Online Reading Comprehension Strategies Among Fifth- and Sixth-Grade General and Special Education Students

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The present study targeted the online reading strategies of upper-elementary and middle school students with and without learning disabilities in the U.S. and in Taiwan. Several aspects of the comprehension process were studied, including: (1) Internet navigation strategies and behaviours, (2) sensitivity to the organisational 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, completed by 119 American and Taiwanese students in the fifth and sixth grades. The results suggested that students (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 organisational cues for informational passages, (3) did not employ recommended online search strategies, and (4) had weak before-reading strategies as well as difficulty distinguishing before- and during-reading strategies, although their after-reading strategies were often advanced.

Introduction

Internet technologies have become an everyday part of school children's daily lives, at school and at home (Lebo, 2003). For purposes that range from entertainment to academic learning, more and more students are embracing the Internet and spending more time reading online. According to government reports, it is necessary to acknowledge the rapid changes brought about by new Internet technologies because Internet text presents a new kind of

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reading challenge (National Institute of Child Health and Human Development, 2000; RAND Reading Study Group [RRSG], 2002). However, very little is yet known about whether Internet text brings additional complexities to reading comprehension or what exactly these new complexities may be (Coiro, 2003; Leu, Kinzer, Coiro & Cammack, 2004). In a 2003 meta-analysis study of 80 research articles on comprehension and technology, only three studies focused on reading comprehension in the context of the Internet (Coiro, Leu, Kinzer, Labbo, & Teale, 2003). Consequently, there is a gap today between what we know about online reading comprehension and what educators, among others, would like to know. Specifically, educators have an interest in knowing whether the Internet requires new comprehension skills or different comprehension processes than print texts, as well as how students read, comprehend, and interact with online texts.

In addition, only few studies have investigated the online comprehension and learning processes of fifth- and sixth-grade students (e.g., Large, Beheshti, & Rahman, 2002; Schacter, Chung, & Dorr, 1998; Wallace, Kupperman, Krajcik, & Soloway, 2000), but no studies examined these topics among students with learning disabilities (LD). Little is known about how students' prior experience or disability status may cause differences with regard to knowledge demonstration, reading comprehension, strategy implementation, and skill application. It may be the case that students with LD use different online reading strategies than students without disabilities when interacting with online hypertext.

Emerging from these questions, the purpose of this study was to investigate the online reading strategies that fifth- and sixth-grade students actually use, with the larger goal of understanding how these students may optimize their reading comprehension with informational texts.

The theoretical framework that serves as a foundation for the current study is drawn from the principles of *Cognitive flexibility*

theory (Spiro, Feltovich, Jacobson, & Coulson, 1991) and *New literacies* (Coiro & Dobler, 2007). Cognitive flexibility theory suggests that, in an ill-structured environment (such as the Internet), readers need to flexibly apply reading strategies that allow them to adapt to new and changing online reading contexts, so that they can revisit materials at different times for different purposes and from different conceptual perspectives (Spiro & Jehng, 1990). Hypertext readers need to integrate and construct meanings from hypertext 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).

New literacies focuses on school contexts to explore how students develop and demonstrate reading literacies and how they use online informational texts in formal school settings. Such students may need to apply new comprehension skills, strategies, and dispositions to communicate, inquire about, search for, locate, synthesize, evaluate, and organise 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 online 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 engage in non-linear and flexible characteristics of reading which contrast with the skills required for reading linear, conventional print (Thuring, Haake, & Hannemann, 1991).

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 1 and Figure 2. 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.

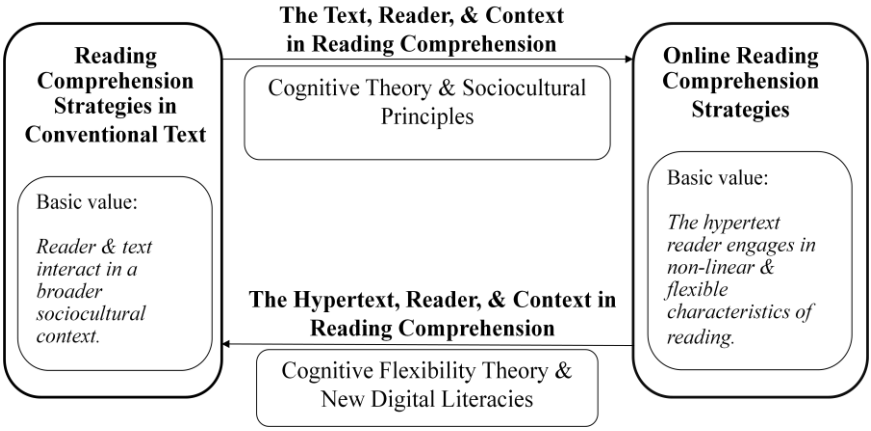

Figure 1. The "Loop" Diagram of Reading Comprehension Strategies

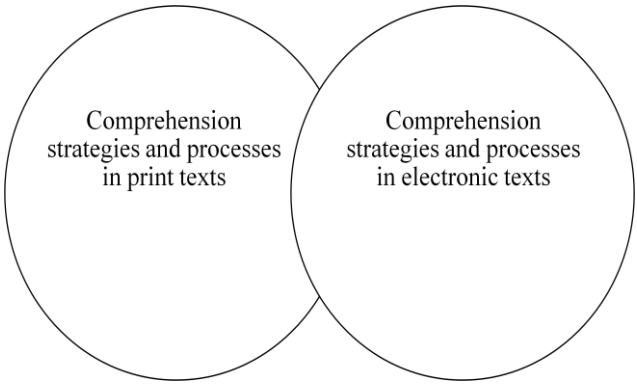

Figure 2. The overlap between comprehension strategies and processes used with print texts and those used with electronic texts.

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 1 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. 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 1. Research Findings in Reading Strategies of Print and Electronic Texts

Stage	***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 ♦ Organise 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

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).

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 Comprehension 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).

In addition, students with disabilities often experience other 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 organisers, 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, organise, 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 behaviours, 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.

A single major research question led to four minor research questions. The major question was: How do fifth- and sixth-grade students with LD and their general education peers in the United States 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 behaviours?
2. How do they perceive and utilize the organisational 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

58 fifth- and sixth-grade students who were general education or special education students with LD participated in this study. These students were from suburban schools in the Midwestern U.S. Each of the students with LD met the criteria for how LD was defined and diagnosed in the public school districts. All students participated in a group survey and then nine students (4 GE, 5 LD) were randomly selected to receive individual measures, which are explained in the following sections.

Data and Instrument

Literacy assessment. Several group and individual measures were utilized to determine each student's reading skills and strategy use on the Internet. First, a whole-class questionnaire about students' reading strategies was administrated. The questionnaire asked questions about their Internet use, reading comprehension in print and online environments, online information searches, online reading comprehension, and online reading strategies. Second, individual online reading activities were measured. Each student was directed to read and answer reading comprehension questions regarding two Websites: one consisted of five Web pages with labels/chunks and navigation tabs, while the other Website consisted of linear hypertext pages without labels and tabs. A readability score of level 5 was obtained using the Flesch-Kincaid (F-K) formula (Kincaid, Fishburne, Rogers, & Chissom, 1975) for each hypertext page of the two Websites. Third, individual online search-engine tasks were implemented to investigate students' Internet reading comprehension abilities and strategies. Two open-ended searching questions were given and students were asked to look for answers using their favorite search engine Website(s). Finally, an individual structured, meta-cognitive interview was conducted to explore the

students' online reading strategy knowledge and thinking processes as they read on the Internet. These questions probed pre-, during-, and post-reading strategies, how students made sense of texts, as well as how they searched for and evaluated Websites.

Measurement and scoring procedures. All of the literacy assessments were administered in school computer labs, libraries, or quiet rooms with Internet access. All assessments were counterbalanced across two topics. The appropriateness and level of the testing texts were evaluated and determined by experienced fifth- and sixth-grade teachers, including both general and special educators. All the testing directions, passages, and questions about literacy measures were read aloud to students to minimize difficulties with word recognition ability or reading fluency speed (Englert, Raphael, & Anderson, 1991).

Data Analysis. Multiple analyses were adopted to triangulate the results from the data.

Quantitative data. In order to answer the research questions related to students' Internet strategies and behaviors in relation to different organisational structures, 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 behaviours (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), (2) *number of strategies used* (e.g., logical sequence of selection, systematic manner of acquisition, different search terms, search decisions, evaluation), (3) *number of special features visited* (e.g., hyperlinks, icons, audio clips, movies), (4) *number of Web pages visited*, and (5) *total time for each online search-engine task*. 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 2).

Table 2. 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		> 2	> 2 Minutes
Feature Explorer		> 2		> 2 Minutes
Apathetic Reader	0	< 2	< 2	< 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 as follows: (1) examination of the data, (2) assignment of labels to themes, (3) identification of common patterns across themes, and (4) comparison of themes across subjects (Glaser, 1992; Merriam, 1988).

Results and Discussion

The following themes emerged from the analysis of the data.

Internet uses and behaviours. 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 interesting 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 further 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 experiences. 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 organisational 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 (see Table 3). When Websites or Web pages lacked appropriate tabs or organisational cues, the non-linear nature and unclear structure confused the students, who often misunderstood the passages' subtopics or subtitles. 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, animations, multimedia, texts) makes the Internet a more challenging reading environment for Internet readers, as it imposes a greater cognitive load (Coiro & Dobler, 2007).

Table 3. Online Reading Comprehension With Different Organisational Structures

Task	***Chunk of Details***		***GE***	***LD***
Retell	0 Chunk		15%	33%
	1 Chunk		33%	33%
	2 Chunk		33%	20%
	3 Chunk		19%	14%
	Details	W/O Tab	*M*=3.58, *SD*=2.94	*M*=1.79, *SD*=2.12
		With Tab	*M*=3.54, *SD*=2.30	*M*=2.36, *SD*=2.10

Furthermore, the results from the present study suggested that the unmarked and unflagged hypertexts were more difficult for online readers to process (see Table 3). When the online readers were presented with unorganised 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).

***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 (see Table 4). 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.

Table 4. Online Search Strategies and Behaviours

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

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.

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 (see Table 5), and had difficulties in distinguishing between before-reading and during-reading strategies (see Table 6). 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.

Table 5. Online pre-reading strategies of selected GE students and their grade-age peers with LD

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

Table 6. The online during-reading strategies of selected GE students and their grade-age peers with LD

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

Practical Implications

With digital literacy now becoming essential for learning in K-12 classrooms, the aforementioned findings highlight new challenges and possibilities for instruction and curriculum. Prior research has shown that most content area teachers do not see themselves as reading teachers (Kamil, 2003) – even when they teach subjects with high reading demands; these teachers do not teach reading strategies to help their students improve their reading comprehension and performance. A similar discrepancy between the instructional needs of students and the realities of teachers' instructional practices was revealed 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 organisation. These untabbed texts hindered their ability to read and understand online information.

Today, then, the urgent question is: Who will teach our K-12 students online reading and search strategies, as well as the knowledge of hypertext structures? Should online reading instruction be shouldered exclusively by language-arts teachers? In addition, which particular strategies should be taught? Do students with LD have to learn every online reading and search strategy? Or just the ones meeting their learning needs and background? These questions are urgent ones for educators and researchers to think about.

This research is of significant implication to educators and researchers because there is scarce empirical work so far to support the claim that Web-based texts introduce additional complexities into the reading comprehension process (Coiro, 2003; Leu et al., 2004). This gap in the research literature means that many K-12 teachers may not be fully preparing their students with the important online comprehension skills and strategies they need to take advantage of the vast and growing opportunities for reading and lifelong learning provided by the Internet.

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 and discussion 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 to retrieve information, rather than synthesizing multiple sources to create their own organised answers.

Fourth, digital literacy is a new literacy for fiftj- and sixth-grade 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 organised 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 organisational 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 fifth- and sixth-grade 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.

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