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Effects of Computer-Assisted Collaborative Strategic Reading on Reading Comprehension for High-School Students with Learning Disabilities

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Effects of Computer-Assisted Collaborative Strategic Reading on Reading Comprehension for High-School Students with Learning Disabilities

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Dedication

To my parents, Moon-Sik Kim and Yoon-Ja Cho, for believing in me and providing me endless love. I could not have done this without them.

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Effects of Computer-Assisted Collaborative Strategic Reading on Reading Comprehension for High-School Students with Learning Disabilities

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Abstract: The effects of Computer-Assisted Collaborative Strategic Reading (CACSR), in comparison with a comparison sample of a typical language arts resource class, on reading comprehension for high school students with learning disabilities (LD) were examined. CACSR is a researcher-developed computer program that provides systematic instruction in four comprehension strategies of Collaborative Strategic Reading (CSR), enhanced with research-recommended technical features of Computer-Assisted Instruction (CAI), for the purpose of enhancing reading comprehension for students with LD.

One language arts resource class teacher and 23 students with LD who attended his class sections participated in this study. The four class sections were randomly assigned to either the CACSR group or the comparison group (i.e., a

typical language arts resource class). Students participated in 25, 50-minute CACSR sessions for 12 weeks.

Before and after the 12-week of the CACSR intervention, all students in both groups were evaluated on comprehension performance as measured by the Woodcock Reading Mastery Test-Revised-Passage Comprehension. Additionally, student interviews were conducted with students who received the CACSR intervention after the intervention was completed.

A 2 (CACSR vs. comparison) by 2 (pretest vs. posttest) repeated measure analysis of variance (ANOVA) revealed that there were no statistically significant intervention or intervention-by-time interaction effects; however, there was a statistically significant time effect on comprehension. Practical significance test using effect sizes revealed that an intervention/comparison group difference effect size at posttest was .24, while it was .13 at pretest. Also, the pretest to posttest mean difference effect size for the CACSR group was .81, while for the comparison group it was .33.

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CHAPTER I

INTRODUCTION

Reading is essential for success in school and life (Bondanza, Kelly, & Treewater, 1998; Snow, Burns, & Griffin, 1998). Adequate reading skills are important for school, social, and economic advancements (Simmons & Kameenui, 1998). Some students learn how to read and comprehend what they read fairly well. However, there are many students who have difficulty in learning how to read and comprehend what they read. In particular, students with learning disabilities (LD) represent a group that has difficulty in this area (Becker & McCormick, 1991; Hallahan, Kauffman, & Lloyd, 1999; Snow et al., 1998). Approximately 80% of the students with LD experience reading difficulty (Bender, 1998; Kavale & Reece, 1992). Consequently, reading difficulty is one of the main reasons students with LD are referred to special education (Snow et al., 1998).

For the past two decades, awareness of the importance of reading has been growing and consequent demands for effective reading instruction have increased (National Reading Panel, 2000; Snow et al., 1998). This growing awareness is reflected in the reading initiatives of several states (e.g., Texas, California) as well as in the announcements of former President Clinton and

President Bush. The goal of these initiatives is to ensure that by the end of third grade, all students are reading at least at the third-grade level. Additionally, many local school districts have targeted improvement in reading as their highest priority. The national attention to reading, however, predominantly focuses on early reading instruction, such as phonological awareness, decoding, and word identification instruction (Kuldanek, 1998; Snow et al., 1998). The rationale for emphasizing early reading instruction is that if effective instruction in early reading skills is provided, the number of struggling readers will be reduced.

Furthermore, it was believed that instruction on early reading skills, such as decoding and word identification skills, must precede instruction in comprehension (Gersten, 1998). Many people assumed that students with LD were unable to learn comprehension strategies because they struggled with early reading skills. As a result, instruction of students with LD, even secondary students with LD, relied on drill-and-practice in early reading skills (Gersten, 1998). However, early reading instruction does not guarantee successful reading comprehension (Bryant et al., 2000; Vaughn, Klingner, & Bryant, 2001). There are students who have difficulty in comprehending text even when they possess decoding and word identification skills (Englert & Thomas, 1987; Klingner & Vaughn, 1996; Williams, 1998). Difficulties in strategic reading and spontaneous comprehension monitoring have been consistently identified as causes for reading

comprehension difficulty for students with LD (Baker, 1982; Brown & Palincsar, 1982; Capelli & Markman, 1982; Torgesen, 1977, 1980; Vaughn, Gersten, & Chard, 2000).

When students begin secondary school, the issue of reading comprehension becomes very important for several reasons (Berninger, 1994; Bryant, Ugel, Thompson, & Hamff, 1999). First, secondary school students are expected to read independently and to demonstrate comprehension in a variety of content areas (Hudson, Lignugaris-Kraft, & Miller, 1993). Second, students are expected not only to understand what they read but also to learn from what they read. Third, textbooks are the predominant materials that teachers use in the classroom (Armbruster & Anderson, 1988). Many secondary students with LD have difficulties in coping with these school curriculum demands (Bryant et al., 1999, 2000).

Because text-based instruction is based on the assumption that students can read and understand what they read (Bryant et al., 1999), the need for effective instruction in reading comprehension for students with LD is often neglected in secondary schools. Many secondary school teachers believe that reading instruction is primarily the responsibility of elementary schools (Bintz, 1997). Hence, many students with LD in secondary schools were provided little or no special assistance in this area (Humphrey, 1992). Despite reading instruction

during elementary grades, however, many students with LD in secondary schools continue to have reading difficulties (Ackerman, Dykman, & Peters, 1977; Finucci, 1986).

This problem challenges secondary school teachers to prepare students with LD to successfully respond to these heavy learning demands. However, most secondary teachers know little about teaching reading and rarely instruct students in the comprehension process (DiCecco & Gleason, 2002; Dupusi, 1984). Even when comprehension instruction was provided by teachers in grade 4 through 12, it generally consists of assigning reading materials to read (e.g., chapters) and asking comprehension questions, with little instruction on how to decipher text structure and interpret information (Beck, McKeown, Hamilton, & Kucan, 1997; Gillespie & Rasinski, 1989).

The limited instruction in reading comprehension has been documented in last three decades since Durkin's (1978-79) observational study of reading comprehension instruction. Durkin found that considerably limited time was allocated to reading comprehension instruction during fourth-grade reading instruction. Unfortunately, the current status of reading comprehension instruction in both general and special education is not different from Durkin's finding. In general education, Pressley and colleagues (1998) reported that explicit comprehension instruction was rarely provided to 4th- and 5th-grade classrooms.

Also, comprehension strategies were rarely taught in their classrooms. Similarly, Vaughn and colleagues (1998) revealed that many elementary special education teachers only asked fact-based questions as their reading comprehension instruction. Few teachers provided instruction in comprehension strategies. The teachers provided little individualized instruction in reading, including reading comprehension. A follow-up study also found that little or no instruction in comprehension strategies was provided by resource room special education teachers (Moody, Vaughn, Hughes, & Fischer, 2000).

Furthermore, students with LD who were placed in special education usually work alone, using reading workbooks or skill sheets, with limited teachers' instructional support during reading instruction (McGill-Franzen & Allington, 1990). In fact, students with LD work on drill-and-practice reading assignments independently with little feedback and few explanations from their teachers for as much as 52% of their reading instruction (Haynes & Jenkins, 1986). A recent summary of research on observations during reading instruction for students with disabilities, including students with LD, revealed that (a) students with disabilities spent a large amount of time on independent worksheets or seatwork assignments during reading instruction, and (b) students received little instruction on reading, especially reading comprehension, with a

considerable amount of time spent waiting to be taught (Vaughn, Levy, Coleman, & Bos, 2002).

Computer-Assisted Instruction (CAI) has been proposed to be a promising alternative to this independent reading assignments (e.g., worksheets) for students with LD for several reasons: (a) CAI has a capacity to deliver individualized instruction, (b) CAI can provide immediate feedback, (c) CAI has a capacity to record students' performance or progress, and (d) CAI can maintain students' interest and motivation (Boone & Higgins, 1993; Lewis, 2000; MacArthur & Haynes, 1995; Rieth & Semmel, 1991; Shiah, Mastropieri, & Scruggs, 1995; Woodward, Carnine, & Collins, 1988).

One may argue the effectiveness of CAI compared to teacher-directed instruction on students' learning. Of course, effective special education would best be accomplished by instruction that is offered by special education teachers, because teachers can be more responsive to students' needs and abilities than any other instructional tool (Kauffman, 1999; Wilson, Majsterek, & Simmons, 1996). To ensure the effective special education, however, teachers should have a small number of students, so that they can deliver one-on-one or small group instruction tailored to students' needs (Wilson et al., 1996). Unfortunately, it is not possible for many special education teachers to utilize one-on-one or small group instruction as their classroom practice, because they usually have a responsibility

to teach many students in their class (Moody et al., 2000; Wilson et al., 1996). The large caseloads often result in the situation in which teachers have difficulties in providing responsive instruction or feedback to students, and students work on drill-and-practice reading assignments independently for a large amount of time during reading instruction.

The use of CAI in providing instruction could reduce teachers' instructional demands related to the large caseloads, thus, resulting in more time allowed for teachers' instructional interactions with their students (Carnine, 1989). Substantial evidence supports that CAI, as a provider of instruction, generally demonstrated significant improvements in reading comprehension (Boone & Higgins, 1993; Higgins & Boone, 1990; Horton, Boone, & Lovitt, 1990; MacArthur & Haynes, 1995). Thus, CAI to provide effective instruction in reading comprehension could assist secondary school teachers with preparing students with LD to successfully respond to the curriculum and learning demands in schools. Teachers could utilize CAI to provide effective instruction in reading comprehension as a part of their reading instruction, so that they can have more time to provide individualized instruction to their students with LD.

To develop CAI to provide effective instruction in reading comprehension, careful consideration to two critical components should be taken: (a) effective reading comprehension instruction for students with LD, and (b) technology-

related elements that are likely to facilitate effective reading comprehension instruction for students with LD. First, based on an accumulation of research, the critical factors associated with improved outcomes in reading comprehension for students with LD have been identified (e.g., activating prior knowledge, comprehension monitoring, identifying main ideas, student-generated questions; Mastropieri & Scruggs, 1997; National Reading Panel, 2000; Pressley, Brown, El-Dinary, & Afflerbach, 1995; Swanson, 1999; Weisberg, 1988; Wong, 1985). Collaborative Strategic Reading (CSR) is an instructional practice that capitalizes on this knowledge base. CSR was designed to provide explicit instruction in four comprehension strategies that students can apply before, during, and after reading: (a) "preview" to activate prior knowledge, (b) "click and clunk" to monitor one's own comprehension, (c) "get the gist" to identify main ideas, and (c) "wrap-up" to generate questions. A synthesis of research on CSR[1] demonstrated that its implementation was associated with improved reading comprehension for students with LD (Klingner & Vaughn, 1996, 2000; Klingner, Vaughn, Hughes, Schumm, & Elbaum, 1998).

Second, researchers have identified several technical features of CAI that are likely to facilitate the delivery of effective reading instruction for students with LD (Boone & Higgins, 1993; Lewis, 2000; MacArthur & Haynes, 1995; Rieth & Semmel, 1991; Shiah et al., 1995; Woodward et al., 1988). These

[1] A synthesis of the literature on CSR will be presented in chapter II.

features include the capability to provide individualized instruction (e.g., individualized learning pace, learning path, reading level), to provide learner control, to monitor and evaluate a student's performance, to provide immediate and corrective feedback, to provide interactive and non-linear learning environment, and to maintain a student's interest and motivation.

CAI that incorporates the four comprehension strategies of CSR, enhanced with research-recommended technical features of CAI, would provide effective instruction in reading comprehension for students with LD. Thus, a Computer-Assisted Collaborative Strategic Reading (CACSR) was designed to incorporate four comprehension strategies of CSR, enhanced with research-recommended technical features of CAI, for the purpose of enhancing reading comprehension of high school students with LD. The rationale for this study and its potential impact on students' reading comprehension are depicted in Appendix A.

The Statement of Purpose and Research Questions

The purpose of this study was to investigate the effectiveness of CACSR, as a responsive instructional tool, in improving the reading comprehension of high school students with LD. In addition to investigating the effects of CACSR on reading comprehension of students with LD, this study examined the students' perceptions about CACSR.

Research Question 1: Following the intervention, will students in the CACSR group outperform students in the comparison group (i.e., typical language arts resource class) on reading comprehension, as measured by the Woodcock Reading Mastery Test-Revised (WRMT-R)-Passage Comprehension?

Research Question 2: What are the perceptions of high school students with LD regarding the efficacy of CACSR they received during instruction?

Definition of Variables

There was two independent variables in the study: (a) intervention with two levels (i.e., CACSR and a comparison sample of a typical language arts resource class), and (b) time with two levels (i.e., pretest and posttest). There was one dependent variable: reading comprehension, as measured by the WRMT-R-Passage Comprehension. For the purpose of this study, each of variables were operationally defined as:

COMPUTER-ASSISTED COLLABORATIVE STRATEGIC READING (CACSR)

Computer-Assisted Collaborative Strategic Reading is a computer-assisted instructional practice designed and developed by the investigator (see Chapter 3 for further information). CACSR incorporates four comprehension strategies of CSR, enhanced with research-recommended technical features of CAI, for the purpose of enhancing reading comprehension of students with LD. In detail,

CACSR provides systematic instruction in *preview* (activating prior knowledge), *click and clunk* (comprehension monitoring and vocabulary development), *get the gist* (identifying main ideas), and *wrap-up* (generating questions) strategies. By incorporating research-recommended technical features of CAI that are likely to facilitate the delivery of effective reading instruction for students with LD, CACSR provides individualized instruction (e.g., individualized learning pace, learning path, reading level, etc.), learner control, immediate feedback, the record of students' performance or progress, and interactive and non-linear learning environment. In this study, students in the CACSR group learned and applied the CSR strategies by interacting with CACSR individually with an assistance of the investigator.

A Comparison Sample of a Typical Language Arts Resource Class

Students in the comparison group participated in a typical language arts resource class. The typical language arts resource class lasted one and a half hours and was offered every other day. The typical language arts resource class consisted of (a) literature instruction, and (b) English grammar instruction.

Reading Comprehension

Reading comprehension refers to the act of thinking or processing in which the reader constructs meaning before, during, and after reading by

incorporating the text information with their prior knowledge (Bondanza et al., 1998; Kaufman, 1992; Snider, 1989; Williams, 1998). In the current study, reading comprehension was measured by WRMT-R-Passage Comprehension. WRMT-R Passage Comprehension is a modified cloze procedure requiring the students to identify a key word missing from the passage (Woodcock, 1998). In this study, raw scores from the WRMT-R-Passage Comprehension was used for data analysis.

CHAPTER II

REVIEW OF LITERATURE

This chapter provides the review of literature in the following order: (a) reading comprehension and students with LD, (b) research on CSR, and (c) research on CAI in reading.

Reading Comprehension and Students with LD

Reading comprehension is the ultimate goal of learning to read and it is the foundation for education (Bondanza et al., 1998). Reading comprehension is viewed as the “essence of reading” and it is essential not only to academic learning in content areas but also to lifelong learning (National Reading Panel, 2000).

Reading refers to the product of decoding and comprehension (Gough, 1996). Decoding is "translating printed word into a representation similar to oral language" (Carnine, Silbert, & Kameenui, 1997, p. 22). Reading comprehension is an active process in which the reader constructs meaning before, during, and after reading by incorporating the text information with their prior knowledge (Bondanza et al., 1998; Kaufman, 1992; Snider, 1989; Williams, 1998). The ability to decode words rapidly and accurately is essential for readers to focus on

constructing meaning from text (Moats, 1998). Although reading comprehension difficulty is often related to deficient decoding skills, many students with LD have reading comprehension difficulty even when they have adequate decoding skills (Englert & Thomas, 1987; Klingner & Vaughn, 1996; Williams, 1998). Difficulties in strategic reading and spontaneous comprehension monitoring have been consistently identified as causes for reading comprehension difficulty (Baker, 1982; Brown & Palincsar, 1982; Capelli & Markman, 1982; Torgesen, 1977, 1980; Vaughn, Gersten, et al., 2000). Thus, students with LD need effective instruction that promotes strategic reading and comprehension monitoring.

EFFECTIVE INSTRUCTION IN READING COMPREHENSION

The effectiveness of reading comprehension strategies has been documented in several studies (Mastropieri & Scruggs, 1997; National Reading Panel, 2000; Pressley et al., 1995; Swanson, 1999; Weisberg, 1988; Wong, 1985). These prominent strategies include: (a) activating prior knowledge, (b) monitoring comprehension (e.g., self-questioning), (c) finding main ideas and supporting details, (d) summarizing, (e) using text structure, (f) drawing inferences, and (g) using mental imagery. The strategies that have demonstrated effectiveness in enhancing reading comprehension can be categorized into the time periods during which they were used: (a) before reading, (b) during reading (e.g., monitoring reading), and (c) after reading (e.g., summarization).

Before Reading

Activating prior knowledge before reading is an important component in improving reading comprehension (Kaufman, 1992; Snider, 1989). Prior knowledge has an impact on constructing meaning from the text as well as comprehension monitoring (Billingsley & Wildman, 1988; Ogle, 1986). According to Becker and McCormick (1991), good readers use their prior knowledge to supplement textual information. Students with LD increase reading comprehension when they use strategies to activate their prior knowledge (Carr & Thompson, 1996; Sachs, 1983, 1984; Snider, 1989). Several strategies, such as brainstorming or making predictions, have been developed to activate prior knowledge.

Brainstorming

Brainstorming appears to be an effective prereading strategy that promotes use of students' prior knowledge (Weisenback, 1988). Teachers and their students use brainstorming to generate and organize what they already know about given topics or subjects (Kaufman, 1992). According to Anderson-Inman and Horney (1997), the process includes three stages: (a) generating, (b) orchestrating, and (c) elaborating. In the generating stage, students identify their prior knowledge on the topic and record it often with semantic webbing techniques to facilitate their understanding of relationships among ideas. In the orchestrating stage, students

organize their existing ideas to fit into appropriate categories or groups. In the elaboration stage, students enrich the organized ideas through elaboration to make them more meaningful (Anderson-Inman & Horney, 1997).

Making predictions

Making predictions is also viewed as an effective prereading strategy for several reasons. It helps readers set a goal for reading (Bondanza et al., 1998), activates their prior knowledge (Bondanza et al., 1998; Graves, Prenn, & Cooke, 1985), and motivates them to read the text to confirm their prediction (Graves, Juel, & Graves, 2001; Nolan, 1991). Previewing cues, such as the title, headings, or pictures, often precedes prediction (Englert & Mariage, 1990). According to Palincsar and Brown (1984), good readers make predictions and form inferences of the text by using their prior knowledge. Later, good readers monitor how their prediction fits into textual information. This process of confirmation or disconfirmation can be viewed as comprehension monitoring, a critical component of reading comprehension (Capelli & Markman, 1982).

Question generation

Providing students with opportunities to generate questions that they would like to ask about the topic prior to reading is another way to activate their prior knowledge (Billingsley & Wildman, 1988). Question generation facilitates the use of students' prior knowledge by forming questions, setting goals for

reading, and paying attention to reading (Miyake & Norman, 1979; Singer & Donlan, 1982; Wong, 1985). To maximize the benefits of question generation, students need to be trained on adequate questioning skills and to be provided enough opportunity to practice how to generate the questions. Also, students need to be trained to ask various types of questions, including fact-based questions or inferential questions (Tierney & Cunningham, 1991).

Other strategies

Other strategies to activate prior knowledge are advanced organizers and K-W-L (What I Know, What I Want To Learn, What I Learned). Using advanced organizers has been viewed as a promising prereading activity to improve the comprehension of students with reading difficulties (Pearson & Gallagher, 1983). Several studies supported the positive effects of advance organizers on comprehension performance for students with LD (Billingsley & Wildman, 1987; Darch & Gersten, 1987; Lenz, Alley, & Schumaker, 1987).

The K-W-L strategy is also viewed as a promising prereading strategy to improve the comprehension of students with LD (Manzone, 1996; Sorrell, 1989). The K-W-L strategy is a three-step procedure, requiring students (a) to assess what they already know on a topic, (b) to determine what they want to learn, and (c) to recall what they did learn after reading (Ogle, 1986).

During Reading

During reading, students make connections that activate their prior knowledge with textual information to construct meaning from text. Good readers actively engage in the comprehension process by (a) monitoring their understanding of the text, and (b) using text structures.

Comprehension monitoring

Comprehension monitoring refers to the ability to check one's own understanding of the text (Garner, 1980). During reading, good readers monitor their comprehension of the text (Becker & McCormick, 1991). Good readers analyze tasks in order to select an appropriate strategy, apply the strategy, and monitor their understanding of the text. When good readers realize that they do not understand what they have read, they identify causes of the failure to comprehend and revise the strategy (Borkowski, 1992; Chan, Cole, & Barfett, 1987). This process is referred to as self-regulation, "the heart of metacognition" (Borkowski, 1992, p. 253). Students with LD are often characterized as using limited self-regulatory skills (Borkowski, 1992).

Fortunately, substantial evidence supports that when systematic instruction in comprehension monitoring is provided, students with LD can improve their self-regulatory skills, which in turn improve their reading comprehension (Chan & Cole, 1986; Jitendra, Hoppes, & Xin, 2000; Wong & Jones, 1982). The self-

questioning strategy has been widely utilized to improve comprehension monitoring for students with LD. In fact, when the self-questioning strategy was used for comprehension-monitoring purposes with students with LD, the intervention yielded the largest effect sizes among a variety of interventions in reading comprehension (Mastropieri, Scruggs, Bakken, & Whedon, 1996).

In an early self-questioning study, a five-step self-questioning procedure was implemented for students with LD to monitor their understanding of main ideas and, consequently, to improve their comprehension. These steps were: (a) setting goals, (b) finding the main ideas, (c) generating questions about the main ideas, (d) learning the answers to the questions, and (e) reviewing the questions and answers (Wong & Jones, 1982). In a similar study, Graves (1986) examined the effects of direct instruction plus self-monitoring procedures, in comparison with direct instruction only or a control condition, on identifying main ideas for students with LD. In self-monitoring procedures, students were taught to stop twice during reading, ask themselves if they understood what they read, and reread the passage if they did not understand. Findings showed that students who used the self-monitoring procedure outperformed students in the comparison group (direct instruction only) and in the control group.

Text structure

Text structure refers to the organizational features of text that can serve as a frame or pattern (Englert & Thomas, 1987). According to Simmons and Kameenui (1998), there is a high relationship between a reader's awareness of text structure and reading comprehension. Hence, sensitivity to text structure is an important component in enhancing reading comprehension (Armbruster, Anderson, & Ostertag, 1987; Gersten, 1998). However, many students with LD are insensitive to both expository and narrative text structures (Williams, 1998). The deficit in text structure awareness may contribute to comprehension difficulties (Englert & Thomas, 1987).

Many research studies found that students with LD can increase their text structure awareness, which in turn improves reading comprehension when systematic instruction in text structure is provided (Dickson, Simmons, & Kameenui, 1998). The positive effects of using text structures on reading comprehension for students with LD have been supported for both expository texts (Bakken, Mastropieri, & Scruggs, 1997; Smith & Friend, 1986) and narrative texts (Baumann & Bergeron, 1993; Dimino, Gersten, Carnine, & Blake, 1990; Gardill & Jitendra, 1999; Gurney, Gersten, Dimino, & Carnine, 1990; Idol, 1987; Idol & Croll, 1987).

A common approach to teaching text structure is to provide instruction in conventional text structures (Englert & Hiebert, 1984). Conventional text structures for the expository text include comparison/contrast, cause/effect, problem/solution, sequence, description, and enumeration (Englert & Hiebert, 1984; Simmons & Kameenui, 1998). Similarly, a story grammar that usually consists of setting, problem, goal, action, and resolution is a conventional text structure for the narrative text (Simmons & Kameenui, 1998). Other approaches that foster an understanding of text structure are: (a) teaching students to generate a representation of the organization of ideas, such as diagrams to represent ideas and their relationship (Armbruster & Anderson, 1980), and (b) using typographical cues such as headings and subheadings as outlines (Taylor, 1982; Taylor & Beach, 1984).

After Reading

After reading, the goal is to synthesize and consolidate what was read (Carnine et al., 1997). Good readers summarize the text, generate questions answer questions on what they read, and provide answers to their questions.

Summarization

Summarization is an important strategy to help students concentrate on important portions of the text while deleting unnecessary details (Gajria & Salvia, 1992). Summarization has been viewed as an effective postreading activity for

several reasons. Through summarization, students (a) understand the organization of the text, (b) have opportunities to review main ideas, and (c) remember main ideas (Carnine et al., 1997).

A number of studies have demonstrated successful implementation of summarization to improve the reading comprehension of students with LD (Gajria & Salvia, 1992; Jenkins, Heliotis, Stein, & Haynes, 1987; Malone & Mastropieiri, 1992). Gajria and Salvia (1992) taught students with LD to summarize what they read using five basic rules of summarization proposed by Brown and Day (1983): (a) deleting trivia, (b) deleting redundancies, (c) substituting a superordinate term for a list of items or actions, (d) selecting topic sentences, and (e) inventing a topic sentence if necessary. Findings showed that students who were trained on summarization outperformed students in the control group. In some studies, researchers combined a summarization strategy with a self-questioning procedure for the purpose of improving reading comprehension for students with LD (Jenkins et al., 1987; Malone & Mastropieiri, 1992). The findings indicated that students who received "summarization plus self-monitoring" as well as students who received "summarization only" exhibited better reading comprehension than did the students in the control condition (Jenkins et al., 1987; Malone & Mastropieiri, 1992).

Questioning

Student-generated questioning has been identified as an effective way to improve reading comprehension (National Reading Panel, 2000). Traditionally, teachers have asked questions after reading (Tierney & Cunningham, 1991). However, little support for the sufficiency of teacher questioning for improving reading comprehension has been realized. Recently, student-generated questions have been recommended for use for several reasons: (a) to encourage students to focus on what they read (Gillespie, 1990), (b) to help students identify and remember main ideas (Andre & Anderson, 1978-79; Texas Center for Reading And Language Arts, 2000), and (c) to provide students opportunities to review (Texas Center for Reading And Language Arts, 2000).

According to Wong (1986), student-generated questions are more likely to produce better comprehension than teacher-generated questions. To maximize the benefits of student-generated questions, students need to be trained on adequate questioning skills. Good questions should emphasize main ideas, contain both literal and inferential comprehension questions, and go beyond "yes or no" responses (Carnine et al., 1997). Also, higher-level questions yield better comprehension than do lower-level questions (Denner, 1982). Because students often have difficulties in generating high-level questions without training, it is

important to train students how to generate higher-level questions (Denner, 1982; McFeely, 1984; Vaughn et al., 2001).

Research on CSR

Until the 1980s, many studies of comprehension instruction limited to an examination of the effects of an individual comprehension strategy, rather than the coordinated use of comprehension strategies (Pressley et al., 1995). However, effective strategy instruction in reading comprehension emphasizes the use of a flexible application of several comprehension strategies that students can apply before, during, and after reading (Gersten, Fuchs, Williams, & Baker, 2001; Mastropieri & Scruggs, 1997; National Reading Panel, 2000; Pressley et al., 1995; Vaughn et al., 2001). Through the coordinated use of comprehension strategies, students can promote their strategic reading and comprehension monitoring, resulting in improving their reading comprehension. CSR is an instructional practice that teaches a flexible application of four comprehension strategies that students can apply before, during, and after reading.

OVERVIEW OF CSR

CSR is an instructional practice that combines two instructional approaches: (a) reading comprehension strategies (e.g., Palincsar & Brown, 1984; Pressley et al., 1995), and (b) cooperative learning or pair learning.

Reading Comprehension Strategies within CSR

CSR consists of four reading comprehension strategies that students can apply before, during, and after reading. These reading strategies are: (a) "preview" (before reading), (b) "click and clunk" (during reading), (c) "get the gist" (during reading), and (d) "wrap-up" (after reading).

Preview

"Preview" is designed to provide students with opportunities to: (a) activate their prior knowledge, (b) make predictions about what they will read, (c) learn from their peers, and (d) generate interest (Vaughn et al., 2001). "Preview" consists of two activities: (a) brainstorming, and (b) making predictions. Brainstorming activates students' prior knowledge about the topic. During brainstorming, students can expand on what they know by hearing about the background knowledge and connections to text made by peers. Making predictions generates students' interest and motivates them to read the text to confirm or disconfirm their predictions.

Click and clunk

"Click and clunk" is a strategy that teaches students to: (a) monitor comprehension during reading, (b) use fix-up strategies when they realize their failure to understand text, and (c) enhance vocabulary development (Bryant et al.,

2000; Klingner & Vaughn, 1999; Vaughn et al., 2001). "Click" refers to portions of the text that students understand, and "clunk" refers to portions of the words or phrases in the text that students do not understand (Klingner & Vaughn, 1998). When students click, they know information provided in the text, so they continue reading until they clunk. When students clunk, they do not understand words or phrases and need to figure out the unknown words or phrases by using fix-up strategies.

Get the gist

"Get the gist" provides students with a strategy to identify a main idea and paraphrase it in their own words during reading (Bryant et al., 2000; Klingner & Vaughn, 1999; Vaughn et al., 2001). Identifying the main idea is important but is difficult to teach. While many teachers ask students to identify the main idea during reading, few teachers teach students how to identify the main idea (Vaughn et al., 2001). One way to identify the main idea is to answer the following questions: (a) "who or what is it about?," and (b) "what is most important about the who or what?" (Vaughn, Chard, et al., 2000). In addition, students are taught to limit their response to ten words or less because it helps students include the most important ideas while they exclude unnecessary ideas (Vaughn et al., 2001).

Wrap-up

"Wrap-up" is a strategy that teaches students to generate questions and to summarize what they have read after reading (Bryant et al., 2000; Klingner & Vaughn, 1999; Vaughn et al., 2001). "Wrap-up" provides students with an opportunity to review what they have read, which assists with their understanding and interpretation of what they have learned (Vaughn & Klingner, 1999). "Wrap-up" consists of two activities: (a) generating questions, and (b) reviewing. Generating questions requires students to identify important ideas in the text and to generate questions about these ideas. Keywords such as who, what, why, when, where, and how are provided to facilitate the generation of questions (Vaughn, Chard, et al., 2000). "Reviewing" requires students to tell what they learned from the text. It helps the students focus on the text as a whole and summarize what they have learned (Texas Center for Reading And Language Arts, 2000).

Cooperative Learning/Pair Learning

Structuring classroom instruction affects teacher-student and student-student interactions, which in turn affect the effectiveness of instruction (Schumm, Moody, & Vaughn, 2000). Traditionally, ability grouping based on students' achievement (high-medium-low) was the most common grouping practice during reading instruction (Barr & Dreeben, 1991). As academic and social concerns associated with ability grouping have emerged, however, there

has been a shift toward heterogeneous grouping format in reading instruction (Schumm et al., 2000). More importantly, when students with disabilities are working in small groups, they improve their reading performance to a greater extent than in large groups (Elbaum, Vaughn, Hughes, & Moody, 2000; Elbaum, Vaughn, Hughes, & Moody, & Schumm, 2000; Polloway, Cronin, & Patton, 1986). Thus, a heterogeneous, small grouping practice holds promise as an effective instructional grouping practice during reading instruction for students with disabilities. Cooperative learning and peer tutoring, which are incorporated in CSR, are heterogeneous, small grouping practices.

Cooperative learning is an instructional approach in which students of different levels of ability work together in small groups, using a variety of learning activities to improve their understanding of a subject (Cohen, 1994). Students in cooperative groups have interdependent goals (Cohen, 1994). Thus, each member of the group is responsible not only for completing his or her own task but also for helping other members complete their assignments (Johnson & Johnson, 1989). Students with disabilities may benefit from cooperative learning, because they get extra assistance from peers while increasing social interactions with peers (Bryant & Bryant, 1998). There are four major key elements of cooperative learning: (a) heterogeneous groups (Slavin, 1990), (b) positive interdependence through shared goals and group rewards (Johnson & Johnson,

1989; Slavin, 1983), (c) accountability for one's own learning (Mainzer, Mainzer, Slavin, & Lowry, 1993), and (d) collaborative and interpersonal skills (Bryant & Bryant, 1998).

Some researchers found positive effects of cooperative learning on reading achievements for students with LD (Stevens & Slavin, 1995; Stevens, Madden, Slavin, & Farnish, 1987). While the positive effects of cooperative learning on academic and social outcomes for students without disabilities have been well-documented (Newmann & Thompson, 1987; Sharan, 1980; Slavin, 1991, 1995), there have been equivocal results from the critical syntheses on the effects of cooperative learning on academic achievements for students with LD (Stevens & Slavin, 1990; Tateyama-Sniezek, 1990). Further research examining the effects of cooperative learning on academic outcomes for students with LD is needed.

Peer tutoring is a teaching arrangement in which students implement instruction for other students (Maheady, Harper, & Sacca, 1988). In peer tutoring, students with disabilities are paired with students of different levels of ability. Students with disabilities can take the tutor, tutee, and reciprocal role to deliver or receive academic instruction on a one-on-one basis (Mathes & Fuchs, 1994). Research studies have reported that students with disabilities increase their reading performance by effectively playing the role of tutor (Top & Osguthorpe, 1987), the role of tutee (Russell & Ford, 1983), and the reciprocal role (Simmons,

Fuchs, Fuchs, Hodge, & Mathes, 1994). Furthermore, students with LD demonstrated a preference for working in pairs, rather than in large groups or independently (Vaughn, Schummm, Klingner, & Saumell, 1995). Peer tutoring is practical for teachers to implement in their classrooms because students share instructional responsibility with the teachers (Vaughn, Hughes, Moody, & Elbaum, 2001).

SYNTHESIS ON CSR

The synthesis was conducted to examine and summarize the effects of CSR on the reading comprehension of students with LD. A thorough search of the professional literature and contact with a researcher (Sharon Vaughn) with expertise in this area yielded a total of six intervention studies in which CSR was used as a sole instructional practice or as one instructional practice included in a multi-component intervention. The synthesis provides a detailed description of the purpose, participants, procedures, measures and effect sizes (Appendix B).

Effect sizes were calculated for treatment/comparison group design studies as the difference between the mean posttest score of the intervention group minus the mean posttest score of the comparison group divided by the pooled standard deviation (Klingner, Vaughn, & Schumm, 1998). For single-group design studies, effect sizes were calculated as the difference between the mean posttest score minus the mean pretest score divided by the pooled standard deviation (Klingner

& Vaughn, 1996, 2000; Klingner, Vaughn, Hughes, Schumm, & Elbaum, 1998)[2]. However, when authors reported effect sizes in their paper, those effect sizes were used (Bryant et al., 2000; Vaughn et al., 2000).

Findings revealed that CSR generally yielded improved reading comprehension for students with LD. Four of the six intervention studies were associated with medium to large effect sizes (mean ES = .51 to 1.51). A standardized reading test was utilized as one of the measures in three of the studies, and CSR was implemented by classroom teachers in the three studies. Considering that (a) a teacher-implemented intervention is less likely to yield desired outcomes than a researcher-implemented intervention (Talbott, Lloyd, & Tankersley, 1994), and (b) a standardized reading test is less sensitive than a researcher-developed test to measuring the effects of intervention (Swanson & Hoskyn, 1998), the medium to large effect sizes (mean ES = 0.51 to 1.51) provide confidence regarding positive effectiveness of CSR on reading comprehension for students with LD.

In two studies, CSR was associated with small effect sizes (mean ES = 0.28 and 0.33, respectively; Klingner, Vaughn, & Schumm, 1998; Vaughn, Chard et al., 2000). There are several possible explanations for these findings. In the study by Klingner et al. (1998), the effect size of .28 appeared to be influenced by

[2] Effect sizes calculated by this procedure for single-group design studies are inflated to some extent. Thus, caution should be taken in interpreting the results.

the outcome measures selected. Considering the Gates-MacGinitie Reading Test as a standardized reading test, the effect size of .44 can be considered as a moderately high effect size. Similarly, the effect size of .12 on the content measure can be considered as a positive effect of CSR for the following reason: students in the CSR group were not taught the content by a teacher, but learned the content through their group work with other students; while students in the control group were taught the content by the teacher. Despite no direct instruction on the content by the teacher, the students in the CSR group were comparable to the students who were taught the same content by the teacher.

In the study by Vaughn, Chard et al. (2000), the effect size of .33 appeared to be influenced by the reading abilities of participants. In this study, the participants were at the lower grades (e.g., 3rd grade), when compared to participants in other studies. Because many of the participants in this study were at or below second grade reading level, it may be difficult for them to use fairly complex comprehension strategies included in CSR. Those students still had difficulties in decoding; thus, they spent too much effort trying to decode words, rather than using the comprehension strategies to understand the meaning of the text. According to Miller (1956), when students spend considerable effort to decode, decoding interferes with comprehension because only a limited information-processing capacity is available for comprehension of text.

Research on CAI in Reading

Studies on CAI with students with disabilities have expanded over the last two decades (Woodward & Rieth, 1997). The accessibility and rapid evolvement of computer technologies have contributed to increases in computer use for education (Fabry & Higgs, 1997; Fletcher-Flinn & Gravatt, 1995; Shiah et al., 1995). CAI has been viewed as a promising instructional tool for reading instruction by special education teachers (MacArthur, Ferretti, Okolo, & Cavalier, 2001). According to a recent survey by Burton-Radzely (1998), 85% of special educators use technology in their reading instruction and 91% expect that they will increase their use of technology in the future (MacAurthur et al., 2001).

Educational computer programs can perform three roles: tutor, tutee, and tool (Higgins & Boone, 1993; Taylor, 1981). A computer as a tutor is used for delivering instruction or providing learning guidance; this process is sometimes called CAI (Lewis, 2000). CAI is often categorized as tutorial, drill-and-practice, game, or simulation, depending on its function (Lewis, 2000; Wissick, 1996). A computer as a tutee is used for students to create their projects, and students are in charge of the teaching and learning by taking various roles (e.g., researchers or designers; Wissick, 1996). A computer as a tool has two purposes: (a) helping students compensate for their limitations and maximize their strengths, rather than teaching (e.g., word processor or spelling checker; Okolo, Bahr, & Rieth, 1993),

and (b) increasing the teachers' effectiveness in demonstrating information to students (e.g., movie file, Powerpoint; Wissick, 1996).

A computer as a tutor, CAI, has been focus of research on educational computer program use (Higgins & Boone, 1993). In an early period, tutorial and drill-and-practice CAI programs were popularly used. However, new design of a computer program, hypermedia model, has been introduced in the last two decades (Higgins & Boone, 1993; Lewis, 2000). Hypermedia refers to non-linear presentation of text, graphics, sound, animation, videos, and so forth (Wissick, 1996). Non-linear hypermedia learning environment allows students to take control over their own learning path and speed depending on their needs and abilities (Lewis, 2000).

CAI has emerged as a promising instructional tool to teach students with LD over the last two decades for several reasons. First, CAI has the capacity to provide individualized instruction to meet a student's needs and abilities. Second, CAI can provide immediate feedback and a motivating learning environment. Third, CAI can be used to monitor and evaluate a student's progress. Finally, CAI can maintain students' interest and motivation (Hughes & Maccini, 1997; Schmidt, Weinstein, Niemic, & Walberg, 1985-86; Shiah et al., 1995).

In response to these promising capacities of CAI, a number of studies have been conducted to examine the effects of CAI on reading performance for

students with disabilities. The effects of CAI on reading performance for students with disabilities were examined in the following areas: (a) early reading skills (e.g., decoding, word identification), and (b) reading comprehension.

EARLY READING SKILLS

CAI appeared to be effective with low-level learning of students with disabilities (Schmidt et al., 1985-86). In the area of reading, the effectiveness of CAI on early reading skills for students with disabilities has been documented by several studies (MacArthur et al., 2001; Okolo, Cavalier, Ferretti, & MacArthur, 2000; Shiah et al., 1995; Torgesen & Horen, 1992). CAI targeting improved early reading skills can be divided into two types: (a) drill-and-practice, tutorial, and/or game formatted CAI programs, and (b) CAI programs incorporating speech synthesizers into the program.

First, many studies have designed drill-and-practice, tutorial, and/or game formatted CAI to provide ample opportunities for students to practice early reading skills. Examining the effectiveness of CAI on decoding with students with LD, Jones, Torgesen, and Sexton (1987) conducted a study with 20 elementary students with LD. Ten students were randomly assigned to the "Hint and Hunt program" group and the other 10 students were assigned to the spelling program group. The tutorial plus game formatted "Hint and Hunt program" was designed to help students recognize and analyze words. All students participated in five,

15-minutes sessions over a period of 10 weeks. Speed and accuracy of word analysis (both context-free and paragraph reading) were administered as pretest and posttest. Results showed that at posttest, students in "the Hint and Hunt program" performed significantly better than students in the comparison group.

In similar studies, drill-and-practice with tutorial or game formatted CAI was implemented to help students with reading difficulties, including students with LD, learn decoding and word identification skills. The findings were that students who received CAI programs increased their performance of decoding and word identification (Barker, & Torgesen, 1995; Cohen, Torgesen, & Torgesen, 1988; Foster, Erickson, Foster, Brinkman, & Torgesen, 1994; Roth & Beck, 1987).

Second, CAI incorporating speech synthesizers has been used to build decoding skills for students with disabilities. van Daal and Reitsma (1990) compared 31 students assigned to one of three groups with regard to decoding skills: (a) whole-word synthetic speech feedback, (b) subword synthetic speech feedback, and (c) control group. Students with LD participated in a 10-minute session per day over three or four weeks. The accuracy of reading context-free words was administered as pretest and posttest. Results showed that students using synthetic speech feedback (both whole-word and subword) were significantly more accurate in reading words than students in the control group. In

similar studies, students using CAI programs with speech synthesizers improved their performance in word decoding and recognition skills, compared to students in the control groups (Olson, Flotz, & Wise, 1986; Olson & Wise, 1992; Wise, et al., 1989).

However, there were some studies that reported different results. Lundberg and Olofsson (1993) demonstrated that students using CAI with a speech synthesizer did not improve their decoding skills. In another study, Torgesen, Waters, Cohen, and Torgesen (1998) manipulated the types of presentation of the programs on sight word learning (graphic representation alone, graphic plus synthetic speech, or synthetic speech alone). The results showed that all students improved their performance in accuracy and speed of reading sight words, but there were no statistically significant differences among the three groups.

READING COMPREHENSION

The scope of research on CAI in reading has been limited to early reading skills, such as decoding and word identification (Higgins & Boone, 1993). Although there is an abundance of studies related to CAI in early reading skills (e.g., decoding, word identification) for students with disabilities, only a small number of studies that examined the effects of CAI on reading comprehension are available. Over the last decade, there have been efforts to examine the effects of

CAI on reading comprehension for students with reading difficulties, including students with LD (Boone & Higgins, 1993; Higgins & Boone, 1990; Horton et al., 1990; MacArthur & Haynes, 1995).

CAI, targeted at improved reading comprehension, can be divided into two categories: (a) CAI as a simple tool, and (b) CAI as a provider of instruction. First, several studies examined the effects of CAI as a simple tool by manipulating computers' technical aspects (e.g., screen reading vs. print reading) without involving instructional components on reading comprehension of students with reading difficulties, including students with LD. A majority of studies included in this category examined: (a) the effects of computer screen reading or computer screen reading with reread option on reading comprehension (Keene & Davey, 1987; Swanson & Trahan, 1992), and (b) the effects of a computer program with a speech synthesizer on reading comprehension (Farmer, Klein, & Bryson, 1992; Lundberg & Olofsson, 1993). Similarly, the effects of advanced computer programs with a speech synthesizer were examined on comprehension of students with reading difficulties (Elkind, Cohen, & Murray, 1993; Leong, 1995). Elkind et al. (1993) used a computer reader (*Bookwise* system), which scanned, displayed, and read the text via a speech synthesizer. The computer reader also included a dictionary that syllabicated and defined the selected words. Leong (1995) expanded on the simple computer program with a speech

synthesizer by adding different types of enhancements: (a) no explanation of words, (b) explanation of words, (c) explanation of words and metacognitive reading awareness prompts, and (d) simplified passages. Not surprisingly, when CAI was used as a simple tool, it did not yield significantly better improvements in reading comprehension than comparison conditions (e.g., typical reading instruction, print reading, computer programs without speech synthesizer, etc.) for students with reading difficulties.

Two other studies examined the manipulation of a computer's technical aspects on reading comprehension for students with reading difficulties. Montali and Lewandowski (1996) compared the effects of different modalities (bimodal vs. auditory/visual) on reading comprehension. Results revealed that bimodal reading (simultaneous presentation of visual and auditory stimuli) was associated with significantly better reading comprehension performance than either visual or auditory reading. The other study compared the effects of animation on reading comprehension. Results revealed that high animation on screen was associated with significantly lower reading comprehension than were the low animation or adult reading (Okolo & Hayes, 1996).

Second, several studies examined the effects of CAI as a provider of instruction on reading comprehension for students with reading difficulties. These studies can be subcategorized into: (a) computer-based texts with instructional

enhancements, (b) computer-based texts with study guides, and (c) computer-based reading programs providing drill-and-practice formatted comprehension instruction. Computer-based texts with instructional enhancements have been developed and their effects on reading comprehension of students with reading difficulties were examined (Boone & Higgins, 1993; Higgins & Boone, 1991; Reinking, 1988; Reinking & Schreiner, 1985). Instructional enhancements to electronic passages included: definition of vocabulary, simplified passage, background information, main ideas, and questions inserted as prompt. Overall, findings revealed that computer-based texts with instructional enhancements yielded significantly higher comprehension outcomes than control conditions (Boone & Higgins, 1993; Reinking, 1988; Reinking & Schreiner, 1985).

Computer-based texts with study guides have been used for the purpose of enhancing comprehension of students with reading difficulties (Higgins & Boone, 1990, Higgins, Boone, & Lovitt, 1996; Horton et al., 1990; Horton, Lovitt, Givens, & Nelson, 1989; MacArthur & Haynes, 1995). Horton and colleagues (1989; 1990) developed electronic study guides consisting of a reading segment and a question segment (short answer questions about main ideas). Results revealed that computer-based text with study guides yielded significant improvements in reading comprehension for students with reading difficulties. Higgins and colleagues (1990, 1996) developed similar electronic study guides (a

reading segment and a question segment), supplemented with instructional enhancements (e.g., replacing difficult vocabulary with easy vocabulary, presenting related graphics). Results showed that students with reading difficulties comprehended and learned the content of the text at least as well from computer-based text with study guides as they did from lecture. MacArthur and Haynes (1995) developed two different electronic study guides: (a) a basic electronic study guide consisting of a reading segment and a notebook, and (b) an enhanced electronic study guide consisting of a reading segment and a notebook, supplemented with instructional enhancements (e.g., on-line glossary, highlighting of main ideas, supplementary explanations, speech synthesis, etc.). Results revealed that the enhanced study guide was associated with higher comprehension performance of students with LD than the basic study guide.

Several studies have examined the effects of computer-based reading programs which provide drill-and-practice formatted comprehension instruction on comprehension of students with reading difficulties. Computer-based reading programs using a modified cloze procedure with instructional feedback were implemented to provide students with reading difficulties practice opportunities to check their comprehension (Grocke, 1982; Harper & Ewing, 1986). Boettcher (1983) designed the computer-based reading program (*Reading Comprehension System*) which provided passage questions from five comprehension skill areas

(i.e., semantics, syntax, relationships, inference, interpretation). Overall, these studies revealed that the computer-based reading programs were effective to improve reading comprehension for students with reading difficulties. However, caution should be taken in interpreting the results of this set of the studies because of the less rigorous research designs associated with these studies (e.g., pilot study, single-group design with no control group).

In summary, studies utilizing CAI as a provider of instruction generally demonstrate significant improvements in reading comprehension, while studies utilizing CAI as a simple tool do not yield significant improvements in reading comprehension for students with reading difficulties. Hence, overall findings may suggest that CAI can be an effective instructional tool to improve reading comprehension of students with reading difficulties when CAI employs instruction components.

CHAPTER III

METHOD

This chapter presents the development process and description of CACSR. It is followed by a presentation of the research questions, research design, participants, materials, pilot study, procedure, measures, data collection, and data analysis.

Development Process and Description of CACSR

CACSR was designed and developed to incorporate four comprehension strategies of CSR, enhanced with research-recommended technical features of CAI. In detail, CACSR provides systematic instruction in "preview" (activating prior knowledge), "click and clunk" (comprehension monitoring and vocabulary development), "get the gist" (identifying main ideas), and "wrap-up" (generating questions) for the purpose of enhancing reading comprehension for students with LD. By incorporating research-recommended technical features of CAI, CACSR facilitates the delivery of a systematic reading comprehension instruction in several ways: (a) providing individualized instruction (e.g., individualized learning pace, learning path, reading level, etc.), (b) providing learner control, (c) providing a record of student's performance to allow a teacher's progress

monitoring, (d) providing immediate feedback, and (e) maintaining a student's interest and motivation.

CACSR was designed and developed by employing an instructional system development model by Yang, Moore, and Burton (1995). It consisted of three phases: (a) analysis, (b) development, and (c) evaluation (Appendix C).

CONCEPTUAL FRAMEWORK

The conceptual framework for CACSR was an integration of two critical components designed to promote reading comprehension for students with LD. The first component was effective reading comprehension instruction (Bryant et al., 2000; Klingner & Vaughn, 1999, 2000; Pressley et al., 1995). Based on an accumulation of research, the critical factors associated with improved outcomes in reading comprehension have been identified (Mastropieri & Scruggs, 1997; Pressley et al., 1995; Swanson, 1999; Weisberg, 1988; Wong, 1985). CACSR capitalized on this knowledge base and integrated these components into CAI program for students with LD. The second component was a technology-related element that can facilitate the effectiveness of reading comprehension instruction for students with LD (Boone & Higgins, 1993; Lewis, 2000; Shiah et al., 1995). The conceptual framework that highlights the key features of both components is presented in Appendix D.

THE STRUCTURE OF CACSR

The purpose of CACSR is to provide systematic instruction in research-based comprehension strategies for students with LD for the purpose of enhancing reading comprehension for students with LD. The overall structure of CACSR is illustrated in Appendix E.

The program starts with an opening screen with a place where students can type their name. When students type their name and start the CACSR program, the file for each student is created on his or her own computer and it keeps a recording of his or her learning paths and performance. The recorded information can be reviewed by a teacher for the purpose of monitoring and evaluating the students' performance. Once students start CACSR, the main menu is presented. The main menu consists of two parts: (a) "learning CSR," and (b) "using CSR to learn" (Illustration 3.1). Students begin with working on the "learning CSR" first and then move to the "using CSR to learn." Each part (learning CSR and using CSR to learn) is followed by the "Reading Level Selection" which allows students to select the reading level appropriate to their reading abilities.

When students select the reading level in "learning CSR," the learning CSR menu is presented. This menu consists of (a) preview, (b) click and clunk, (c) get the gist, and (d) wrap-up (Illustration 3.2). Each section provides instruction on what each strategy is (i.e., preview, click and clunk, get the gist,

and wrap-up), when each strategy is used, why it is important to use each strategy, and how each strategy is used (Illustration 3.3). CACSR puts an emphasis on teaching how each strategy is used. This section consists of (a) overview (Illustration 3.4), (b) modeling (Illustration 3.5), (c) guided practice (Illustration 3.6), and (d) independent practice (Illustration 3.7).

For "using CSR to learn," CACSR provides ample opportunities for students to use CSR to learn the content of the reading selection. When the students select the reading level in "using CSR to learn," a list of all reading passages at the selected reading level are presented (Illustration 3.8). When the students choose a reading passage, the reading passage with directions on what they are supposed to do is presented (Illustration 3.9). Students are asked to fill out the learning log where they type what they learn by using the four strategies (i.e., preview, click and clunk, get the gist, and wrap-up; Illustration 3.10). Once the students type their gist, they can check their gist with the ideal gist that has been identified by the investigator and a reading expert (interrater reliability = 90%). The students can get instructional supports from a clunk expert, dictionary, and quick review on CSR. The clunk expert provides the guidance to apply fix-up strategies for any possible clunks that students may encounter. For instance, if the clunk is "harmless," the clunk expert provides information about (a) how to break "harmless" into small parts with one talking vowel (*harm-less*), (b) a word attack

strategy that students can apply to decode the word (r-controlled: h*ar*mless), and (c) the meaning of the suffix, *less* (without). The clunk expert stores approximately 1,500 words with the guidance to apply fix-up strategies for each word. Students can select their clunk from the drop-down menu, where approximately 1,500 words are stored, and get guidance on applying fix-up strategies. A dictionary provides the definition of the word. The words stored in the dictionary are the same words stored in the clunk expert. Students can also select their clunk from the drop-down menu and get the definition of the word. The quick review provides the review on specific steps for using each strategy.

TEACHER'S ROLES

CACSR has been designed as a responsive instructional tool which can be part of the reading class. Since CACSR has a function to record students' learning paths and performances, a teacher can monitor and evaluate students' performances, resulting in a better understanding of students' strengths and difficulties. With better understanding of students' current performance levels, a teacher can design instruction individualized to each student's needs. Thus, the following is a list of a teacher's roles in implementing CACSR.

1. The teacher primarily takes a role of an assistant or a facilitator.
2. When students request further instruction on any part of instruction in CACSR, the teacher provides additional instruction to those students.

3. The teacher reviews and evaluates students' recorded data (learning paths, performances in activities, etc.) in order to understand students' strengths and difficulties.
4. When a student shows difficulties in understanding any activity, or a student demonstrates a need for further instruction on any part of instruction in CACSR based on the recorded data, the teacher provides additional instruction to that student.

Research Questions

This study examined the effects of CACSR on the reading comprehension performance of high school students with LD. In addition, student interviews were conducted to elicit information on the participants' perceptions about CACSR. Thus, there were two research questions to guide this study.

Research Question 1: Following the intervention, will students in the CACSR group outperform students in the comparison group (i.e., typical language arts resource class) on reading comprehension, as measured by the WRMT-R-Passage Comprehension?

Research Question 2: What are the perceptions of high school students with LD regarding the efficacy of CACSR they received during instruction?

Research Design

This study employed a one between and one within factor repeated measure design. The between factor had two levels, (a) the CACSR group and (b) the comparison group. The within factor also had two levels, (a) pretest and (b) posttest. As with most school-based intervention research, random assignment of participants to each condition could not be utilized. Rather, random assignment of student cohorts by section to each condition was utilized. The dependent variable was the reading comprehension score, as measured by the WRMT-R-Passage Comprehension.

This study was also designed to provide descriptive information regarding participants' perceptions about the efficacy of CACSR they received. Student interviews were conducted to obtain the descriptive information.

Participants

One language arts resource class teacher and his twenty-three students with LD who met the predetermined inclusion criteria were selected from one urban high school. After obtaining consent from the principal of the high school to be a site for this study, the investigator contacted special education resource class teachers in the school. The study was described and the CACSR program was demonstrated to the teachers. One language arts resource class teacher agreed

to participate in this study. After the teacher consented to the participation in the study, he was asked to nominate students with LD who attended his classes. Consent forms were distributed to the parents of the nominated students. To qualify for inclusion in this study, students had to meet the following criteria.

1. Be in high school;
2. Be identified as having LD, using the legal eligibility criteria;
3. Decode words at least at the 2.5 grade level, as measured by the WRMT-R-Word Identification or Word Attack;
4. Comprehend passages at least two years below grade level, as measured by the WRMT-R-Passage Comprehension;
5. Attend a language arts resource class;
6. Be identified as having English as the dominant spoken and written language; and
7. Provide written consent from a parent/guardian for participating in the study.

The four class sections of the participating teacher were randomly assigned to either the CACSR group or the comparison group (2 sections in the CACSR group; 2 sections in comparison group). Initially, 28 students who met the inclusion criteria for this study agreed to participate. Over the 12 weeks of the intervention period, 5 students (2 in the CACSR; 3 in the comparison group) discontinued their participation in the study for various reasons (e.g., dropped out

of school, change in class sessions). Thus, 23 students participated in this study (14 in the CACSR group; 9 in the comparison group). Fisher's Exact probability test showed no statistically significant differences between the two groups on the basis of the number of dropouts. Results are summarized in Table 3.1.

Table 3.1

Attrition Rate

CACSR	Comparison	Total	
A/I	A/I	A/I	
2/16	3/12	5/28	Fisher's Exact Probability = .639

Note. A = Attrition. I = Initial enrollment.

STUDENT INFORMATION

Demographic information about the students is presented in Table 3.2. The two groups were compared on the demographic variables of grade, ethnicity, gender, socioeconomic status, age, Intelligent Quotient (IQ), and reading achievement. IQ was measured by the Wechsler Intelligence Scale for Children-Third Edition (WISC-III). Reading achievement was measured by the Wechsler Individual Achievement Test (WIAT)-Basic Reading and Reading

Comprehension. Fisher's exact probability test was used for non-continuous variables. Due to the small number of observations, grades 9 & 10, and 11 & 12 were combined for the purpose of testing group differences on the basis of grades. Similarly, African-American & Hispanic-Americans were combined and compared with European Americans between the CACSR and comparison groups. The *t* test for independent samples was employed for continuous variables. As shown in Table 3.2, no statistically significant group differences were observed.

Table 3. 2

Student Demographic Information

Variables	CACSR (n = 14)		Comparison (n = 9)	
	N	%	N	%
Grade				
9 & 10	7	50.00	6	66.67
11 & 12	7	50.00	3	33.33
Fisher's Exact Probability = .669				
Ethnicity				
AA & HA	8	57.14	5	55.56
EA	6	42.86	4	44.44
Fisher's Exact Probability = 1.000				
Gender				
Male	7	50.00	6	66.67
Female	7	50.00	3	33.33
Fisher's Exact Probability = .669				
SES				
Free/Reduced	8	57.14	7	77.78

Not on Free/Reduced	6	42.86	2	22.22

Fisher's Exact Probability = .400

Variables	CACSR (n = 14)		Comparison (n = 9)			
	M	SD	M	SD	t	p
Age	16.80	1.23	16. 50	1.72	.490	.629
WISC - III						
Verbal	85.40	5.99	81.86	7.58	1.078	.298
Performance	88.50	13.03	87.71	11.49	.128	.900
Full	85.50	8.18	83.29	7.25	.574	.574
WIAT						
Basic Reading	80.54	8.52	77.63	8.63	.757	.458
Reading Comprehension	83.61	11.43	80.00	10.54	.724	.478

Note. AA = African American. HA = Hispanic American. EA = European American. SES = Socioeconomic Status. Free/Reduced = Free/Reduced Lunch. Not on Free/Reduced = Not on Free/Reduced Lunch. WISC - III = Wechsler Intelligence Scale for Children - III. WIAT = Wechsler Individual Achievement Test.

TEACHER INFORMATION

One language arts resource class teacher participated in this study. This teacher was an African-American male with a chronological age of 52. He had a Bachelor's degree in special education and had three-year experience of teaching language arts resource classes in high school. During the intervention period, he was teaching four language arts resource classes and one biology resource class.

Materials

READING MATERIALS

"Read Naturally" (Ihnot & Ihnot, 1997) was used for the reading materials. There are several factors that need to be considered when selecting reading materials for CSR. First, reading materials should be at the students' instructional level, which generally refers to students being able to decode about 90% of the words correctly. Second, reading materials should consist of several paragraphs. Third, reading materials should provide students with opportunities to read different types of text structures (e.g., cause and effect, chronology). Fourth, reading materials should be interesting (Texas Center for Reading And Language Arts, 2000). Finally, reading materials should also have features related to CSS (e.g., title or pictures for previewing). "Read Naturally" passages met these stated criteria.

Reading passages at nine different reading levels were used in CACSR. Each reading level included 19 reading passages, resulting in a total of (approximately) 170 reading passages. Reading levels included were grade 2.5, grade 3, grade 3.5, grade 4, grade 4.5, grade 5, grade 5.5, grade 5.8, and grade 6 level.

OTHER MATERIALS

The CACSR class took place in a computer lab. The computer lab was equipped with 22 computers. The computers were Pentium with 32MB memory and CD driver and had audio capability available. During CACSR sessions, the headphones were provided to students to allow them to listen to the instructions provided by the CACSR program. For the quiz materials, the publisher-developed quiz for each "Reading Naturally" passage was used.

Pilot Study

Upon completion of the development of CACSR, it was piloted individually with two secondary school students with LD (7th-grade and 10th-grade) and three graduate students in special education. The pilot study with the students with LD was conducted to get feedback from the viewpoint of possible participating students for the study. The pilot study with the graduate students in special education was conducted to get feedback from the viewpoint of a teacher.

The purpose of each pilot study was to get feedback/suggestions regarding the CACSR program (e.g., content, overall structure and flow of the program, screen display, navigation, etc.) and to refine and revise the CACSR program. Each pilot session lasted for approximately 50 minutes. The investigator provided a short introduction to the CACSR program and asked each participant to work on the CACSR program. During each participant's engagement in the CACSR program, the investigator asked specific questions about various aspects of the CACSR program by using the CACSR pilot testing checklist.

The following revisions were made to the CACSR based on feedback and suggestions from the pilot study:

1. Direction/Navigation/Screen Display
    - Sound function was added to the CACSR program to allow students to hear directions on how to use the CACSR program and instruction in the overview and modeling sections.
    - The size of the navigation buttons was enlarged, and unnecessary navigation buttons were deleted for easier navigation.
    - Color contrasts for background and text were adjusted to make the text more visible.

2. Learn CSR
    - In the modeling, guided practice, and independent practice sections, chunking of reading passages on each screen was adjusted.
    - In the guided/independent practice sections, the directions on practice activities were changed to be specific enough to allow students to understand exactly what they are supposed to do. For instance, the direction on a brainstorming activity was changed from "write down what you brainstorm" to "write down at least two ideas that you brainstorm."
    - In the guided practice section, the duration of time provided for the activities was shortened.
    - In the "click and clunk" section, the definitions of prefixes and suffixes were added when presenting examples of words having prefixes or suffixes. Also, the direction on an independent practice activity was elaborated to reduce confusion on what student are supposed to do.
3. Use CSR
    - Directions on how to activate the "learning log," "clunk expert," "dictionary," "quick review" were added.
    - Descriptions for the functions of "learning log," "clunk expert," "dictionary," and "quick review" were added.

Additionally, several minor changes were made throughout the program based on the participants' comments and suggestions to reduce any confusion. The revised CACSR program was implemented in this study.

Procedure

General procedures included: (a) pre-testing of all participating students, (b) implementing CACSR by the investigator, and (c) post-testing of all participating students and student interviews with students in the CACSR group. First, students in both CACSR and comparison groups were individually assessed on the WRMT-R-Passage Comprehension. Next, the investigator implemented CACSR with students in the CACSR group for 12 weeks (a total of 25, 50-minute sessions). After the 12-week intervention, the students in both CACSR and comparison groups were individually assessed on the same measure. Additionally, students in the CACSR group were individually interviewed regarding their perceptions about CACSR.

IMPLEMENTATION OF CACSR

Implementation of CACSR was conducted in three phases: (a) overview of CACSR, (b) learning CSR, and (c) using CSR to learn.

Overview of CACSR

During the first two sessions, an overview of CACSR was provided to participating students. Topics covered in the overview sessions included: the purpose of the study, the overall description of the CACSR program (e.g., the focus of the CACSR program, the overall structure of the CACSR program), specific steps on how to use the CACSR program, a demonstration of the CACSR program, and students' practice to use the CACSR program. During the demonstration of the CACSR program and students' practice, the projector was used to allow all students to be able to see the screen together. During students' practice to use the CACSR program, the investigator guided students through each screen by each screen by requiring students to follow the exact step that the investigator demonstrated.

Learning CSR

During the approximately next ten sessions, students engaged in "Learning CSR." In "Learning CSR," students learned four strategies of CSR: (a) “preview,” (b) “click and clunk,” (c) “get the gist,” and (d) “wrap-up.” For each strategy, the CACSR program provided instruction on what the strategy is, when the strategy is used, why it is important to use the strategy, and how the strategy is used. Additionally, the CACSR program provided overview, modeling, guided practice, and independent practice on how each strategy is used.

In the overview section, the CACSR program played the role of a teacher presenting specific steps for using for each strategy. For instance, when using the "preview" strategy, two steps were presented with video clips of a teacher using this strategy: (a) step 1: when you brainstorm, you think of everything you already know about the topic; it could be something that you read, saw in a movie or on TV, or heard friends talk about; and (b) step 2: when you predict, you skim the information such as the title, subheadings, pictures, and graphs and key words to predict what you think you will learn by reading the text.

In the modeling section, the CACSR program provided modeling on how each strategy is used step by step with a sample reading passage. For instance, when using the "click and clunk" strategy, the CACSR program played the role of a teacher to demonstrate how to use the "click and clink" strategy step by step: (a) first, I will read the first paragraph and then stop, (b) second, I will check to see if there are words I do not understand. I had trouble with understanding the word, "*toad,"* and (c) third, there are four fix-up strategies to help figure out clunks. I can start by applying the first clunk strategy and then move to the next one if I still do not figure out the word. The first fix-up strategy is "break the word into small parts that have one talking vowel and use the word attack." I can use the word attack strategy. The word "toad" has a vowel team, *oa* in it. I will sound out "*t*," "*oa*," and "*d*," then I will put them together. So, it is "*toad*." I know the

meaning of "*toad*." It is a type of small animal that looks like a large frog. The CACSR allowed students to hear the sounds of the words or word parts by clicking them.

In the guided practice section, the CACSR program played the role of a teacher who asked students to engage in guided activities and also provided feedback. For instance, when using the "get the gist" strategy, the CACSR program provided multiple-choice activities that provided students with opportunities to practice how to use the "get the gist" strategy with feedback: (a) read a paragraph and think about the gist before you answer the questions, (b) answer the question, "who or what that the paragraph is mostly about?" (answer choices: "it is about termites" or "it is about houses and buildings"), (c) answer the question, "what is the most important about who or what?" (answer choices: "termites can build a big house fast," "termites build their house in Africa," or "termites' home is as big as the Empire State Building"), and (d) answer the question, "is the gist in 10 words or less?" (answer choices: "yes" or "no").

In the independent practice, the CACSR program provided students with independent practice activities. Students were expected to complete the activities by themselves without feedback from CACSR. Once the students completed the activities, they were allowed to check their answers. For instance, when using the "wrap-up" strategy, the CACSR program asked students to (a) write down the

questions about the gist, (b) write down the questions about anything that you learned, and (c) write down important ideas that you learned.

Using CSR to Learn

After students completely finished with "Learning CSR," students began with "Using CSR to Learn." During approximately the next 13 sessions, the students engaged in "Using CSR to Learn." In "Using CSR to learn," students applied four strategies of CSR when reading their instructional-level passages. The CACSR program had a built-in learning log, clunk expert, dictionary, and quick review. Students were asked to fill out the learning log while they engaged in reading. Students could get instructional support from the clunk expert, dictionary, or quick review on CSR. The clunk expert provided guidance to apply fix-up strategies for possible clunks (approximately 1,500 words) that students may encounter. The quick review provided the review on specific steps for using each strategy.

Preview

Students activated “learning log: preview,” where the directions on brainstorming and making predictions were presented. They then typed what they brainstormed and what they predicted. Students could also activate “quick review” for the brief review about how to use the "preview" strategy.

Click and Clunk

Students activated “learning log: click and clunk,” where the steps for figuring out clunks were presented. They then typed how they figured out the clunks. Students could activate “clunk expert” if they needed assistance for figuring out the clunks or could activate “dictionary” if they still did not know the meaning of the clunks despite the help from the “clunk expert.” Students could also activate “quick review” for the brief review on how to use the "click and clunk" strategy.

Get the Gist

Students activated “learning log: get the gist,” where the directions on getting the gist were presented. They then typed their gist. If students typed the gist in more than 10 words, the dialogue box appeared and asked them to write the gist in 10 words or less. Once the students typed their gist, they could check their gist with an ideal gist. Students could also activate “quick review” for the brief review on how to use the "get the gist" strategy.

Wrap-Up

Students activated “learning log: wrap-up,” where the directions on making questions and reviewing were presented. They then typed their questions

and their review. Students could also activate “quick review” for the brief review on how to use the "wrap-up" strategy.

COMPARISON CONDITION: A TYPICAL LANGUAGE ARTS RESOURCE CLASS

Students in the comparison group participated in a typical language arts resource class. A typical language arts resource class lasted one and a half hour and was offered every other day. A typical language arts resource class consisted of (a) literature instruction, and (b) English grammar instruction.

For literature instruction, the teacher used the text version of *The Tragedy of Hamlet*. The typical instruction consisted of the teacher reading the text and leading a discussion on what was read. During the discussion, the teacher generally explained the plot of the story (e.g., main characters such as Hamlet, Ophelia, or Ghost, major events, etc.)

For English grammar instruction, the teacher used a textbook, entitled *AGS Basic English Grammar* (Walker, 1997). The 14 chapters covered in the grammar book included: noun, pronoun, adjective, action verb, state-of-being verb, adverb, preposition, conjunction, interjection, sentence construction, subjects and predicates, sentence patterns, sentence patterns with a linking verb, complex sentences, and the verbal and the verbal phrase. The teacher primarily relied on the textbook during instruction. The typical instruction consisted of teacher modeling and student independent work-sheet practice. For instance, the

teacher provided modeling on how to identify subject, linking verb, and predicate noun by (a) writing a sample sentence on the white board, (b) underlining each component (i.e., subject, linking verb, adjective) and (c) explaining the meaning of each component (e.g., a noun refers to a person, thing, or place). Then, the teacher asked students to independently work on a practice activity in the book (e.g., Practice activity A: Write the sentence on your paper and identify subject, linking verb, and predicate noun). During students' independent activities, the teacher monitored students' work and provided assistance if needed. After the students finished the practice activity, the teacher checked the correct answers as a whole class.

A Typical Reading Improvement Class

One student in the CACSR group and one student in the comparison group participated in a reading improvement class in addition to the language art resource class. A typical reading improvement class lasted fifty minutes and was offered every day. Topics covered in this class included identifying main ideas, drawing conclusions, summarizing, making inferences, etc. A teacher primarily used worksheets, which consisted of 25 units for each topic (e.g., drawing conclusions). Each unit had five short paragraphs and five multiple-choice questions. The typical instruction was composed of the teacher modeling and student completing work-sheet practices. For instance, the teacher read the first

short paragraph and provided modeling on how to draw a conclusion. Then, the teacher asked students to take turns reading the paragraphs and answering the questions.

Measures

WOODCOCK READING MASTER TEST-REVISED

WRMT-R is a battery of individually-administered subtests measuring important aspects of reading ability: Word Identification, Word Attack, Word Comprehension, and Passage Comprehension. For the purpose of this study, the subtest Passage Comprehension was used as the pretest and posttest measures of students' reading comprehension. Passage Comprehension is a modified cloze procedure requiring students to identify a key word missing from the passage. In this study, raw scores from the WRMT-R-Passage Comprehension was used for data analysis.

The WRMT-R (1987) is a revised edition of the 1973 WRMT with updated and expanded norms. Normative data for the WRMT-R were collected from 6,089 subjects (4,201 subjects in grades K-12) in 60 geographically diverse U.S. communities. Regarding region of the U. S., 34% were from the South, 26.3% were from the North-Central, 20.9% were from the Northeast, and 18.5% were from the West. Regarding community size, 27.7% were from the central

city, 31.8% were from the urban fringe, and 40.8% were from the outside urban and rural areas. In terms of race/ethnicity for grades K-12, 82% of the subjects were European-American, 14.7% were African-American, 2.2% were Asian-Pacific American, and 0.8% were Native American.

The WRMT-R test provides two alternate equivalent forms (G and H). Each form of Passage Comprehension contains 68 items arranged in order of difficulty. Each form has internal consistency reliability coefficients (Split-Half) ranging from .82 to .92 for Passage Comprehension (Median coefficient = .92). Concurrent validity was obtained through correlations between the WRMT-R and the WJ (Woodcock-Johnson Psycho-Educational Battery) reading tests. Concurrent validity correlations in total ranged from .85 to .91. The correlation between WJ total reading and WRMT-R Passage Comprehension ranged from .52 to .71. Content validity of the WRMT-R can be obtained through an examination of the scope and sequence of items in the WRMT-R tests, the supplementary GFW (G-F-W Sound-Symbol Tests), and the WJ tests.

INTERVIEW QUESTIONNAIRES

An interview questionnaire was developed by the investigator to examine students' perceptions about CACSR (Appendix F). Specially, the interview questionnaire consisted of nine open-ended questions designed to elicit information about students' perceptions about the CACSR intervention they

received and the factors that contributed to their perceptions. Sample questions include "How was the CACSR program helpful? (Probe)" or "Would you continue with the CACSR class? Why or why not?"

FIDELITY OF IMPLEMENTATION CHECKLIST

A 3-point Likert-type scale that addressed fidelity of implementation for CACSR was developed by the investigator to evaluate the accuracy with which (a) students participated in CACSR, and (b) the teacher implemented CACSR (Appendix G and H). The fidelity checklist had student items (e.g., “a student is involved in a brainstorming activity before reading”) and teacher items (e.g., “a teacher guides a brainstorming activity"). For student items, a score of 1 for a particular activity meant that a student did not engage in the activity when he or she was supposed to; a score of 2 meant that a student engaged in the activity in a limited way (e.g., he or she used the strategy, but not correctly or comprehensively, or he or she was often off-task while using the strategy); and a score of 3 meant that a student engaged in the activity consistently and as it was supposed to be done. For teacher items, a score of 1 for a particular item meant that a teacher did not implement; a score of 2 meant that the teacher implemented, but not consistently throughout the lesson; and a score of 3 meant that the teacher implemented appropriately.

The fidelity of treatment checklist was implemented by a teacher and a trained research assistant 10 times during 12 weeks of implementation. Mean interobserver reliability of the two observers' scoring was 85% (range 69-92%), Kappa = .77. A composite percentage score (i.e., the scores obtained divided by the total scores) was calculated (Simmons et al., 1994). The mean score for students was 2.58, and the mean score for the investigator was 2.99, indicating high levels of fidelity of implementation over time for both the students and the investigator.

Data Collection

The investigator and a trained research assistant administered the WRMT-R-Passage Reading to students in both CACSR and comparison groups. Before and after the 12-week intervention, each student was individually assessed on the WRMT-R-Passage Comprehension in a relatively quiet area.

After the 12-week intervention, each student in the CACSR group was individually interviewed in a relatively quiet area by a research assistant who was not associated with this study. The interview began with informing students of the purpose of the interview and the confidentiality of their responses. Each interview lasted approximately 10-20 minutes.

Data Analysis

Quantitative Data Analysis

Fisher's exact probability test and the *t* test for independent samples were employed to compare the CACSR and comparison groups on the demographic variables and the pretest measure of outcome (the WRMT-R-Passage Comprehension). No statistically significant differences were observed. Thus, pre-experimental equivalence was assumed. A 2 (CACSR vs. comparison) by 2 (pretest vs. posttest) repeated measure analysis of variance (ANOVA) was performed to examine the intervention, time, and intervention by time interaction effects on the outcome measure after testing the appropriate assumptions (Stevens, 2002). Specially, normality and homogeneity of covariance matrices were tested. Also, it should be pointed out that repeated measure ANOVA is robust against the lack of multivariate normality with respect to type I error. All analyses were tested at the .05 level of significance. The Statistical Package for Social Sciences (SPSS) was used for the purpose of data entry, manipulation, and analysis.

Interview Data Analysis

Students' interviews were audio-taped and then transcribed. The interview data were analyzed using two types of coding: (a) open coding (theme

identification), and (b) axial coding (Strauss & Corbin, 1990). Open coding refers to "the process of breaking down, examining, comparing, conceptualizing, and categorizing data" (p. 61; Strauss & Corbin, 1990). During open coding (theme identification), the investigator read and re-read entire interviews to identify salient themes in data and categorize the data around the themes.

Axial coding refers to a set of procedures whereby data are put back together in new ways after open coding, by making connections between a category and its subcategories (Strauss & Corbin, 1990). During axial coding, the investigator refined and narrowed categories by relating them to subcategories and re-categorized the data around the refined/narrowed themes. Original quotes from students were used as evidence to support these themes.

CHAPTER IV

RESULTS

This research examined the effects of CACSR on the reading comprehension performance of high school students with LD. A one between and one within factor repeated measure design was employed for the purpose of this study. The intervention was conducted in a computer lab with 23 high-school students with LD for 12 weeks (25, 50-minute sessions). The four class sections were randomly assigned to either the CACSR group or the comparison group. In addition, student interviews were conducted to elicit information on the participants' perceptions about CACSR.

Research Question 1: Following the intervention, will students in the CACSR group outperform students in the comparison group (i.e., typical reading instruction) on reading comprehension, as measured by the WRMT-R-Passage Comprehension?

Research Question 2: What are the perceptions of high school students with LD regarding the efficacy of CACSR they received during instruction?

This chapter consists of four sections. The first section presents the results of testing assumptions for repeated measures ANOVA; the second section provides results of testing comparability of groups; the third section provides

results of testing intervention effects; and the final section presents findings from an analysis of student interviews.

Test of Assumptions

The two assumptions for repeated measures ANOVA were tested: (a) normality, and (b) homogeneity of covariance matrices.

NORMALITY

The normal distribution assumption of the WRMT-R-Passage Comprehension scores at pretest and posttest was tested. Specifically, the Kolmogorov-Smirnov showed that the distributions were normal. Results are summarized in Table 4.1.

Table 4.1

Test of Normality

	CACSR (n = 14)		Comparison (n = 9)	
	Kolmogorov-Smirnov	p	Kolmogorov-Smirnov	p
Pretest	.136	.200	.161	.200
posttest	.122	.200	.271	.055

HOMOGENEITY OF COVARIANCE MATRICES

The Box's test showed that the assumption of homogeneity of covariance matrices had been met, Box's M = 4.382, F (3, 11616) = 1.297, p = .273.

Analysis of Pretest Data

The t-test for independent samples showed no statistically significant difference between the CACSR and comparison groups on the pretest measure of the dependent variable (passage comprehension). Therefore, pre-experimental equivalence between the two groups on the dependent measure was assumed. Results are summarized in Table 4.2. A group comparison of pretest and posttest measures is summarized in Table 4.3.

Table 4.2

Group Comparison on a Pretest Outcome Measure (Raw Scores)

	CACSR (n = 14)		Comparison (n = 9)			
	M	SD	M	SD	t	p
Passage Comprehension	39.93	7.91	38.89	8.43	.300	.767

Table 4.3

Pretest and Posttest Means and Standard Deviations (Raw Scores)

	CACSR (n = 14)		Comparison (n = 9)	
	M	SD	M	SD
Pretest	39.93	7.91	38.89	8.43
Posttest	42.57	7.73	40.89	6.31

Analysis of Intervention Effects

A 2 (CACSR vs. comparison) by 2 (pretest vs. posttest) repeated measure analysis of variance (ANOVA) was performed to compare the CACSR and the comparison groups on passage comprehension. Specifically, three effects on the passage comprehension measure were tested: (a) intervention main effect (CACSR vs. comparison), (b) time main effect (pretest vs. posttest), and (c) intervention by time interaction effect. Partial eta-squared (η^2) was used to measure the proportion of variance effect size. According to Cohen (1988), this effect size was characterized as .01 as small, .06 as medium, and .14 as a large effect. The level of significance was set, a priori, at .05.

The repeated measures ANOVA revealed that there was a statistically significant time effect on passage comprehension, $\underline{F}$ (1, 21) = 5.751, $\underline{p} < .05$, η^2 =

.215, indicating pretest to posttest improvement on passage comprehension in both groups. However, the intervention effect, F (1, 21) = .188, p = .669, η^2 = .009, was not statistically significant, indicating that the CACSR and the comparison groups did not significantly differ on passage comprehension. The intervention by time interaction effect, F (1, 21) = .110, p = .743, η^2 = .005, was also not statistically significant. Results of the repeated measures ANOVA on passage comprehension are summarized in Table 4.4 and Figure 4.1.

Table 4.4

Intervention by Time Repeated Measures ANOVA Results on Passage Comprehension

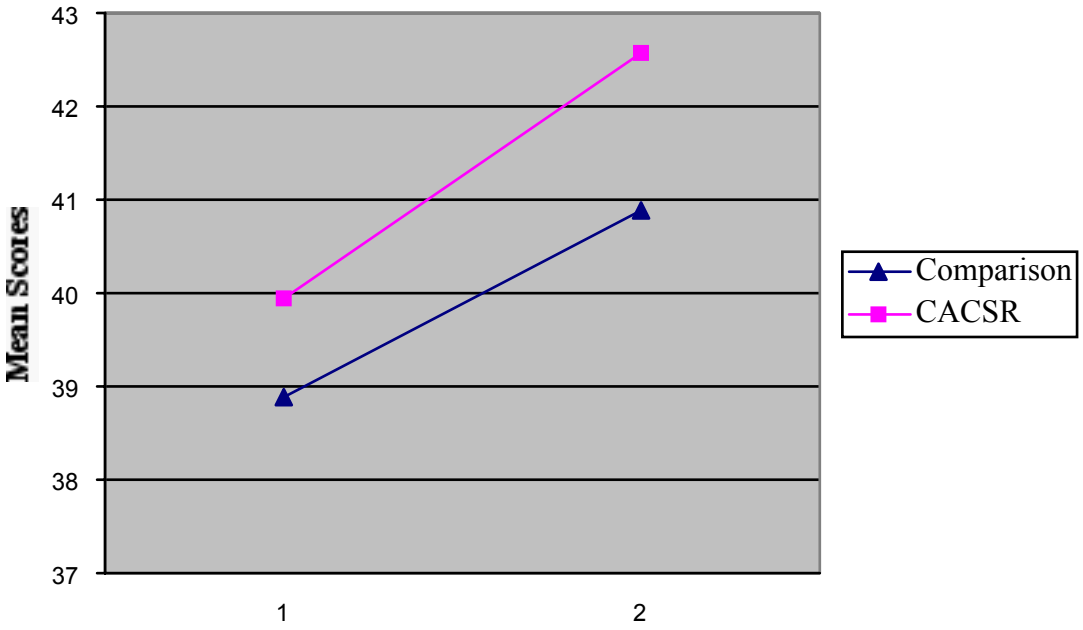
Source	SS	df	MS	F	p	η^2
Intervention	10.15	1	10.15	.188	.669	.009
S (Intervention)[a]	1131.26	21	53.87			
Time	59.05	1	59.05	5.75	.026	.215
Intervention by Time Interaction	1.132	1	1.132	.110	.743	.005
S(Intervention) by Time[b]	215.61	21	10.27			

[a]S (Intervention), subjects nested in intervention, first error term.

[b] S (Intervention) by Time, subjects nested in intervention by time interaction, second error term.

Figure 4.1

Intervention Effects on Passage Comprehension (Raw Scores)



Effect sizes were calculated to examine practical significance of CACSR on passage comprehension. Intervention/comparison group difference effect sizes at pretest and posttest were calculated as the difference between the mean posttest score of the intervention group minus the mean posttest score of the comparison group divided by the pooled standard deviation. Practical significance test revealed that the intervention/comparison group difference effect size at posttest was .24, while it was .13 at pretest.

To better understand the nature of the time effect, pretest to posttest standardized mean difference effect sizes were computed for each group by dividing the mean difference by the standard deviation of the mean difference. The effect size was characterized as .2 as small, .5 as medium, and .8 as large effect (Cohen, 1988). Results showed that while comprehension improvement from pretest to posttest for the CACSR group was .81, such improvement for the comparison group was only .33, indicating that students in the CACSR group improved their comprehension to a greater extent than did the students in the comparison group.

Additionally, individual responses over time were examined, using the effect sizes. First, the number of students who achieved a half of the standard deviation (SD) increase in comprehension performance from pretest to posttest in the CACSR and comparison groups was compared. A half of the SD was selected,

because it corresponds with a .50 effect size, which is significant for educational decision making. While 43% of the students (n = 6) in the CACSR group achieved a half of the SD increase in comprehension performance from pretest to posttest, 22% of the students (n = 2) in the comparison group obtained such gains. This finding suggests that more students in the CACSR group were identified as relatively "strong" responders to the intervention than in the comparison group.

Second, the number of students who did *not* achieve a tenth of the SD increase in comprehension performance from pretest to posttest in the CACSR and comparison groups was examined. A tenth of the SD was selected because it corresponds with a .10 effect size, which represents the lowest effect size needed to determine adequate response to treatment. While 29% of the students (n = 4) in the CACSR group did not achieve a tenth of the SD increase in comprehension performance from pretest to posttest, 22% of the students (n = 2) in the comparison group did not obtain such gains. Although more students in the CACSR group were identified as "low" responders to the intervention than those in the comparison group, the difference between two groups was small.

Descriptive Interview Data

In addition to examining the effects of CACSR on reading comprehension, this study attempted to examine participants' perceptions about the CACSR

intervention that the students had received (n = 14). The student interviews revealed many similarities and some differences in the ways students reported their perceptions of the intervention. Analysis of students' interview data revealed five themes: (a) overall efficacy of CACSR, (b) attributes of CACSR that were viewed as helpful or as not helpful, (c) comparison of the CACSR class to other classes, (d) perceptions about reading improvement as a result of CACSR, and (e) desire to continue with class. Quotes from students are summarized according to the five themes in Appendix I.

OVERALL EFFICACY OF CACSR

When asked about their overall perceptions about CACSR, all students except two reported positive attitudes toward CACSR. Some examples of their general insights about CACSR were as follows:

> *I thought it was good because it helped me to learn more like how to read and read better and understand how to do paragraphs and find, you know, how to find the answers and things like that.*
>
> *I thought it was, uh, it was different. It was learning, a different way of learning. It was pretty fun.*
>
> *It was pretty good. It helped me with the reading and stuff, figuring out words, if I didn't understand the word.*

Hmm, I think that, uh, that it was like, it could help teach you how to read and everything.

At the beginning, I kind of did not like it, I guess the first few levels I didn't like. But then after a while it got interesting, the stories did and it helped me...got all the way down.

ATTRIBUTES OF CACSR THAT WERE VIEWED AS HELPFUL OR AS NOT HELPFUL

In addition to students' overall perceptions about CACSR, the attributes of CACSR that were viewed as helpful and those that were viewed as not helpful were investigated. Students' responses were organized and presented in four categories: (a) strategies of CACSR that were viewed as helpful, (b) strategies of CACSR that were viewed as not helpful, (c) features of CACSR that were viewed as helpful, and (d) features of CACSR that were viewed as not helpful.

Strategies of CACSR that were viewed as helpful

There are four comprehension strategies in CACSR, namely, "preview" strategy, "click and clunk" strategy, "get the gist" strategy, and "wrap-up" strategy. The most frequently identified strategy as helpful was "get the gist" strategy. Several students were specific about the aspects of the "get the gist" strategy that helped them read. For instance, one student demonstrated that the

fourth step of the "get the gist," that is, check if the gist is in 10 words or less--facilitated her understanding of the main idea by stating,

> *It made me think, actually because...you had to get ten words or less and sometimes you ran over so you actually had to think and reword.*

Another student identified the first step of the "get the gist" strategy as helpful. This step suggests that students read the first paragraph and stop to get the main idea for the first paragraph, rather than read the whole passage and then try to get the main idea.

> *It would help you find, it helped you find an idea in your reading. You read the first paragraph and then you stop, you get the main idea from that. You go to the next, so you won't have to read all the paragraphs and then go back.*

The next most frequently identified strategy as helpful was "click and clunk." Among four fix-up strategies, the second fix-up strategy, that is, reread the sentence with the clunk and the sentences before or after the clunk--was the most frequently reported strategy as helpful. For instance, one student stated,

> *With figuring out the words. It helped me figure out words, like, read before the sentence and after the sentence to figure out the word.*

Another student commented,

Some of the vocabulary was helpful. I had to go back and forth a couple of times.

One student revealed that the "preview" strategy was helpful. Interestingly, no student identified the "wrap-up" strategy as helpful.

Strategies of CACSR that were viewed as not helpful

When asked what parts of CACSR were not helpful, four students stated that all parts of CACSR were helpful. While no student identified the "wrap-up" strategy as helpful, three students revealed that it was not helpful. Although three students commented that the "wrap-up" strategy was not helpful, none of them specified what aspects of the strategy led them to perceive it as not helpful. Two students commented that the "click and clunk" was not helpful. However, the reason for this perception was not directly related to instruction. For instance, one student said,

It [click and clunk] really wasn't useful because you knew the word already, you didn't need it or you skipped it.

Features of CACSR that were viewed as helpful

In addition to the strategies of CACSR, an analysis of student interview data revealed that the features of CACSR were also associated with students' perceptions regarding helpfulness of CACSR. Features of CACSR that students

perceived as helpful were further subcategorized into: (a) reading passages, (b) reading level, (c) ease of CACSR, and (d) student choice in selecting reading passages. Reading passages and reading level were the two most frequently identified features that were viewed as helpful. All of the students remarked that the reading passages were interesting enough to draw and maintain their attention. Appropriateness of reading level was identified as a helpful feature of the program. The students noted that the different reading levels offered in CACSR allowed them to work on the reading passages that were matched with their own reading level. For instance, one student stated,

> *Because on a computer program you have all the way to level six. You have more levels, it's like more advanced and helps you learn more.*

Similarly, another student expressed appreciation for the appropriateness of the reading levels of the passages by stating,

> *There were no words that were actually hard for me to read or anything. It was like my level of reading.*

Two students expressed their favorable perceptions about the ease of CACSR compared to other classes, "*Uh, oh, you work on the computer and lessons, uh, I think it's more easier than other classes*." One student identified being able to choose reading passages based on her preference as a favorable

feature of the CACSR, "*You could pick the stories that you wanted to read instead of them picking them for you*"

Features of the CACSR that were viewed not helpful

Interestingly, reading passages and reading level were also perceived as not helpful features. Students perceived lower-level reading passages as not helpful because the passages were either not challenging enough or not motivating. For instance, one student stated,

It was, some of it was too easy. It wasn't hard enough and challenging.

Another student also stated,

Just the beginning levels. It was way too easy and I did not want to do it, but I did it.

The frequency of CACSR sessions was revealed as a feature that was viewed as not helpful. Since the participating school was in a block schedule, students participated in the CACSR session for the second half of the class time during every reading class session. Students asserted that having a CACSR session during every reading session was too much to maintain their motivation, as noted in the following comments:

It got boring after awhile, constantly doing it…doing the same thing every day.

It kind of got kind of boring at the end. We were doing it every single day....I got kinda bored.

I would [like to continue with CACSR], but not as much as I did. Like, have it like maybe twice a week or something.

Lastly, one student mentioned that typing during the CACSR activity was hard, "*Doing all that writing, that's what killed...typing....I don't like typing and stuff*."

COMPARISON OF THE CACSR CLASS TO OTHER CLASSES

Whether students perceived the CACSR class differently from their other classes, and those aspects of the CACSR class that contributed to their perceptions, were also investigated. Overall, students identified specific contrasts to their other classes. Two major contrasts were identified from students' responses: (a) learning environment, and (b) learning principles.

First, students stressed that CACSR provided a different type of learning environment. The students said that CACSR provided a more interactive learning environment where they could more actively participate in the learning process, as noted in the following comments:

Because all you do is sit there and be bored and the teachers, they hand you work and all this stuff to do and usually they have boring lessons. In this class it wasn't boring because I got to work on the computer, which I

like working on the computer and I got to listen to what the computer lady on the thing was saying and it helped me a lot.

Everything is on the computer. You ain't got to sit there and just write and worry about what the teacher is going to say because you are reading instructions and whatever. You have teachers talking and I go to sleep. When teachers talk, I'm going to sleep.

In English we just sit there and listen to the teacher talk and do worksheets and stuff like that.

Second, several students felt that CACSR employed learning principles that may promote learning effects. These learning principles included: (a) allowing the students to learn at their own pace, (b) providing repeated practices, and (c) providing hands-on learning activities. Examples of their comments are as follows:

You can work at your own pace. You don't have to work with everybody else. You can just learn at your own speed.

You are actually interacting with something that can help you figure out what you are trying to say and if you do something wrong you can always go back on the computer.

Uh, more hands-on, get to use the computer and helps your reading.

PERCEPTIONS ABOUT READING IMPROVEMENT AS A RESULT OF CACSR

In addition to examining the effects of CACSR, students' perceptions about their own reading improvement were examined. Specifically, students were asked in what ways they perceived their reading had improved as a result of CACSR. Many students asserted that their vocabulary improved after the intervention. The students' responses were quite varied with regard to the aspects of CACSR that helped them to improve their vocabulary. One student specified that she could use a fix-up strategy (using a contextual clue) to figure out the meaning of the word after the intervention, "*Like if I stumble over a word, I know to go back and read the sentence before and after*." Another student remarked that he benefited from another fix-up strategy (decoding strategy) to improve his vocabulary by stating "*The bigger words, I can start sounding them out and reading them*."

Two students stressed that CACSR motivated them to read more, and that they viewed this change as their major reading improvement as a result of CACSR. Both of them reported that they read more after the intervention, and reading more improved their reading, as noted in the following comments,

> *It got me reading better. And, because in class I never used to, I never used to read and now when I'm in this class, I'm always reading. It just*

got me back into reading because I never used to read. Now I just started reading after I got into the program.

I think it (my reading) has improved, it made me want to read more.

Comprehension monitoring was also identified as an area of reading improvement by two students. The students noted that they slowed down or stopped after each paragraph to ensure their successful comprehension, as noted in the following comments,

I actually slow down when I read... actually understand what I read.

Try to read the first paragraph only, then read a little bit.

One student mentioned that she felt that her comprehension in general had been improved after the intervention, "*Since now I can read them and I can understand what I'm reading*."

DESIRE TO CONTINUE WITH CLASS

When asked if students would continue with the CACSR class, all students except two said that they would. One student who said he would not continue with the CACSR class thought that he already knew how to read, thus, there was no need for him to take the CACSR class. Another student who said he would not continue with the CACSR class said that the CACSR got boring since it was offered on every reading session.

The strongest reason for the students' desire to continue with the CACSR class was that they wanted to improve their learning. Many of the students explained that the reason that they would continue with the CACSR class was that they wanted to challenge themselves. Examples of their comments are as follows:

Just to learn more, to challenge myself.

See how far and see if it got harder, would it actually help me, or probably show other kids how to do it.

It helps me learn but I would want to go higher.

Maybe I would start reading a lot better than what I am right now.

Two students wanted to continue with the CACSR class because they could improve their ability to identify the main ideas with CACSR, as noted in the following comments,

Because I will be able to do more work, not do more work, but, uh, learn how to read paragraphs and understand like what's the main parts of it and all that stuff.

Learn more about it. All the sentences put together and reading....finding the main ideas.

Two students stated that they wanted to continue with the CACSR class because they wanted to improve their vocabulary. For instance, one student stated that "*It helped me figure out words, like, read before the sentence and after the*

sentence to figure out the word." One student identified the desire to improve her spelling as the reason for her desire to continue with the CACSR class.

CHAPTER V

DISCUSSION

Reading comprehension is critical for success in school. Students are expected to read and understand what they read. This expectation increases when students begin secondary school, where text-based instruction is predominant. Secondary school students are expected to independently read, understand, and learn from textbooks in a variety of content areas (Armbruster & Anderson, 1988). Many secondary school students with LD have difficulties in coping with these curriculum demands (Bryant et al., 1999, 2000; Grossen & Carnine, 1991). This problem challenges secondary school teachers to prepare students with LD to successfully respond to heavy curriculum and learning demands. However, most secondary teachers know little about teaching reading and do not instruct students in the comprehension process (DiCecco & Gleason, 2002; Dupuis, 1984).

To prepare students with LD for successful integration in content area classes, special education resource teachers must provide instruction in reading strategies, including comprehension strategies (MacArthur & Haynes, 1995). CACSR is a computer-assisted instruction designed to be a responsive instructional tool for special education teachers to use as part of their instruction for the purpose of improving comprehension of students with LD. CACSR was

designed to accomplish this goal--to be a responsive instructional tool--by providing systematic instruction in research-based comprehension strategies.

This study attempted to address the effectiveness of CACSR as a responsive instructional tool to improve reading comprehension for high school students with LD. To address this research question, the effects of 12 weeks of a CACSR intervention was compared with a typical language arts resource instruction on comprehension performance of high school students with LD. In addition to examining the effects of CACSR on reading comprehension, this study examined students' perceptions about the CACSR intervention that they received.

Discussion of Quantitative Results

Results revealed that there were no statistically significant intervention or intervention by time interaction effects. However, there was a statistically significant time effect, indicating pretest to posttest improvement on passage comprehension among all participants. There are several possible explanations for these findings.

First, a statistical significance test alone may not achieve a comprehensive understanding of the effects of CACSR in this study. There has been a growing concern with the limitations of statistical significance tests (Falk & Greenbaum, 1995; Kirk, 1996; Thompson, 1999; Vacha-Haase, Nilsson, Reetz, Lance, &

Thompson, 2000). The first limitation of statistical significance tests is that *p* values are confoundedly influenced by sample size. For instance, large sample sizes can lead to small *p*-values without resulting in practical significance. The second limitation is that *p* values do not address the replicability of a study's results. Third, statistical significance tests do not indicate the strength or magnitude of relationships or differences, which is often referred to as practical significance. The awareness of these limitations associated with statistical significance tests has led to a search for supplementary measures of effect magnitude. Effect size has been strongly recommended as a supplementary measure by numerous researchers and currently by the American Psychological Association (American Psychological Association, 2001; Cohen, 1994; Kirk, 1996; Thompson, 1996, 1999; Wilkinson & the Task Force on Statistical Inference, 1999; Zakzanis, 1998).

For this reason, effect sizes were calculated using partial eta-squared (η^2) and Cohen's *d* to examine practical significance of the CACSR in this study. The effect size at posttest was .24. Although an effect size of .24 is small to moderate, it can be considered a "meaningful" difference between the intervention and comparison groups. In an education, the effect size of .25 is often considered a "meaningful" difference between two groups, suggesting the implementation of the intervention for the purpose of increasing students' positive outcomes. To

further understand practical significance of the CACSR, the pretest to posttest mean difference effect size was computed for each group. More favorable effects on comprehension were evident for the CACSR group (d = .81) than for the comparison group (d = .33).

Second, reading comprehension has been documented as one of the most difficult components of reading to measure. Researchers have struggled with the development and identification of measures that adequately assess comprehension. Comprehension measurement problems are one of the reasons why limited numbers of research studies in reading comprehension have been conducted in the past 15 years (Gersten, Fuchs, Joanna, & Scott, 2001). Given the limited availability of appropriate comprehension measures, the WRMT-R-Passage Comprehension has been considered to be one of the best measures currently available to assess reading comprehension.

Although the WRMT-R-Passage Comprehension is one of the best measures currently available to assess reading comprehension, it still could be considered as a distal measure of the intervention (i.e., CACSR) provided in this study. Passage Comprehension from the WRMT-R uses a cloze reading procedure designed to measure "the subjects' ability to study a short passage--usually two or three sentences long--and identify a key word missing from the passage" (p. 8; Woodcock, 1998). However, the intervention in this study focused on four

comprehension strategies with an emphasis on identifying the main ideas and generating questions about what students read. Thus, it is perceived that students' comprehension outcomes in this study might have been better measured by using a proximal measure of the comprehension strategies taught to students in the study.

Results from power analysis also support the concern regarding the measurement issue. Low power even with the large sample size may suggest measurement error. In this study, a series of power analyses was conducted to address the measurement issue. The observed power for interaction effect in the current study (n = 14 in CACSR and n = 9 in comparison) was .055. The observed power with a sample size of 400 (n = 200 in CACSR and n = 200 in comparison) was still .291. With an extremely large sample size of 1600 (n = 800 in CACSR and n = 800 in comparison), the power of .805 was obtained. Thus, the results support the notion that the WRMT-R-Passage comprehension may be a distal measure of the intervention.

Recently, the construct validity of the WRMT-R, when used with special education students, has been challenged (Williams & Eaves, 2001). The WRMT-R claimed to measure two important aspects of reading ability: (a) basic skills (i.e., Word Attack and Word Identification), and (b) reading comprehension (Word Comprehension and Passage Comprehension). However, a factor analysis

of the WRMT-R with special education students disconfirmed the Woodcock's hypothesized two-factor structure. Rather, the result from a factor analysis indicated a single-factor structure of the WRMT-R (Total Reading Full-Scale). This finding implies that the WRMT-R appeared to be a valid measure for the general reading construct measure, but data from the separate reading scores (i.e., basic skills or reading comprehension) should be interpreted with considerable caution for special education students (Williams & Eaves, 2001).

Overall, although differences between two groups were not statistically significant, effects of the intervention (i.e., CACSR) appear to be practically significant based on the obtained effect size for group differences. Furthermore, large differences between the pretest to posttest mean difference effect sizes for the CACSR and the comparison groups support the notion that the students in the CACSR group improved their comprehension to greater extent when compared to those in the comparison group. Additionally, considering that the total hours allocated to the CACSR intervention was only approximately 20 hours, it contributes more confidence to positive effectiveness of CACSR on reading comprehension for high school students with LD.

Considering the practical significance associated with this study, findings concur with previous CAI studies on positive effects of CAI as a provider of reading instruction on comprehension for students with LD (Boettcher, 1983;

Elkind et al., 1993; Grocke, 1982; Higgins & Boone, 1990; Horton et al., 1989; MacArthur & Haynes, 1995; Swanson & Trahan, 1992; Thomas & Clapp, 1989). In this study, CACSR was designed to provide instruction in comprehension strategies, rather than to be used as a simple tool capitalizing on its technical capabilities. The effects of CACSR were compared with the typical language arts resource class delivered by a special education teacher. The effect size between the two groups (ES = .24) suggests that students in the CACSR group who did not receive direct instruction by the teacher were at least comparable with the students who received reading instruction by the teacher with regard to comprehension performance.

Discussion of Findings from Student Interviews

Student interview responses revealed students' perceptions regarding the efficacy of CACSR, their opinions on how the CACSR class differed from other classes, their perceptions about reading improvements as a result of CACSR, and their willingness to continue with CACSR. The findings revealed that students with LD generally perceived CACSR as helpful and different from their other classes in a positive way (e.g., providing a more interactive environment, repeated practices, etc.). Many of the students also perceived that their reading improved as a result of CACSR and expressed their desire to continue with CACSR. These

findings were similar to the findings from McCray, Vaughn, and La Vonne (2001), in that students generally expressed favorable perceptions about the efficacy of CACSR, which was designed specifically for students with LD to provide explicit instruction in comprehension strategies.

An analysis of student interviews provided an important insight on what attributes of CACSR were perceived as helpful or as not helpful by students. Students identified the "get the gist" section as most helpful, followed by the "click & clunk" section. On the other hand, the "wrap-up" section was identified as least helpful. Positive features of CACSR mentioned by the students included interesting reading materials, various levels of reading passages, ease of CACSR, and student choice to select the passages to read. Features of CACSR liked least by students included the frequency of sessions, typing requirement, and lower-level reading passages. This information would guide the refinement and revision of CACSR for the purpose of making it more effective in enhancing comprehension of students with LD. The following section provides suggestions for refinement and revision of CACSR based on student interview data and other findings of this study.

Suggestions for Refinement and Revision of CACSR

Although many students with LD have difficulties with reading comprehension itself (e.g., difficulty with strategic reading and comprehension monitoring), it is also important to note that comprehension problems of many other students with LD are often associated with inadequate decoding skills. For these students with LD having significant decoding problems, comprehension may be challenging because they may pay too much attention to decoding words, resulting in few resources left for comprehension (Armbruster & Nagy, 1992; Bryant et al., 1999). For this reason, only students who could decode at least at the 2.5 grade level were included in this study. However, quite a few students in this study still had difficulties with decoding words, especially multisyllabic words. For instance, one student stated, "*When they [CACSR] use the big words, I don't know what they are saying*." Furthermore, it is important that educators address comprehension difficulties of struggling readers with significant decoding difficulties. There seems to be a way to modify CACSR so that the struggling readers can receive comprehension instruction through CACSR, that is, CACSR may need to incorporate a whole-word synthetic speech feature. The whole-word synthetic speech feature would allow readers to hear the sound of the whole word by clicking on it. The current CACSR provides synthetic speech feedback to vowel sounds (e.g., short i, long o, -oa, -ow) or common word pattern sounds

(e.g., -ight, -tive, -tch, -ck) in conjunction with direction on how to break the multisyllabic words into syllables, rather than providing synthetic speech feedback to the whole words. CACSR was purposely designed in this way to provide the students with opportunities to learn and practice the decoding skills. However, this decoding-related task has been challenging to some students with LD who participated in this study. Furthermore, when it came to mutisyllabic words, this decoding task in the current CACSR has become more challenging to the students with LD in this study. Thus, it is recommended that whole-word synthetic speech feature would be added into CACSR. This recommendation is supported by research evidence indicating that CAI programs incorporating speech synthesizers are generally associated with students' improved performances in word decoding and recognition skills (Olson et al., 1986; Olson & Wise, 1992; van Daal & Reitsma, 1990; Wise, et al., 1989).

One of the most surprising findings from student interviews was their negative response to the "wrap-up" strategy, specially "generating questions." Providing students with opportunity to generate questions has been recommended as an effective strategy to improve comprehension (Gillespie, 1990; National Reading Panel, 2000; Wong, 1986). Contrary to previous literature, students perceived the "generating questions" strategy as least helpful. One explanation for this contradictory finding may be related to the incompleteness of the "wrap-up"

section. Previous literature indicated that a student-generating question strategy is associated with better comprehension when emphasizing the importance of (a) generating questions capitalizing on main ideas, and (b) generating higher-level questions rather than lower-level questions (Carnine et al., 1997; Denner, 1982; McFeely, 1984; Vaughn et al., 2001). However, the current "wrap-up" section does not provide sufficient instruction or guidance to appropriately reflect these important findings from previous literature. Thus, it is recommended to revise the "wrap-up" section so that it provides explicit instruction in what "good questions" look like and practice for students to generate "good questions," with scaffolded guidance.

Although the "get the gist" section was designed to provide explicit instruction in how to identify the gist and was identified as most helpful by students, some students struggled with understanding what a "good gist" looked like. A "good gist" should address "the most important information about the who or what" in one complete sentence form. Some students failed to understand that they should specify "the most important information about the who or what" in their gist. For instance, one student identified the gist as, "what the horned toad looks like," rather than " the horned toad is a frightening-looking animal that has sharp scales." Other students identified only "what the paragraph is mostly about" as their gist, rather than "the most important information about the who or what."

For instance, a student identified the gist as, "it is the big poison snake." This gist failed to contain what is the most important information about "the big poison snake." Thus, it is recommended to add instruction in what a "good gist" looks like, with ample examples and practice for students to identify a "good gist." Such an addition would better prepare students for working on the current "get the gist" section.

Implications for Practice

Research clearly indicates that students with LD, compared to typically achieving readers, have more difficulty with comprehension, even when controlling for the level of decoding (Englert & Thomas, 1987; Hansen, 1978; Saenz & Fuchs, 2002; Taylor & Williams, 1983; Wong, 1980; Wong & Wilson, 1984). Empirical evidence indicates that strategy instruction in research-based comprehension strategies would help students with LD enhance their comprehension difficulties (Mastropieri & Scruggs, 1997; Pressley et al., 1995; Swanson, 1999; Vaughn, Gersten, et al., 2000; Weisberg, 1988). Reading comprehension strategies associated with the highest effect sizes for students with LD were: (a) asking questions that activate prior knowledge, (b) comprehension monitoring, (c) finding main ideas and summarization, and (d) question generation (Gersten et al., 1998; Jenkins et al., 1987; Mastropieri et al., 1996;

National Reading Panel, 2000; Swanson, Hoskyn, & Lee, 1999; Wong & Jones, 1982). In CACSR, these three comprehension strategies, associated with the highest effect sizes, were incorporated. The "preview" strategy was designed to activate students' prior knowledge. The "click & clunk" strategy to assist students with monitoring their comprehension and using fix-up strategies when their comprehension breaks down. The "get the gist" strategy to help students identify main ideas. The "wrap-up" strategy to help students generate questions about what they read. Thus, CACSR could be a useful instructional tool that teachers may use for their students with comprehension difficulties. Since these recommended strategies are taught by CACSR, teachers can readily include CACSR as part of their classroom practices.

Importantly, teachers could implement these comprehension strategies (preview, click & clunk, get the gist, wrap-up) with their classes by themselves, instead of through CACSR. When teachers implement these strategies, it is recommended that they provide explicit instruction in these strategies and ample practice in the coordinated use of the strategies before, during, and after reading. Thus, teachers who prefer to deliver instruction by themselves rather than by using computers, can still benefit from these research-based comprehension strategies to enhance comprehension of students with LD.

Another implication of this study is that the reading comprehension performance of students with LD should be monitored on an on-going basis. During implementing CACSR, one of the most important roles teachers should take is to monitor students' comprehension performance on an on-going basis. By on-going progress monitoring, the teachers can identify students' areas of difficulties and provide additional instruction to the students. The built-in function of CACSR to record students' performance can be a useful tool to assist teachers with monitoring students' performance. Teachers can review students' recorded performance data after each session. With such data, teachers of students with LD can determine which students are in need of more explicit instruction in specific comprehension strategies (i.e., preview, click & clunk, get the gist, and wrap-up). Moreover, since the teachers can evaluate students' comprehension performance by reviewing the recorded data after the class session, their instructional time during classroom instruction can be dedicated to providing responsive instruction to the students.

Substantial research evidence supports that on-going progress monitoring to inform instruction is an essential component of high quality education. Furthermore, research has shown that on-going progress monitoring to inform instruction has yielded positive effects on students' achievement at every grade level (Fuchs & Fuchs, 1986). Thus, it is recommended that teachers monitor

students' comprehension performance on a regular basis and make instructional plans to reflect students' needs. CACSR with a performance tracking function built in can be a useful tool to make it easier for teachers to monitor students' comprehension performance.

Previous research has indicated that many teachers are aware that students with LD need specific instruction to meet their educational needs but that teachers feel that they do not have sufficient training to adequately equip themselves to teach students with LD (Scruggs & Mastropieri, 1996; Semmel, Abernathy, Butera, & Lesar, 1991; Vaughn et al., 1998). More specifically, teachers often do not know enough about effective, research-based strategies to provide explicit instruction in the strategies. CACSR seems to have potential to be used for teacher training for several reasons. First, CACSR was designed to teach four research-based comprehension strategies so that teachers who seek research-based comprehension strategies would have information regarding effective, research-based comprehension strategies. Second, CACSR puts a primary emphasis on the "how" section for each strategy, in which step-by-step procedures for using each strategy are provided with guided and independent practices. Thus, the teachers using CACSR could learn not only what research-based comprehension strategies are available, but also how these strategies are applied.

Recommendations for Future Research

One of the important goals of strategy instruction in reading is to help students become independent readers who can continue to apply the learned strategies to other tasks or materials. Lysynchuk, Pressley, d'Ailly, Smith, and Cake (1989), however, noted that one of the major problems in intervention research studies of comprehension strategy instruction was an exclusion of the examination of long-term effects or the generalization effects of strategy instruction. Unfortunately, the current study also did not examine long-term effects or generalization of strategies to other tasks or materials. As a result, the students' generalizability of the learned strategies to other tasks or materials is unknown. Thus, it is recommended that further research should examine long-term and generalization effects of CACSR on comprehension of students with LD.

One of the findings from an analysis of student interviews was students' favorable perceptions about CACSR regarding interesting reading materials and flexible reading levels. This finding is in line with previous literature regarding appropriate reading materials, that is, appropriate reading materials should be interesting and should be at students' instructional level (Texas Center for Reading And Language Arts, 2000). Although reading passages from "Read Naturally" used in CACSR meet these criteria and students perceived them as

helpful, it is also important to note that students with LD in secondary schools need to be prepared to compensate for their comprehension difficulties in content area reading. In previous CSR research studies conducted with secondary school students with reading difficulties, CSR was integrated into content instruction (i.e., science instruction, social studies, English/language arts instruction; Bryant et al., 2000; Klingner & Vaughn, 2000). These previous studies revealed that CSR, if integrated into content instruction, yielded improved reading outcomes. Thus, future research should examine the effects of CACSR coupled with content reading materials on reading comprehension of students with LD.

In intervention research studies, the importance of selecting an appropriate outcome measure that is tailored to the aims of the intervention has been emphasized (Marsh & Yeung, 1998). In reading comprehension research studies, comprehension was most frequently measured by factual questions, followed by retell assessments, strategy assessments, and other assessments (e.g., standardized reading tests, inferential questions, student-generated questions, vocabulary assessments, etc.; Talbott et al., 1994). However, research suggests that "good" comprehension questions would contain both literal and inferential comprehension questions (Carnine et al., 1997). Furthermore, factual questions are more likely to lead to shallow comprehension processing, while higher level questions (e.g., inferences) are more likely to lead to deeper comprehension

processing (Peverly & Wood, 1999). Given this research evidence, the "most frequently" used comprehension assessment, factual questions, may not be the "best" assessment to measure comprehension. The second most frequently used comprehension assessment was retelling. Some researchers, such as Johnston (1983), argued that "retelling is the most straightforward assessment of the result of text-reader interaction" (p. 54). However, there have also been several critical issues raised related to using retelling as a valid and reliable comprehension assessment. The validity of using retelling as an assessment of reading comprehension is still in need of further research (Gambrell, Koskinen, & Kapinus, 1991). Also, the reliable procedures of the story retelling assessment has not been firmly established (Kalmbach, 1986). Given that the validity and reliability of the two most frequently used comprehension assessments were not firmly supported by research literature, it led to a question: "What would be a valid and reliable assessment to adequately measure reading comprehension?" In this study, the WRMT-R-Passage Comprehension was used to measure comprehension. Although the WRMT-R-Passage Comprehension is considered to be one of the best measures currently available to assess comprehension, it may not be an ideal assessment to adequately measure reading comprehension. Thus, future research should pursue the development and refinement of valid and

reliable comprehension assessments that adequately measure the construct of reading comprehension.

This study had one independent variable with two levels--CACSR and a comparison sample of a typical language arts resource class. Since CACSR was developed to incorporate CSR strategies, it would be a reasonable empirical research question to compare the effects of CACSR with CSR on the reading comprehension of students with LD. Without having CSR as a comparison condition in this study, whether CACSR is more effective than CSR or vice versa is unknown. Thus, future research comparing effects of three conditions (CACSR, typical CSR, comparison condition) on comprehension of students with LD is warranted.

Vocabulary is critical to reading comprehension (National Reading Panel, 2000). The targets of the "click & clunk" strategy are two-fold: (a) comprehension monitoring, and (b) vocabulary development. A previous CSR study examined the effects of CSR on vocabulary and revealed that vocabulary performance of students with reading difficulties significantly increased after the CSR intervention (Klingner & Vaughn, 2000). In this study, however, vocabulary performance was not included as a dependent measure. Future research examining effects of CACSR on vocabulary of students with LD is recommended.

This study was initially planned to train a classroom teacher to use CACSR and have the teacher implement CACSR as his class practice. However, due to the concern with the fidelity of implementation, CACSR was implemented by the investigator. According to Talbott et al. (1994), researcher-delivered interventions were associated with significantly higher effect sizes than teacher-delivered interventions. Thus, it is recommended that future research examine (a) the effects of a teacher-delivered CACSR on comprehension of students with LD, and (b) the extent to which teachers effectively implement CACSR as part of their routines.

Finally, since the intervention in this study occurred approximately 25 times in 12 weeks (a total of approximately 20 hours), a more extensive examination of the effects of CACSR is recommended. Although the duration of 12 weeks can be argued as a relatively long intervention study, this duration may not be long enough for those high school students with LD who have experienced reading comprehension difficulties during their school lives.

Limitations of the Study

Several limitations of this research study may have influenced the effects and the interpretations of the study. As with most school-based intervention research, the findings should be interpreted in light of the limitations of this study.

Although this study attempted to avoid some of the methodological flaws in previous school-based research, it still contains several limitations, described below.

First, obtaining a large sample of students with LD at the high school level and obtaining permissions from schools, teachers, and parents was challenging. Although extensive efforts to obtain an adequate sample size were made, the obtained sample size was smaller than expected. The total number of 23 students (n = 14 in CACSR and n = 9 in comparison) was the sample size that could be engaged in the "controlled' study. The small sample size in this study dramatically reduced the power to detect statistical significance.

Second, school-based intervention research rarely provides opportunities for random assignment of participants to each condition. As with most school-based intervention research, random assignment of participants to each condition could not be utilized in this study. This study could only be conducted through random assignment of student cohorts by section to each condition. In this study, pre-experimental equivalence was established on the demographic variables and the pretest measure of outcome (the WRMT-R-Passage Comprehension).

Third, obtaining adequate measures of reading comprehension has been an on-going challenge in conducting intervention studies in the area of reading comprehension. Although the WRMT-R-Passage Comprehension may not be an

ideal measure to assess reading comprehension, it is one of the best measures currently available. Thus, the WRMT-R-Passage Comprehension was selected as a dependent measure for this study. However, the WRMT-R- Passage Comprehension appeared not to be suitably proximal to CACSR, the independent variable in this study.

Fourth, the sustainability and generalizability of effects of CACSR on comprehension of students with LD is unknown because this study did not conduct follow-up or transfer tests.

Fifth, while there were a sufficient number of computers available in the participating school, the computers were fairly old, with only 32MB memory. The low quality of computers caused delay of instruction of CACSR due to low speed and frequent crashes. Furthermore, the delay of instruction using CACSR often led to students' behavioral problems (e.g., disturbing other students while waiting for the program to restart), and to students' complaints or reduced motivation.

Summary

The purpose of this study was to examine the effects of CACSR on reading comprehension of high school students with LD in comparison with a comparison sample of a typical language arts class. In addition, the study attempted to examine students' perceptions about CACSR.

The results of this study revealed that there was no statistically significant intervention or intervention by time interaction effects. However, there was a statistically significant time effect, indicating pretest to posttest improvement on passage comprehension among all participants. Although differences between the two groups were not statistically significant, the effects of CACSR appear to be practically significant based on the obtained effect sizes. When considering several issues associated with the limitations of this study, the findings of this study indicate that CACSR has the potential to be a promising instructional means of enhancing reading comprehension for high school students with LD. Furthermore, an analysis of student interviews revealed that students generally expressed favorable perceptions about CACSR. Thus, this study contributes to the small but growing knowledge base on teaching reading comprehension to high school students with LD.

Illustration 3.1

A Main Menu

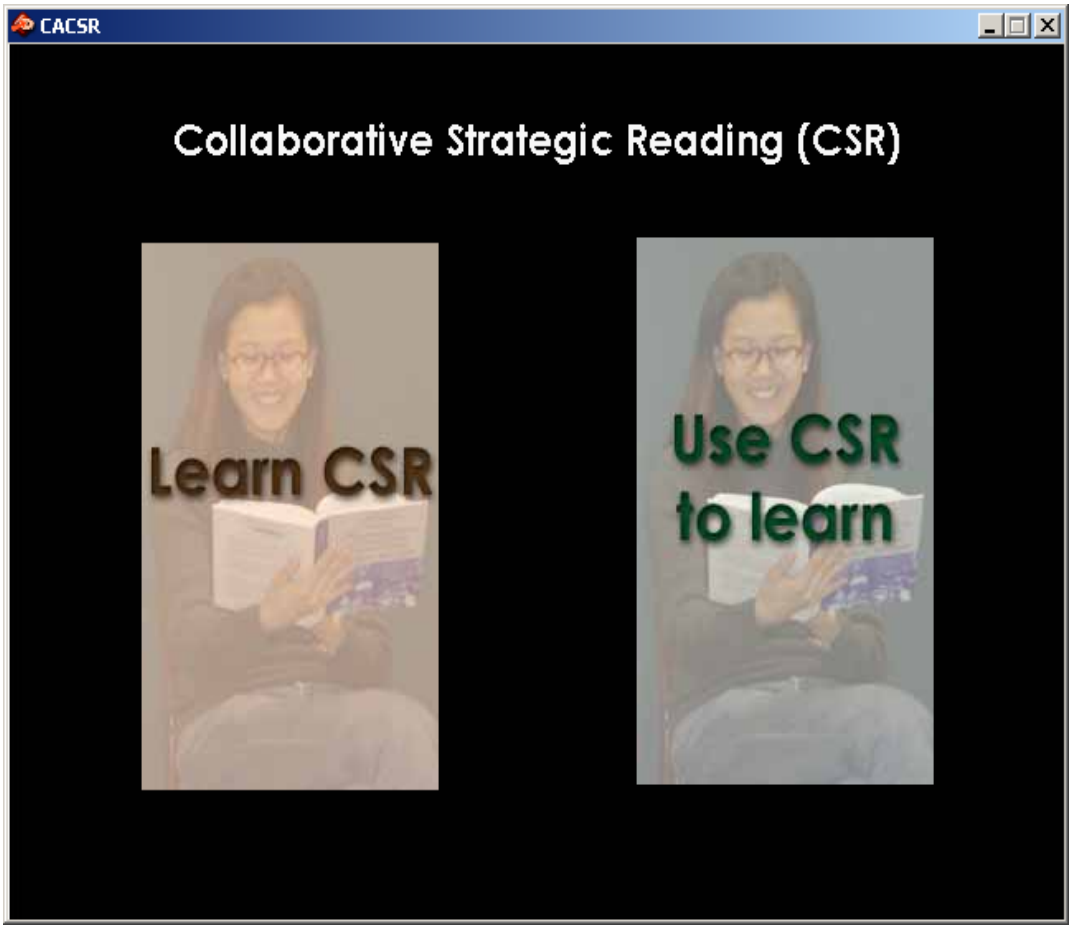


Illustration 3.2

A Learning CSR Menu

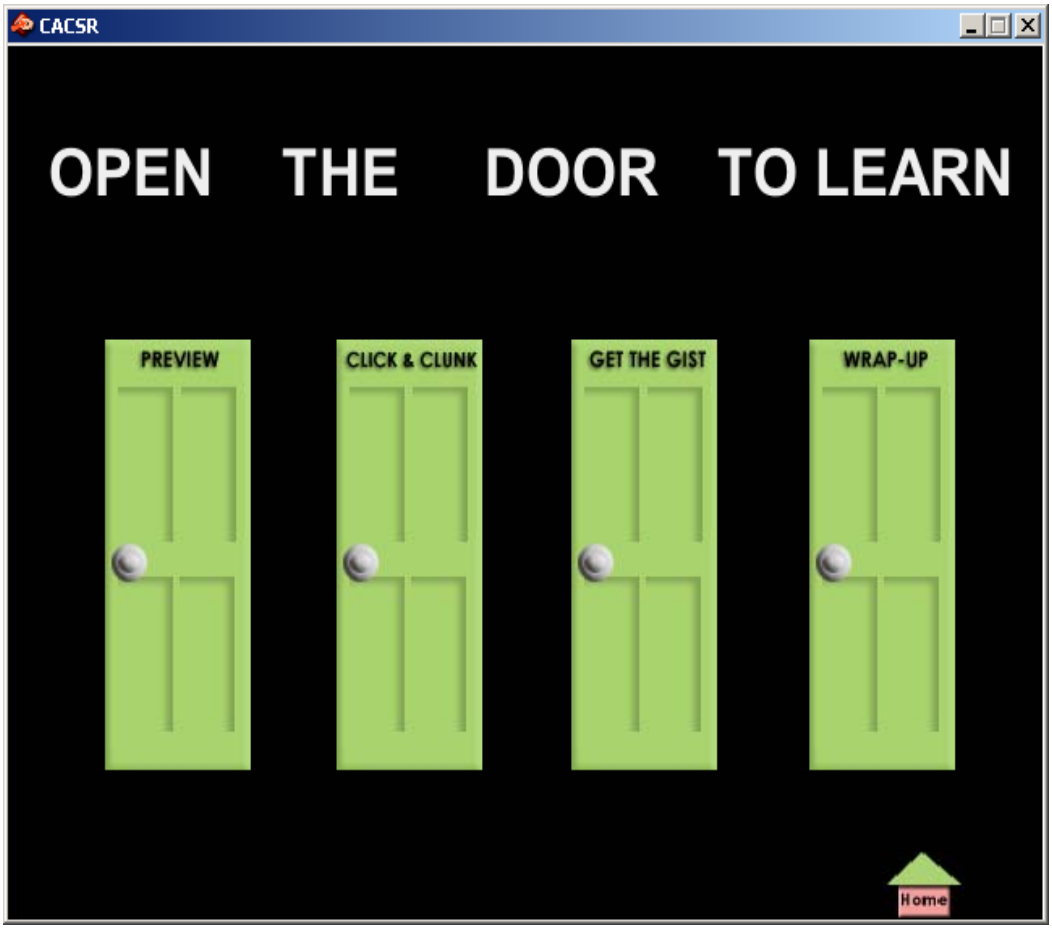


Illustration 3.3

What, When, Why, and How Section (Wrap-Up)

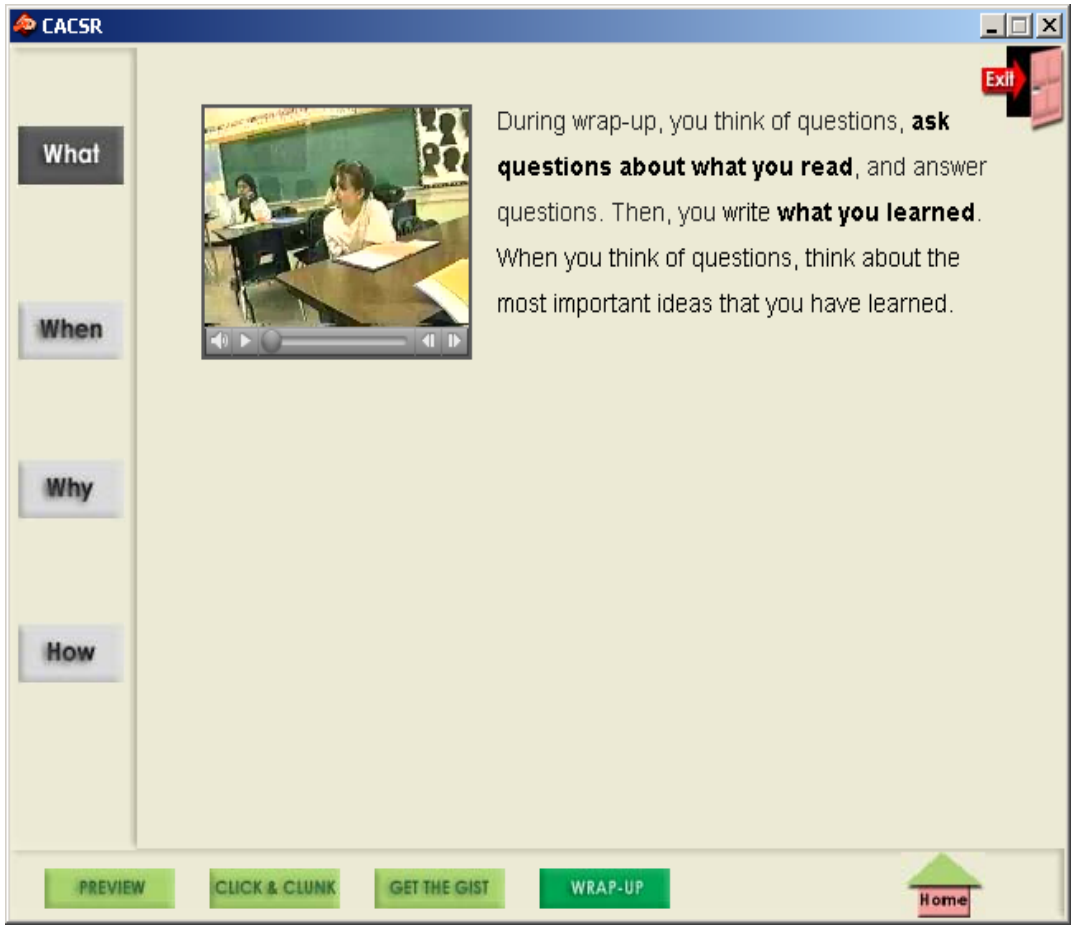


Illustration 3.4

An Example of the Overview (Preview)

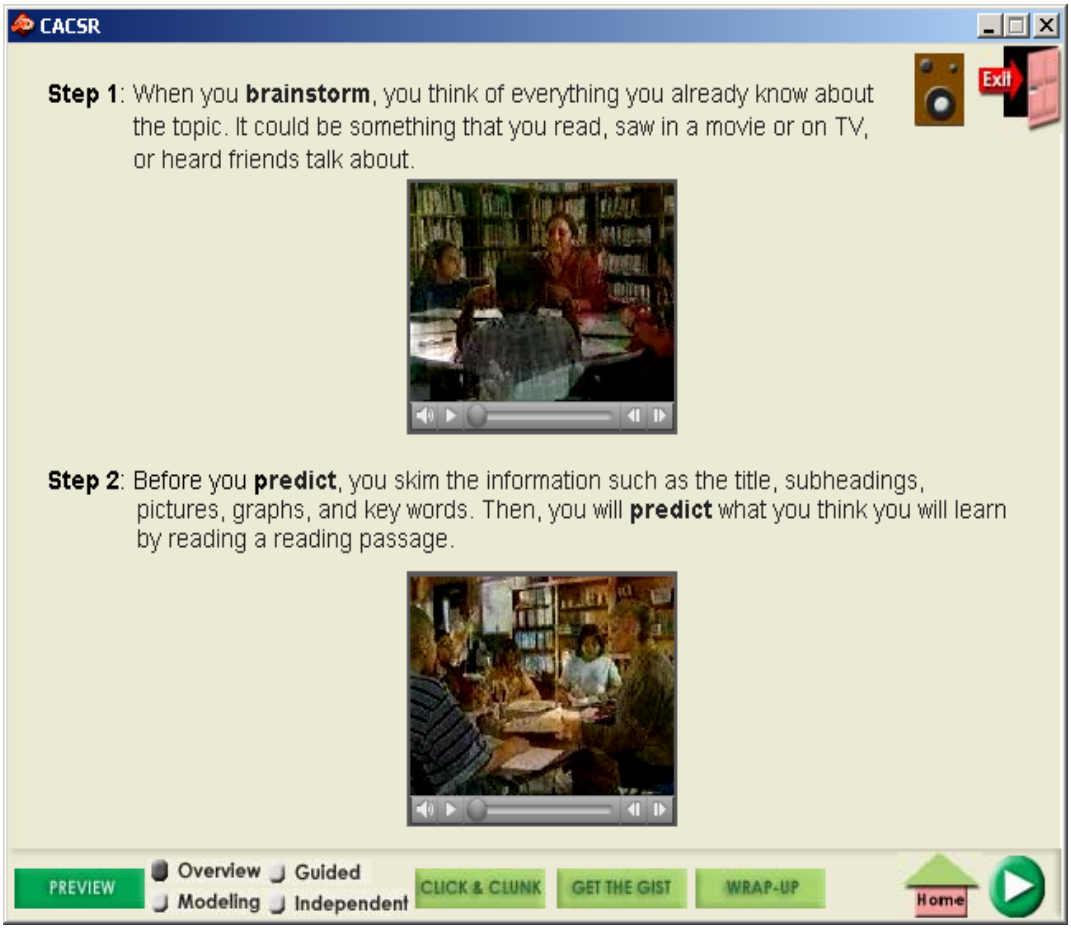


Illustration 3.5

An Example of the Modeling (Click and Clunk)

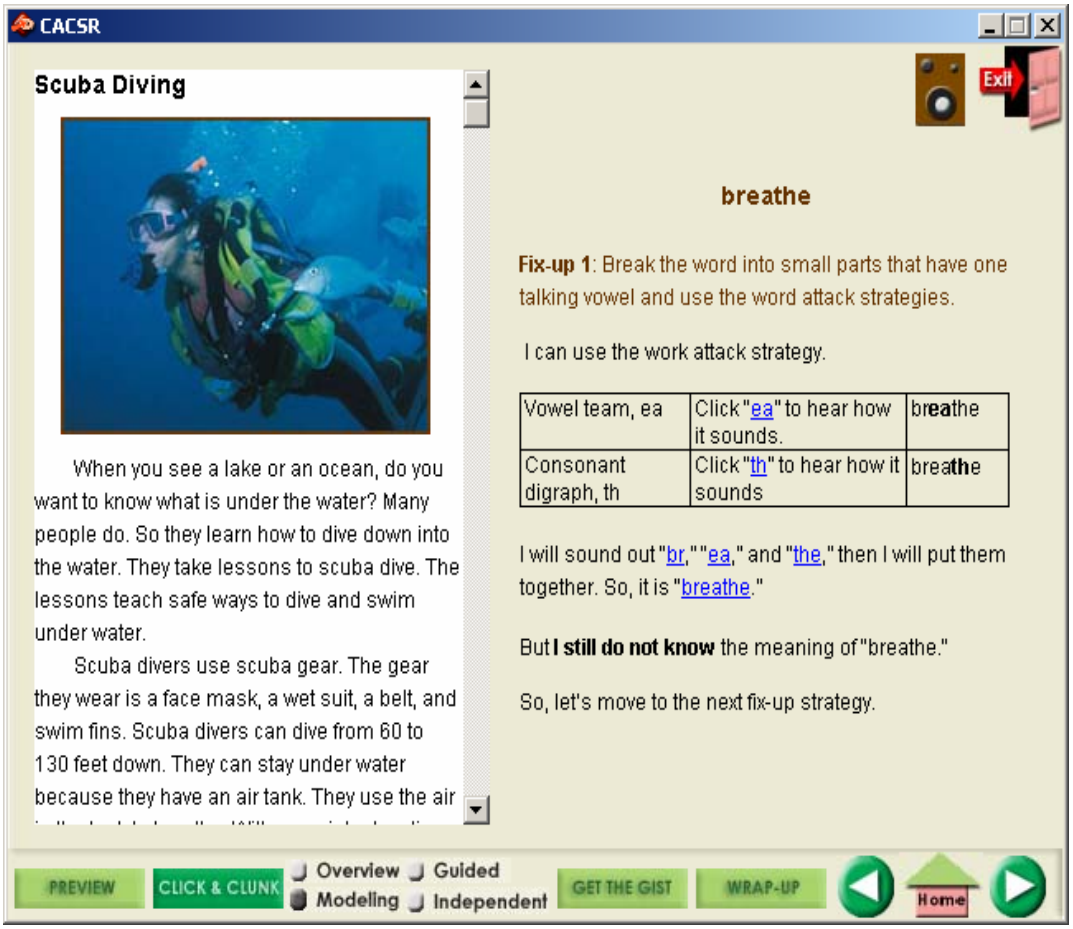


Illustration 3.6

An Example of the Guided Practice (Get the Gist)

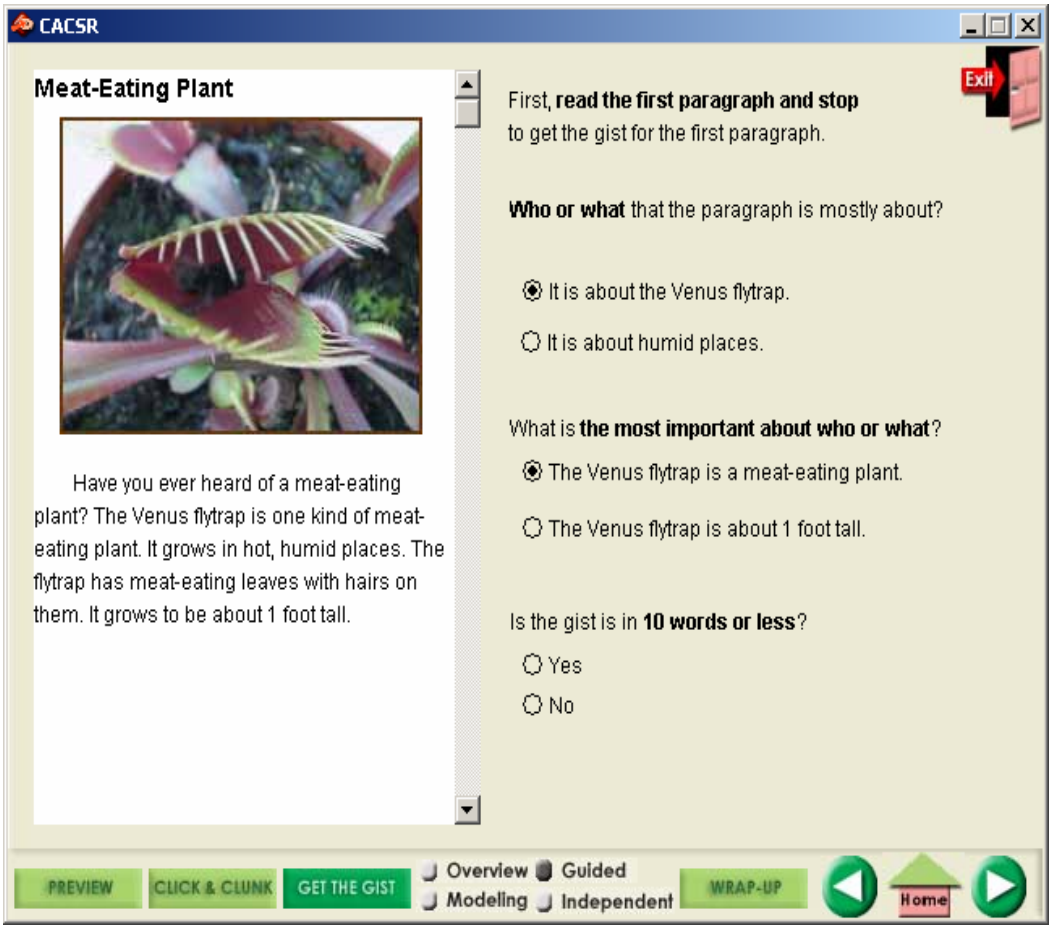


Illustration 3.7

An Example of the Independent Practice (Wrap-Up)

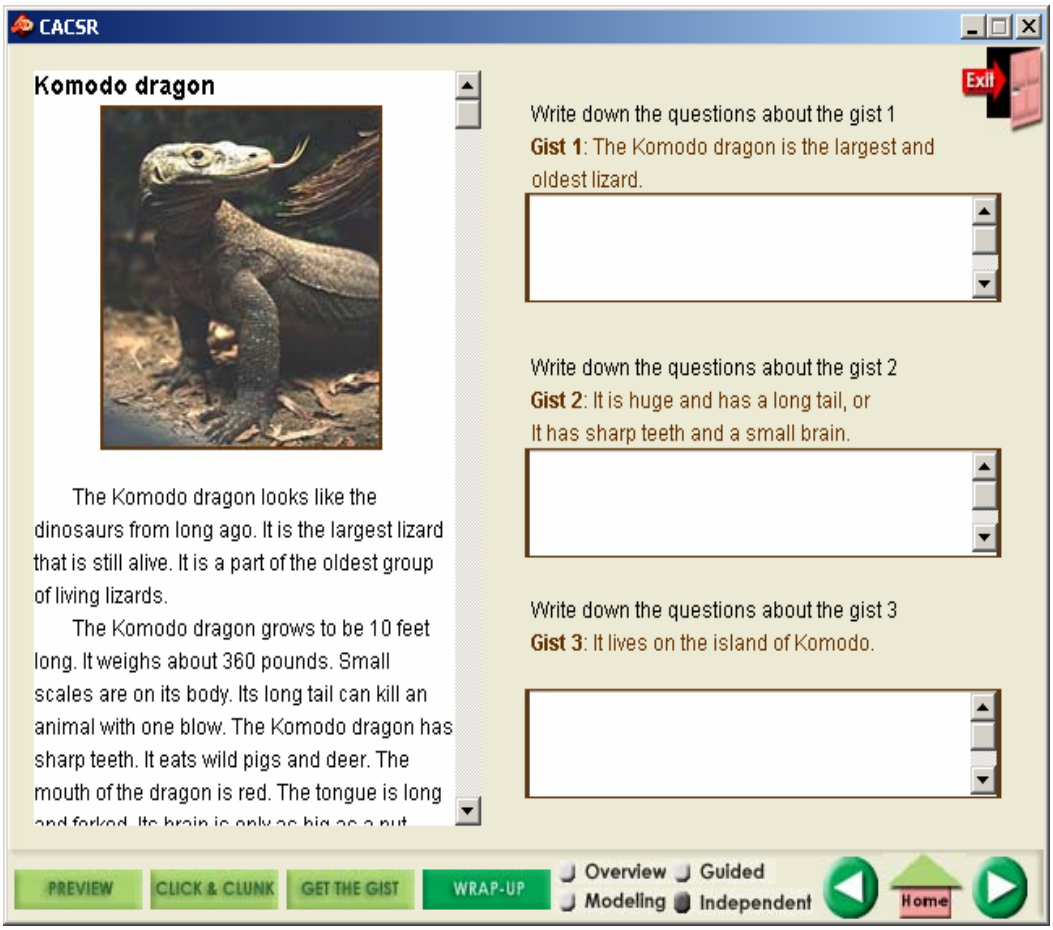


Illustration 3.8

A List of All Reading Passages at Reading Level 6

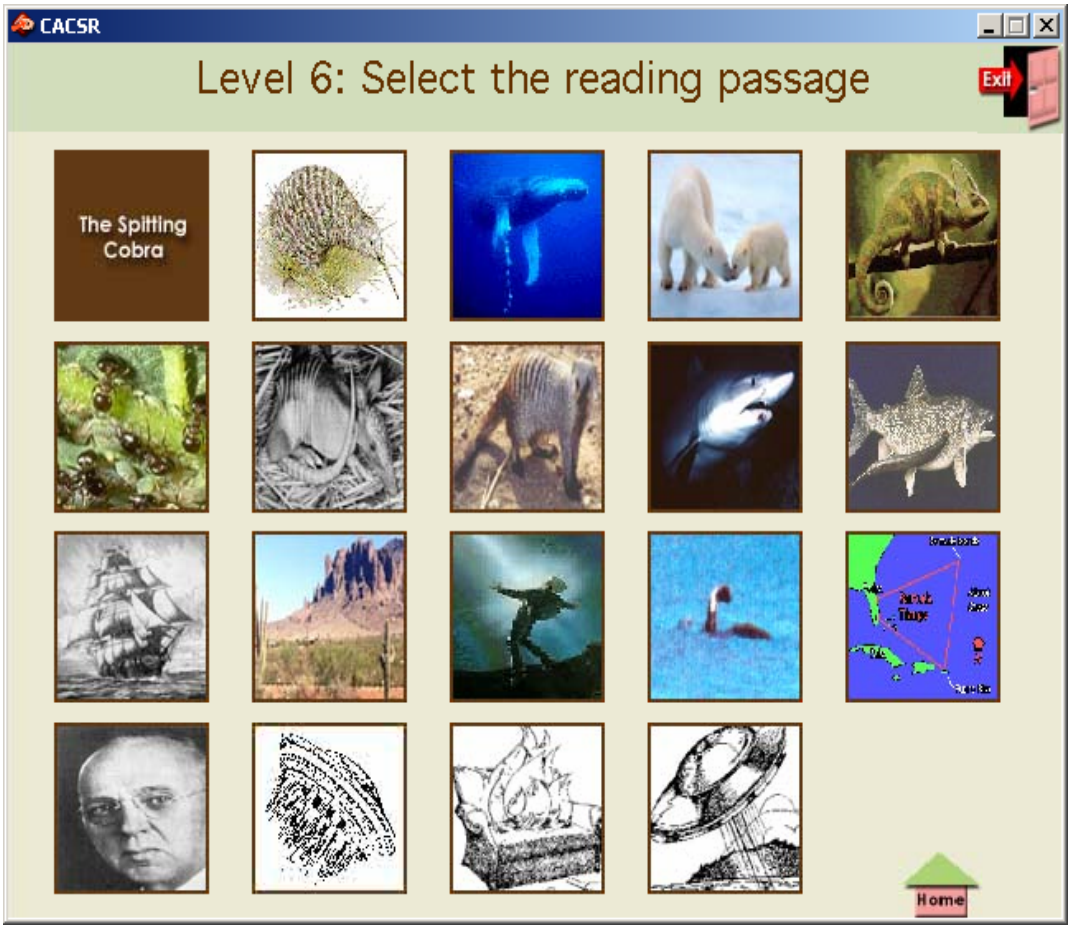


Illustration 3.9

An Example of the Reading Passage

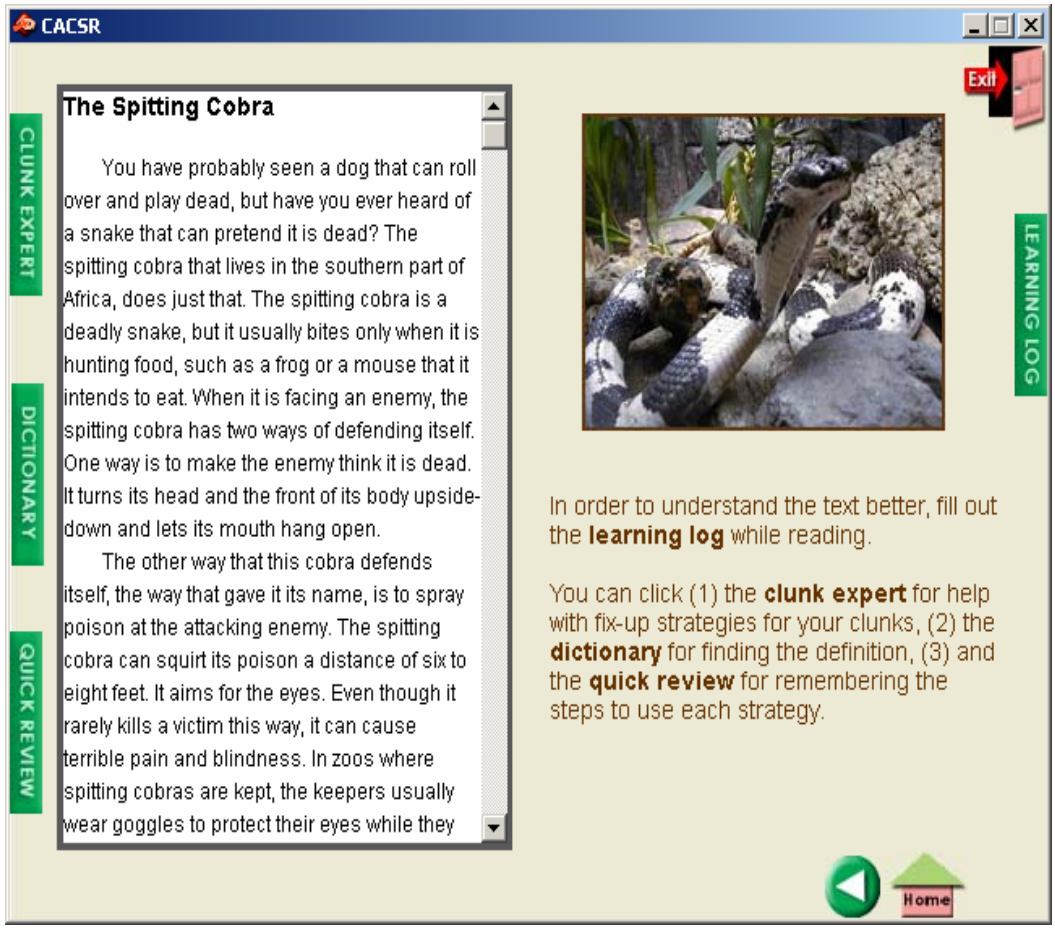
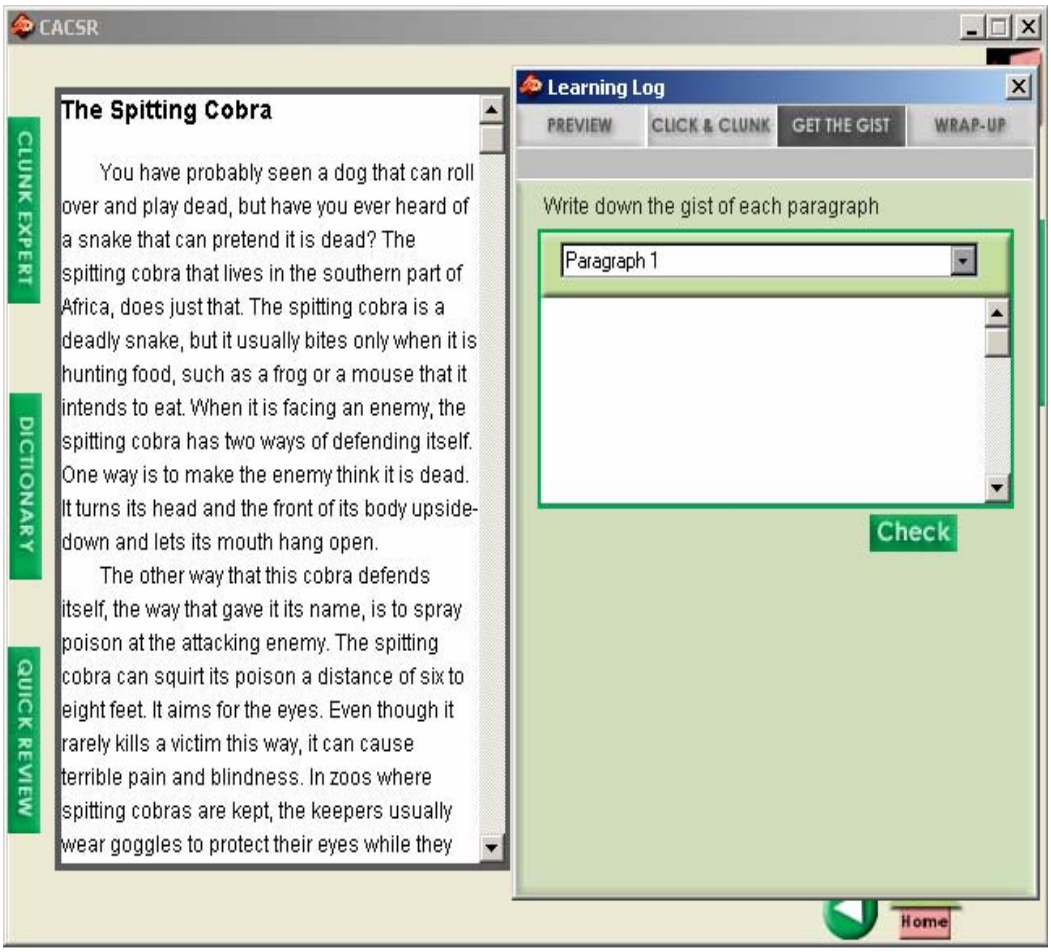


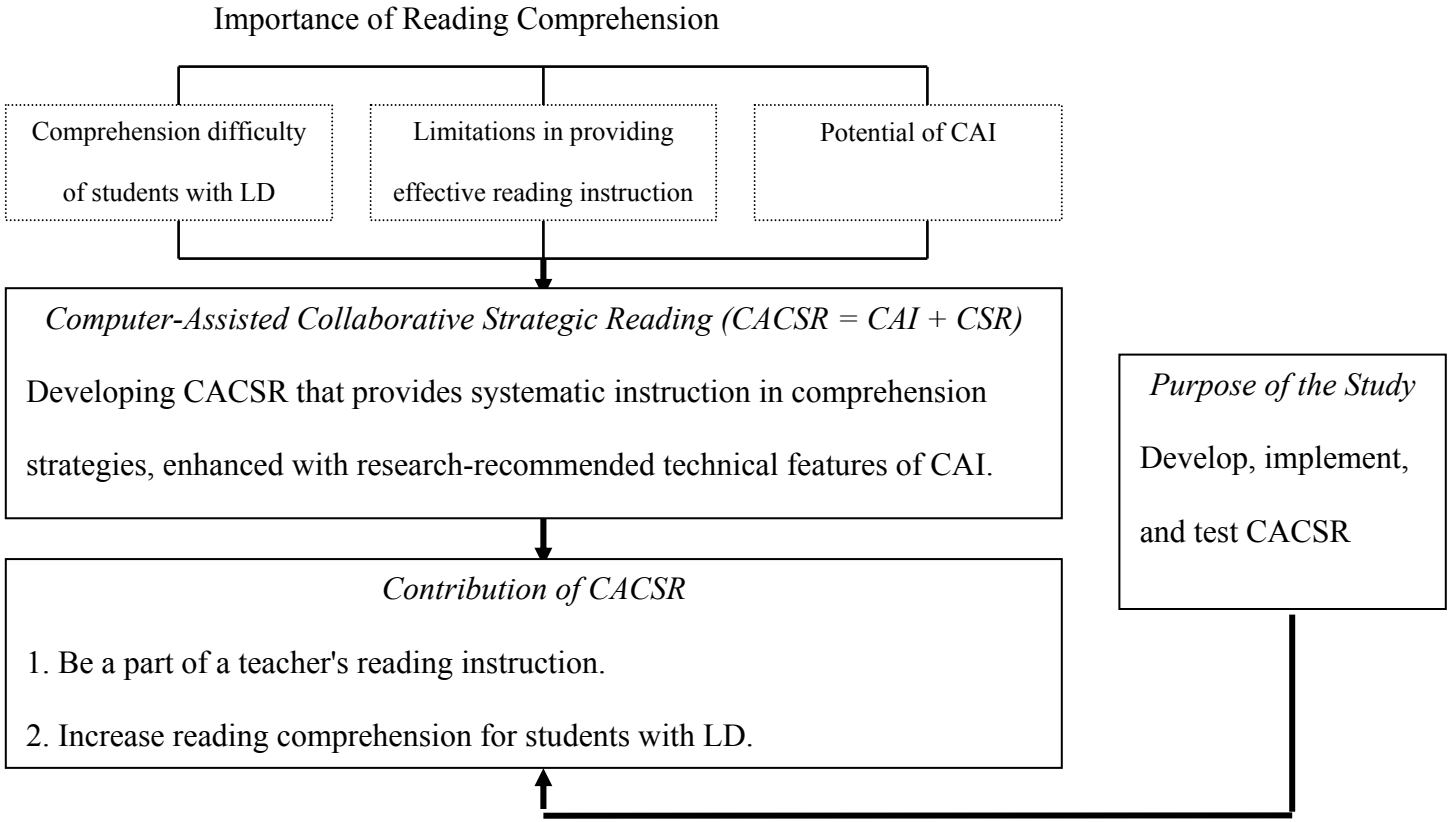
Illustration 3.10

An Example of the Learning Log



Appendix A

The Rationale for the Study



Note. CACSR = Computer-Assisted Collaborative Strategic Reading. CAI = Computer-Assisted Instruction. CSR = Collaborative Strategic Reading.

Appendix B

Summary of Interventions Using Collaborative Strategic Reading (CSR)

Study/ Participants/ Purpose	Intervention	Measure/Effect size	Mean Effect Size
Klingner & Vaughn (1996): 26 ESL students with LD in seventh- and eighth grades. *Purpose*: To examine the effect of reciprocal teaching on reading comprehension.	• Pre/posttest multiple treatments design. • Modified reciprocal teaching: While students were reading passages, they learned the six strategies: (a) predict, (b) brainstorm, (c) clarify words and phrases, (d) highlight the main idea, (e) summarize the main idea(s) and important detail(s), and (f) ask and answer questions. • Phase I: All students received 15, 40-minute modified reciprocal teaching instruction sessions in groups of 6 or 7 students each day. The procedure was: purpose-setting statements; researcher's modeling of the entire process of reading a passage and applying the strategies; involving students in discussions; students' taking turns leading discussions in the role of teachers with researcher's assistance; and students' playing roles as teachers with researcher's minimal assistance. • Phase II: Students were assigned to either cross-age tutoring group or cooperative learning group.	*Pre vs. Post* GMRT-Comprehension for tutoring: 0.54 WJTA-Passage Comprehension for tutoring: 1.31 Strategy interview for tutoring: 1.25 GMRT-Comprehension for cooperative learning: 0.55 WJTA-Passage Comprehension for cooperative learning: 0.88	0.91

	In cross-age tutoring group, students tutored younger students in comprehension strategies for 12, 35-40 minute instruction each day. In cooperative learning group, students implemented the comprehension strategies for 12, 35-40 minute instruction each day.	Strategy interview for cooperative learning: 0.91	
♦ Klingner, Vaughn, & Schumm (1998): 141 fourth-grade students (59 males & 82 females). *Purpose*: To examine the effects of CSR on reading comprehension.	• Pre/posttest treatment/control design. • Each of classes was assigned to (a) intervention group (n = 85) or (b) control group (n = 56). • Same content was used in both groups. • Intervention group (T): Students received CSR instruction in a following procedure: (a) the investigator introduced CSR; (b) the investigator modeled how, why, and when to use strategies; (c) students had opportunities to practice using the strategies; (d) small groups of students took turns modeling the CSR process; and (e) students used CSR in a heterogeneous group. • Control group (C): Students were not taught CSR. The investigator followed the guidelines in the teacher's manual. A typical instruction procedure included: (a) the investigator introduced key vocabulary; (b) students examined and discussed pictures; (c) students read the text; (d) the investigator summarized the contents; and (e) the investigator asked questions.	*T vs. C* GMRT-Comprehension: 0.44 Content measure: 0.12	0.28
* Klingner, Vaughn, Hughes, Schumm, &	• Pre/posttest single-group design. • Professional development: Teachers participated in	*Pre vs. Post*	0.78

Elbaum (1998) 114 students in grades three through six, including 25 students with LD *Purpose*: To examine the effect of a multicomponent intervention on reading.	4 all-day workshops to learn 4 instructional practices: (a) writing process approach, (b) CSR, (c) classwide peer tutoring, and (d) making words. • Implementation of instructional practices: Teachers implemented the instructional practices with their students. Teachers and researchers met after school once a month for 2 hours to problem-solve and share ideas about the implementation of the instructional practices.	BASS-Reading: 0.78	
Klingner & Vaughn (2000): 37 fifth-grade students, including 8 low-achieving students. *Purpose*: To examine the effects of CSR on students' oral reading, use of comprehension strategies, procedural discussion, and vocabulary.	• Pre/posttest single-group design. • Phase I (Learning CSR): An investigator taught CSR to the classroom teacher during an all-day workshop and conducted five demonstration lessons in the teacher's classroom. The procedure included: (a) the investigator explained the purpose of CSR and modeled the entire CSR, (b) the investigator provided explicit instruction in how to implement CSR, (c) the investigator assigned students to 4 groups, each including at least 2 high- or average-achieving students & at least 2 LEP students; and (d) the teacher and students took over the responsibility while the investigator continued visiting the class. • Phase II (Implementing CSR): CSR was applied into science instruction (two chapters about the human body) and implemented in 2 or 3, 30-40	*Pre vs. Post* Vocabulary test for ch. 14: 1.33 Vocabulary test for ch. 15: 1.66	1.50

	minute sessions per week for 4 weeks.		
* Bryant, Vaughn, Linan-Thompson, Ugel, Hamff, and Hougen (2000): 60 sixth-grade students, including 14 students with LD and 17 low-achieving students. *Purpose*: To examine the effects of multicomponent reading intervention on word identification, fluency, and comprehension.	• Pre/posttest single-group design. • Multicomponent reading intervention: Consisted of DISSECT (word identification), PR (fluency), and CSR (content area comprehension). • Professional development: Content area and special education teachers were taught multicomponent reading intervention through three all-day workshops (one strategy per workshop); following each workshop, workshop leaders provided co-teaching and modeling to classroom teachers to support implementation; and meetings between teachers and researchers twice a month • Implementation procedure: The procedure included: (a) pretesting, (b) describing and modeling the strategy, (c) having students practice the strategy's step, and (d) having students apply the strategy. Each strategy was implemented two or three times a week for 16 weeks.	*Pre vs. Post* Reading comprehension test: 0.22 TORF: 0.67 WISVPC for LD: 0.64	0.51
Vaughn, Chard, Bryant, Coleman, Tyler, Thompson, & Kouzekanani (2000): 111 third-grade students, including 16 students with RD. *Purpose*: To compare	• Pre/posttest multiple treatments design. • Students were assigned to CSR (n=55) or PR (n=56). • Professional development: Teachers were assigned either CSR or PR groups based on their preference and sampling of students. Professional development was provided separately for each group. Teachers received 3-hour initial training, a 2-hour booster session prior to implementation, co-	*Pre vs. Post* GORT–3-Rate: 0.35 GORT–3-Accuracy: -0.03 GORT–3-Comprehension:	0.33

the effects of CSR with partner reading on fluency and comprehension.	teaching and modeling in the classroom, and support group meetings. • Implementation in classrooms: Teachers modeled the procedures to the entire class. Then, students worked in pairs. Each strategy was implemented two to three times a week for 12 weeks.	-0.16 Correct Words Per Minute: 1.18	

Note. CSR = Collaborative Strategic Reading. LD = Learning Disability. ESL = English as a Second Language. RD = Reading Disability. T = Treatment. C = Control. Pre = Pretest. Post = Posttest. GMRT = Gates-MacGinitie Reading Test. WJTA = Woodcock-Johnson Tests of Achievement. BASS = Basic Academic Skills Samples. LEP = Limited English Proficiency. DISSECT = *D*iscover the context, *I*solate the prefix, *S*eparate the suffix, *S*ay the stem, *E*xamine the stem, *C*heck with someone, *T*ry the dictionary. PR = Partner Reading. TORF = Test of Oral Reading Fluency. WISVPC = Word Identification Strategy Verbal Practice Checklist. GORT = Gray Oral Reading Test-3.

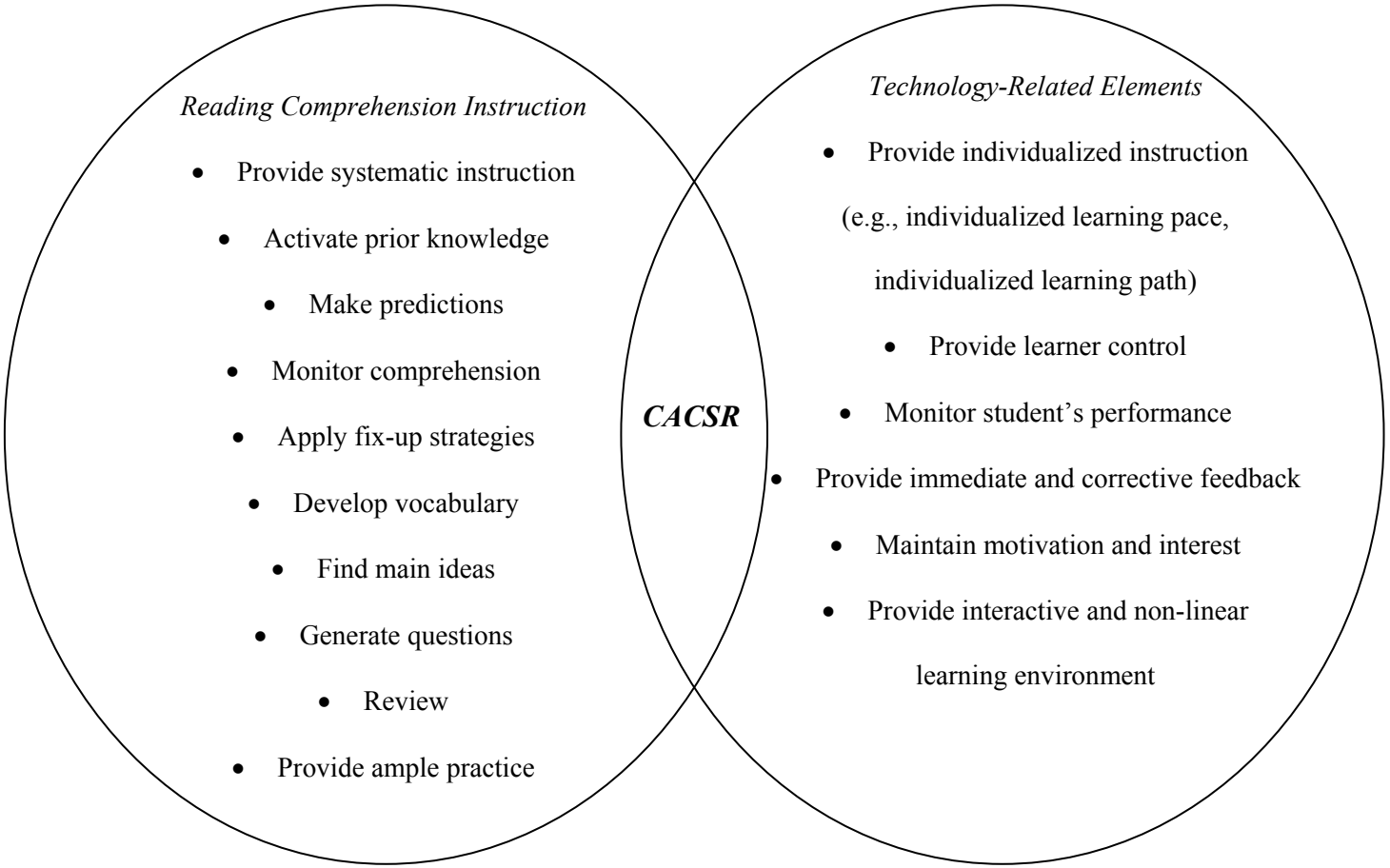
Appendix C

Instructional System Development Model

Phase	Sub-components for each phase
Phase I: Analysis	Define goal
	Define learners
Phase II-1: Development-Design	Construct content
	Design objectives and text items
	Select instructional approach and strategies
	Select media
	Select instructional setting
Phase II-2: Development-Production	Create initial flowchart
	Create storyboards
	Create detail flowchart
	Author the program
Phase III: Evaluation	Pilot test

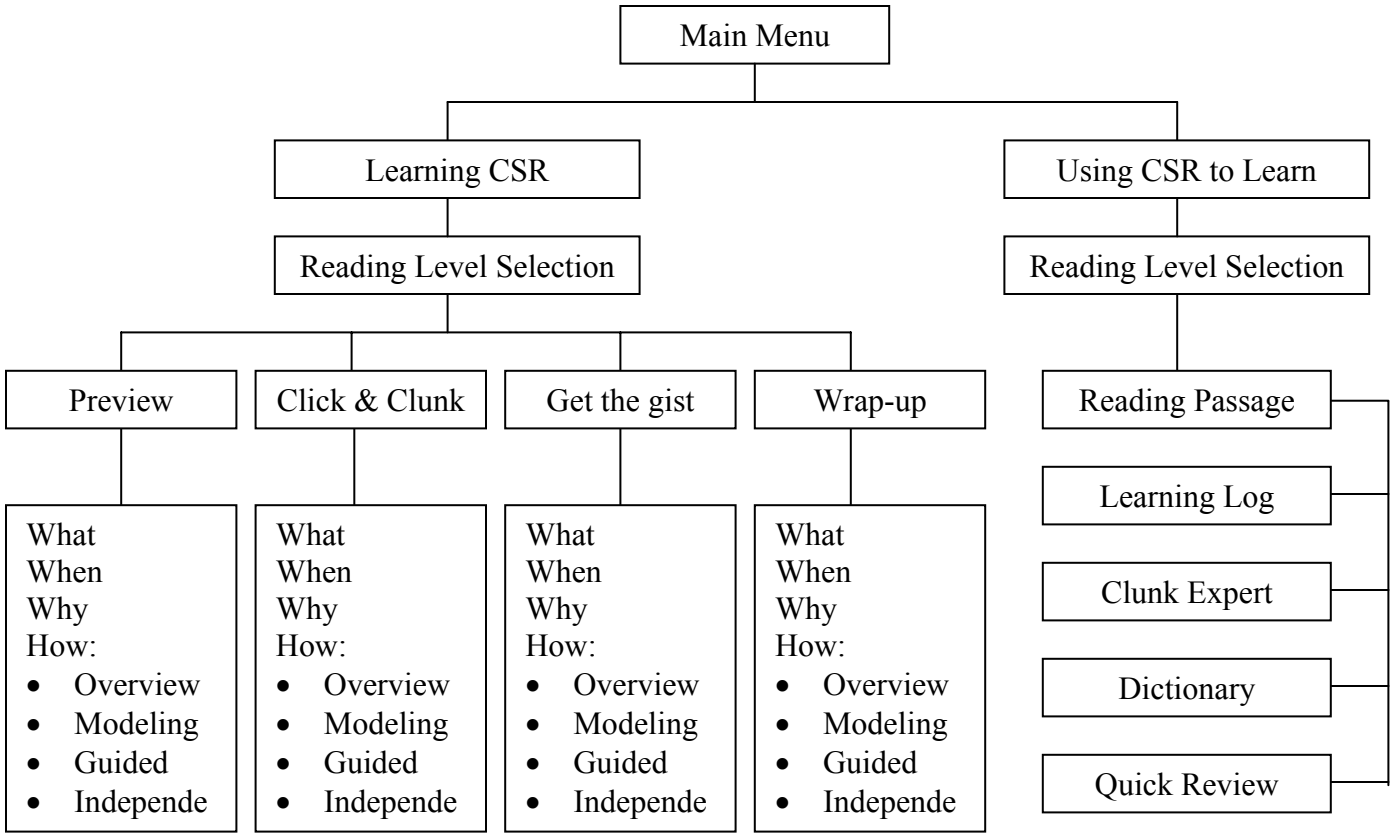
Appendix D

Conceptual Framework for Computer-Assisted Collaborative Strategic Reading (CACSR)



Appendix E

The Structure of Computer-Assisted Collaborative Strategic Reading (CACSR)



Appendix F

Student Interview: Perception about the Intervention

Name _____ Grade_____ Age _____

Introduction: I would like to ask you some questions about your perceptions about the computer-assisted collaborative strategic reading program. To make sure that I write down accurately what you say, I would like to tape-record your answers. The recorded tape will be erased after I transcribe your answers. I will not share your answers with your teacher or parents.

1. In general, what did you think of the computer-assisted strategic reading program?

2. Were there parts of the computer-assisted strategic reading program that you really liked?

3. Were there parts of the computer-assisted strategic reading program that you didn't like very much?

4. How was the computer-assisted strategic reading program helpful? (Probe)

5. What parts of the computer-assisted strategic reading program were not helpful? (Probe)

6. How does the computer-assisted strategic reading class compare to other classes you take?

7. Would you continue with the computer-assisted strategic reading class? Why or why not?

8. Do you feel that your reading has improved since we began? In what ways?

9. Has anyone else (teacher, parent, friends, aide) noticed an improvement in your reading? What did they say?

Appendix G

Fidelity of Implementation Checklist for a Student

Observer: _____ Date: _____

Classroom: _____ Class Time: _____

	Not Observed	Observed But Not Done Well	Observed & Done Well
A student is involved in brainstorming activity before reading.	1	2	3
A student is involved in predicting activity before reading.	1	2	3
A student reads a passage.	1	2	3
A student identifies clunk.	1	2	3
A student uses at least one fix-up strategy when they have a clunk: (a) break the word into small parts that have one talking vowel, (b) reread the sentence with, before, and after the clunk, (c) look at the prefix and suffix, and (d) break the word apart into smaller words that they know.	1	2	3
A student writes down gist in less than 10	1	2	3

words.			
A student generates questions.	1	2	3
A student is involved in reviewing.	1	2	3

Note. 1 = He or she does not engage in the activity when he or she is supposed to do. 2 = He or she engages in the activity in a limited way (e.g., he or she uses the strategy, but not correctly or comprehensively, or he or she is often off-task while using the strategy). 3 = He or she engages in the activity constantly and as it is supposed to be done. If the activity is not needed, disregard that item and do not include for calculating fidelity score.

Descriptive Information:

- Preview-Brainstorming:

  _____

  _____

- Preview -Predicting

  _____

  _____

- Click and Clunk:

  _____

  _____

- Get the Gist:

  _____

  _____

- Wrap-up-Generating questions:

  _____

  _____

- Wrap-up-Reviewing:

  _____

  _____

Others

- Was this class managed effectively?

1 2 3

not effective moderately effective highly effective

- Were there any behavior-related issues?

  _____

  _____

Appendix H

Fidelity of Implementation Checklist for a Teacher

Observer: _____ Date: _____

Classroom: _____ Class Time: _____

	Not Observed	Observed But Not Done Well	Observed & Done Well
A teacher provides direction on an activity at the beginning.	1	2	3
A teacher moves around the classroom to monitor students.	1	2	3
♦A teacher provides instruction, such as modeling or scaffolding, if needed.	1	2	3
♦A teacher answers the questions or provides feedback, if needed.	1	2	3
♦A teacher provides instruction, based on students' recorded data	1	2	3

Note. ♦ = If this activity is not needed, disregard this item and do not include for calculating fidelity score. 1 = A teacher does not implement. 2 = A teacher implements the activity, but not consistently throughout the lesson. 3 = A teacher implements the activity appropriately.

Descriptive Information:

_____

_____

_____

_____

Appendix I

Summary of Student Quotes to Support Themes

Overall Efficacy of CACSR
• I thought it was good because it helped me to learn more like how to read and read better and understand how to do paragraphs and find, you know, how to find the answers and things like that. • I thought it was, uh, it was different. It was learning, a different way of learning. It was pretty fun. • It was pretty good. It helped me with the reading and stuff, figuring out words, if I didn't understand the word. • Hmm, I think that, uh, that it was like, it could help teach you how to read and everything. • At the beginning, I kind of did not like it, I guess the first few levels I didn't like. But then after a while it got interesting, the stories did and it helped me...got all the way down. • Uh, it was different, nothing that I was expecting. I didn't know what it was going to be about or nothing. That's it. • Very good. It was a good program, because it taught us about how to find answers and stuff about the passage or whatever we were reading. • It was okay. It was kind of fun. I learned about stories I didn't know. • I think it was good. It...that you pick, like if you want to learn about the bears it tells you about the bears. If you want to learn about the ____, it tells you about the ____. Anything you want to know, it has it all on the computer. • It was sort of helpful. • It was okay, I kinda liked it. • It was all right. I liked it. It was all right because it gave me some new meaning for things, like, on Martin Luther King, I didn't know that much stuff about him. I knew stuff, but not that much, that I knew. Some of the stuff that I did know was wrong. • It was okay. It really didn't help me that much with the, to read more better, it really didn't.

Strategies of CACSR that Were Viewed as Helpful

Getting the Gist

- It made me think, actually because...you had to get ten words or less and sometimes you ran over so you actually had to think and reword.
- It would help you find, it helped you find an idea in your reading, if you understand what you are reading. You are reading and you, you read the first paragraph and then you stop, you get the main idea from that. You go to the next, so you won't have to read all the paragraphs and then go back.
- The gist part and then like, yeah, just the gist, that's like the main, not general questions, not the review or the wrap-up or whatever, it's just the gist part. That helps you out a lot.
- It (getting the gist) made me remember the stories that I had to read.
- Yeah, I liked the get the gist stuff.
- Sort of like the main idea.

Click & Clunk

- With figuring out the words, I guess. Like the, uh, I don't remember what it was called. Click and cluck. That. It helped me figure out words, like, read before the sentence and after the sentence to figure out the word.
- Some of the vocabulary was helpful. I had to go back and forth a couple of times.
- It helped you like figure out words you didn't know, you know.
- Uh, understand the words you are reading.

Preview

- And the preview, because you could go to the brainstorming and write down everything, write down what you know about the topic.

Strategies of CACSR that Were Viewed as Not Helpful

All Parts Helpful

- I can't say, all of it was, so it don't matter.
- I think all of it was helpful. Nothing was really not helpful.
- Everything was helpful.
- Hmm, I think none of the parts were because all of them seemed helpful to me and helped me understand it more.

Wrap-up

- Probably the, where you had to write the questions in each paragraph. I don't think that was helpful.
- Uh, probably writing the questions down. Making up questions.

- Uh, I didn't like the wrap up, 'cause, like because you have to, I don't like that test. It just took up more time to finish up other stories and stuff. It was just like, kind of like a waste of time but it kind of wasn't.

Click & Clunk

- It [click & clunk] really wasn't useful because you knew the word already, you didn't need it or you skipped it.
- Uh, figuring what the words actually meant, because when they use the big words, I don't know what they are saying.

Preview

- Like, it says write everything that you know about it and what you will learn.

Features of CACSR That Were Viewed as Helpful

Reading passages

- I liked a lot of the stories actually. There were no words that were actually hard for me to read or anything. It was like my level of reading.
- I liked learning about the different animals and stuff.
- I liked all the stories that they had because it mainly had a lot of stuff on animals. Me personally, I'm an animal freak. I love animals. I know a lot of stuff about, and there was some of the stuff that I didn't even know that I found out about .
- It was all right because it gave me some new meaning for things, like, on Martin Luther King, I didn't know that much stuff about him.

Reading level

- Because on a computer program you have all the way to level six. You have more levels, it's like more advanced and helps you learn more.
- There were no words that were actually hard for me to read or anything. It was like my level of reading.
- The different levels. It gets a little bit harder on the way up.

Ease of CACSR

- Uh, oh, you work on the computer and lessons, uh, I think it's more easier than other classes.
- I liked it because we get to, we don't really have to do no work and stuff, just go in there and do that. It's an easy grade.

Student choice to select reading passages

- You could pick the stories that you wanted to read instead of them picking them for you.

Features of the CACSR that That Were Viewed as Not Helpful

Reading passages

- The stories were too, they were too short.

Reading level

- Just the beginning levels. It was way too easy and I did not want to do it, but I did it.
- It was, some of it was too easy. It wasn't hard enough and challenging.

The number of sessions

- It got boring after awhile, constantly doing it…doing the same thing every day.
- It kind of got kind of boring at the end. We were doing it every single day....I got kinda bored.
- I would, but not as much as I did. Like, have it like maybe twice a week or something.

Typing

- Doing all that writing, that's what killed...typing....I don't like typing and stuff.

Comparison of the CACSR Class to Other Classes

Learning environment

- Because all you do is sit there and be bored and the teachers, they hand you work and all this stuff to do and usually they have boring lessons. In this class it wasn't boring because I got to work on the computer, which I like working on the computer and I got to listen to what the computer lady on the thing was saying and it helped me a lot.
- Everything is on the computer. You ain't got to sit there and just write and worry about what the teacher is going to say because you are reading instructions and whatever. You have teachers talking and I go to sleep. When teachers talk, I'm going to sleep.
- In English we just sit there and listen to the teacher talk and do worksheets and stuff like that.

Learning principle

- You can work at your own pace. You don't have to work with everybody else. You can just learn at your own speed.

- You are actually interacting with something that can help you figure out what you are trying to say and if you do something wrong you can always go back on the computer.
- Uh, more hands-on, get to use the computer and helps your reading.

Perceptions about Reading Improvement as a Result of CACSR

Vocabulary

- Like if I stumble over a word, I know to go back and read the sentence before and after.
- The bigger words, I can start sounding them out and reading them.
- It just kind of gave me a new vocabulary and stuff. Some of the words I couldn't say at first, now I can kind of say them a little if I try to.
- I can understand bigger words and read a little bit faster.
- Just my vocabulary.

Motivating to read

- It got me reading better. And, because in class I never used to, I never used to read and now when I'm in this class, I'm always reading. It just got me back into reading because I never used to read. Now I just started reading after I got into the program.
- I think it (my reading) has improved, it made me want to read more.

Comprehension monitoring

- I actually slow down when I read... actually understand what I read.
- Try to read the first paragraph only, then read a little bit.

Comprehension in general

- Since now I can read them and I can understand what I'm reading. My reading has been going really good and I'm actually like making like really good grades.

Other

- Uh, finding words faster.

Desire to Continue with Class

Challenge Themselves to Learn

- Just to learn more, to challenge myself
- See how far and see if it got harder, would it actually help me, or probably show other kids how to do it.

- It helps me learn but I would want to go higher.
- Maybe I would start reading a lot better than what I am right now.

Vocabulary

- Because it is helpful in whatever I do. [Probe]. Uh, just with figuring out the words, I guess. Like the, uh, I don't remember what it was called. Click and cluck. It helped me figure out words, like, read before the sentence and after the sentence to figure out the word.
- Because I could be like reading all them big words and be smart. I'm smart now, I'm just saying I'd be smarter.

Main ideas

- Because I will be able to do more work, not do more work, but, uh, learn how to read paragraphs and understand like what's the main parts of it and all that stuff.
- Learn more about it. All the sentences put together and reading....finding the main ideas.

Spelling

- So I can learn how to spell my words better.

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