do they employ strategies? Thus, this section will mainly discuss the reading process and comprehension in the online information platform.

Theoretical Perspectives

Although there are many theoretical perspectives in the field of online reading comprehension, such as critical theory (Giroux, 1988), flow theory (Csikszenthmihalyi, 1990), and social semiotic theory (Lemke, 1989), two unique theoretical stances are used to frame this research that best fit the purposes and research questions in the study.

Cognitive flexibility theory. Cognitive flexibility theory was first proposed by Spiro, Feltovich, Jacobson, and Coulson (1991). Spiro et al. claimed that cognitive flexibility is a condition for developing mastery of complexity and knowledge transfer. The meaning of this theory is that the reader needs to synthesize multiple representations (e.g.,

schema, organization, argument, prototype, analogy, etc.) when thinking about a conceptual topic in flexible ways. In open-networked information platforms, even more rapid changes are required in switching from one reading context to another, making hypertext environments even less structured and more variable for the user to navigate and synthesize (Spiro et al., 1991, 2004). This theory suggests that the reader in an ill-structured environment (such as the Internet) needs even more flexible reading strategies that allow the user to adapt to new and changing online reading circumstances, so that they can revisit the materials at different times for different purposes and conceptual perspectives (Spiro & Jehng, 1990). Such a hypertext reader has to integrate and construct meanings from the online text and images, as well as through the flexible and purposeful construction of meaning based on hyperlinks, icons, interactive photographs, diagrams, and multimedia clips (e.g., movies, audio files). Therefore, the online reader needs the abilities and skills to flexibly integrate existing knowledge structures with new knowledge applications in new reading situations (Spiro, 2004). In fact, the learning strategies applied in print text formats are much different in complex environments such as the Internet (Spiro, 2004). Therefore, it is important to find out the differences and unique characteristics of learning strategies and comprehension practices in open-networked reading environments.

New literacies. The term *new literacies* has been defined in many different ways by different researchers. Street's (1999) perspective of new literacies is derived from research on social practices, and Gee (2003) contends that new literacies entail the acquisition of new discourses for new technologies. Other researchers suggest that new literacies involve the students' increasing awareness and mastery of the symbolic or cultural contexts created through new technologies (Cope & Kalantzis, 2000; Kress, 2004), while

some scholars see new literacies as extensions of everyday literacies based on a social and linguistic point of view (e.g., Chandler-Olcott & Mahar, 2003; Guzzetti & Gamboa, 2004).

This research adopts Coiro and Dobler's (2007) perspectives which focus on school contexts, as well as cognitive, social, and linguistic views to explore how students develop and demonstrate reading literacies and how they use online informational texts in formal school settings. This perspective of new literacies lies in the fact that today's literacy is rapidly changing because of new technologies (Alexander & Jetton, 2000; Lankshear & Knobel, 2003; Reinking, 1998), so that reading comprehension and strategy use online are important issues to be explored. Students may need to apply new comprehension skills, strategies, and dispositions to communicate, inquire about, search for, locate, synthesize, evaluate, and organize information on the Internet (Leu et al., 2004). From that perspective, it seems that traditional reading comprehension skills and strategies are necessary, but not adequate when reading and locating information in online hypertexts (Coiro & Dobler, 2007).

The Hypertext, Reader, & Context in Reading Comprehension

Hypertext. A hypertext is a computer-based text which can be read on the screen. It is "a kind of information environment in which textual materials and ideas are linked to one another in multiple ways" (Burbules & Callister, 2000, p. 43). Hypertext is also "a network of links between words, ideas and sources, one that has neither a centre nor an end" (Snyder, 1998, p. 127). The term "hypertext" first appeared in the 1960s in Nelson's research report, referring to one text that was presented in a non-linear, user-assigned format (see Boyle, 1997). Currently, the most common hypertext is the World Wide Web

(WWW), which represents diverse textual genres and subject domains (Spires & Estes, 2002).

There are several key differences between hypertext and traditional print. These differences relate to textual boundaries, linearity, and navigation. The first difference—regarding textual boundaries—pertains to the limitation of the computer screen. An on-line reader may see less text at one time in a restricted area, while traditional print (i.e., books, newspapes, etc.) can be read from top to bottom across a page and front to back from page to page. Burbules and Callister (2000) and others (i.e., Hass, 1996; Sutherland-Smith, 2002) have in mind the fact that it is difficult to draw the borders or boundaries of a hypertext. With a printed text, the reader can physically lay it out on the floor and draw a physical line around it. With a hypertext, a page, image, or other element may exist in several places at once, since it is linked in several places. So it is much more difficult to draw or define the physical dimensions of the text. Hass (1996) believed that the online reader faces more challenges to make meanings and understand the hypertext than the reader of traditional text.

The second difference between text and hypertext, which is frequently cited and discussed, pertains to the idea of linearity. Researchers claimed that the traditional text is sequential, which means it has a linear progression from paragraph to paragraph and from page to page, while the hypertext is non-sequential, and non-linear, which means that there is no strictly prescribed order in which the content should be read (Burbules & Callister, 1996; Nielsen, 1995; Slatin, 1991; Sutherland-Smith, 2002). Bolter (1991) even argued that hypertext is multi-linear, rather than non-linear. Whereas Bolter believed that traditional print is designed to be read in one direction, with one order, and one pre-

determined format, hypertext is open to be read in a multi-directional manner with multiple options for readers who may choose among available connections and subtopics. Furthermore, the layout properties of hypertext mean that the hypertext reader has to select a target among a set of embedded links and explicit navigation tab names (Marchionini & Shneiderman, 1988) instead of turning pages to move through the text (Rouet & Levonen, 1996) or to make connections between texts (Bolter, 1991). These embedded features in hypertext systems allow readers to construct their own meanings, evaluate the content, and adjust their paths through multiple texts in a non-linear manner (Coiro & Dobler, 2007). In other words, readers can directly interact with the text, decide the sequence or information they want to access, and read in a manner that is more comfortable or meaningful to them (Jonassen, 1986; Landow, 1992). This is the essential difference in the reading function of hypertexts compared to traditional texts.

A third difference is that the navigation of hypertext entails a more complex cognitive activity compared to what is required by linear text. Hypertext has a non-linear nature which imposes a higher cognitive load and disorientation (Heller, 1990; Jonassen & Wang, 1990; Schroeder, 1994; Spiro & Jehng, 1990), meaning that the reader must remember what links are clicked and where s/he is in the hypertext architecture, decide where to go next, skip or explore the information based on goals and questions, understand how to find information and do further research, and monitor or track the Web pages previously visited (Edward & Hardman, 1989; Gray, 1990; Wright, 1991). When Internet users browse unstructured information along author-created links (i.e., external or internal links), browsing does raise traditional problems of disorientation and cognitive overhead (Zellweger, 1989). One of the reasons is that choices and multiple paths

through hypertext overload the reader's cognitive capacities, in turn creating cognitive disequilibrium and disorientation (Lee & Tedder, 2003). Also, because of the dynamic flexibility in Web-based learning, it may allow the online reader too much freedom to navigate at will. When moving back and forth between the links and text units, there are two possible effects of the discontinuity in processing information. First, the interruption of hypertexts may interfere with the integrated representation of the text as a whole (Dee-Lucas & Larkin, 1995) because the reader processes the hypertext units as segmented information bits rather than as interrelated messages (Lee & Tedder, 2003). That is, the reader has to build a connection between new pieces of information in the hypertexts as well as build connections with his/her prior knowledge. It might therefore be more difficult to identify the main ideas and supporting details for the overall texts. Second, the interrupted hypertext may increase the difficulty of information processing because the reader is attending to each individual unit. That is, the reader has to pay more attention to the textual cues and unit titles when retrieving information in hypertexts (Dee-Lucas & Larkin, 1995).

Several researchers (e.g., Charney, 1994; Dee-Lucas & Larkin, 1995) have also pointed out that structural tools (i.e., headings, sub-headings, pages, table of contents) are important in the print text, which is similar to the structural cues (i.e., headings, explicit navigation tab names) in a hypertext. If these structural cues are not represented in the hypertext, the reader's strategies, navigation (Naumann, Waniek, & Krems, 2001), and comprehension (Foltz, 1996) will be disturbed, causing disorientation, cognitive overload, loss of information or purpose, or even random progression. Therefore, the hypertext raises specific challenges to comprehension and navigation because the reader has to en-

gage in non-linear and flexible characteristics of reading which contrast with the skills required for reading linear, conventional print (Thuring, Haake, & Hannemann, 1991).

Besides these characteristics and differences, hypertexts also require visual literacy skills to comprehend multimedia elements (Sutherland-Smith, 2002). Hypertext reading engages the reader to process and integrate text and nontext components, such as graphics, images, photos, diagrams, and multimedia (audios and videos). Visual components can supplement the reading process and give clues about where to look on the Web. However, visual elements can also distract the reader and cause difficulty with finding written information in the hypertext. In terms of conveying convey pertinent information, the images play a role as important as text. Reading with an eye to the visual components on a Website may become another reading strategy that can help the reader quickly catch the gist of a Web page. Often the gist may be gleaned from quickly glancing over a page's images, treating them like headings. In other words, examining and evaluating the images can help the reader discern the meaning, incorporate visuals into the reading process, and supplement the reading comprehension process (Sutherland-Smith, 2002). Therefore, as Bolter (1998) pointed out, "literacy in electronic environments may have more to do with the production and consumption of images than the reading and writing of either hypertextual or linear prose" (p. 7). Teaching the hypertext reader how to evaluate the hypertext and visual components is another important lesson to be addressed.

Hypertext structure is another focal issue in online reading comprehension. The reader has to understand the hypertext structure in order to develop an action plan and retrieve information before engaging in reading (RRSG, 2002). The hypertext structure helps the reader understand the organizational pattern and establish a mental process for

finding the information from the text (Unrau, 2004). The strategic reader is aware of the structure and catches the implication and meanings from the author, as well as pays attention to the organization and searches for the cohesiveness of the logical sequence and arrangements (Kymes, 2005). Therefore, when the reader is equipped with the knowledge of the hypertext structure, the search for information and evaluating the Website is much easier (Kuiper, Volman, & Terwel, 2005; Kymes, 2005).

In one research article exploring the hypertext structure and navigation strategies of hypertext readers (Gray, 1990), ten students tried to read information from a hypertext with different structures. Think-aloud protocols were recorded during the hypertext navigation. When experienced students were asked to draw a representation of the hypertext structure from what they read, they could show simple hierarchies, sequences, and tables. The author concluded that novice hypertext readers need more structural cues in hypertext reading, while the experienced readers could deal with more ill-structured hypertexts after appropriate instruction and training (Gray, 1990).

In fact, structural cues may be an important factor of hypertext readability. Beside the chronological sequence, hierarchical map (concept map), and procedural illustration (i.e., tables, charts) that were mentioned in the above study, headings, connections, and other graphic organizers can provide organizational cues to benefit text comprehension. These structural cues can help the reader locate information, keep track of previous steps, and remember the content (Rouet & Levonen, 1996).

Several studies have argued that structuring hypertext improves reading performance and navigation. Dee-Lucas and Larkin (1992) asked college students to read hypertext in two formats: alphabetic index (unstructured version) and hierarchical index

(structured version). The results suggested that the students better recalled the organization of titles in the hierarchical index than the alphabetic one; they selected more Web pages and had more efficient navigation patterns in the hierarchical index as well. These results are consistent with those reported by Simpson and McKnight (1990), who investigated the navigation effects of hierarchical and alphabetic indexes. Another study conducted by Mohageg (1992) even reported that the hierarchical structure could support faster searching than could unstructured or linear text. These studies all showed that structural cues facilitate navigation in hypertext because readers may build up mental maps through the hierarchical representations and hypertext structure (Dillon, McKnight, & Richardson, 1990).

The reader. The reader may experience both similarities and differences among the comprehension processes used with electronic and print texts (Duke, Schmar-Dobler, & Zhang, 2006). These similarities and differences among comprehension processes and strategy applications are shown in Figure 2 and Figure 3. These figures show that the reader may transfer some strategies acquired in traditional text formats into electronic text environments, while some strategies are specific to particular textual environments. Expert hypertext readers may apply a variety of strategies that correspond to specific genres.

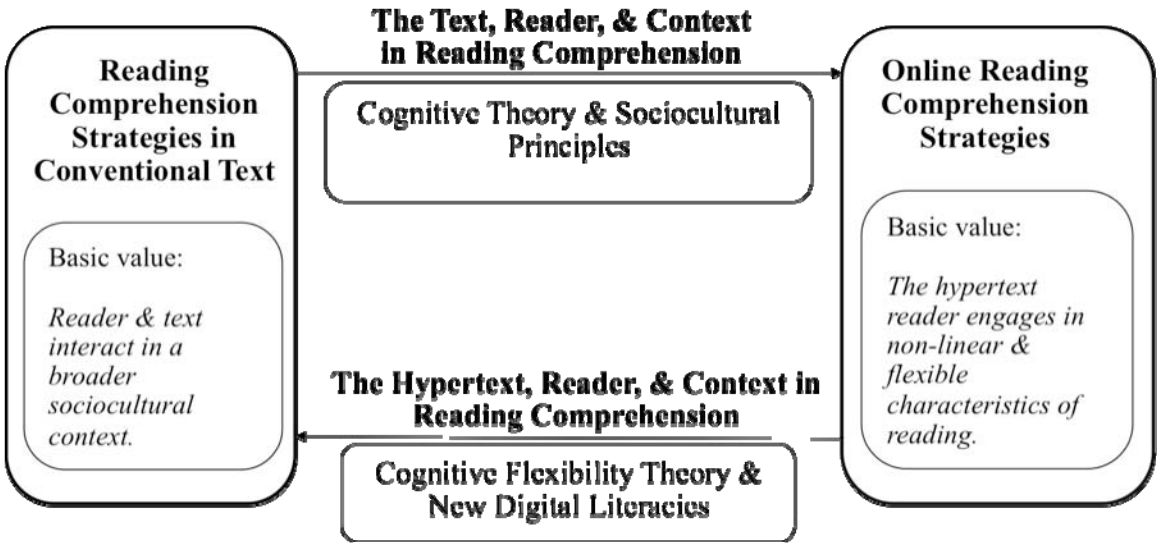


Figure 2. The "Loop" Diagram of Reading Comprehension Strategies

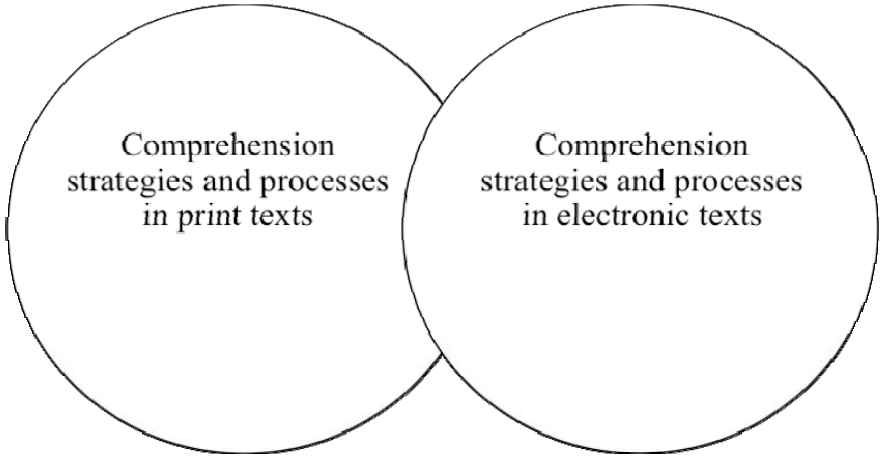


Figure 3. The overlap between comprehension strategies and processes used with print texts and those used with electronic texts.

Researchers have concluded that a skilled hypertext reader takes an active role in finding information, encountering and exploring different types of information (Bourne, 1990; Dee-Lucas& Larkin, 1995), and applying a number of comprehension strategies which are similar to those used in print-based texts (e.g., Altun, 2000; Baker & Brown, 1984; Coiro & Dobler, 2003; Hillinger & Leu, 1994; Kim & Kamil, 1999; Lawless &

Kulikowich, 1994; Schmar, 2002; Schmar-Dobler, 2003). Table 4 further illustrates the similarities between the reading strategies applied by expert readers while reading both formats (hypertexts and print texts). These strategies include planning (setting up a purpose before reading), activating background knowledge, previewing, predicting, noticing hypertext structure and main ideas, evaluating hypertext, and monitoring. Also, good online readers use the "hypertextual links" of Web pages to locate information and jump among different chunks of hypertexts, in the same way that they use the table of contents or index of print texts to jump among multiple sections (Jaynes, 1989).

Altun (2000) addressed the way that such expert readers skillfully transfer their print text reading strategies to the computer reading environment; however, these print-text strategies are utilized differently in hypertext reading. For example, informational reading in print-text enlists a more linear approach in which readers read page by page without much active decision-making about what and where to read next, while hypertext uses a non-linear structure in which readers have to make decisions to decide about whether to click on a link or access the text (Duke et al, 2006). Along these lines, hypertext readers may encounter more choices, challenges, and difficulties, than they did with linear print texts, a situation that can cause cognitive overload, impair comprehension, and divert attention (Gordon, Gustavel, Moore, & Hanky, 1988; Rouet, Levonen, Dillon, & Spiro, 1996). These readers need to exert "control over" what and how they read (Patterson, 2000) with more "cognitive energy" (van Oostendorp & de Mul, 1996) or they need to extend their "thinking processes" (Coiro, 2003) to make meanings from hypertexts (Duke et al., 2006). These differences in the online context make Internet reading a

challenging task and may require that online readers develop additional effective reading strategies to cope with the online reading environment (Kamil & Lane, 1998).

Table 4. Summary of Research Findings in Reading Strategies of Print and Electronic Texts

	Print Reading Strategies	Online Reading Strategies
Before	•Set a purpose and goals for reading (e.g., to study, for entertainment) •Preview the text (e.g., title, introduction, headings, pictures/graphics, captions, summary, questions) •Plan how to read the text (e.g., front to back, or specific sections)	•Plan or set up a purpose •Scan the hypertext (e.g., title, headings, pictures, graphics) •Preview hyperlinks •Search for information or locate Websites using keywords or terms in a systematic manner
During	•Think about what is already known about the topics •Anticipate and utilize text structures •Ask questions and seek answers •Predict, confirm, or modify predictions •Identify important information and details •Relate important points across the text •Paraphrase and summarize as a means to remember what was read •Infer, add missing details, make associations •Visualize what is described •Monitor comprehension •Mend breakdowns in comprehension (e.g., re-read, use the glossary, consult graphics) •Take notes and highlight important ideas.	•Notice hypertext structure and main ideas •Make decision about exploring or giving up for specific Websites or Web pages •Apply non-linear, non-sequential, and non-hierarchical strategies of thinking •Use visual literacy skills to comprehend and evaluate multimedia components •Transfer hypertexts or graphics to a jump drive or Word processor for further work •Organize information from the search list to deduce an answer
After	•Summarize •Reflect •Synthesize •Write	•Save Websites or Web pages as an Internet bookmark •Search for related Websites for further research or interests •Evaluate hypertext

Reading and searching for information on the Internet is an interactive process between the reader and the hypertext (Wang, Hawk, & Tenopir, 2000). Reader characteristics, including prior knowledge, attitude, age, and gender are important factors in the reading process and results.

First of all, it is easier for the reader with more prior knowledge to generate appropriate keywords when searching for information and to evaluate the reliability of the information on the Internet. In other words, prior knowledge about the topic is closely related to online searching skills, and knowledge of online searching is necessary for exploring new topics (Fidel, Davies, Douglass et al., 1999).

Second, students' disposition and attitude influence their willingness to explore the Web and the success they are likely to have. Student engagement, motivation, prior successful experience, and positive attitude are all important characteristics in exploring and searching the Internet. These affective attitudes may affect the quality of student understanding and learning (Mistler-Jackson & Songer, 2000). When students are fully involved in the searching process, they also experience emotions, such as optimism in the beginning, frustration with a hard search, and satisfaction when a challenging search task is completed (Kuhlthau, 1997).

Third, age may be another key characteristic affecting the reading process and searching strategy; however, little research to date has investigated this area, as most researchers limit their studies to a specific age group (i.e, college students or adolescents). Kafai and Bates (1997) included several age groups of elementary-school students in their research and concluded that older children can indicate why a particular Website is useful or not, while younger children only state that they like this Website.

Another factor that appears to affect the searching and reading process is the reader's gender. In one study of 53 sixth-grade students, the results showed that boys tended to apply more search strategies than girls did; boys used a single keyword more often, while girls used combinations of keywords; boys clicked more often on links and jumped backward and forward between Web pages; boys spent less time on reading each Web page (Large, Beheshti, & Rahman, 2002). Gender differences do influence the academic and behavioral areas of the offline curriculum, and differences between boys and girls offline also appear in the Web environment.

Another characteristic of expert hypertext readers is that they need to be active and navigate a hypertext constantly to avoid becoming disoriented on the Web (Altun, 2000; Duke et al., 2006; van Oostendorp & de Mul, 1996). They need to be aware of the hypertext structure to know where they are, where they want to go, and how to get there (Kim & Hirtle, 1995). This strategy reflects the fact that reading is a cognitive activity with multiple facets (Rouet et al., 1996).

As the Internet has become more widely used by school children, it seems clear that online search engines and Web browsers have replaced the traditional library. Two research reports from the Pew Internet and American Life Projects provided a snapshot of students' online literacy practices. In the first Pew Internet project, 754 students aged 12 to 17 and their parents were surveyed. The results showed that these middle and high school Internet-savvy students and their parents share a perception of the Internet as the best tool to help students finish their schoolwork because the Internet is a virtual textbook and has replaced the library (Lenhart, Simon, & Graziano, 2001). Similarly, in the second Pew Internet project, 136 youth in 14 equal-gender racially diverse focus groups de-

scribed the Internet as a “virtual textbook and reference library,” “virtual tutor and study shortcut,” “virtual study group,” and “virtual guidance counselor” (Levin, Arafeh, Lenhart, & Rainie, 2002). Wells and Chen (2007) conducted a case study regarding the Internet and computer behaviors. The findings suggested that seven out of eight adolescents preferred to use the Internet rather than the library. They went to Google as their primary search resource. Besides Google, they also used several others Websites, such as Wikipedia and Yahoo, when they looked for information for their school assignments. They expressed that using these Websites was much convenient and faster than going to the library.

Several researchers have indicated that hypertext readers seem to need more time to read online than print-text readers because additional time is used to explore or select information (e.g., Blohm, 1982; Lawless & Kulikowich, 1993; see Lawless et al., 2003; Reinking & Schreiner, 1985). The method of navigation or selection of information online can distinguish three types of hypertext readers: (1) a knowledge seeker, (2) a feature explorer, and (3) an apathetic reader (Anderson-Inman & Horney, 1994; Barab, Bowdish & Lawless, 1997; Lawless & Kulikowich, 1996, 1998; Niederhauser, Salmen, & Reynolds; 1998). Knowledge seekers use strategies to pursue related information online. They read the computer screen in a logical sequence and locate information in a systematic way. Readers in the second category, feature explorers, are readers who enjoy interacting with computerized media, such as graphics, audio features, video files, and other multimedia features. They are curious about the multimedia features in hypertexts and willing to invest time in understanding how the multimedia relate to the text. Readers in the third category, apathetic hypertext users, do not aggressively pursue information or

explore computerized media. They may randomly click the available multimedia features, but they do not apply strategies to acquire knowledge. They read without following any logical order and without making meaningful selections, and they explore randomly.

With different types of navigation on the Internet, there are also various ways to search for information using online search engines and Web browsers: typing keywords with different levels of complexity in a search engine, browsing through topics in an index, entering a specific Web address (Uniform Resource Locator [URL]), and clicking links (internal or external links) on a Website (Kuiper et al., 2005). How do elementary and middle school students search for information on the Internet?

Kafai and Bates (1997) were two of the pioneers to explore the use of the Web by elementary schoolchildren in Grades 1-6. They found that most of the children in the higher elementary grades could find relevant information for their class projects using search engines with keywords and some specific Websites, but it was difficult for them to select or evaluate good sites. Elementary-aged students selected some Websites after looking only at the titles on a search results page and they were not patient enough to read the descriptions of sites or to carefully read through a whole list of search results. In a similar study, researchers found that four students (two sixth- and two ninth-grade students) who were observed had difficulties in selecting and spelling keywords and using Boolean operators when searching for answers on the Internet (Lyons, Hoffman, Krajcik, & Soloway, 1997).

Online searching strategies and behaviors can also be seen in school children in other studies. One experimental study conducted by Schacter, Chung, and Dorr (1998) on 32 upper-elementary students (fifth- and sixth-grades) found that children preferred to

browse Web pages rather than use keywords to locate information. This means that those students searched for information in an intuitive way, rather than in a systematic manner. Similarly, Large and Beheshti (2000) interviewed and observed 50 sixth-grade students and found that elementary-school students preferred to browse Web pages rather than use keywords because they did not know how to choose suitable keywords to locate information. Schacter et al. (1998) concluded that elementary-school children experienced more difficulties in browsing passages, searching for information, finding answers, and using strategies online because the Internet is a vague abstract environment (with ill-structured texts), not a precise, concrete task (with well-structured passages).

Other researchers (Wallace, Kupperman, Krajcik, & Soloway, 2000) argued that even if students had sufficient technical skills to locate information on the Internet, they were still unable to use the information they found to complete their projects. For example, eight sixth-grade students from one study only entered specific Websites and tried to find specific, concrete answers in a restricted area instead of transforming the information they found to deduce an answer or make inferences. As mentioned earlier, they also randomly and unsystematically used keywords and did not spend much time examining the information to make immediate decisions about whether the Website was useful (Wallace et al., 2000). Similarly, in Hirsh's (1999) research, ten fifth-grade students quickly made decisions about whether a Website chosen from the search results page would be helpful after reading several sentences on the Website. Across these various studies, researchers agreed that elementary-school students mainly wanted to find a concrete and easy answer in a quick manner rather than spend time on assessing, deliberating, examining, evaluating, and deducing a complete answer from collecting and organizing information on the

Internet by themselves (Hirsh, 1999; Wallace et al., 2000). When schoolchildren prefer to find information in this "virtual library," it is important that they develop appropriate, adequate comprehension strategies in the online context.

The context. Internet technologies are recognized as having positive effects for literacy learning inside and outside of the school context (Hull & Schultz, 2001). These benefits of using technology include increasing the learners' development skills, such as comprehension (Matthew, 1997), word recognition (Davidson, Elcock, & Noyes, 1996), phonological awareness (Wise & Olson, 1995), spelling (Higgins & Raskind, 2000), motivation in reading (Nicolson, Fawcett, & Nicolson, 2000), and writing (Rowley, Carson, Miller, 1998). All of these skills are important in the comprehensive literacy curriculum. Also, Internet technologies can improve literacy learning and performance for general education students (Allen & Thompson, 1995), at-risk children (Howell, Erickson, Stanger, & Wheaton, 2000), learners with learning disabilities (MacArthur & Haynes, 1995), and even multiple-disabled students (Heimann, Nelson, Tjus, & Gillberg, 1995). Using Internet technologies in literacy learning can work across the borders of school in that students can engage in reading activities anytime and anywhere, as long as they have adequate Web access beyond school (i.e., home, library, or parents' offices).

Reading is a meaning-making process that involves individual self-reflection and others' involvement through think-aloud (Wilhelm, 2001). The think-aloud is often used in the print environment to "hear" and evaluate the reader's comprehension. Through the think-aloud, the reader can voice his thoughts and feelings, and articulate his understanding of a given text's structure.

Similar to the think-aloud in the print environment, using the think-aloud online can help readers internalize the reading strategies required in the information-seeking and online reading behaviors. It has been proven that think-alouds can effectively enhance strategy implementation and decision-making in online environments (Brandt, 2000; Nielsen, 1997; Shapiro, 1994), as well as metacognitive thinking and reading comprehension (Wilhelm, 2001). However, to date, there are no published empirical studies that demonstrate the effectiveness of online think-alouds and their relationship to information search and online reading behaviors (Kymes, 2005). This is a new area that scientific research, cognition studies, and reading research may focus on.

Reading Comprehension in Print and Online Environments for Students with LD

Reading is one of the learning challenges that students with LD face. Researchers believe that students with LD have many reading problems that hinder their reading comprehension, such as insufficient development of metacognitive awareness and knowledge (e.g., Flavell, 1981; Garner, 1992), inadequate monitoring for learning and ineffective learning strategies (i.e., Gersten, Fuchs, Williams, & Baker, 2001; Torgesen & Licht, 1983), limited knowledge of the differences between narrative and informational texts (i.e., Gersten et al., 2001), and little awareness of the different text structures in informational texts (i.e., Gregg & Mather, 2002). These reading challenges and difficulties will be further discussed in the next paragraphs.

Reading Problems in Print Materials for Students with LD

Reading is the most frequently mentioned academic subject for special education students with learning disabilities (LD) (Englert et al., 2009; Lindsey & Kerlin, 1979). These learning-disabled (LD) students experience some of the most serious difficulties in

learning to read, including difficulties with word reading, fluency, decoding, and comprehension (Chen & Englert, submitted; Deshler, Ellis & Lenz, 1996; Gersten, Fuchs, Williams, & Baker, 2001). They also experience several problems in comprehending expository texts (Williams, 2005), such as in applying reading comprehension strategies (Alley & Deshler, 1979; Englert & Thomas, 1987), being alert to expository text patterns (Englert & Thomas, 1987), using text structure knowledge for encoding and retrieving of content area information (Englert & Thomas, 1987), recalling textual ideas (Spring & Prager, 1992; Warren & Fitzgerald, 1997), identifying main ideas and supporting details (Baumann, 1984), attending to extraneous information (Williams, 1993), making inferences (Holmes, 1985), relating new information with background knowledge (Johnson, Graham, & Harris, 1997), and monitoring comprehension (Wong, 1994). Graham and Harris (1997) found that students with LD tend to pay little attention to "the needs of the audience, the organization of text, the development of rhetorical goals, or the constraints imposed by the topic" (Graham & Harris, 1997, p. 414). Such students exhibit common characteristics of inactive learners, such as not adequately monitoring their learning or effectively applying learning strategies (Gersten, Fuchs, Williams, & Baker, 2001; Torgesen & Licht, 1983).

Metacognition. As stated in the previous section, metacognition is a term that refers to knowledge about and control of cognitive processes and activities for the purpose of seeing if one is performing successfully. Metacognition is related to one's learning ability, and includes awareness of learning processes, task difficulty, and strategy application (Baker, 2002). It was first defined as "one's knowledge concerning one's own cognitive processes and products or anything related to them" (Flavell, 1976, p. 232).

Simply put, it is the thinking about one's thinking that Clay (1991) calls "inner control." That is, the reader with metacognition is aware of the easiness or difficulty of the material, which subjects or topics align with his or her interests, and how to prepare for exams by using various strategies or resource materials.

Metacognition is acknowledged as having importance in reading comprehension (e.g., Baker & Brown, 1984; Garner, 1987; Mastropieri & Scruggs, 1997; Mayer, 1998; Paris, Wasik, & Turner, 1991). However, learners with LD have not developed the metacognitive awareness to sufficiently assess their understanding as they read in order to influence their comprehension (Flavell, 1981; Garner, 1992). Other research shows that younger and poor readers also have less metacognitive knowledge and weaker control of their comprehension processes in reading than older and better readers (Baker & Brown, 1984; Garner, 1987; Hacker, 1998; Markman, 1977; Myers & Paris, 1978).

Reader-based strategy use. Struggling readers including learners with LD do not frequently apply learning strategies to help them read (Englert et al., 2009). Failure to employ appropriate strategies is a critical issue for students with LD (Alley & Deshler, 1979). They are often categorized as passive learners who experience problems in spontaneously applying, selecting, and monitoring effective learning strategies (Torgesen, 1982). These problems include less active search (Bransford, Stein, & Vye, 1982; Paris & Meyers, 1981), less efficient text-scanning strategies (DiVesta, Hayward, & Orlando, 1979; Garner & Reis, 1981), less sufficient comprehension-monitoring strategies (Bos & Filip, 1984), and less sensitivity to text structure (Smith & Friend, 1986). They demonstrate a limited knowledge of strategies in literacy learning contexts, with documented difficulties in activating background knowledge, predicting text ideas, self-inquiring, cla-

rifying, rehearsing, and summarizing (Chen & Englert, submitted; Englert et al., in press; Mastropieri & Scruggs, 1997). They tend to insufficiently develop and apply the strategic skills that would enable them to self-regulate and self-monitor their literacy performance (see Englert et al., in press; Graham, MacArthur, & Schwartz, 1995; Graham, Harris, & Larsen, 2001; Mastropieri & Scruggs, 1997). Most importantly, they may not apply various strategies in different reading phases, such as before, during, and after reading (Chen & Englert, submitted; Gersten et al., 2001; Mastropieri, Scruggs, Bakken, & Whedon, 1996; Englert et al., in press).

Outside the U.S. context, international scholars have also discussed reading problems among students with LD. For example, Taiwanese scholars pointed out that elementary-school students with LD might face other reading comprehension problems. Meng (2002) found that these students may not understand the main ideas and details after reading from a text; as well, they may fail to infer the meaning of a word from its context, they may overlook punctuation in sentences, and they may be tripped up by a word with multiple meanings or by different words with similar meanings. Lin (1998) examined students with LD and their general education peers, and concluded that learners with LD did not sufficiently monitor their reading comprehension or use reading strategies to help them read. Even if they did apply strategies, they did so much less frequently and with a smaller number of strategies than their regular class peers.

Textual types. Broadly speaking, there are two main types of text: narrative texts (i.e., stories) and informational texts (expository or explanatory passages). Research shows that students with LD display limited knowledge of the differences between narrative and informational texts (Gersten et al., 2001), and especially experience more diffi-

culties in identifying the important ideas in informational texts and recognizing the organizational patterns that determine how ideas are arranged and signaled in different subgenres of informational texts. They could not use strategies that underlie effective comprehension of informational text or, as writers, identify the text structures that affect the quality of their informational compositions (Chen & Englert, submitted; Englert & Thomas, 1987; Englert et al., 1989). This comprehension difficulty caused by limited knowledge of informational text structures for students with LD will be further explained in the next paragraph.

Text structures. As mentioned in the last section, *text structure* refers to the way a text is organized to guide readers in identifying key ideas and making connections among points (Englert et al., in press; Vaughn & Klingner, 2004). Readers who are aware of text structure will adopt particular courses of action in approaching texts (Meyer, Brandt, & Bluth, 1980). For example, they will tend to "chunk" or organize the text as they read. This ability to understand and use informational text structure is essential in school learning, but it can be a problem for students with LD. Such students demonstrate less awareness of the different text structures in informational texts than their normally achieving peers. These learners with LD often struggle with determining the main ideas and identifying the types of text structures (Chen & Englert, submitted; Gregg & Mather, 2002) that underlie the arrangement of ideas, including compare/contrast, explanation, enumeration, and persuasive texts (Englert & Hiebert, 1984; Englert et al., 1989; Wong, Wong, & Blenkinsop, 1989).

Englert and Thomas (1987), for example, found that students with LD were weak in their abilities to form expectations for the details that would follow a topic or main

idea sentence, which inhibited their ability to anticipate and construct the relationship between the text passages and related details. As an example, if students with LD were shown the sentence stem “there are many ways to travel across town,” they might predict that the next sentence would be “my bike is red,” rather than “these ways include riding a bike, sliding a skateboard, taking a bus, or just taking a walk.” In this example, students with LD showed some sense of the topic (e.g., travel), but they did not identify the text structure (e.g., enumeration) or constrain their identification and production of relevant details and evidence. Furthermore, even though the text is read aloud to control the variable of decoding difficulties for students with LD, they still have limited awareness of text structure, which inhibited them from organizing information and recalling main ideas from the text (Englert & Thomas, 1987; Hansen, 1978; Taylor & Williams, 1983; Wong & Wilson, 1984). This inability influences the abilities of students with LD to read and write coherent passages, since they may not be able to identify the higher-order units corresponding to the purpose and intended meanings of groups of related ideas.

Sensitivity to text structure has a pervasive effect on learning performance since students must apply that knowledge in an iterative fashion throughout the literacy process as part of planning, organizing, summarizing, composing, and monitoring texts. Using text structure to identify and make use of informational ideas is a key element in school literacy, but students with LD may not be equipped with this ability (Dickson, Simmons, & Kame’enui, 1995; Seidenberg, 1989). One of the reasons for this inability is that the structures of informational texts are distinct from those of narrative texts, so students with LD have a hard time transferring the reading strategies applied to narrative text to the task of comprehending expository texts (Seidenberg, 1989). This makes it harder for stu-

dents with LD to recognize the supporting evidence in paragraphs, and identify the gist and main ideas in informational texts (Bakken, Mastropieri, & Scruggs, 1997).

Contextual factors. Contextual (environmental) factors have to be considered in reading tasks, especially for upper-elementary and middle school students with LD. They rely on the academic, social, and environmental settings to cope with and respond to texts in addition to effective literacy instruction that is aimed at increasing their skills and strategies. However, those students who get support from resource rooms receive little reading strategy instruction, especially for hypertexts; instead, they may receive assistance only with completing their homework assignments from their general education courses. This cannot provide students with the ability to transfer knowledge and independently complete tasks when they face similar tasks in the near future.

Important Issues in Online Reading of Students with LD

Students with disabilities often experience reading problems, such as difficulties with reading fluency, text comprehension, text reasoning, and vocabulary learning (Scruggs & Mastropieri, 1993). With the advent of computer technologies in elementary school classrooms, many educators turned to electronic materials to assist students who have difficulties reading (Higgins & Boone, 1997; Kulik & Kulik, 1991). Nowadays, these educators are applying emerging technologies, such as the Internet, to assist such students with reading in general content education (Castellani & Jeffs, 2001). There are several advantages for people with disabilities who have access to hypertext. First, hypertext can accommodate people's particular needs. For example, they can change the size, appearance, and layout of text using screen or text readers in the hypertext. Second, hypertext contains graphics, sound, and video that help motivate students and enhance

their literacy learning (Center for Applied Special Technology, 1996). Third, the hypertext may be effective for special education students because the text provides specific structural cues and textual signals (i.e., headings, explicated navigation tab names, advanced organizers, topic overviews, summarizing statements, preview sentences, and boldface or italics) that reduce working memory load and benefit self-regulated learning processes and recall, even in expository passages (Naumann, Richter, Flender, Christmann, & Groeben, 2007). Such signals or cues help learners form a coherent representation using strategies to comprehend main ideas and supporting details. Also, learners will find it easier to select, organize, and integrate information with prior knowledge when they use the navigation tab names in the hypertext (Naumann et al., 2007).

Reading and searching for information on the Internet is an interactive process between the reader and hypertext (Wang, Hawk, & Tenopir, 2000). Students' characteristics are also important factors that influence the reading process and results. Students with special needs are a particular group that needs and deserves more attention regarding their learning and instruction. However, research to date has paid little attention to the role that student characteristics play in online environments (Kuiper et al., 2005). While the Internet is central in students' learning, it is imperative to examine students' reading characteristics, searching behaviors, and strategy application in this ill-structured, online context, including students with and without learning disabilities. After all, online learning will not only benefit students' school learning, but also their lifelong education.

Purpose of the Study

Because the Internet is pervasive in schools and in people's homes and has become an important tool for teaching and learning (Ministry of Education, Republic of

China (Taiwan), 1998; 2003; U.S. Department of Education, 2004; Web-based Education Commission, 2000), it is important to explore students' online reading strategy use and hypertext processing skill. However, as stated earlier, little is yet known about the comprehension and learning processes of online reading strategy application of elementary-school students with or without learning disabilities, including U.S. and international learners. This is especially true for Taiwanese learners. A systematic search of scholarly databases in Taiwan located only three research articles focusing on the online reading comprehension strategies of students without LD (i.e., Chang, Su, & Sung, 2001; 2002; Sung, Lin, Chang, & Huang, 2004), and no research studies addressing the online reading behaviors of students with LD (Lin, 2006). It therefore seems urgently important to investigate whether disability status may contribute to differences among students with regard to their knowledge demonstration, reading comprehension, strategy implementation, and skill application. It seems plausible that elementary children with learning disabilities may use different online reading strategies than students without disabilities when interacting with hypertext and hypermedia. Very few studies have looked at—let alone thoroughly investigated—how these students meaningfully acquired and integrated hypertexts. Furthermore, when students step into middle schools, informational passages, which are seldom taught in elementary schools, will be the main textual materials. With more and more students reading informational texts of various kinds on the Internet, it therefore also seems urgently important to investigate the reading strategies students with and without LD use with regard to this particular kind of online text.

Drawing on this context, the purpose of this study was to investigate students' (with and without LD) application of online reading strategies and hypertext processing

skills to online expository texts. Based on the fact that, in most schools, Internet use increases substantially for most students in the higher-grade of elementary school, the decision was made to focus on upper-elementary and lower middle school students. To give the study an international and comparative dimension, taking advantage of the author's expertise and background, the decision was made to study students both in the U.S. and in Taiwan.

Research Questions

A single major research question led to four minor research questions. The major question was: How do upper-elementary students with LD and their general education peers in the United States and Taiwan approach the comprehension process in informational literacy tasks involving hypertext environments? The minor questions deriving from this major question were as follows:

1. What are their Internet strategies and behaviors?
2. How do they perceive and utilize the organizational structure provided in online environments?
3. How do they search for information using the Internet?
4. What reading strategies do they utilize before, during, and after an informational literacy task in a hypertext format?

METHOD

Participants

119 fifth- and sixth-grade students participated in this study. This number comprised 52 general education students and 6 students with LD from four US schools, and 52 general education students and 9 students with LD from two Taiwanese schools. The students were from suburban schools in the Midwestern U.S. and from northern Taiwan (see Table 5). Each of the students with LD met the criteria for how LD was defined and diagnosed in the public school district:

1. identification by the school district as having LD, based on a significant discrepancy between ability and achievement using a regression formula;
2. a verbal or Performance IQ scale score between 80 and 135 on the Wechsler Intelligence Scale for Children-Third Edition (WISC-III);
3. an achievement discrepancy of at least one standard deviation in reading or written expression as determined by composite score on a standardized norm-referenced test of educational achievement;
4. absence of sensory motor and emotional disabilities; and
5. English or Chinese/Mandarin as their primary language.

Table 5. Participant information

Location	# of students in Group Survey				# of students in Individual Measures			
U.S.	52 GE	All 5th Grade	M: 21; F: 31	White: 47 Black: 5	4 GE	All 5th Grade	M: 1; F: 3	White: 4
	6 LD	5th Grade: 2; 6th Grade: 4	M: 4; F: 2	White: 4 Black: 2	5 LD	5th Grade: 2; 6th Grade: 3	M: 4; F: 1	White: 4 Black: 1
Taiwan	52 GE	All 5th Grade	M: 27; F: 25	All Taiwanese	7 GE	All 5th Grade	M: 3; F: 4	All Taiwanese
	9 LD	5th Grade: 6; 6th Grade: 3	M: 5; F: 4	All Taiwanese	9 LD	5th Grade: 6; 6th Grade: 3	M: 5; F: 4	All Taiwanese
Total	119 students				25 students			

All 119 students participated in a group survey, and 25 of these students were randomly selected to receive individual measures. These measures are explained in the following sections.

Materials

Literacy Measures. Several group and individual measures were utilized to determine each student's reading skills and strategy use on the Internet. In the first measure (measure A), a whole-class questionnaire about students' reading strategies (see Appendix A) was administrated in the fall semester after the start of school. The questionnaire took approximately 20 minutes and was administered by the researcher. The questionnaire was read aloud to students to minimize difficulties with word recognition abilities or reading fluency speed (Englert et al., 1991). This survey included a paper-pencil format that required the students to answer 18 questions.

The survey questions asked students about their Internet use, reading comprehension strategies in print and online environments, and strategies for online information searches. For example, "*Internet use*" asked about the frequency of students' online activities, such as online reading (i.e., news, blogs, Facebook, Websites, emails, etc.), email use, Instant Messenger/text message typing, TV show/movie viewing, blog/Facebook writing, information searching, Internet game playing, and file downloading. "*Reading comprehension*" surveyed students' understanding of reading activities, such as print materials, online texts, and online information finding. "*Online information search*" measured strategies for finding information online, such as search term selection and search result decision-making. "*Online reading comprehension*" measured students' online reading comprehension through written retelling in structured and less structured texts. The

online "structured texts" were online passages with labels, chunks, categories, or subheadings in the navigation tabs, while the "less structured texts" contained hypertext passages without specified labels or chunks. Students were asked to retell the passages after reading the structured and less structured texts. They were also asked to assign appropriate tabs to the passages. "*Online reading strategies*" measured strategy applications in different reading stages: before, during, and after reading on the Internet.

In the second measure (measure B), individual online reading comprehension activities were measured (see Appendix B). This measure took approximately 20 minutes and was conducted by the researcher. Each of the students individually read and answered reading comprehension questions regarding two Websites: one consisted of five Web pages with labels/chunks and navigation tabs, while the other Website consisted of hypertext pages without labels/chunks and navigation tabs.

In the first Website[2], called "Cheetahs' World," there were five Web pages that presented short informational passages, photographs, diagrams, icons, hyperlinks, and multimedia clips. Each of the five Web pages covered one topic related to the Cheetahs, and each Web page contained hyperlinks with labels/chunks and navigation tabs. These topics encompassed content that pertained to the cheetahs' possible extinction, food and hunting habits, habitat, appearance, and life cycle.

In the second Website[3] the researcher directed each student to a main Web page about "Tasmanian Devils" created by "National Geographic Kids." This Web site displayed arrows that students could click to read a number of informational passages. However, the Web pages in this site did not have any labels/chunks or navigation tabs. Still,

2 https://www.msu.edu/~chenhs11/Cheetah/index.html
3 http://kids.nationalgeographic.com/Animals/CreatureFeature/Tasmanian-devil

the Web site's content fell into five categories or topics: possible extinction, food and hunting habits, habitat, appearance, and offspring. In addition, the Tasmanian Devils Web pages also included photographs, diagrams, icons, hyperlinks, and multimedia clips, so it was graphically and textually similar to the first Website.

The topical content of the two Websites was not related to the students' textbooks or required reading materials in their regular classes. In the first Website, a readability score of level 5 was obtained using the Flesch-Kincaid (F-K) formula (Kincaid, Fishburne, Rogers, & Chissom, 1975). Each Web page of the second Website contained a roughly 200-word passage consisting of 20 sentences, with each sentence averaging 8 words, and 1.5 syllables per word. The readability of the second Website was also at level 5 based on the F-K formula. In the F-K formula, a readability score of 5 means that fifth grade level students can read the materials with ease. In the study, these two Websites were counterbalanced: one half of the students read the first Website (e.g., Cheetah Website) first, then the second Website (Tasmanian Website), while the other half of the students read the passages in the reverse order (e.g., Tasmanian Website first, and then Cheetah Website).

Before exploring and reading the first Website, students were given an instruction sheet to practice how to think aloud before they actually used the technique while looking for information and answering prompts and questions about the content of the Websites (see Appendix E). After practicing the think-aloud, five reading comprehension questions were given to students. These questions were designed to examine if students comprehended the hypertexts with or without labels/chunks and navigation tabs. After answering these online reading comprehension questions, the researcher interviewed each student

regarding beliefs about the usability and accessibility of the content on the two Websites. These questions examined whether organized hypertexts with labels/chunks and navigation tabs were easier for students to read—with regard to locating information and comprehending the content—than less organized hypertexts, or vice versa.

In the third measure (measure C), individual online search-engine tasks were implemented to investigate students' Internet reading comprehension abilities and search strategies (see Appendix C). This measure took approximately 15 minutes and was conducted by the researcher. Two open-ended search questions were given: (1) "*Why do you turn blue when you are cold?*" and (2) "*What is the difference between genotype and phenotype?*" Students were asked to go to their preferred or favorite children's search engine Website (e.g., http://kids.yahoo.com/, http://www.kidsclick.org/, http://tw.yahoo.com/, http://kids.yam.com/) to look for answers. If they chose http://kids.yahoo.com/, they had four ways of searching for information within the Website: (1) search engine, (2) categories, (3) subject hierarchies, and (4) answering board; if they chose http://www.kidsclick.org/, they had three methods: (1) search engine, (2) categories, and (3) subject hierarchies; if they chose http://tw.yahoo.com/, they had three ways: (1) search engine, (2) search services (Web, answers, images, videos, blogs, shopping, dictionary), and (3) categories; if they selected http://kids.yam.com/, they had only two methods: (1) search engine, and (2) categories. As with the second measure, when students used different search terms to search for the open-ended questions, they were encouraged to think aloud to explain the steps and processes of the reading task. For example, they could think aloud to illustrate how and why they selected different search

terms, got the search results, located important information, and evaluated the Websites or Web pages.

Finally, an individual structured, metacognitive interview (measure D) was administered to explore the students' online reading strategy knowledge and thinking processes as they read texts on the Internet (see Appendix D). This measure took approximately 20 minutes and was administered by the researcher. These questions asked students about their pre-reading, during-reading, and post-reading strategies, and how they made sense of texts, as well as how they searched for and evaluated Websites. For example, "*pre-, during, and post-reading strategies*" focused on students' application of reading strategies including previewing, reading for understanding, remembering, and synthesizing information from the Websites. "*Online information search & evaluation*" asked about search term/keyword decisions, Website selection, Website search strategies, Website evaluation, and Website-related predictions. These interview questions examined the students' online searching behaviors and reading strategies in different reading stages.

Measurement and procedures. All of the literacy assessments were either group-administered (the first measurement) or individually administered (the other measurements) in school computer labs, libraries, or quiet rooms with Internet access. All assessments were counterbalanced across the two topics (e.g., Cheetah, Tasmanian Devil). Half of students received the assessments that presented questions about the cheetah first, and the other half of students received questions about the Tasmanian devil first, in order to control for the effect of topic order. The appropriateness and level of the measures was evaluated and determined by four experienced upper-elementary or middle school teachers, including both general and special educators from the U.S. and Taiwan. All the test-

ing directions, passages, and questions about literacy measures were read aloud to students to minimize difficulties with word recognition ability or reading fluency speed (Englert et al., 1991). Students were told to reread the passages as many times as they wished. Students' writing mechanics (e.g., spelling, grammar) were not of much concern in the testing and scoring, although students read aloud the written sections of the texts that were illegible to the examiner. All of the interview responses and online activities from the computer screen were videotaped to see students' non-verbal behaviors.

Data Analysis

Multiple analyses (quantitative & qualitative analyses) were employed in data analysis. This technique is used to triangulate the results and gather data from multiple perspectives and angles.

Quantitative data. In order to answer the research questions related to students' online Internet strategies and behaviors in relation to different organizational structures, data analysis included descriptive statistics and inferential analyses. Before running descriptives and frequencies, an independent samples T-test was first used to examine if there were differences among the groups of students in the two countries. Then, descriptive analysis was used to describe the aggregate results, means, and standard deviations of the frequency of responses on each literacy assessment. These literacy assessments included the scale of the questionnaire, correct answers of comprehension questions, time spent for task completion, number of strategies used, number of Web pages visited, and number of special features visited.

Qualitative data. Several techniques were utilized to analyze the effects from students' individual data. First, all of the interview responses were transcribed and ordered

from least to most sophisticated into a Word document. Second, verbal responses (interview replies) and non-verbal behaviors (online searches and selections) from all of the interview questions and online activities were analyzed and built into a multi-level coding system. This coding system was entered in an Excel codebook to clarify the multiple variables, such as (1) *type of hypertext readers* (knowledge seekers, feature explorers, and apathetic readers, as presented in the literature review), (2) *number of strategies used* (e.g., logical sequence of selection, systematic manner of acquisition, different search terms, search decisions, evaluation) (measures B, C, and D), (3) *number of special features visited* (e.g., hyperlinks, icons, audio clips, movies) (measure B), (4) *number of Web pages visited* (measure C), and (5) *total time for each online search-engine task* (measure C).

All of the students' activities were recorded by video cameras, and then specific behaviors were coded and counted. In this present study, students could be sorted into multiple categories of hypertext readers, if they met multiple definitions and requirements. The definition and requirements of *type of hypertext readers* was based on *number of strategies used*, *number of special features visited*, *number of Web pages visited*, and *total time for each online search-engine task* (see Table 6). The definition of *number of strategies used* was calculated by the logical sequence of selection (clicking and reading information by order or sequence between two Websites), systematic manner of acquisition (not randomly jumping by Web pages), different search terms, search decisions, and evaluation of Web pages. For example, students needed to follow the flow or design of Websites to read Web pages by the order of the navigation tabs; they needed to read Web pages in a systematic way, not just jump between random Web pages, and/or they needed

to use keywords to locate information rather than browse Web pages; they needed to apply different search terms or combinations of terms when they searched for answers in search engines; they needed to make choices from among hundreds of search results presented in search lists; and they also needed to evaluate which links or Websites were useful to enter to look for information.

Table 6. Definition of Variables for Individual Measure in Qualitative Analysis

Type of Hypertext Reader	# Strategies	# Special Features	# Web Pages (Measure C)	Time of Tasks (Measure C)
Knowledge Seeker	> 2 Strategies		> 2 Web Pages	> 2 Minutes
Feature Explorer		> 2 Features		> 2 Minutes
Apathetic Reader	0 Strategy	< 2 Features	< 2 Web pages	< 2 Minutes

Third, grounded theory was adopted to analyze the interview transcripts, field observations, and codebook based on the previous variables. The four general steps of this analysis were taken by the researcher as follows: (1) examined the data, (2) assigned labels to themes, (3) looked for common patterns across themes, and (4) compared themes across students (Glaser, 1992; Merriam, 1988). All the interview transcripts were read and examined line by line, and then searched and coded, sorted and re-coded. During this process the researcher wrote memos and assigned labels to themes. This line-by-line coding provided the basis for a more in-depth analysis, increasing the depth of interpretation. The process was iterative and focused on the incidents that allowed for comparisons across students.

RESULTS

Quantitative findings

Developing new skills and strategies to read, comprehend, and respond to informational texts on the Internet plays a key role in students' academic learning especially in this new technology age. This study relied on quantitative and qualitative methods to evaluate the extent to which new reading comprehension skills and strategies beyond the traditional reading strategies are required on the Internet.

The quantitative findings mainly came from all of the 119 students' self-reported questionnaires. The questionnaires included general survey questions (i.e., online background information, online reading strategies) and reading retelling tasks. Before running the descriptive statistics (descriptives and frequencies) to examine the Internet strategies and behaviors of students with or without LD, independent samples T-tests were performed to examine if there were any differences among the students in two different countries. The results suggested that there were not many significant differences between U.S. and Taiwanese students' Internet strategies and behaviors, based on their self-reported questionnaires (see Appendix F), except for their *reading materials* ($p < .01$, Q2 in Appendix A, v2 in Appendix F), *online locations* ($p < .01$, Q3 in Appendix A, v2 in Appendix F), some options from *Web page evaluation* ($p < .01$, Q10 in Appendix A, v10 in Appendix F), an average of *total words from the retelling passage without clear subtopics* ($p < .01$, Q15 in Appendix A, v1501 in Appendix F), and some options from *reading strategies* ($p < .01$, Q16-18 in Appendix A, v1601-1810 in Appendix F). For example, based on their personal ratings on a likert-type scale, the Taiwanese students seemed to

prefer to read from a computer screen, while the American students tended to prefer to read print materials.

The above independent samples T-tests showed that there were not many significant differences between students in the two countries. It therefore seems plausible that none of these factors influenced the results obtained from the later reading comprehension tasks, online search activities, and metacognitive interview. Also, the research questions for this study did not address the issue of comparing students' overall learning across the two countries, so the quantitative findings of the two groups (students' with LD and their general education peers) are therefore presented in the following paragraphs in terms of the order of the research questions related to students' online strategies and behaviors under different online organizational structures.

Internet strategies and behaviors. From the 119 self-reported questionnaires, the results suggested several similarities and differences between the two groups of general education (GE) students and their peers with LD.

First, when asking about their online experiences and background information, (1) 82% of GE students and 57% of students with LD usually read online *at home*; (2) 60% of GE students and 64% of students with LD prefer to read *print materials* (books, newspapers) rather than texts on a *computer screen* (see Figure 4); (3) 71% of GE students and 79% of students with LD have <u>never</u> written a *blog*; (4) 47% of GE students and 43% of students with LD have <u>never</u> used *e-mail*; and (5) 51% of GE students and 57% of students with LD have <u>never</u> used Instant Messenger, text messages, chat rooms, or message boards.

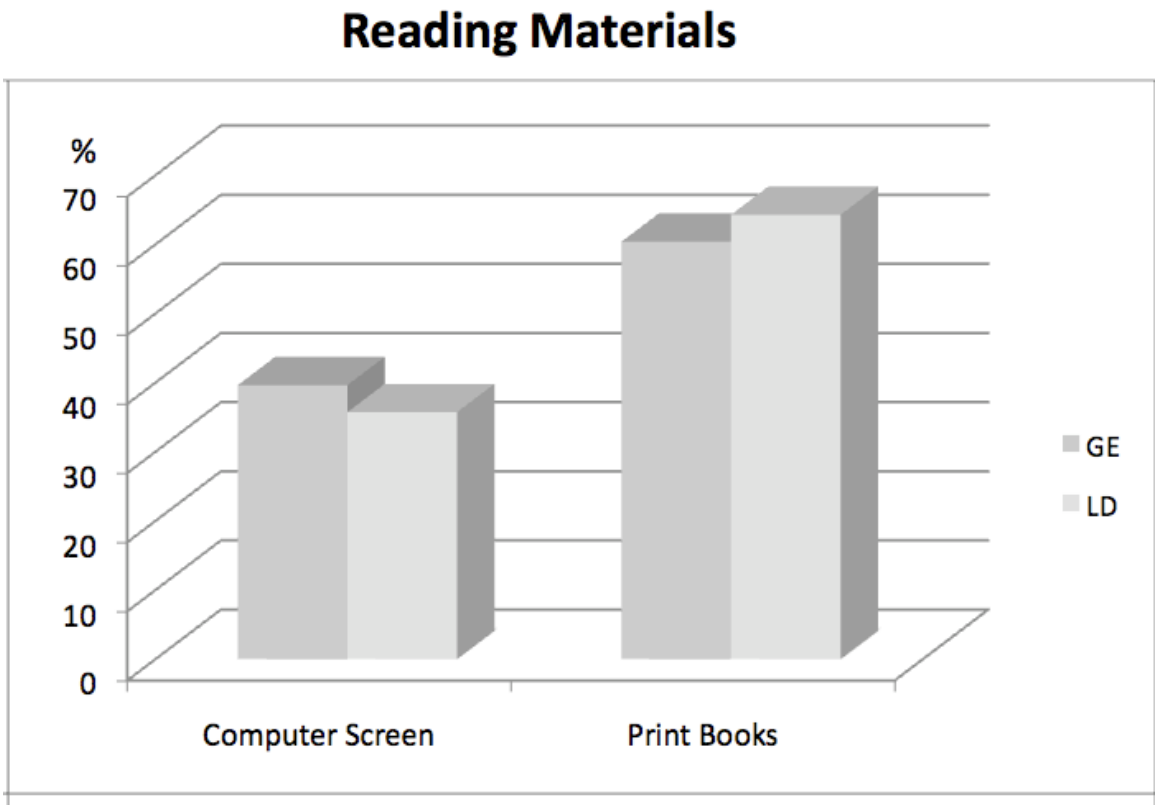


Figure 4. When you read for fun, do you prefer to **read** *print* materials (books, newspapers) or read from a *computer screen*?

Second, when asked to rate their understanding and their skills with regard to reading comprehension, (1) 57% of the GE students rated themselves very good at reading and understanding *print* materials (i.e., story books, textbooks, newspapers, magazines), but only 43% of them rated themselves as very good at understanding *online* passages (i.e., news, blogs, Facebook, Websites, email); and (2) 57% of the students with LD rated themselves just OK at reading and understanding *print* passages, but 43% of them rated themselves just OK at understanding *online* materials (see Figure 5). Although the population of students with LD was small, they mirrored the proportional breakdown of students who preferred print texts to online texts. The self-reported data might also suggest

that the majority students (57% GE/LD dropped to 43%) in this study find online texts more difficult to understand than print texts.

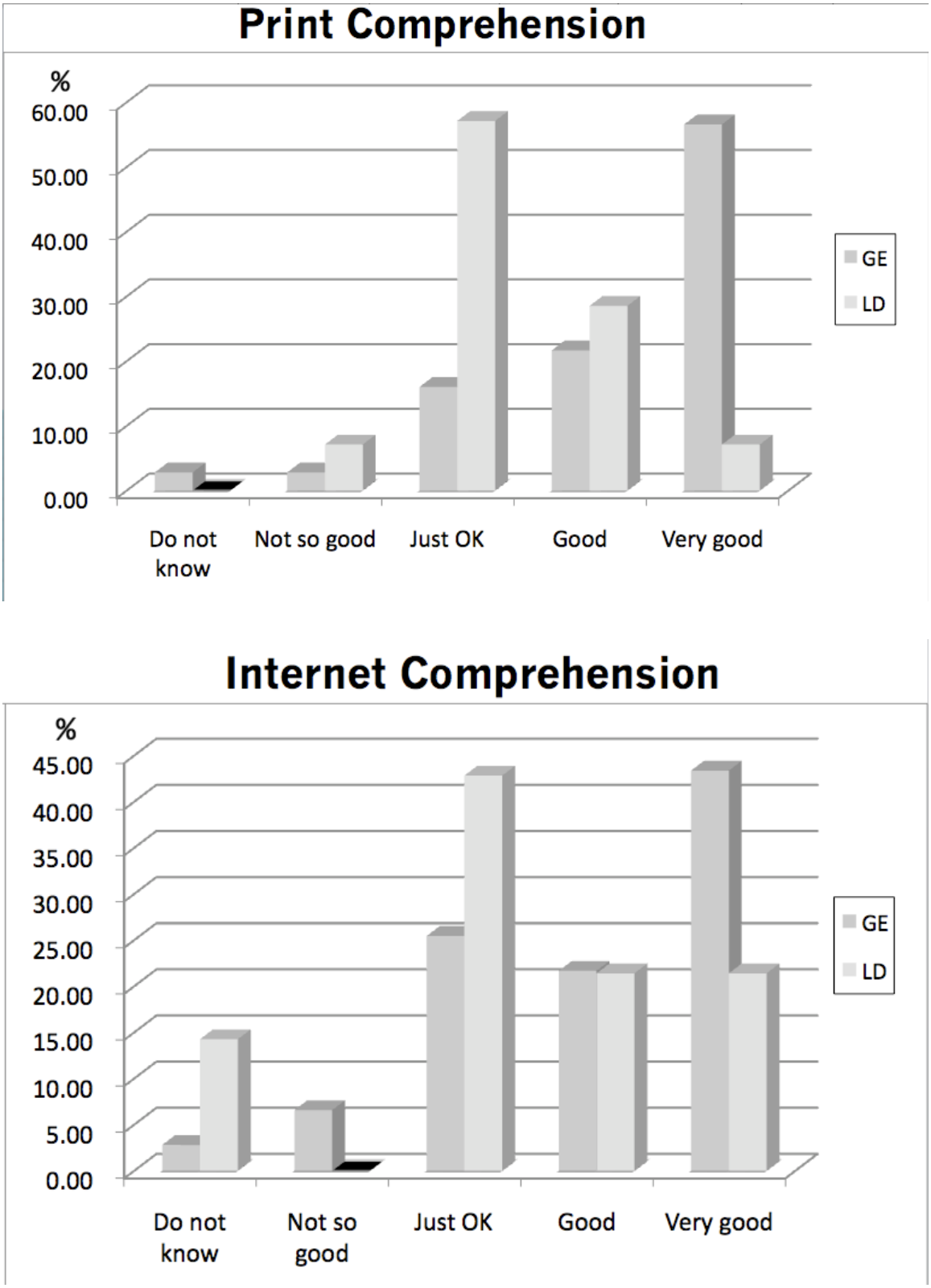
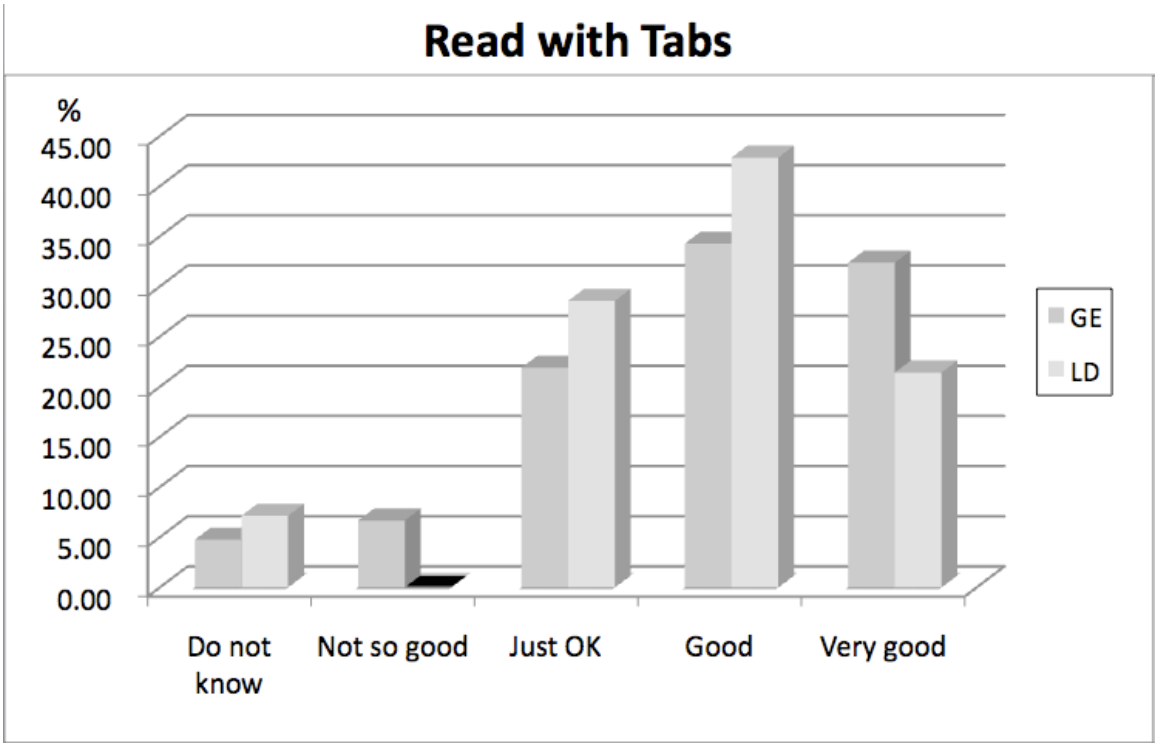


Figure 5. Rate your understanding or skills to read & understand **Print** materials and materials on the **Internet**.

Third, when asked about the advantage of the navigational features of Web pages, the differences between groups were less distinctive. 34% of the GE students rated themselves good at reading and understanding a Website *with* navigation tabs, but only 30% rated themselves good at understanding a Website *without* navigation tabs (students saw examples of types of "navigation tabs" before they were asked these questions). Similarly, 43% of the students with LD indicated that they are good at understanding a Website *with* navigation tabs, but 43% of them answered that they are just OK at understanding a Website *without* tabs (see Figure 6).

The data from Figure 6 suggested that students with LD seemed to stand apart in terms of their greater confidence in reading with tabs. They were aware that Web pages with navigation tabs could aid their comprehension, because their ratings shifted to "Just OK" without tabs (from "Good" with tabs). For GE students, there is little bit less of a shift from "Good" with tabs to "Good" without tabs. It might suggest that GE students were also aware of the difference and benefits of tabs, but they might apply some during-reading strategies to mend breakdowns in their comprehension while reading Web pages without navigation tabs. More discussion of this point will be presented in the following paragraphs.



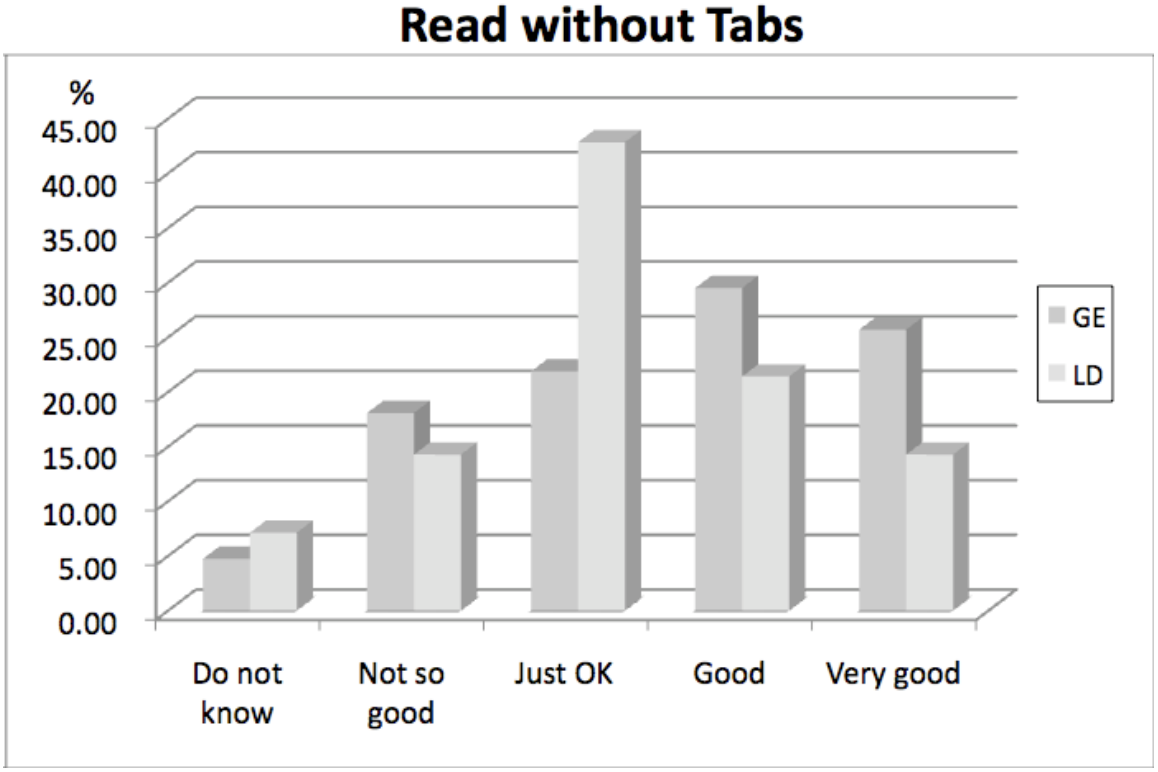


Figure 6. Rate your understanding or skill to read & understand one Website *with* or *without* **navigation tabs**.

There were other differences revealed by the data. First, when asked about their online experiences and background information (see Figure 7-9), 49% of the general education (GE) students preferred asking their *parents* for help with their schoolwork, while only 29% of students with LD asked their *parents* for help with their schoolwork; at the same time, 28% of the general education (GE) students used the *Internet* to help with their schoolwork, while 36% of students with LD chose the *Internet* as their most useful method (see Figure 7). Further, 56% of the GE students had used the Internet for more than 3 years, while only 29% of students with LD had used the Internet for more than 3 years. For the GE students, 31% of them *read online* once per week (e.g., news, blogs, Facebook, Websites, emails), 25% of them *read online* two to three days per week, 10% of them *read online* once per day, 13% of them *read online* several times per day, and 20% of them never regularly *read online*. For the students with LD, 36% never regularly read online, 29% of them *read online* once per week, 7% of them *read online* once per day, and 29% of them *read online* several times per day (see Figure 8). Finally, 39% of the GE students use the Internet to *search for information* once per week, while 58% of students with LD participated in this activity either once per week or several times per day (29% each, see Figure 9). The above data also revealed a simple bimodal distribution or extreme differences *within* the LD group in terms of their online reading and searching patterns. A high percentage of students with LD relied on the Internet as their source of learning, and spent a large amount of time reading and searching for online information; on the other hand, a small group of students with LD did not develop online reading habits to regularly read information on the Internet (such as news, blogs, facebook, Websites, emails, etc.).

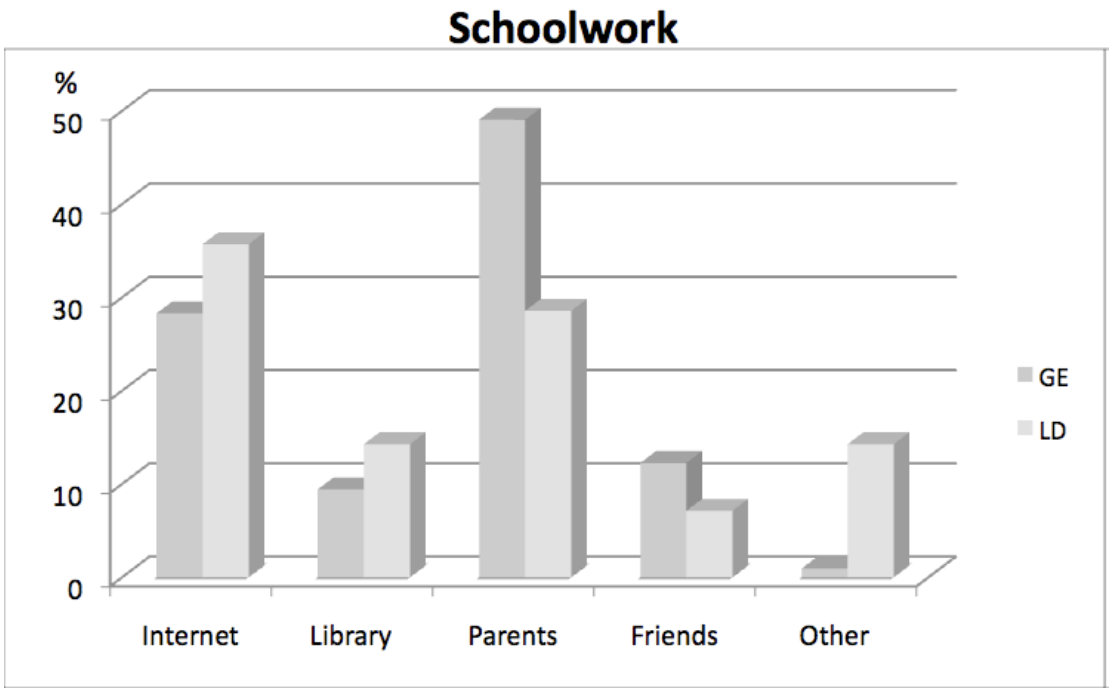


Figure 7. Which of the following is the most useful to you in helping with your **school-work?**

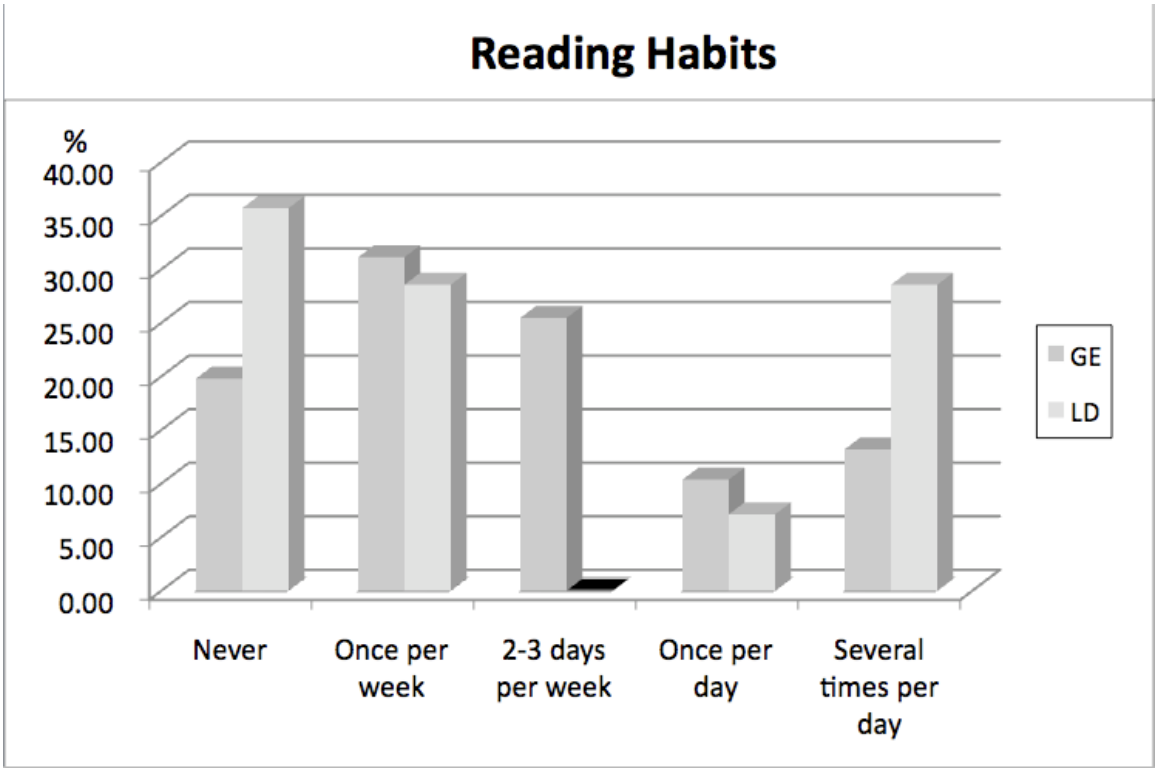


Figure 8. How frequently do you use the *INTERNET* to **read** (e.g., news, blogs, Facebook, Websites, emails)**?**

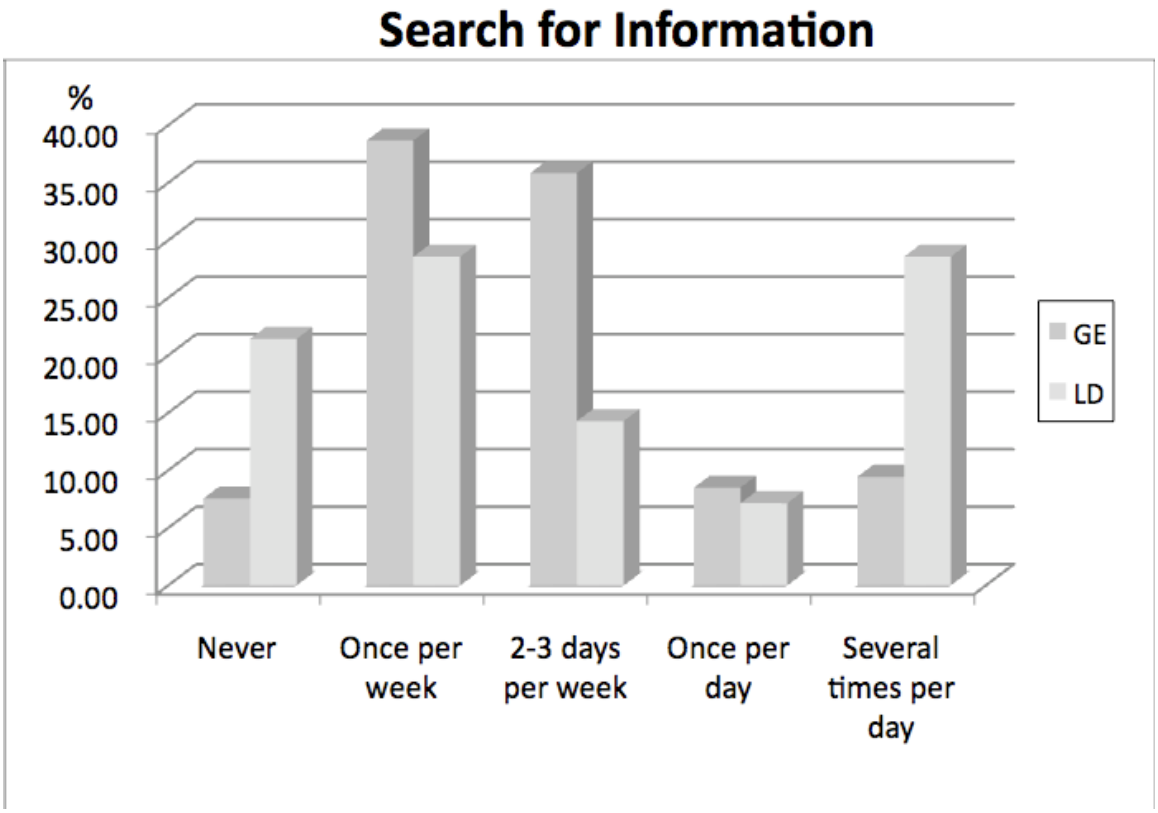


Figure 9. How frequently do you use the *INTERNET* in **searching for information?**

Second, when asked to rate their understanding and their skill during an online search, (1) 41% of the GE students rated themselves very good at finding the information they wanted on the Internet, but only 34% of them indicated that they were satisfied with the search results; however, 29% of the students with LD rated themselves very good at finding information online, and 36% of them rated themselves as very satisfied with the search results. The data revealed that although a higher percentage of GE students might be more likely to search for online information, they might not always find the information they want; on the other hand, some students with LD might frequently use the Internet to look for information, but they might not develop advanced abilities and skills to examine if the answers they found were correct or appropriate. Students with LD might be more likely to think the information they found was good and reliable.

Organizational structure in online environments. From the 119 self-reported questionnaires, the results also showed similarities and differences in terms of the application of online strategies with different hypertext organization between the two groups (GE students and their peers with LD).

First of all, in order to examine if the students could comprehend one passage without clear tab headings, which often happens on Webpages, one paragraph containing two subtopics about *Cheetahs* was assigned to all the students; they were asked to read and write down possible names of tabs. Only 9% of the GE students could assign *two* correct navigation tabs to the text, but 45% of them could assign *one* correct navigation tabs; *none* of the students with LD correctly assigned two tabs, but 47% of them could assign *one* correct navigation tabs. The data suggested that both groups of GE students and stu-

dents with LD weak naming strategies. This meant that they did not assign correct, appropriate navigation tab names after they read passages.

Second, when given a short passage with three unclear subtopics about *Cheetahs*, all 119 students were asked to retell the passage given a blank piece of paper after reading the passage several times. To analyze and calculate details retold by students, two related details under one category or subtopic were counted as one chunk. The results suggested 66% of the GE students could recall either *1* or *2* chunks of related details, which meant they could identify and retell 1 or 2 subtopics from the passage; similarly, 66% of the students with LD could retell only *1* or even *0* chunk of details, which meant they could at most identify and recall 1 subtopic from the text.

Besides the passage without clear tabs, students were also presented with a short passage that contained a clear topic about *Tasmanian Devils' appearance*. Given this organized and signaled passage (students were told the passage was about *Tasmanian Devils' appearance*), GE students could retell 3.54 details on average from one passage with clear subtopics and 3.58 details on average from the other passages without clear subtopics; however, students with LD could recall only an average of 1.79 details from the passage without clear subtopics, while they could retell an average of 2.36 details from the text with one clear topic.

This finding suggests that the students with LD in this study may closely resemble those studied in other research reports regarding the impact of passages without clear structure. In this study, there seemed to be a difference in favor of organized passages for students with LD. The reasons may be that such students have little metacognitive awareness of text structures, and this hinders their comprehension when they are left to their

own resources to infer text patterns (Taylor & Williams, 1983). Consequently, they have difficulties distinguishing between important and unimportant ideas (Englert & Thomas, 1987; Wilson & Rupley, 1997), developing relevant expectations or predictions for the related details that will follow a given text structure, and confirming the relationship between a text statement and its supporting details (Englert, Stewart, & Hiebert, 1988).

However, the finding from the GE students may diverge from findings reported by Taylor and Samuels (1983). In this present study, there was not too much difference in favor of organized passages for the fifth-grade GE students. Taylor and Samuels (1983) claimed that fifth- and sixth-grade "good" readers who made greater use of their text structure knowledge recalled more central information from well-organized expository passages, and they could not take advantage of the text structure when they were given randomly organized passages. In fact, the "good" readers in Taylor and Samuels's (1983) study were all identified as reading on or above grade level as indicated by teacher judgment and placement in the basal reading series used in their school. Since this population consisted of more advanced readers, the finding may not be generalized to this current study.

Table 7. Online Reading Comprehension With Different Organizational Structures

Task	Chunk of Details		GE	LD
Retell	0 Chunk		15% (16/104)	33% (5/15)
	1 Chunk		33% (34/104)	33% (5/15)
	2 Chunk		33% (34/104)	20% (3/15)
	3 Chunk		19% (20/104)	14% (2/15)
	Details	W/O Tab	AVG 3.58 Details STDEV 2.944	AVG 1.79 Details STDEV 2.119
		With Tab	AVG 3.54 Details STDEV 2.304	AVG 2.36 Details STDEV 2.098

Online Information Search. GE students and their peers with LD shared common characteristics in terms of information search on the Internet. In the self-reported questionnaires of all 119 students, for example, students were asked to fill out their search term/keyword/phrase that they would use to find information about *cheetahs' habitats*. The results revealed that less than 50% of GE students (N = 104) and their peers with LD (N =15) used appropriate search terms to look for information in the search engines of the Websites (see Table 8). Most of them just indicated that they would search for the term "*Cheetah(s)*".

Table 8. Online Search Strategies and Behaviors

Task	GE	LD
(Self-reported Questionnaire) **Search Term**	49% Correct (51/104)	47% Correct (7/15)

In addition, when they were surveyed about what would be helpful in finding useful Web pages, students with LD and their GE peers answered similarly. For instance, they all replied that they would read the *title* of the page (GE 77%, LD 53%) and the *content* (GE 73%, LD 67%) to evaluate Web pages or Websites when they searched on the Internet, and almost half of the students with LD (47%) even answered that they would check a Webpage's *authorship* first.

Online Reading Strategies. In the 119 self-reported questionnaires, students were surveyed about their online reading strategies—the before-, during-, and after-reading strategies they use for finding information and learning on the Internet. The data (Figures 10 - 12) showed several interesting findings regarding online reading strategies used by the GE students (N = 104) and by their peers with LD (N = 15).

First, from their self-ratings, it appeared that students (especially the students with LD) rated that they had weaker before- and during-reading strategies when they read on the Internet. Both GE students and their grade-age peers with LD tended to read *every word* in a hypertext passage (Figures 10 & 11). They did not distinguish before- and during-reading strategies, because they started reading from the beginning to the last of the passages. In addition, students with LD had difficulties in applying before-reading strategies because they tended to randomly read some passages without following any logical selection procedure or strategic order (47%), while GE students tended to apply some advanced strategies, such as previewing the tabs and titles (55% & 47%, respectively), or thinking about their reading purposes and goals (52%, Figure 10).

Also, GE students indicated that they applied more during-reading strategies, in comparison with the students with LD. They indicated that they used note-taking and lo-

cated main ideas (63% & 63%, respectively) while reading expository passages. In comparison with GE students, the students with LD rated themselves lower in using during-reading strategies when they read on Websites (Figure 11). 73% of them (11/15) answered they would read every word on a Website. The data suggested that they browsed the Web pages verbatim or nearly verbatim.

With regard to after-reading strategies, both GE students and their peers with LD performed better than with pre- and during-reading strategies. Students with LD preferred to print out online materials to read them on paper, and they engaged in more online searches for further research (53% & 53%, respectively). As for GE students, they were more likely to remember main ideas (63%), search for other related Websites (59%), and save Website URLs into their browser's bookmarks (52%, Figure 12) so that they could retrieve them easily later on when they needed them.

The above data uncovered that students had deficiencies in the areas of strategic application and performance, especially students with LD. GE students and their peers with LD did not demonstrate mature literacy strategies to ensure successful learning in online contexts. The reason for unsuccessful online learning is that those students had weak online pre-reading strategies, and they experienced difficulties in distinguishing pre- and during-reading strategies. Although their online post-reading strategies seemed to be better than their pre- and during-reading strategies, they still wasted a lot of time and applied limited strategies in their pre- and during-reading.

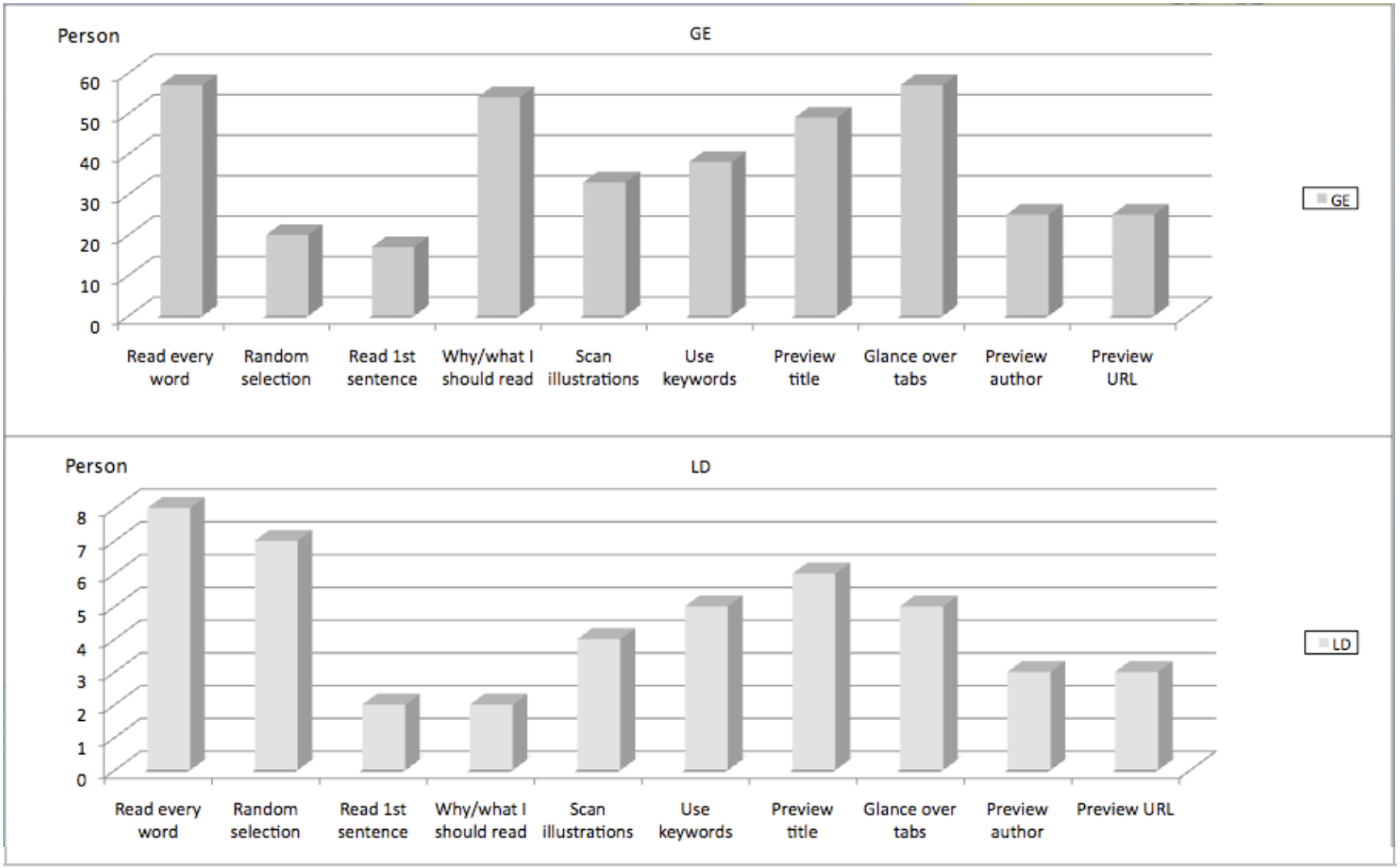


Figure 10. What strategies will you use *before* you start reading on the Websites?

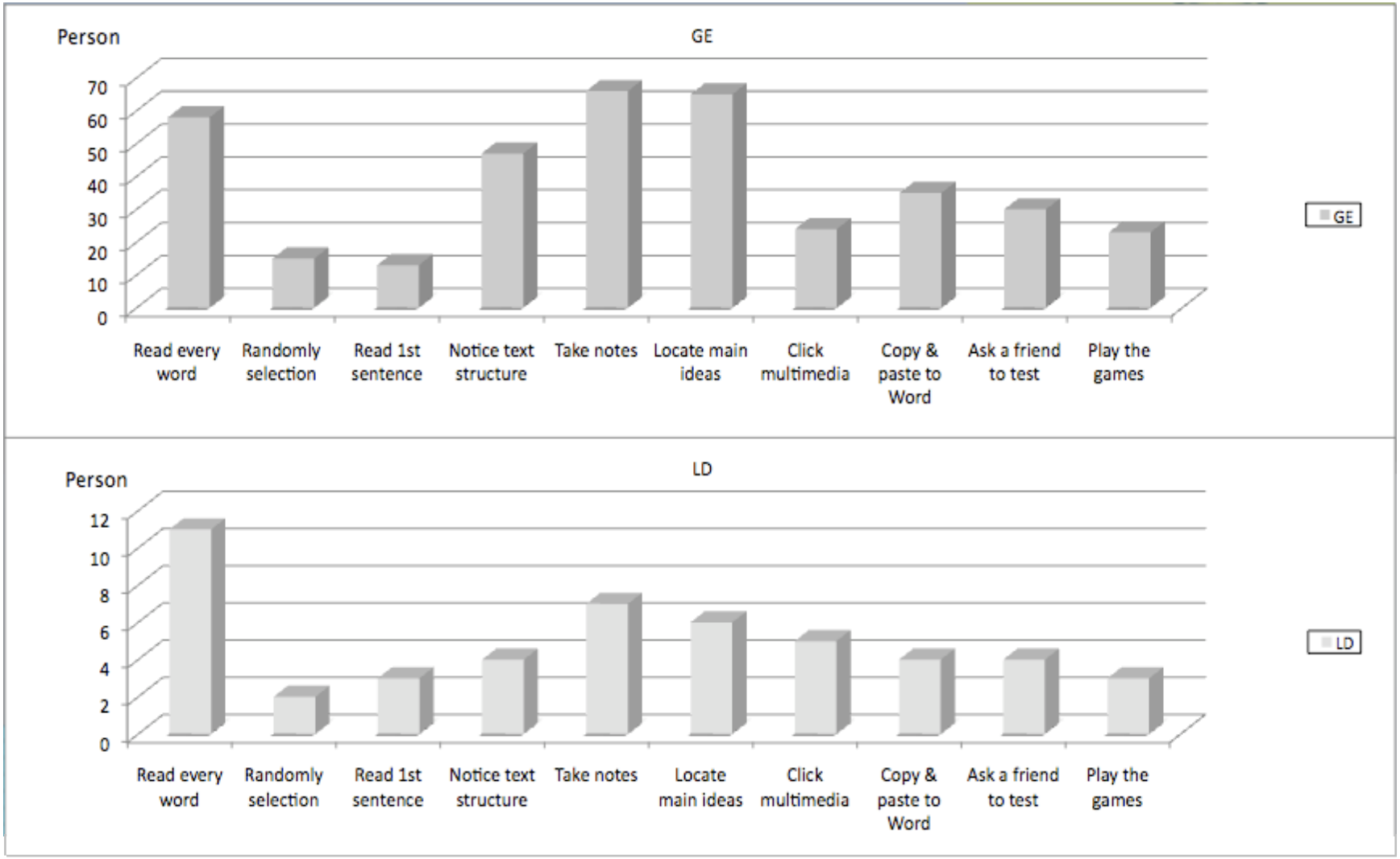


Figure 11. What strategies will you use *while* you read the Website

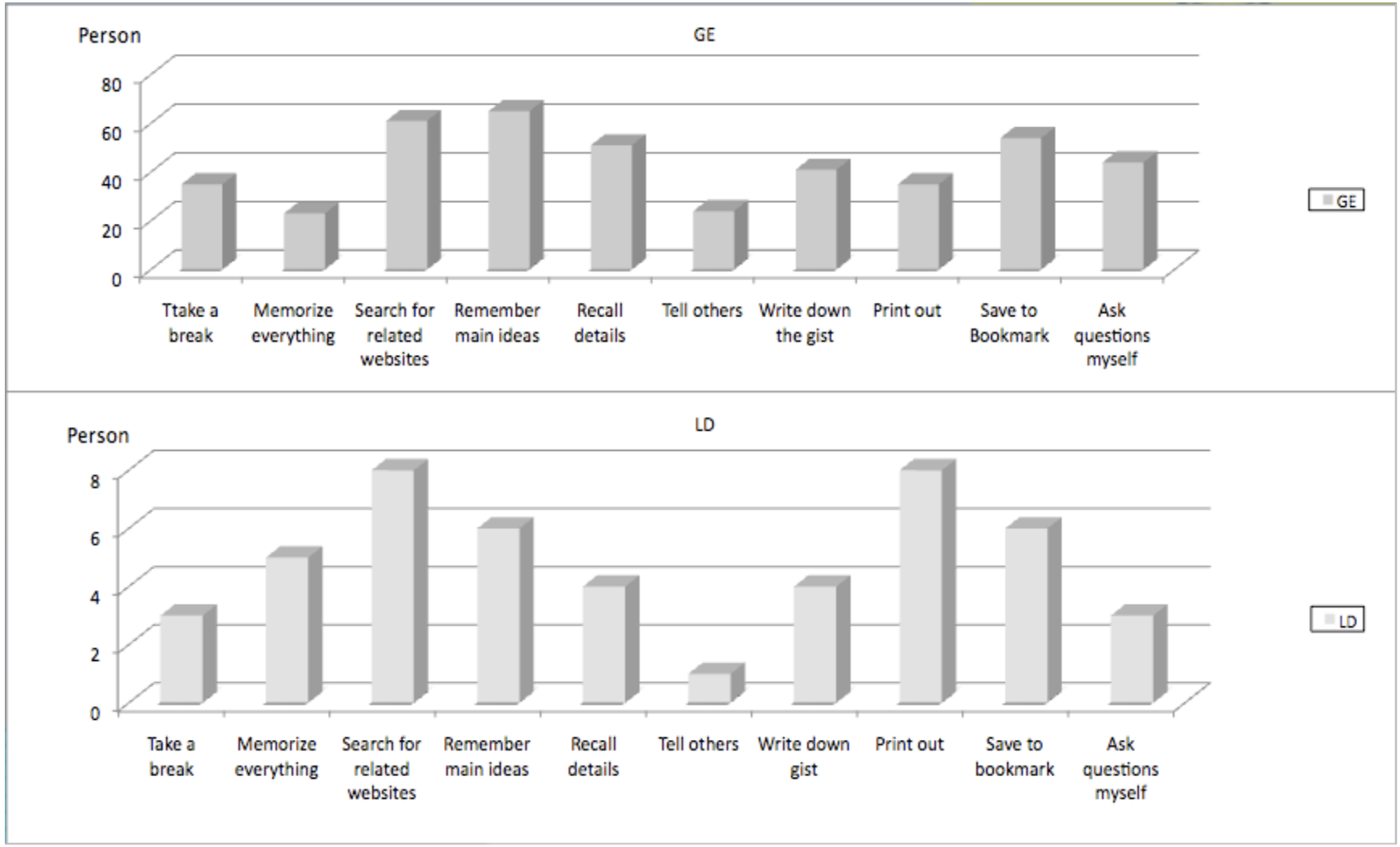


Figure 12. What strategies will you use *after* you finish reading the Website

Qualitative findings

The previous section, quantitative findings, was based on students' self-reported questionnaires. This section, qualitative findings, presents the findings from individual measures: online reading comprehension tasks, online search activities, and metacognitive interviews. In other words, besides the quantitative analyses, this study also relied on qualitative methods to evaluate the extent to which new reading comprehension skills and strategies beyond the traditional reading strategies are required on the Internet. The participants in these individual measures were 11 general education students and 14 students with LD.

Internet strategies and behaviors. All of the selected students (N = 25) had prior experiences using computers and being online to look for information. Most of the students indicated that they had not been taught any Internet strategies (i.e., reading, searching for information, using search engines). Three students who all attended the same school were the exception to this general trend. This school's media specialist expressed that she taught a few online strategies based on her own online experiences. For example, she taught students how to use keywords to look for related information in *Google.com*. Among the three interviewed students from this school, only one student with LD[4] had more advanced search strategies, as the media specialist pointed out. He said:

> When you look for information in Google, you do not need to type every word there [*he pointed out the search engine*]. You only type the most important words from the question, no need to put the whole question, because "why" gives you the question, "do you turn blue" gives the specific answer (Boy, 5th Grade, LD, US).

4 The mother of this LD student with more extensive knowledge and strategies for online reading was his elementary school teacher; she reported paying close attention to his studies and the school's curriculum.

When asked about his search results, he also explained that:

> … I'd only read [the search results from the search list] if the keywords [*he typed in the search engine*] from the question are in the title [from the search results]…

When he was asked how to quickly find answers from a Web page or Website, he said:

> …I'd only read the first paragraph [in the Web page] because it will tell the main ideas…

From the response of this student with LD, we can infer that he had some advanced search strategies, but that he lacked other reading strategies. The first finding was that he could apply search strategies because he did not retype the question word-by-word. He seemed to realize that some function words were not helpful in the search; also, he understood the relationship of keywords, such as question words (*why, what, when, how*), to the main ideas from the question. The second finding was that he read only titles containing the highlighted keywords for which he searched, and he skipped titles without his keywords. This was an advanced search strategy, though it might not be sufficient for applying search strtaegies. He did not take time to evaluate the Websites based on their *descriptions* and *URLs* before clicking to visit Web pages. Also, when unsure about the Website's safety, he would click "*cached*"[5] rather than entering it directly. The third finding was that he did not demonstrate mature online reading strategies, especially in terms of his before-reading strategies. He only read the first paragraph, but did not preview the

5 Most search-engine Websites (like Google or Yahoo) take a snapshot of each page the search engine examines and "cache" (i.e. store) that version as a back-up. The cached version of the Webpage is what search-engine Websites use to judge if a page is a good match for a searcher's query. Clicking on the "cached" link of that web page, instead of the most current version of the page, is useful if the original page is unavailable because of (1) Internet congestion, (2) a down, overloaded, or just slow website, (3) recently removed page from the Web, or (4) a registration or subscription requirement.

tabs, titles, sub-titles, headings, sub-headings, tables, charts, images, or highlighted phrases to get a quick idea of the Webpage or passage. This seems to confirm the overall group finding that students had weak online pre-reading strategies because they typically start reading the Website when they entered the Web pages.

Organizational structure in online environments. After the group measures (questionnaires and retelling tasks), 25 students were randomly selected to participate in the more in-depth reading tasks and interview pertaining to their online reading comprehension activities. First they were directed to read two Websites about animals – one with clearly labeled tabs and the other without any tabs. Then, they were directed to locate answers to some content-focused questions about the two animals, assign tabs to two Web pages, and retell passages from the two Websites.

The data showed that only four GE students (n = 11, 36%) and four students with LD (n = 14, 29%) could assign two correct tabs to the Web page without tabs. The other remaining students either assigned one correct tab or irrelevant tabs to the paragraphs. The results here closely matched the quantitative results, but the percentage rate of students was a little bit higher than in the quantitative results (9% of GE could assign *two* correct navigation tabs to the text, but *none* of the students with LD correctly assigned two tabs). Since the quantitative method was implemented through paper-based questionnaires, while the qualitative method was administrated on the computer screen, the quantitative and qualitative findings side-by-side may explain that it may be easier for GE students and students with LD to identify chunks of organized ideas or identify categories when reading hypertexts than when reading paper-based texts. Still, as mentioned in the quantitative findings, this qualitative data suggested that both groups of GE students and

students with LD had weak chunking and tab-naming strategies; they had trouble assigning relevant, appropriate navigation tab names to passages, no matter whether they were reading paper-based texts or online texts.

The other result that echoed the quantitative results involved the retelling tasks. The GE students could retell an average of 2.5 details from the Web page *without* tabs, but 4.5 details from the one *with* a tab. Similarly, the students with LD could retell an average of 2.2 details from the Web page *without* tabs, but 2.8 details from the one *with* a tab. This qualitative finding may suggest that GE students may benefit significantly more from tabbed Web page than from untabbed ones, while students with LD may benefit more from paper-based passages with clear subtopics than from ones with unclear subtopics or unclear structure. But again, as discussed in the literature review, the text recall of the "good" and "poor" comprehenders was similar when they were given randomly organized passages because neither group could take advantage of the text structure (Taylor & Samuels, 1983). Both groups of "good" and "poor" comprehenders need to apply knowledge of text organization to enhance their comprehension performance, because research shows it permits them to remember more chunks of organized ideas.

After the online reading comprehension tasks, students were asked several open-ended questions regarding the two Websites. Most of the students, 10 GE students (91%) and nine students with LD (64%), explicitly reported during the metacognitive interview that, when looking for information on the Website *without* clear tabs, they experienced more difficulties and spent more time locating answers. The responses of all GE and LD students were similar. One of the GE students said:

> The "Devil" Website [*the one without tabs*] has too much different information in one paragraph. It's too confusing… It seems to put several topics in a text… The "Cheetah" Website [*the one with tabs*] has tabs or sections for different paragraphs. It has information in an [specific] area, like food… But the Devil one has information about food in different pages… (Girl, 5th Grade, GE, US)

Another GE student commented:

> The "Devil" Website [*the one without tabs*] is really hard to find information because it has no tabs and too many arrows to [move and] read text, but for the "Cheetah" Website [*the one with tabs*], I can click tabs to easily find answers to easily remember main points and details… (Boy, 5th Grade, GE, TW)

One of the students with LD indicated:

> The Cheetah Website has topics and titles, but the Devil one only has left or right arrows [to move to the next section of the text to read]… (Boy, 5th Grade, LD, US)

Another student with LD similarly replied:

> The "Cheetah" Website has a sequence… it is easier to find [answers]… The "Cheetah" Website has tabs… The "Devil" Website has the next or forwarding icons [arrows]… The "Devil" Website is hard to find information [*Interviewer asked, "Why? Could you please explain more?"*] Because it has no tabs… [*Interviewer asked, "How about the Cheetah Website?"*] I can click tabs [on the "Cheetah" Website] to find answers easily… (Boy, 5th Grade, LD, US)

Grounded theory was adopted to analyze the qualitative data from all the interview transcripts, including from the above four replies. The steps of this analysis were taken as follows: the researcher (1) examined all the data, (2) assigned labels to themes, (3) looked for common patterns across themes, and (4) compared themes across students (Glaser, 1992; Merriam, 1988). Starting with the above four students as examples, all the inter-

view transcripts were read and examined line by line. Codes or labels were then assigned to recurring words and phrases (*tabs, sections, topics, titles in different pages* V.S. *arrows, icons, several topics in a text*), and these were sorted and re-coded (*tabs* V.S. *no tabs*). During this time, researcher memos were written (*Click tabs to find information is easier than move arrows to read text, especially in the hypertexts without tabs*), and coding labels were gradually grouped into themes (*experienced more difficulties, spent more time locating answers*). The initial line-by-line coding provided the basis for a more in-depth analysis, increasing the depth of the interpretation.

At the end of the above-described qualitative analysis, the data suggested that those students found it to be more time efficient to find answers on the Website *with* clear tabs (i.e., food, habitat, appearance, extinction, family), because they could quickly understand the context and get the gist from the tabs showing on the left side of the Website. The Website without any tabs did not allow this. Also, when students read untabbed hypertexts, especially ones with arrows or icons that they needed to click to move from one passage to another, the comprehension process imposed an additional cognitive load, so that they could not take advantage of hypertext structure to remember more chunks of organized ideas.

Online Information Search. GE students and their classmates with LD also had different search strategies, behaviors, selection procedures, and preferences when they were asked to find information on the Internet. All of the 25 selected students were asked to engage in a search task. The search question that was asked was: "Why do you turn blue when you are cold?" Most of the students (Total n = 17 students[6]: 10 LD, 7 GE) re-

6 Typed full-blown question: n = 17 (10 LD, 7 GE), Typed keywords: n = 6 (2 LD, 4 GE), Do not Know: n = 2 (2 LD, 0 GE)

typed the *full-blown question* (in the form of a sentence) from the original interview question in the search engine box[7], and did not delete the function words (e.g., *do, you, are*) or modify the search terms in conducting their search. In addition, only some students with LD (n = 2, 14%) and their GE peers (n = 4, 36%) chose to use different *keywords* in their search, such as "turn blue when cold" or "why no blood, cold weather" to look for different answers in search engines. The data suggested that fifth- and sixth-grade students had limited online search strategies. They had difficulties in applying different combinations of keywords in search engine boxes, and did not know that function words or full-blown sentences were not necessary or required in a search engine.

The results also suggested another finding about the search strategies and behaviors of GE students and their peers with LD. For example, only three GE students (27%) and two students with LD (14%) chose to click "Next" to view a second page of search results, which meant that they only read the first 10 search results from the first page. Furthermore, the GE students on average spent *6* minutes to locate answers, while the students with LD on average spent only *2.8* minutes. Similarly, the GE students on average clicked and read *1.6* pages from the search list, while students with LD on average read only *0.85* pages to finish the task. Almost all of the interviewed students could find answers, either correct or wrong ones. However, there were two students with LD (14%) who answered that they did not know what the answer was or how to find answers. The above data also suggested that, on average, students with LD spent most of the time searching for information, while most of the GE students spent most of the time reading the Web pages before they ended their search.

7 The data showed that 81% of Taiwanese students used the search engine at http://tw.yahoo.com/, while 100% of American students used the search engine at http://www.google.com/

In addition, when finding answers on the Internet, five GE students (45%) and three students with LD (21%) chose "*Yahoo Answers*" or "*Wiki Answers*" to be their answer source. The data suggested that those students desired a quick answer because all the answers were pre-selected and showed on the top Web page of "*Yahoo Answers*[8]" or "*Wiki Answers*," even though those answers were not 100% correct. It seemed that they had limited skills and strategies in evaluating and organizing online information, because they relied on unreliable and unauthorized online sources. Furthermore, only five GE students (45%) and three students with LD (21%) clicked "*Suggested Search Results*" or "*Related Searches*" when they found they spelled wrong words or simply followed the search list's suggestions for further search. Using "*Suggested Search Results*" or "*Related Searches*" is a useful online search strategy, because this search-engine feature helps online information seekers get suggestions (prompts or hints) from search engines (like Google or Yahoo) to find answers quickly, instead of visiting erroneously retrieved pages or finding irrelevant information. For example, when users mistyped Web addresses, the "*Suggested Search Results*" feature would show suggested pages below the search page. For "*Related Searches*," most search engines showed related searches with correctly spelled words that could be useful in terms of correcting or refining a search query. For example, you may have limited knowledge about "marketing," but you may want to find information about "marketing strategies." When you type "marketing" at Microsoft Windows Live Search (or Yahoo or Google), you will see a list of "*related searches*": "Internet marketing," "direct marketing," "search engine marketing," and so on. In this case, Windows

8 "Yahoo! Answers" is a forum or bulletin that everyone can find and share information. Everyone can ask questions on any topic, get answers from real people, and share his/her insights and experiences. Question initiator will choose the "best answer" among replies, so that the best answer will be listed on the top of the Web page.

Live Search finds popular queries that contain your keyword. However, in this present study, most of the fifth- and sixth-grade students (55% GE, 79% LD) did not use these online search strategies. They just typed, and retyped full-blown sentences into the search engine boxes, and wasted a lot of time finding irrelevant answers.

Table 9. Online Search Strategies and Behaviors

Task		**GE**	**LD**
Search Question		73% Sentence (8/11) 27% Keyword (3/11)	79% Sentence (11/14) 7% Keyword (1/14) 14% Don't know (2/14)
Search Time		6 Mins	2.8 Mins
Search List "Next" Page		27% (3/11)	14% (2/14)
Search Page		1.6 pages	0.85 page
Search Selection (Google/Yahoo)	Yahoo/Wiki Answers	45% (5/11)	21.4% (3/14)
	General Web pages	55% (6/11)	64.2% (9/14)
	Do not know	0	14.4% (2/14)
	"Suggested Search Results" /"Related Searches"	45% (5/11)	21% (3/14)

After the online search task, students were asked additional questions. The first question was: "When you used a search engine, how did you decide which search terms or keywords to use?" Five of the total 25 students (20%: 4 LD, 1 GE) answered they would type questions that were given to them (full-blown sentences); 17 of the total 25 students (68%: 8 LD, 9 GE) answered they would only type relevant *keywords* in the search engine based on the assigned question. However, when executing their online search task, 12 of the above 17 students did in fact type *full-blown sentences* in the search

engine box, but not keywords. It seemed that although they understood that they did not need to type every word from the assigned question into the search engine box, they still intuitively typed full-blown sentences in the search engine.

The second question was: "How did you decide which Website you wanted to explore further from the search list? How did you know if you wouldn't find the answer on a site?" Eight of the total 25 students (32%: 6 LD, 2 GE) replied that they would only read *titles* from the search results page, five students (20%: 3 LD, 2 GE) said they would read both *titles and descriptions*, two students (32%: 1 LD, 1 GE) said they would read *descriptions* only, and two students (32%: 1 LD, 1 GE) said they would click *every link* on the search results page. Only three of the total 25 students stated multiple answers. One student said:

> Yahoo is a good source… I would say I would read these two lines [*student pointed to titles and descriptions on the search results page*]. Oh, I would only click the first link from the search results (Girl, 5th Grade, GE, US).

Another student replied:

> I would only read the blue words, [*Interviewer prompted: titles, descriptions, or Web address*], titles, especially the links that have been clicked (Boy, 6th Grade, LD, US).

The other student said:

> I would read these two things *[Interviewer asked: the blue lines, black lines, or green lines?]*, the blue and black words, then click each link, but skip unrelated links. [*Interviewed asked: what do you mean "unrelated links"?*] It is just unimportant ones. You wouldn't find information there (Boy, 5th Grade, LD, TW).

The third question in the interview was: "As you are entering this Website [*point to site from the students' search list*], how did you find your answers quickly?" Seven of the 25 students indicated that they would read *every word* from the Website (28%: 6 LD, 1 GE), five students (20%: 2 LD, 3 GE) would read *tabs*, *headings*, or *subheadings*, and two students would choose "Yahoo Answers." One of these two students said:

> I entered one "Yahoo Answer" Web page because I could read the "Best Answer" from the top of the Web page to get the answers quickly (Girl, 5th Grade, GE, US)

From the above data (i.e., observation, metacognitive interview, and online activities), the 25 interviewed students could be classified into three main kinds of hypertext readers: 16 knowledge seekers (11 GE, 5 LD), 10 feature explorers (4 GE, 6 LD), and 5 apathetic readers (0 GE, 5 LD). In the present study, students could be sorted into multiple categories, if they met the multiple definitions and requirements of the different types of hypertext readers (see Table 6 & 10). As described in the qualitative data section, the definition of each *type of hypertext reader* was based on *number of strategies used*, *number of special features visited*, *number of Web pages visited*, and *total time for each online search-engine task* (see Table 6). *Number of strategies used* was defined through a combination of the logical sequence of selection, systematic manner of acquisition, different search terms, search decisions, and evaluation of Web pages. For example, students needed to follow the flow or design of Websites to read Web pages by the order of the navigation tabs (logical sequence of selection); they needed to read Web pages in a systematic way, not just jump between random Web pages, and/or they needed to use keywords to locate information rather than browse Web pages (systematic manner of acquisition); they needed to apply different search terms or combinations of terms when

they searched for answers in search engines; they needed to make choices from among hundreds of search results (search decisions); and they also needed to evaluate which links or Websites were useful and relevant to enter to look for information (evaluation of Web pages).

The first kind of hypertext reader, the knowledge seeker, uses strategies to pursue related information online. This reader reads Webpages in a logical sequence and locates information in a systematic way. In the present study, if any student applied any two of the online strategies described in the above paragraph, he or she was counted as a knowledge seeker. The results suggested that all GE students (100%) could be categorized as "knowledge seekers" because they clicked and read Web pages according to the order of the tabs listed or the sequence of the search results, they tried different search terms, and they made search decisions between search results. For example, one GE student (Boy, 5th Grade, US) spent four minutes reading Web pages and read according to the order of the navigation tabs. He also followed his own logical sequence in reading Web pages, instead of jumping between random Web pages. Another GE student (Girl, 5th Grade, TW) tried three different search terms ("cold, turn blue," "pale, cold," and "cold weather, body") when she searched for answers in search engines. After that, she made selections from among the search results to select two Websites to enter to locate information. However, no GE student in this present study could use keywords (i.e., Firefox: "Edit" > "Find") to locate information within a Webpage. GE students just browsed Web pages and read every word (or most of the words) from paragraphs or passages.

The second kind of reader, the feature explorer, interacts extensively with computerized media (i.e., graphics, audio features, video files). He or she is curious about the

multimedia features in hypertexts and invests more time than other readers in understanding how multimedia elements relate to the text. The findings indicated that four GE students (36%) and their six peers with LD (43%) were classified into this subtype. These students clicked the multimedia elements (i.e., sounds, videos, maps, pictures, tables) on the Websites. For example, one student (Boy, 5th grade, GE, US) watched a short video clip from the "Video & Sound" section of the "Tasmanian Devil" Website to learn more about their behaviors, and then clicked the "Map" to reveal the animal's habitat; another student (Boy, 5th grade, LD, TW) laughed at one picture on the "Cheetah" Website, and summarized the information from a Table describing the cheetah's size.

In fact, all four of the feature explorers from the GE group and three of the six feature explorers from the LD group were also classified as knowledge seekers (see Table 10 & Figure 13). The above data regarding the first two types of hypertext readers suggested that when students knew that their purpose was to meaningfully locate information, they clicked the multimedia features, and they used more advanced strategies to search for information from multiple Websites by accessing the hyper-links associated with those pages. They explored the multi-media features of the Websites, while they simultaneously sought relevant information about their topic and relevant sub-topics.

The third kind of reader, the apathetic hypertext user, does not actively or strategically pursue information or explore computerized media. He or she applies limited strategies to acquire information. He/she reads without following any logical order and without making meaningful selections, and explores facts randomly. Five students with LD (36%) were sorted into this category because they did not apply mature strategies to logically locate information, nor did they keep track of their findings, evaluate the Websites, or

patiently read more pages before they declared their conclusion or answer. Two of the five students (14.4%) classified as apathetic readers responded immediately that they could not find answers and then gave up quickly. In order to analyze and examine whether or not these five students were computer users, their self-report surveys were reexamined. The results showed that four of the students had been going on the Internet for at least two years (two had more than three years of Internet experience), while another had started using the Internet within the last six months; three of them read online materials several times per day, while the other two students read online once per week. This suggested that even though they had been online for a period of time or read more frequently, they still had difficulties in developing systematic, logical strategies to pursue online information.

Table 10. Online Reader Type

Reader Type		**GE** (# of persons)	**LD** (# of persons)
Reader Type (*Search Task*/ *Reading*)	Knowledge Seeker	11 (100%)	5 (36%)
	Feature Explorer	4 (36%)	6 (43%)
	Apathetic Reader	0 (0%)	5 (36%)

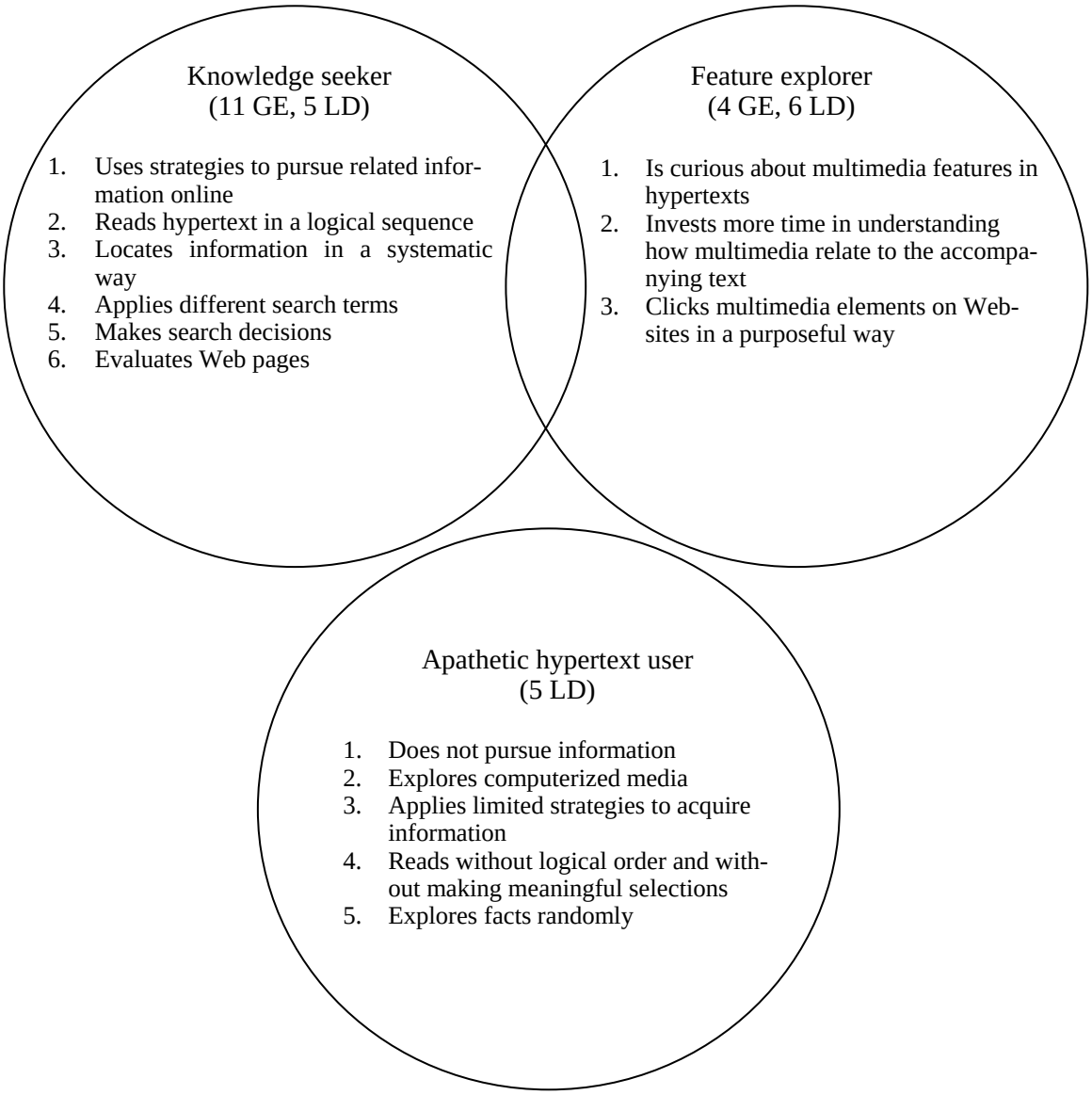


Figure 13. Online Reader Types derived from from 25 Interviewed Students

Online Reading Strategies. The qualitative data from the structured metacognitive interviews showed that the students with LD and some of the GE students did not demonstrate mature or effective online pre-reading strategies when they read in the online environment. All student responses from the metacognitive interviews were transcribed and then coded, as shown in the following table (see Table 11). In response to the first question: "What strategies did you use before you started reading for information on this

Website?" 20 of the students (76%) answered that they just read *every word* from the Web pages. Only two GE students (18%) answered that they read the tabs, titles, and pictures before starting to read more thoroughly; one GE student (9%) indicated he would read only the first sentence of each paragraph; one student with LD (7%) said he would read only the first paragraph on Web pages. 24 of the students provided only a single pre-reading strategy. The outlier was a GE student (Girl, 5th Grade, US) who provided two strategies. She said: "I read titles, pictures, and then the first sentence of paragraphs from Web pages."

These qualitative results regarding the online pre-reading strategies of the 25 interviewed students were closely matched with their quantitative data. Those students who answered that they would read *every word* on a Web page also checked "read every word from the Website" on their questionnaires. Other answers from the questionnaires closely echoed answers given during the interviews. For example, the previously mentioned female student checked "read first sentence of each paragraph," "glance over the Website's tabs," "use keywords to locate information," and "randomly select some paragraphs to read" on her questionnaire. Her interview answers were similar, though she did not include all of her survey answers, such as "use keywords to locate information" and "randomly select some paragraphs to read." Similarly, 20 of the interviewed students checked "read every word from the Website," "use keywords to locate information," "think about why and what I should read," "preview the Website's title, headings, & subheadings," or/and "glance over the Website's tabs" on their questionnaires, but in their metacognitive interview they said only that they would "read every thing from the Website." The data suggested that fifth- and sixth-grade students might have some knowledge of pre-

reading strategies in paper-based contexts, but that it might be hard for them to transfer those strategies to hypertext contexts.

Furthermore, none of the GE students and their peers with LD provided evidence of complete, mature online pre-reading strategies. For example, good pre-reading strategies in the online environment could include planning or setting up a reading purpose; quickly scanning the hypertext from its title, headings, pictures, and graphics; previewing hyper-links; and also searching for information or locating Websites using keywords or related terms in a systematic manner.

Table 11. Online pre-reading strategies of selected GE students and their grade-age peers with LD

Online Pre-Reading Strategy	# of Persons	
Read everything	12 LD (86%), 8 GE (73%)	20 (76%)
Read titles, tabs, pictures	2 GE (18%)	2 (8%)
Read 1st sentence	1 GE (9%)	1 (4%)
Read 1st paragraph	1 LD (7%)	1 (4%)
Some sentences	1 GE (9%)	1 (4%)
No strategy	1 LD (7%)	1 (4%)

When students were asked, “What strategies did you use while you were reading the Websites to understand and remember the information?” similar results were obtained. 76% of the students (11 LD, 8 GE) answered that they read every word from the Web-sites (see Table 12). Only two GE students (18%) replied they would read main ideas from the Web pages; one GE student (9%) indicated he would pick some paragraphs to read; one student with LD (7%) said he would read only the first paragraph on a Web

page. Every student asked this question provided only a single strategy (no one named multiple strategies).

As with the pre-reading strategies, the above-described qualitative results regarding online *during-reading* strategies closely matched the quantitative data, though the two sets of data diverged on certain points. In their self-report surveys, it seemed that fifth- and six-grade students had some knowledge of during-reading strategies, though it might be harder for them to apply every one of these strategies to their online reading. For example, one student on his survey checked "read every word from the Website," "randomly select some paragraphs to read," "read first sentence of each paragraph," "locate main ideas," "click every link & multimedia," and "copy and paste information from the Website to a Word document," but he provided only a subset of these responses during his metacognitive interview. This student sai the following:

> I read the first paragraph from the Websites because it will talk about the main ideas (Boy, 5th Grade, LD, US).

In fact, none of the interviewed students gave evidence of complete, advanced online during-reading strategies. For example, online during-reading strategies may include noticing hypertext structure and main ideas, applying non-linear, non-sequential, and non-hierarchical strategies of thinking, and using visual literacy skills to comprehend and evaluate multimedia components.

Table 12. The online during-reading strategies of selected GE students and their grade-age peers with LD

Online During-Reading Strategy	# of Persons	
Read everything	11 LD (79%), 8 GE (73%)	19 (76%)
Read main ideas	2 GE (18%)	2 (8%)
Read some paragraphs	1 GE (9%)	1 (4%)
Read 1st paragraph	1 LD (7%)	1 (4%)
Do not know	2 LD (14%)	2 (8%)

Finally, students were asked, "What strategies do you use after you finished reading the three Websites?" 76% of the students (n = 19: 9 LD, 10 GE) indicated that they would read *several times* to remember the passages, either reading the passages on the computer screen or printing them out to read them on paper, while 44% of the interviewed students (n = 11: 6 LD, 5 GE) said they would summarize the *gist* of what they read on a piece of paper or in a Word processor; three students (12%: 1 LD, 2 GE) indicated they would ask themselves questions to self-test; two students (8%: 1 LD, 1 GE) answered that they would save good Websites' addresses into their Internet Bookmarks (see Table 13). One of the GE students said:

> I would read some hard paragraphs again and again until I get it (Boy, 5th Grade, GE, US).

Another GE student indicated:

> I would say I took notes after reading, and then wrote reports (Girl, 5th Grade, GE, US).

Also, one student with LD[9] replied:

9 This student with LD was the one mentioned earlier in the "Internet strategies and behaviors" section.

> I printed out the pages to read, maybe sometimes highlighted, and then wrote it [the gist or main ideas]… oh, I also saved it to my Internet bookmarks (Boy, 5th Grade, LD, US).

Echoing the quantitative data, the qualitative data showed that fifth- and sixth-grade students had more knowledge and strategies in the area of online after-reading strategies, as compared with their pre- and during-reading strategies. They could save their favorite Websites or Web pages as Internet bookmarks and search for related Websites for further research. Also, 12 of the students (48%: 5 LD, 7 GE) provided two online after-reading strategies. However, none of the students indicated how to evaluate the accuracy or trustworthiness of the Websites they searched for. This data also closely echoed the data showing that fifth- and sixth-grade students looked for quick answers in the "Yahoo Answers" or "Wiki Answers," but did not evaluate the Websites' trustworthiness and accuracy. When students can easily get all kinds of information on the Internet, teaching them to have good evaluation abilities for online information is an important topic for our educators to focus on.

Table 13. The online post-reading strategies of selected GE students and their grade-age peers with LD

Online Post-Reading Strategy	# of Persons	
Read again	7 LD (50%), 4 GE (36%)	11 (44%)
Read several times to recite every-thing	1 LD (7%), 5 GE (45%)	6 (24%)
Write down on a piece of paper	4 LD (29%), 3 GE (27%)	7 (28%)
Write or edit in the Word processor	2 LD (14%), 3 GE (27%)	5 (20%)
Print out to read	3 LD (21%), 1 GE (9%)	4 (16%)
Ask myself questions to test myself	1 LD (7%), 2 GE (18%)	3 (12%)
Save the Websites' URLs to the In-ternet "Bookmarks"	1 LD (7%), 1 GE (9%)	2 (8%)
Highlight the passage (after printing it out)	1 LD (7%)	1 (4%)
Do not know	1 LD (7%)	1 (4%)

DISCUSSION

While many research studies have examined different aspects of online reading, most of them have focused on reading within a single Website (Zhang & Duke, 2008). This study investigated online reading and comprehension strategies used by students across multiple Websites, in the way that online readers usually read and search for information from different Websites, following external and internal hyperlinks as well as relying on search engines.

The purpose of this study was to address one major research question: How do upper-elementary students with LD and their general education peers in the United States and Taiwan approach the comprehension process in informational literacy tasks involving hypertext environments? This main research question was sub-divided into four minor questions:

1. What are their Internet strategies and behaviors?
2. How do they perceive and utilize the organizational structure provided in online environments?
3. How do they search for information using the Internet?
4. What reading strategies do they utilize before, during, and after an informational literacy task in a hypertext format?

Internet uses and behaviors. In 2009, most fifth- and sixth-grade students with LD have had opportunities to use computers to access the Internet. The results suggested that the fifth- and sixth-grade students with LD in this study preferred to use the Internet to cope with their homework, while their grade-level GE peers tended to ask their parents for help in completing homework. This result was significant because it revealed an in-

teresting fact. Recent research reports have suggested that American youth spend more time on the Internet than they do on any other single activity and regard the Internet as their primary and most useful resource in helping them with their schoolwork (Gee, 2003; Lenhart, Simon, & Graziano, 2001; Levin & Arafeh, 2002). Even for those students with LD who spent more time than average on the Internet completing their schoolwork, this study suggested that they still had limited skills and abilities to search and comprehend online hypertexts. These results suggested that the upper-elementary and lower-middle school students were not taught and/or had not acquired necessary Internet strategies and skills, such as how to use appropriate keywords or terms in search engines, how to evaluate search results, and how to apply other online reading strategies. Students need additional literacy strategies to help them access and comprehend online texts and thrive as students, citizens, and life-long learners in a world that is increasingly online.

The results also showed that the students with GE and their peers with LD had more opportunities to use computers and read online at *home* than they did at school. The reason may be that home computer use is much more prevalent than school computer use. In fact, students often had opportunities to use computers in their school library or computer labs. However, most media specialists and English language arts teachers in the students' schools did not seem to devote sufficient time to teaching online reading and search strategies to the students. This claim is based on the responses that students gave to questions that inquired about their past instructional history, as well as items that examined their skill in applying appropriate strategies to access the content of hypertexts.

Overall, the data suggested that fifth- and sixth-grade students had developed "strategies" through trial and error. All of the "strategies" they used came from their own expe-

riences. Furthermore, students preferred to read *printed* materials rather than *online* information for leisure and entertainment, possibly because they had not been taught how to transfer their reading strategies from print texts to hypertexts, which influenced their online reading comprehension. (One fifth-grade, male student with LD indicated that he would rather print out Web pages to read so that he could highlight and take notes on paper). All students, including GE students and their peers with LD, felt less confident and expressed lower self-efficacy regarding reading Websites without tabs, because they had difficulty inferring the main ideas and sub-topics within expository materials. Furthermore, students were generally not satisfied with their search results, because their online search "strategies" were not sufficient to help them get correct, quick answers.

Online organizational structures. Both the students with LD and the GE students agreed that navigation tabs within Websites were a key factor that influenced their search process and reading comprehension on the Internet. When Websites or Web pages lacked appropriate tabs or organizational cues, the non-linear nature and unclear structure confused the students, who often misunderstood the passages' subtopics or subtitles. In digital environments, texts are often very open-ended and can be read, for different purposes, along a number of different paths. Consequently, students have to be even more metacognitive and directed in their executive search and comprehension processes; otherwise, they may become disoriented (Heller, 1990; Jonassen & Wang, 1990; Schroeder, 1994) and confused by the texts they are reading. Students in this study seemed to be aware of these difficulties and of their own limitations in directing their comprehension process. In general, the scope of the navigation space, the abundance of choices represented by multiple hyperlinks, and the variety of printed and graphical information (i.e., graphics, ani-

mations, multimedia, texts) makes the Internet a more challenging reading environment for Internet readers, as it imposes a greater cognitive load (Coiro & Dobler, 2007).

Furthermore, the results from the present study suggested that the unmarked and unflagged hypertexts were more difficult for online readers to process. When the online readers were presented with unorganized and unlabeled online passages (i.e., Websites without navigation tab labels), their comprehension recall suffered. Those students missed important main ideas because the related details were not chunked together or labeled as categories. This was especially true for the students with LD. These students had difficulty in identifying the main ideas and the related details which were internally related through the text structure. Structural cues were one of the elements that students with LD had limited performance in retelling and summarizing, and recent research shows that missed structural cues have especially adverse consequences for the comprehension of informational texts (Englert et al., 2009).

Many researchers have suggested that difficulties comprehending less structured hypertext are related to the non-linearity of hypertext and the challenges of navigation in a non-linear environment. Hypertext is nonsequential, nonlinear, and nonhierarchical (Burbules & Callister, 1996; Nielsen, 1995; Slatin, 1991; Sutherland-Smith, 2002). Even an highly organized hypertext is seen as multilinear because it affords the reader many options and many paths of traversal, as well as new ways of making connections among subtopics (Bolter, 1991). As discussed in the previous paragraphs, when students do not develop an awareness of the characteristics of hypertext structure and organizational cues, they easily miss or misunderstand important ideas and related details. In addition, many researchers believe that hypertext imposes a greater cognitive load on online readers than

print text imposes on print readers, so that novice online readers easily get disorientated within Web pages (Heller, 1990; Jonassen & Wang, 1990; Schroeder, 1994; Spiro & Jehng, 1990). Online readers need to remember where they are, where to go next, when to skim and when to slow down and explore, how to find information, and when to remind themselves to track and monitor their comprehension of online information. When they jump between multiple Web pages, especially unmarked and unflagged hypertexts, readers may experience discontinuity. As discussed in the earlier Results section, when students did not keep track of previous steps and organize the information they encountered in less structured passages, their cognitive processing was interrupted or jumbled, resulting in a fragmented, incomplete representation and not an integrated representation of what they had read (Dee-Lucas & Larkin, 1995; Lee & Tedder, 2003). This suggests that text organization and structure are important textual cues to help online readers improve their reading comprehension (Rouet & Levonen, 1996), their reading performance (i.e., recall), and their navigation (Dee-Lucas & Larkin, 1992; Mohageg, 1992; Simpson & McKnight, 1990).

Online search strategies. The data suggested that the students in this study had not developed a diverse repertoire of online search strategies, although they were often on the Internet to look for information for their school assignments and to pursue their own interests. All of the students (including all the GE and students with LD) heavily relied on search engines (especially *Google* or *Yahoo*, but not *Yahoo! Kids* or other educational search engines) when looking for answers, even if they were given choices of other search methods, such as browsing through topics in an index, entering a specific URL, or finding answers from an "answering board" (such as *Yahoo! Kids*'s "Ask Earl").

In addition, both GE students and their peers with LD had limited skills and strategies for online searching. First, they experienced difficulties when selecting and narrowing down search terms (for example, they would type “Cheetah habitats” but not “Cheetahs”), spelling keywords, and using different combinations of keywords. Most of them just typed the full-blown sentence in their chosen search engine, but not keywords. Second, they looked at some *titles* in the list of search results, but they did not read the *descriptions* or *URLs* showing in the search list. In fact, most of them read only the first 10 search results on the first page (if that many), and they did not click the “next” page to search for additional information. These findings confirm the findings of other researchers (e.g., Lyons, Hoffman, Krajcik, & Soloway, 1997). Third, when they made decisions to access particular Web pages, they often chose “*Yahoo! Answers*” or “*Wiki Answers*” to be their primary sources, only because the “answers” on these sites were used and voted on by other Web users. The data further showed that the students generally sought easy, quick answers, but lacked the ability to select and evaluate good, reliable sources.

Moreover, the results suggested that the fifth- and sixth-grade students had not developed the skills or abilities to use keywords to locate information within a Webpage. Both GE students and their grade-age peers with LD preferred to browse whole Web pages, rather than use keywords to locate specific information quickly. Once they opened a Web page, they often read the entire hypertext because they did not know what the keywords were, or how to distinguish the main ideas and the related details.

The above findings suggested that fifth- and sixth-grade students also had not developed sufficient, mature online search strategies. Students in this study exhibited weak abilities in selecting and narrowing down keywords in search engines; they preferred to find

answers on public bulletin boards or in user forums, rather than through reliable, authorized sources; they also had difficulties in evaluating online information, because of limited evaluation strategies regarding Internet information. The Internet is ill-structured compared with traditional print-text environments. Spiro (2004) claimed that learning strategies that are effective with print texts are much different in complex ill-structured environments (i.e. the Internet). Coiro and Dobler (2007) also argued that traditional reading comprehension and skills are necessary, but not adequate when reading and locating information online. Therefore, students need to be taught more flexible reading strategies (Spiro & Jehng, 1990), and need to develop more abilities and skills to flexibly integrate prior knowledge with new knowledge to adapt to new and rapidly changing online reading contexts (Spiro, 2004). New approaches to instruction may include teaching students to think in more flexible ways (Spiro, Feltovich, Jacobson, & Coulson, 1991), as well as how to integrate and construct meaning from online features, so that they know how to synthesize multiple representations. These search strategies are also related to students' online reading strategies, which are discussed in the next paragraph.

One of the interesting findings in this study is that students may exhibit the characteristics of multiple online reader "types," and students with LD were not always inactive and unstrategic learners. Researchers have proposed categorizing online readers into three types: (1) knowledge seekers, (2) feature explorers, and (3) apathetic readers (Anderson-Inman & Horney, 1994; Barab, Bowdish & Lawless, 1997; Lawless & Kulikowich, 1996, 1998; Niederhauser, Salmen, & Reynolds; 1998). However, past researchers has not explicitly defined how to distinguish online readers and sort them into the three sub-types. In this present study, the analysis that found students could be assigned to

more than one type or profile. The analysis further showed that when students understood their purpose for reading, they demonstrated more advanced strategies in looking for information or seeking knowledge on the Websites they visited. In addition, students with LD were not all classified as "apathetic readers." In fact, they were almost evenly categorized into each of the three sub-types. Some students with LD had better search and reading strategies, which helped them locate and access online information. However, most of the students with LD had not developed mature search strategies. This weakness may be related to their generally weaker online reading strategies, the area that is discussed in the next paragraphs.

O*nline reading strategies.* The analyses showed that the fifth- and sixth-grade students had limited online reading strategies. Both GE students and their grade-level peers with LD had weak before-reading strategies, and had difficulties in distinguishing between before-reading and during-reading strategies. From the minute they first looked at the Web pages, they began reading every word from the passages, without previewing or scanning the contents of the pages for headings or other cues. Although the GE students indicated in their survey answers that they would first preview headings and think about their pupose for reading, they had a hard time applying these strategies to the online texts they read during the individual interviews.

As they read, most of the students preferred to read everything in each passage, and they did not seem to employ appropriate during-reading strategies to efficiently locate information in the Web pages. Although some of the GE students apparently possessed some metacognitive knowledge regarding during-reading strategies, they did not readily transfer this knowledge from the print to the online environment.

However, in comparison with the before- and during-reading strategies, both GE students and their grade-level peers with LD performed better when applying after-reading strategies. They read some sections again, recalled the important ideas, memorized the details, and saved URLs for future reference. It seemed that they applied more and better strategies across the printed and online contexts, compared with their pre- and during-reading strategies.

Duke et al. (2006) claimed that online readers experience both similarities and differences in comprehension processes across electronic and print texts. Readers transfer some strategies acquired in traditional text formats to electronic text environments, while some strategies are specific to particular textual environments. This interpretation closely fits the findings in this study. The data showed that fifth- and sixth-grade students preferred to read online passages several times to understand and remember the main ideas. This strategy may be shared by both of the contexts – online and print environments. Also, students expressed that they would save some Websites' URLs (Web addresses) to their Internet "Bookmarks," so that they could retrieve them easily and quickly when they needed them later.

Implications

Digital literacy is more and more necessary for success in K-12 education, and this study suggested implications for instruction and curriculum. Most content area teachers do not see themselves as reading teachers. Even when they teach subjects with *high reading demands*, they do not teach reading strategies to help students increase their reading comprehension and performance (Kamil, 2003). A similar discrepancy between the instructional needs of students and the realities of teachers' instructional practices was re-

vealed in this study. Although literacy strategies are paramount to successful performance in online reading contexts, this study uncovered deficiencies in students' strategic and metacognitive performance. Students did not demonstrate the literacy strategies or executive control needed to ensure independent learning. Also, students reported experiencing more difficulties in finding main ideas and related details when reading hypertexts without clear text structure and organization. These untabbed texts hindered their ability to read and understand online information.

There are many underlying questions that must be considered to resolve this issue. One question is students' access to technologies in school settings, and the teaching agents who will apprentice students in the literacy strategies that are necessary for skillful performance. First, many schools are not equipped with all computer resources they need so that students can access expository texts in online environments. Obviously, students will not acquire literacy strategies unless they have access to the technology at school and instructional mentors to ensure a complete apprenticeship. Moreover, it cannot be assumed that students will successfully transfer new literacy strategies used in the context of print-based media to the comprehension of digital media.

A second concern is identifying the instructional agents who will teach online reading and search strategies, as well as knowledge of hypertext structures, to upper-elementary and middle school students. Is this instructional responsibility best assigned to Media specialists, Librarians, English language arts teachers, or tier-one reading specialists? Also where in the school curriculum should the instructional content be taught? Should it go with the literacy curriculum or with particular subjects? In addition, what strategies do students most urgently need to learn, and in what order? Do students with

LD have to learn every online reading and search strategy? Or just the ones meeting their particular learning needs and background? These questions are imperative for K-12 educators to think about and plan for.

Third, as presented in the Results and Discussion sections, students had higher metacognitive knowledge, but often failed to act upon this knowledge, in authentic contexts. The data showed that students often had some declarative knowledge, as evidenced by their ability to name some good online reading and search strategies. However, they did not perform and apply those strategies when they were given actual online tasks. This may indicate that the students had less procedural knowledge (knowing how to employ the strategies), and conditional knowledge (knowing when and why the strategies should be employed) (Anderson, 1993; Enns, 1993; Paris, Lipson and Wixson, 1983; Smith and Ragan, 1999). For example, students said they knew they should type keywords, but then they proceeded to type full-blown sentences in the search engine; they said they should preview titles and scan illustrations, but then they proceeded to read everything on the Webpage. One factor contributing to this discrepancy may be that, while students have some knowledge of reading strategies for print-texts, they do not know how to transfer those strategies into the online environment. They may have had more practice using these strategies with their paper-based homework, assignments, and tests, but not in online contexts.

A fourth issue is interpreting the results from a traditional viewpoint of print-based learning. While many researchers have investigated typing keywords with different levels of complexity into a search engine, they have reported that more-skilled Internet users are flexible in generating keywords and constructing Boolean operators when searching for

answers on the Internet (Lyons, Hoffman, Krajcik, & Soloway, 1997; Wallace et al., 2000). However, for some students, especially for students with special needs, maybe it is more efficient to retype or copy the entire original question. The reason is that selecting, summarizing, and narrowing down statement questions into a few words may consume large amounts of cognitive resources and search time. Likewise, there may be individual differences in the search behaviors of users that may not be explained by the methods employed in the current study. When Internet users browse unstructured information along author-created links (i.e., external or internal links), browsing does raise traditional problems of disorientation and cognitive overhead, but it may also bring out information serendipity. Users can also apply searching and structuring techniques, such as maps and paths, to make browsing more effective (Zellweger, 1989). These creative methods can be very effective for some Internet reading and searching purposes, and they are uniquely responsive to the hypertext environment and sensitive to the goals of the users. In turn educators may need to think about alternative, unique ways to teach students to search for information in online environments in an efficient and generative manner. After all, students need more flexible reading strategies to adapt to new and changing online reading circumstances and technologies (Spiro & Jehng, 1990).

Another implication of the present study pertains to educational Website design and online program development. The data of this study suggested that, to fifth- and sixth-grade students, the Internet presents itself as an ill-structured, vague, and abstract environment. Students are not equipped with adequate online reading and search strategies to take full advantage of the Internet. Elementary and middle-schools students, including students with special needs and general education students, heavily rely on the structural

cues and overall organization of educational Websites and software programs to advance their learning. However, many of the Websites students visit—even those designed by national agencies and prestigious publishers—are often not well-suited to meet students' diverse needs, comprehension skills, cognitive capabilities, and learning styles. These Websites may have abundant information for our students, but their sequencing of elements and their visual flow may not fit students' learning aptitudes and reading processes. In light of our emerging understanding of the difficulties our students' experience, we can hope that national organizations and publishers, among others, will devote greater attention to addressing students' needs. In the end, software and Web interface designers can do as much as teachers can to help our students take full advantage of everything the Internet has to offer.

Limitations

Every study has its limitations and this one was not an exception. There were several limitations of this study. First, the fatigue effect might be considered. It is possible that students got tired during the interview questions, reading tasks, and online search activities. It is also conceivable that they wanted to finish earlier for other reasons. Further, the fact of being pulled out of their classroom to participate in this study may have affected the search behaviors and skills the subjects exhibited. Second, the small sample size of the interview participants limited the statistical power of the study and its findings. A related limitation involving the small number of interview participants in the present study is that the 25 students were not particularly diverse since they all came from suburban schools in two particular areas (a single Midwestern U.S. state and northern Taiwan); these students very likely do not represent all U.S. or Taiwanese upper-elementary and

middle school online readers. Third, this study's results are not generalizable because the participants were not randomly selected from the whole population. Fourth, the participants came from two different countries, so the limitations may involve the influence of cultural differences, such as learning styles, teaching philosophies, and educational outcomes. Also, the teaching materials, course objectives, and students' textbooks may have played a role in influencing the students' knowledge of particular topics (i.e., Cheetahs and Tasmanian Devils). Fifth, this study was intended to distinguish and classify the participating students into three subtypes of readers: (1) knowledge seekers, (2) feature explorers, and (3) apathetic readers (Anderson-Inman & Horney, 1994; Barab, Bowdish & Lawless, 1997; Lawless & Kulikowich, 1996, 1998; Niederhauser, Salmen, & Reynolds; 1998). However, the students' observed navigation and selection of information may have been influenced to a large extent by reading context, searching purpose, and learning motivation. These factors may have significantly influenced the students' actual search behaviors and strategy application, but an examination of these constraints was beyond the purpose of the current study. Finally, the results were not generalizable to other textual genres such as narrative texts, with which elementary students typically have much more experience (Duke, 1998; see Olinghouse, 2007; Stein & Trabasso 1982; Winograd & Bridge, 1986), about which they have better knowledge (De La Paz, 1997; see Olinghouse, 2007), and which they typically have less difficulty reading and writing (Hidi & Hildyard, 1983; see Olinghouse, 2007; Pelligrini, Galda, & Rubin, 1984; Winograd & Bridge, 1986).

Future Research Directions

As there is little research about how to teach readers to comprehend hypertexts (Duke et al., 2006), there is a substantial need for empirical research in this area. Do students benefit when they receive instruction in hypertext comprehension? What kinds of instruction do they need as they read on the Internet and use hypertext resources? As they receive such instruction, will they apply and transfer it to the print-text context? Specifically, who should teach comprehension of text to students? Does the responsibility belong to the classroom teacher, reading specialist, technology instructor, or all of them?

Researchers have written about the urgent need to teach online reading comprehension strategies and skills, as well as to evaluate and assess these skills (e.g., Coiro, 2003; RRSG, 2002). Exploring reading comprehension in the electronic environment may also shed light on and re-energize research of print texts. In addition, there is a clear need to compare the differences between students' reading and search strategies in print and digital contexts. The differences of strategy application that emerge across the two different contexts may also reveal and explain how students bring to bear newer or more creative ways to adapt to online texts. Do students with special needs bring more different strategies and behaviors to the online environment than their GE peers? Do general education students consistently apply reading and search strategies across the two contexts? Is there any advantage to promoting more consistency or more creativity, or can both be encourage? These questions may help researchers develop more appropriate and individual instruction to assist each student with his or her particular learning style.

Since this research was targeted at students' online reading comprehension strategies, future studies may implement effective online reading interventions to compare the

differences in outcomes across interventions, as well as the qualitative changes over time in students' online reading processes and comprehension.

CONCLUSION

Students come to school with a wide range of diverse learning needs and backgrounds. Helping them develop their knowledge, skills, and strategies is necessary and essential, so that they can more successfully engage in their schooling and learning.

The foregoing quantitative and qualitative findings, discussion, and implications together open new possibilities for theory, research and practice to support readers with individual differences. Above all, this study revealed several underlying issues of instructional needs and learning discrepancies that must be considered. First, instructional practices in the area of Internet literacy strategies are insufficient to support the growing demands and opportunities of students' online learning. Students in this study did not demonstrate the mature literacy strategies and executive control needed to ensure independent online learning. With the Internet becoming more and more pervasive in K-12 classrooms, it is essential for students at a young age to develop digital literacy skills and strategies to access the rich informational resources and experiences afforded by the Internet.

Second, many schools are not equipped with adequate computer resources to fully support their students' acquisition of expository information literacy in online environments. The needed resources include technology hardware and software, as well as instructional mentors to help students successfully transfer literacy strategies from print-based media to the digital media.

Third, students bring new, flexible strategies into the online context. The students in this study relied on public bulletin boards or forums (such as Yahoo Answers or Wiki Answers) to retrieve information, rather than synthesizing multiple sources to create their own organized answers. The results also showed that the students wanted quick,

easy answers, and were not equipped with good evaluation abilities and skills. In addition, some of the students did develop strategies and could use search engine functions, such as "Related Searches" and "Suggested Search Results." These functions can help online users locate specific information quickly and easily. As Spiro (2004) claimed in the context of his Cognitive Flexibility Theory, learning strategies developed with print texts look much different when used in complex ill-structured environments (i.e. on the Internet). Given that little yet is known about how students use comprehension strategies in online reading environments (Coiro & Dobler, 2007; Kamil & Intrator, 1998; Leu, 2000, 2002; Reinking, 1998), the findings from this study may shed useful light on students' online reading performance.

Fourth, digital literacy is a new literacy for upper-elementary and middle school students. When students read hypertext, they need to understand its structure to help their reading comprehension. For example, they need to understand the affordances of navigation tabs in organized texts and the usefulness of applying naming strategies (a strategy to recognize and identify main topic or sub-topic of Web pages) to less structured hypertexts, so that they can easily locate information, keep track of previous steps, and remember the content (Rouet & Levonen, 1996) to improve their reading performance (i.e., recall) and navigation abilities (Dee-Lucas & Larkin, 1992; Mohageg, 1992; Simpson & McKnight, 1990). The relevance of this naming strategy is another difference between reading print texts and hypertexts.

Finally, Internet text presents a new reading challenge *(*NICHD, 2000). Hypertext is an ill-structured text and may appear vague or abstract, as compared with well-structured print texts. Therefore, school educators and instructional developers need to consider

providing appropriate structural cues and organizational schemes for the online resources they use, so that students can benefit from the ever-expanding virtual library that is the Internet to advance their learning.

In sum, this research is a preliminary study aiming to understand how upper-elementary and middle school students applied online reading comprehension strategies when reading hypertexts with different hypertext structures in an online environment. It affirms the importance of curriculum and instruction for developing digital literacy, and aims to lay a foundation for improving curriculum and instruction in the future. The study's overarching aim is, ultimately, to make a positive contribution to student literacy learning and societal wellbeing.

APPENDICES

APPENDICES

Appendix A. Group questionnaire about online reading comprehension strategies & information search

These questions will be asked about your Internet use and reading strategies in the print and online environments. Please rate the degree to which the following statements reflect your current personal experience.

1. **Which of the following is the most useful to you in helping with your schoolwork** (choose one answer)**?**
   □Internet □Library □Parents □Friends □Other (please specify) ____

2. **When you read for fun, do you prefer to read print materials (books, newspapers) or read from a computer screen** (choose one answer)**?**
   □Print books (i.e., story books, newspapers, magazines) □Computer screen

3. **Where do you usually read *ONLINE*** (choose one answer)**?**
   □Home □Friend's house □Parent's office □School □Public library
   □Other (please specify) _____

4. **How long would you say that you have been going *ONLINE*** on the Internet (check *one answer*)?

Within the last 6 months	**1 year ago**	**2 years ago**	**3 years ago**	**More than 3 years ago**

5. **How frequently do you use the *INTERNET* for the following activities** (1 is never, 5 is the most frequency) (circle *one answer* in each row)**?**

	Never (1)	**Once per week (2)**	**2-3 days per week (3)**	**Once per day (4)**	**Several times per day (5)**
Reading (e.g., news, blogs, Facebook, Websites, emails…)	(1)	(2)	(3)	(4)	(5)
Using e-mail	(1)	(2)	(3)	(4)	(5)

Using Instant Messenger, text messages, chat rooms, or message boards	(1)	(2)	(3)	(4)	(5)
Watching TV shows, videos, or movies	(1)	(2)	(3)	(4)	(5)
Writing blogs	(1)	(2)	(3)	(4)	(5)
Writing on Facebook or MySpace	(1)	(2)	(3)	(4)	(5)
Searching for information	(1)	(2)	(3)	(4)	(5)
Playing Internet games	(1)	(2)	(3)	(4)	(5)
Downloading music or videos	(1)	(2)	(3)	(4)	(5)

6. **Rate your understanding or skills for using the following activities** (1 is never or do not know how to do this, 5 is the best) (circle *one answer* in each row)**.**

	Do not know (1)	Not so good (2)	Just OK (3)	Good (4)	Very good (5)
You are able to read & understand *PRINT* materials (i.e., story books, textbooks, newspapers, magazines)	>☹< (1)	☹ (2)	😐 (3)	☺ (4)	"☺!" (5)
You are able to read & understand on the INTERNET (i.e., news, blogs, Facebook, Websites, emails…)	>☹< (1)	☹ (2)	😐 (3)	☺ (4)	"☺!" (5)
You are able to find the information that you want on the Internet	>☹< (1)	☹ (2)	😐 (3)	☺ (4)	"☺!" (5)
You are satisfied with search results that you have conducted on the Internet	>☹< (1)	☹ (2)	😐 (3)	☺ (4)	"☺!" (5)
You are able to read & understand one Website with the navigation tab names	>☹< (1)	☹ (2)	😐 (3)	☺ (4)	"☺!" (5)
You are able to read & un-	>☹<	☹	😐	☺	"☺!"

derstand one Website without any labels/categories/subheadings and navigation tab names	(1)	(2)	(3)	(4)	(5)

Direction: from #7 to #18, please check the box(es) or fill in the blanks that best answer the question.

< Online Information Search Tasks>

7. **If you want to search for information about cheetahs' habitats, what is a search term/keyword/phrase that you would use to find information? Please write a good search term in the blank.**
   Your search term/keyword _____

8. **If the search term/keyword is "Cheetah females are lonely", what kind of information might you find** (check one best answer)**?**
   □The cheetah has a long body
   □Male cheetahs live with female and young cheetahs
   □Female cheetahs live alone
   □Cheetahs' history
   □Female cheetahs teach their young to hunt

9. **If you want to search for information about cheetahs, which of the following would be the best search term/keyword to find information about their appearance** (check one best answer)**?**
   □Lean body
   □A cheetah's tail ends in 4-6 black rings
   □What does the cheetah eat?
   □What does the cheetah look like?
   □Weighs 68-140 pounds
   □A cheetah's face

10. **When you search on the Internet, which of the following is helpful to you in finding useful Web pages** (check all that apply)**?** .
    □Title of the page
    □Author
    □Content
    □Layout and design of the page
    □Length of the page
    □Readability of the page
    □Overall feel of the page
    □Organization affiliated with the page
    □Other (please specify) _____

< Online Comprehension: Texts with/out Navigating Tab names >

11. Here are some tab names. Which one would best answer to find information "cheetahs are endangered species? (check one answer)**"**

□Food □Habitat □Behavior □Extinction □Appearance

12. If a Cheetah's Website displays the following navigation tab names, what information might you expect to find on each Web page? Please write the relevant information that is listed below next to the tab name where it is likely to be found.
Tabs are Food Habitat Hunt

Information is as follows:

■ Birds, rabbits ■ Spotted furs ■ Small antelopes, pigs
■ Females raise the cubs ■ Large paws ■ Grass lands
■ Africa and Asia ■ Nocturnal predators ■ Stalk victims

Please record information below. The first one has an example that has been done for you.

Food Birds, rabbits; …… _____
Habitat _____
Hunt _____

13. Here is some information from a Website about Cheetahs (see below). What title of the navigation tab name(s) would you assign to this text? Please write the tab name(s) in the blank below.

Text: Cheetahs like to live in open areas, such as grasslands, plains, savannahs, and areas with tall grass. The cheetah can also be found in the prairie nearby forests in all parts of Africa. It hunts mainly by the daytime. It follows its prey for a short distance before it attacks.

What tab name(s) or title would you assign to it?

_____

14. Here is one paragraph about Cheetahs. Please read this paragraph several times and try your best to retell the passage on the back side of the paper. Please do not look back at this passage while you recall it.

Paragraph: Male cheetahs will defend a home territory. Female cheetahs on the other hand usually live a solitary life and like the freedom of being on their own with their cubs. A cheetah has a small head with very high set eyes. The cheetah's chest is deep and its waist is narrow with black tear marks going along the sides of the nose to its mouth to keep the sunlight away from its eyes. Juvenile cheetahs stay with the mother for about a year and following this period the litter members

live together for a time perfecting their hunting skills. At around 23 months of age, the female cheetahs leave siblings to be with older dominant males.

Retell the paragraph in the back side of the paper.

15. Here is another paragraph about the Tasmanian Devil's appearance. Please read this paragraph several times and try your best to retell the passage in the back side of the paper. Please do not look back at this passage while you recall it.

Paragraph: The Tasmanian Devil has the appearance of a medium sized dog, but more stocky and muscular. Unusual for a marsupial, the Devil's forelegs are slightly longer than its hind legs. The Devil has long whiskers on the face and on the top of the head. It also has a thick-set, squat build, with a relatively large broad head, as well as a short, thick tail. The devil stores body fat in its tail, so unhealthy devils often have thin tails. The fur is mostly or wholly black, but white markings often occur on the chest, rump and shoulders. Adult males are usually larger than adult females. Large males weigh up to 12kg (26 pounds), and stand about 30cm (12 inches) at the shoulder.

Retell the paragraph in the back side of the paper.

< Online Reading Strategies >

16. Let's say you are reading a Website to find and learn information for a class report or project, what strategies will you use *before* you start reading (check all that apply)**?**

□Read every word from the Website
□Randomly select some paragraphs to read
□Read first sentence of each paragraph
□Think about why & what I should read
□Scan illustrations, graphs, charts, tables
□Use keywords to locate information
□Preview the Website's title, headings, & subheadings
□Glance over the Website's tabs
□Preview the Website's author, organization affiliation, & references/sources
□Preview the Website's Web addresses (URL: Uniform Resource Locator)

17. Continuing #14. What strategies will you use *while* you read the Website to understand and remember the information (check all that apply)**?**

□Read every word from the Website
□Randomly select some paragraphs to read
□Read first sentence of each paragraph
□Notice text structure
□Take notes
□Locate main ideas
□Click every link & multimedia (e.g., audio, pictures, movies)

□Copy & paste information from the Website to a Word document
□Ask a friend to test me on the information
□Play the games on the Website

18. Continuing #15. What strategies will you use *after* you finish reading the Website (check all that apply)**?**
□Drink water and take a break
□Memorize everything from the Website
□Search for related Websites for further research
□Remember main ideas
□Recall details
□Tell others about this Website
□Write down the gist or a draft
□Print out for future reference
□Save Websites on the Internet bookmark
□Ask questions myself to see if I understand the content from the Website

Appendix B. Individual online reading comprehension

Statement: In this reading activity, I'll have you read two Websites. First, you will have 3 minutes to explore one "Tasmanian Devils" Website. You may click the left or right arrow to move and read the text. You may also click the tabs above the title of "Tasmanian Devils" to explore this Website if you'd like; then, you will have 3 minutes to read the second Website. This Website is about "Cheetahs" and has six Web pages. You may click the top or left tables to explore this Website. You may also click any of the links in this Website if you'd like. After reading each Website, you will be asked several questions to examine if you comprehend the texts from the two Websites. You may look back at the Websites to look for answers if you'd like.

Comprehension Questions:

1. What do Tasmanian Devils/Cheetahs eat?

2. Where we can find Tasmanian Devils/Cheetahs?

3. How can we recognize Tasmanian Devils/Cheetahs?

4. What causes Tasmanian Devils/Cheetahs to be endangered?

5. What's the relationship of the young Tasmanian Devils/Cheetahs to their mothers?

Interview Questions:

1. Please read this Web page[10] (Tasmanian Devils) for 1 minute and retell the passage in your own words. What appropriate title(s) would you assign to this Web page? Why would you give this title?

2. Please tell me on what Web page you can find the fact about how "Tasmanian Devils are active at night and rest in the day".

3. Please read this Web page[11] (Cheetahs) for 1 minute and retell the passage in your own words. What appropriate title(s) would you assign to this Web page? Why would you give this title?

4. Please tell me on what Web page you can find the fact about how "Cheetahs only eat freshly killed prey".

Opinion Questions

10 http://kids.nationalgeographic.com/Animals/CreatureFeature/Tasmanian-devil Page 4 of 12

11 https://www.msu.edu/~chenhs11/Cheetah/Appearance.html

5. Which Website do you like best? Why?

6. Which Website does give you more information to learn from these animals?

7. What are the differences of these two Websites? What are their similarities?

8. Which Website makes it hard to read or comprehend for you? Why? Which one is easier?

Appendix C. Individual online search-engine task

Statement: You will be given two searching topics. Please go to one of the children's search engine Websites (i.e., http://kids.yahoo.com/, http://kids.yam.com/, http://tw.yahoo.com/) to look for answers. When you use different search terms to search the open-ended questions, please explain aloud what you are doing and the steps you are taking.

Topics:
1. Why do you turn blue when you are cold?
2. What is the difference between genotype and phenotype?

Ways of finding information within the Website:
1. search engine
2. categories
3. subject hierarchies
4. answering board

Appendix D. Individual metacognitive interview about online reading strategies

Statement: Let's say the information you just searched for (the previous activity) was for your Science homework assignment. What strategies did you use to help you comprehend and learn the online materials? What did you do to find the answers?

Prompt 1-1: When you used search engines, how did you decide the search terms or keywords?

Prompt 1-2: Here is your list of search results for "*Why do you turn blue when you are cold?*" that you just found, how did you decide which Website you wanted to explore further? How did you know if you wouldn't find the answer on a site?

Prompt 1-3: As you are entering this Website (*point to site from the students' search list*), how did you find your answers quickly?

Prompt 1-4: What strategies did you use ***before*** you started reading for information on this Website?

Prompt 2-1: Here are three Websites (*choose three sites from the students' searching list*) you were reading about "*Why do you turn blue when you are cold?*". Please rank these Websites from #1 to #3. #1 means this Website has the best, most appropriate information, and #3 means this Website has the least, most inappropriate information. Which one is the best Website? Second? Last? Why?

Prompt 2-2: What strategies did you use ***while*** you were reading the three Websites to understand and remember the information?

Prompt 3-1: What strategies did you use ***after*** you finished reading the three Websites?

Prompt 3-2: Let's say we won't have enough time to read over this Website, how do you figure out what to read next? Can you predict what information the Website will mention or discuss?

Appendix E. Think-aloud practice (cited with permission from Dr. Laurie Henry (2003):

Initiation — Present the term “think-aloud” to your students. Have them brainstorm what they think it might mean. Ask students to report how it might be applied to reading.

Modeling — Model a think-aloud by presenting a poem on the overhead. As you read each line out loud to the students, stop and vocalize “thinking aloud” about the poem.

Example — This is a think-aloud for the poem “Dream Variation” by Langston Hughes.
To fling my arms wide

In some place of the sun,

To whirl and to dance

Till the white day is done.
[*I’m picturing a young girl with bare feet and a summer dress twirling in her front yard with her arms outstretched.*]
Then rest at cool evening

Beneath a tall tree
[*I'm picturing a large willow tree and sitting underneath it. Fireflies are blinking among the branches.*]
While night comes on gently,

Dark like me—
[*I'm now going back to my original picture of the young girl and can add more detail to the image in my mind. I'm also thinking about the words "white day" and how they contrast with the words "night" and "dark."*]
That is my dream!
[*I think about how children's lives are so filled with dreams. This young girl seems to be free spirited and probably has many dreams.*]
To fling my arms wide

In the face of the sun,

Dance! Whirl! Whirl!
[*I once again see the image of the young girl twirling in her yard and how free she is...like she is flying.*]
Till the quick day is done.

Rest at pale evening...
[*Hmmm...This poem includes several words that relate to color--white, dark, and pale. I wonder if the poet is trying to make a point about color.*]

A tall, slim tree...

Night coming tenderly

Black like me.
[*There is another color word--black. I think the poet has some kind of hidden meaning here but I'm not sure what it is. The poem seems to portray freedom. Maybe the title "Dream Variation" helps make this point. Is this poem about slavery and the only way to be free is in a dream? I think that I might want to look up some information about the author and the date that this poem was published. That might help me to understand it better.*]

Appendix F. Independent Samples T-tests from American and Taiwanese Fifth- and Sixth-Grade Students' Survey Data

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	US		Taiwan	
							Mean	Std. Deviation	Mean	Std. Deviation
v1	Equal variances assumed	3.647	.059	-.159	118	.874	2.50	1.013	2.47	1.197
	Equal variances not assumed			-.160	116.854	.873				
v2	Equal variances assumed	45.015	.000	-6.914	118	.000*	1.88	.329	1.35	.482
	Equal variances not assumed			-6.999	108.072	.000*				
v3	Equal variances assumed	7.106	.009	-1.417	118	.159	1.76	1.393	1.44	1.096
	Equal variances not assumed			-1.406	108.204	.163				
v4	Equal variances assumed	.929	.337	1.103	118	.272	3.53	1.635	3.85	1.545
	Equal variances not assumed			1.101	116.225	.273				
v501	Equal variances assumed	.043	.835	.572	118	.568	2.59	1.312	2.73	1.357
	Equal variances not assumed			.573	117.870	.568				
v502	Equal variances assumed	.137	.712	.248	118	.804	2.07	1.362	2.13	1.287
	Equal variances not assumed			.248	116.213	.805				
v503	Equal variances assumed	2.841	.095	2.119	118	.036	1.76	1.174	2.26	1.390
	Equal variances			2.131	116.819	.035				

12 All items corresponded to Questionnaires in Appendix A.

	not assumed									
v504	Equal variances assumed	.031	.860	-3.595	118	.000				
	Equal variances not assumed			-3.590	116.606	.000	2.93	1.197	2.16	1.148
v505	Equal variances assumed	3.793	.054	1.761	118	.081				
	Equal variances not assumed			1.769	117.426	.079	1.38	.952	1.71	1.092
v506	Equal variances assumed	4.247	.042	1.793	117	.076				
	Equal variances not assumed			1.802	116.864	.074	1.46	1.135	1.85	1.278
v507	Equal variances assumed	.261	.611	2.159	118	.033				
	Equal variances not assumed			2.170	117.259	.032	2.53	1.012	2.97	1.173
v508	Equal variances assumed	2.466	.119	-2.335	118	.021				
	Equal variances not assumed			-2.330	115.807	.022	3.47	1.287	2.94	1.199
v509	Equal variances assumed	.773	.381	1.720	118	.088				
	Equal variances not assumed			1.725	117.897	.087	1.93	1.183	2.32	1.303
v601	Equal variances assumed	4.166	.043	-4.126	118	.000				
	Equal variances not assumed			-4.143	117.624	.000	4.53	.903	3.81	1.022
v602	Equal variances assumed	3.116	.080	-1.336	118	.184				
	Equal variances not assumed			-1.339	118.000	.183	4.03	1.092	3.76	1.169
v603	Equal variances assumed	2.313	.131	.058	118	.954				
	Equal variances not as-			.058	117.316	.954	4.10	.831	4.11	.960

	sumed									
v604	Equal variances assumed	.418	.519	-.702	117	.484				
	Equal variances not assumed			-.700	114.453	.485	3.79	1.120	3.66	1.015
v605	Equal variances assumed	.005	.944	-.621	117	.536				
	Equal variances not assumed			-.619	114.335	.537	3.88	1.156	3.75	1.043
v606	Equal variances assumed	.887	.348	-1.595	117	.113	3.67	1.248		
	Equal variances not assumed			-1.591	113.701	.114			3.33	1.106
v8	Equal variances assumed	.992	.321	.190	117	.850				
	Equal variances not assumed			.191	116.511	.849	3.07	.792	3.10	.889
v9	Equal variances assumed	1.139	.288	-.112	116	.911				
	Equal variances not assumed			-.113	114.349	.911	3.72	1.073	3.70	1.253
v1001	Equal variances assumed	.851	.358	-.460	117	.646				
	Equal variances not assumed			-.461	116.997	.646	.76	.432	.72	.452
v1002	Equal variances assumed	.272	.603	.261	117	.795				
	Equal variances not assumed			.261	116.934	.795	.24	.432	.26	.444
v1003	Equal variances assumed	373.105	.000	7.314	117	.000*				
	Equal variances not assumed			7.172	70.655	.000*	.47	.503	.97	.180
v1004	Equal variances assumed	2.512	.116	-.792	117	.430				
	Equal variances not as-			-.791	114.803	.431	.28	.451	.21	.413

	sumed									
v1005	Equal variances assumed	.040	.842	-.100	117	.921	.12	.329	.11	.321
	Equal variances not assumed			-.100	116.378	.921				
v1006	Equal variances assumed	8.786	.004	1.540	117	.126	.28	.451	.41	.496
	Equal variances not assumed			1.543	116.771	.125				
v1007	Equal variances assumed	30.568	.000	4.641	117	.000*	.19	.395	.57	.499
	Equal variances not assumed			4.668	113.401	.000*				
v1008	Equal variances assumed	12.308	.001	1.724	117	.087	.19	.395	.33	.473
	Equal variances not assumed			1.732	115.122	.086				
v1100	Equal variances assumed	4.091	.045	-1.071	116	.286	3.76	.709	3.60	.887
	Equal variances not assumed			-1.075	112.070	.285				
v1401	Equal variances assumed	1.817	.180	-1.256	117	.211	30.83	16.991	26.49	20.399
	Equal variances not assumed			-1.262	115.036	.209				
v1402	Equal variances assumed	2.144	.146	-.683	117	.496	3.55	2.045	3.26	2.536
	Equal variances not assumed			-.687	114.004	.493				
v1501	Equal variances assumed	7.911	.006	.709	117	.480	33.24	18.359	36.30	27.507
	Equal variances not assumed			.715	105.106	.476				
v1502	Equal variances assumed	5.001	.027	1.941	117	.055	2.84	2.323	3.87	3.319
	Equal variances not as-			1.958	107.669	.053				

	sumed									
v1503	Equal variances assumed	2.146	.146	-1.067	117	.288	1.60	1.059	1.41	.920
	Equal variances not assumed			-1.063	112.921	.290				
v1601	Equal variances assumed	3.499	.064	3.316	117	.001	.40	.493	.69	.467
	Equal variances not assumed			3.312	115.701	.001				
v1602	Equal variances assumed	11.730	.001	-1.688	117	.094	.29	.459	.16	.373
	Equal variances not assumed			-1.679	109.914	.096				
v1603	Equal variances assumed	43.748	.000	-2.954	117	.004*	.26	.442	.07	.250
	Equal variances not assumed			-2.915	89.065	.004*				
v1604	Equal variances assumed	2.154	.145	3.147	117	.002	.33	.473	.61	.493
	Equal variances not assumed			3.150	116.985	.002				
v1605	Equal variances assumed	5.699	.019	1.199	117	.233	.26	.442	.36	.484
	Equal variances not assumed			1.202	116.805	.232				
v1606	Equal variances assumed	23.594	.000	-3.173	117	.002*	.50	.504	.23	.424
	Equal variances not assumed			-3.159	111.509	.002*				
v1607	Equal variances assumed	2.828	.095	2.160	117	.033	.36	.485	.56	.501
	Equal variances not assumed			2.162	116.961	.033				
v1608	Equal variances assumed	.579	.448	.810	117	.420	.48	.504	.56	.501
	Equal variances not as-			.810	116.617	.420				

	sumed									
v1609	Equal variances assumed	27.497	.000	2.484	117	.014				
	Equal variances not assumed			2.503	110.119	.014	.14	.348	.33	.473
v1610	Equal variances assumed	123.477	.000	4.476	117	.000*				
	Equal variances not assumed			4.542	91.106	.000*	.07	.256	.39	.493
v1701	Equal variances assumed	8.515	.004	2.508	117	.014				
	Equal variances not assumed			2.503	115.192	.014	.47	.503	.69	.467
v1702	Equal variances assumed	.553	.459	-.371	117	.711				
	Equal variances not assumed			-.371	115.308	.712	.16	.365	.13	.340
v1703	Equal variances assumed	70.402	.000	-3.472	117	.001*				
	Equal variances not assumed			-3.410	75.360	.001*	.24	.432	.03	.180
v1704	Equal variances assumed	17.658	.000	6.916	117	.000*				
	Equal variances not assumed			6.959	112.866	.000*	.16	.365	.69	.467
v1705	Equal variances assumed	33.946	.000	-5.134	117	.000*			.41	.496
	Equal variances not assumed			-5.168	112.137	.000*	.83	.381		
v1706	Equal variances assumed	1.034	.311	-.518	117	.606				
	Equal variances not assumed			-.518	116.878	.605	.62	.489	.57	.499
v1707	Equal variances assumed	93.821	.000	4.143	117	.000*				
	Equal variances not as-			4.197	96.656	.000*	.09	.283	.39	.493

	sumed									
v1708	Equal variances assumed	.000	.995	.003	117	.997	.33	.473	.33	.473
	Equal variances not assumed			.003	116.696	.997				
v1709	Equal variances assumed	1.614	.206	.634	117	.528	.26	.442	.31	.467
	Equal variances not assumed			.635	116.997	.527				
v1710	Equal variances assumed	30.229	.000	2.566	117	.012	.12	.329	.31	.467
	Equal variances not assumed			2.588	107.954	.011				
v1801	Equal variances assumed	37.809	.000	-3.474	117	.001*	.47	.503	.18	.388
	Equal variances not assumed			-3.451	107.089	.001*				
v1802	Equal variances assumed	.092	.763	-.151	117	.880	.24	.432	.23	.424
	Equal variances not assumed			-.151	116.450	.880				
v1803	Equal variances assumed	10.858	.001	3.756	117	.000*	.41	.497	.74	.444
	Equal variances not assumed			3.745	113.955	.000*				
v1804	Equal variances assumed	11.258	.001	2.514	117	.013	.48	.504	.70	.460
	Equal variances not assumed			2.508	114.683	.014				
v1805	Equal variances assumed	.314	.577	.294	117	.769	.45	.502	.48	.504
	Equal variances not assumed			.294	116.741	.769				
v1806	Equal variances assumed	15.588	.000	1.897	117	.060	.14	.348	.28	.452
	Equal variances not as-			1.909	112.193	.059				

	sumed									
v1807	Equal variances assumed	14.493	.000	2.273	117	.025	.28	.451	.48	.504
	Equal variances not assumed			2.280	116.588	.024				
v1808	Equal variances assumed	4.826	.030	-1.158	117	.249	.41	.497	.31	.467
	Equal variances not assumed			-1.156	115.533	.250				
v1809	Equal variances assumed	.003	.960	2.716	117	.008	.38	.489	.62	.489
	Equal variances not assumed			2.716	116.679	.008				
v1810	Equal variances assumed	4.117	.045	1.087	117	.279	.34	.479	.44	.501
	Equal variances not assumed			1.088	116.994	.279				

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