EFFECTS OF COMPUTER-BASED AND PRINT-BASED FLUENCY INSTRUCTION ON STUDENTS AT RISK FOR READING FAILURE

By

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For Sean, Mom, Dad, and
Kemuel
Thank you for your love, encouragement, and
humor

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By

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The purpose of this study was to determine whether computer-assisted fluency instruction is as effective as print-based teacher-led fluency instruction for third-grade students experiencing delayed fluency development. An experimental pretest posttest group design was paired with a changing treatments single-subject design to answer several research questions. Participants in the group portion of the study (N = 50) were randomly assigned to one of three conditions: a print group, a computer-assisted text-equivalent group, and a computer-assisted time-equivalent group. The text-equivalent group was equivalent to the print group in that both groups were exposed to one fluency passage in a given 20-minute session. The time-equivalent group was equivalent to the print group in that both groups experienced fluency instruction during a given 20-minute period.

An analysis of covariance (ANCOVA) revealed no significant differences across groups on two of the three outcome measures (i.e., fluency and comprehension). An ANCOVA indicated significant differences between two of the three treatment groups in the area of vocabulary. Differences between the two computer treatment groups (i.e., text-equivalent and time-equivalent) favoring the time-equivalent group, may have occurred because participants in

the time-equivalent group received more exposure to vocabulary words than those students in the text-equivalent group. Participants in the single subject portion of the study (N = 3) were exposed to all three conditions. Visual analysis of data from the three participants who were exposed to all three conditions yielded varied results. Two of the three students experienced increased rates of on-task behavior across all three treatment groups. The remaining student was more responsive to the time equivalent computer-assisted condition than the other two conditions. The results from the three participants who were involved in the single subject portion of the study suggest that different students vary in how they engage with computer-assisted instruction. Implications for future research include: designing systematic evaluations of the characteristics of students who exhibit high engagement with computer-assisted instruction (CAI), evaluating the cost effectiveness of CAI as compared to more traditional forms of instruction, and evaluating the use of CAI as a supplemental form of instruction.

CHAPTER 1
INTRODUCTION

Reading achievement is essential for overall school and societal success (Adams, 1990; Brandt, 2001; Snow, Burns, & Griffin, 1998). Good readers experience an advantage over poor readers in that they are more likely to also do well in content areas, such as mathematics, science, and social studies (Hall, Hughes, & Filbert, 2000). School success significantly influences the extent to which students are able to advance socially and economically once they enter into society (Snow, et al., 1998). Because of the positive long term effects of reading success, it is important to know what instructional factors contribute to good reading. The National Reading Panel (NRP) (2000) has established five key components of reading instruction and makes recommendations for best instructional practices in each of the components.

Fluency

The ultimate purpose for learning to read is to comprehend text. Reading comprehension has been identified as "essential to both academic and life-long learning" (National Reading Panel, 2000, p. 4-1) and is listed as one of the NRP's five key components of reading instruction. Although, the remaining four components of reading instruction (e.g., phonemic awareness, phonics, fluency and vocabulary) also make significant contributions to comprehension development, many researchers have found that reading fluency is most highly correlated with comprehension (Chard, Vaughn, & Tyler, 2002; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Torgesen & Hudson, 2006) especially in the primary grades (Schatschneider, et al., 2005).

Reading fluency can be defined as reading effortlessly (rate), accurately (accuracy), and with proper expression (prosody) (Meyer & Felton, 1999). Reading rate refers to how quickly one reads, reading accuracy refers to the correct identification of words in connected text, and reading prosody refers to reading expressively using correct tone and intonation. Reading

fluency acts as a bridge between word recognition and comprehension (Johns & Berglund, 2002; Kuhn, 2004/2005; Kuhn, 2005; Schwanenflugel, et al., 2006). Because fluent readers do not focus their attention on decoding words it allows them to focus on text comprehension (NRP, 2000). Snow, Burns, and Griffin (1998) and Kuhn and Stahl (2003), attribute our ability to acquire meaning from printed text to quick and accurate word recognition ability and reading fluency.

In addition to increased comprehension, the ability to read quickly, accurately and with expression is a defining characteristic of good overall reading (Kiley, 2005). According to Kuhn and Stahl (2003) and Rasinski (2006) a strong correlation exists between reading fluency and overall reading achievement. Rasinski has also found that students who score well on standardized measures of oral reading fluency also score well on standardized measures of overall reading achievement such as the National Assessment of Educational Progress (NAEP). Because of the relationship that exists between oral reading fluency and overall reading achievement, Johns and Berglund (2002) and Rasinski have recommended that students, especially those who struggle, receive explicit instruction in oral reading fluency. This instruction can lead to increases in both reading fluency and in overall reading achievement.

A History of Oral Reading Fluency Instruction

Oral reading fluency instruction can be traced back to the colonial period (Rasinski, 2006). During that time, it was not uncommon to find that only one member of a household could read. Because of this, it was crucial that the person who could read be able to read aloud expressively to the rest of the family. At around the beginning of the 20th century, however, the push for oral reading began to dwindle (Rasinski). At this time, reading materials became more readily accessible than they had been in the past. In addition, reading scholars began to argue that oral reading resulted in too much emphasis being placed on the mechanics of reading which took

away from the meaning of the text (Rasinski). The increased likelihood that more members of a household could read and the decreased need for oral expressive reading led to an increased emphasis on silent reading.

This emphasis remained unchallenged until 1974 when a revolutionary theory, the theory of automatic information processing, was developed by Laberge and Samuels (Rasinski, 2006). According to this theory, struggling readers differ from good readers in some very fundamental ways. When struggling readers read, they spend the majority of their time trying to decode words which leaves little time for the actual understanding of text. Good readers, on the other hand, are more automatic in their decoding and word recognition ability. This allows for more time for actual understanding of the text. The theory of information processing brought about a significant question. Since successful reading fluency leads to increased comprehension, how can we help struggling readers improve their reading fluency? Researchers have found that direct oral reading fluency instruction in the form of repeated readings, fluent models, assisted reading, and partner reading could have a significant impact on the reading fluency of struggling readers (Kuhn & Stahl, 2003; Rasinski, 2000; Samuels, 1979).

Oral Reading Fluency Instruction Today

A recent study performed by the National Assessment of Educational Progress (NAEP) found that 44% of a representative sample of the nation's fourth graders scored low in fluency (NRP, 2000). Students who scored low in fluency also scored low in comprehension (NRP). According the NRP, students, especially those who struggle with reading, need explicit instruction in oral reading fluency. This instruction should begin at around the end of first grade when students have basic word recognition and decoding skills (Rasinski, 2003). Oral reading fluency instruction should take the form of guided repeated oral reading which involves re-reading text with guidance and feedback from a fluent model.

Guided repeated oral reading has been linked to increases in word recognition, speed, accuracy and overall reading fluency (Rasinski, 2003). It can be practiced through the use of a variety of activities including—adult modeling, partner reading, and computer-assisted reading. Adult modeling can be facilitated by a parent, teacher, aide, or tutor. It involves the teacher modeling fluent reading of text for students and then providing guidance and feedback during student readings of that same text. Adult modeling has been linked to increases in reading accuracy, rate, and prosody (Kuhn & Stahl, 2003). Partner reading can also help to facilitate increases in reading fluency. Partner reading can take on two forms. First, a more fluent reader can be paired with a less fluent reader. The more fluent reader reads the text first and acts as the fluent model. The less fluent reader then reads. While the less fluent reader is reading, the more fluent reader provides guidance and feedback to the less fluent reader. Rasinski (2000) suggests that this form of partner reading is beneficial for both partners. The second kind of partner reading pairs readers who have the same reading ability. After hearing an adult fluent model read a piece of text, partners are sent off to take turns reading that same piece of text. The partner who listens and follows along provides guidance and feedback to the partner who is reading. Computer-assisted reading can also help provide fluency instruction and practice to students. The computer can not only provide a model of fluent reading but it can also provide students with guidance and immediate feedback. The computer allows students to work on fluency passages at an individualized pace and can help students to chart their progress. Many software programs allow students to request speech feedback on pronunciation of specific words. Researchers who have evaluated the effects of computer-assisted reading on fluency skills have found significant increases not only in reading fluency but also in overall reading achievement (Florida Center for Reading Research, 2003).

Fluency instruction is most effective when students are provided with opportunities to read text repeatedly with guidance and feedback from a fluent model (Samuels, 2002). This guidance and feedback is best provided to students individually (Osborn, Lehr, & Hiebert, 2003). Individualized instruction provides students, especially those who struggle, with the opportunity to master skills at their own pace. However, with recent increases in teacher shortages and increases in under-qualified teachers, it is often difficult to deliver appropriate levels of instruction to children at risk for reading failure.

Students with Reading Difficulties

Approximately 3% of all school age children have been diagnosed with a reading disability (Snow, Burns, & Griffin, 1998). Different types of students experience reading difficulties, including students from low income backgrounds, students who have cognitive disabilities, students with learning disabilities, and students who experience behavior difficulties. These students often struggle with one or more of the critical aspects of reading: phonemic awareness, decoding, word recognition, fluency, or comprehension (Anderson-Inman & Horney, 1998; Snow, Burns, & Griffin, 1998). Students often struggle due to one or a combination of factors including inadequate or inappropriate reading instruction in school, inadequate preparation or parental support, and cognitive or physical disabilities that may interfere with reading (Anderson-Inman & Horney; Snow, Burns & Griffin). Researchers have implemented a variety of interventions to combat reading difficulties which include the use of supplemental basals/textbooks, mainstreaming students with learning disabilities, enhancing home literacy environments, and computer software (U.S. Department of Education, 2002).

Students with Behavior Difficulties

Students with behavior difficulties pose a range of dynamic challenges for education. Some students exhibit externalizing (e.g., low task engagement, disruption, and aggression)

problems while others experience problems that manifest themselves internally (anxiety, depression, withdrawal). There are, however, some characteristics that all of these students share. According to Coleman and Vaughn (2000), students with behavior challenges experience emotional variability, fear of failure, lack of trust and an inability to remain engaged and on-task. Some if not all of these variables may have an effect on students ability to learn (Kauffman, Cullinan & Epstein, 1987).

The Reading-Behavior Connection

Researchers have found that students who have or who are at risk for behavior difficulties are also inclined to lack academic skills (Glassberg, Hooper & Mattison, 1999; Gunter & Denny, 1998; Kauffman, Cullinan & Epstein, 1987, Snow, Burns, & Griffin, 1998). In a sample of 233 students newly identified as having behavior challenges, Glassberg, Hooper and Mattison (1999) found 53.2% of them met at least one of the requirements for learning disabilities. The requirements set by Glassberg et al. (1999) included a discrepancy between ability and achievement of at least 22 points, a regression-based ability-achievement discrepancy of 1.5 standard errors or more, and low achievement of at least 1.5 standard deviations below the mean in either math, reading or written language. Gunter and Denny (1998), found that students with behavior challenges had lower grade point averages, had failed more courses, had failed more grade level competency exams and were less likely to finish school than other groups of students with disabilities. Kauffman, Cullinan and Epstein (1987) found that only 30% of students with behavior difficulties were rated by their teachers as performing at or above grade level in the areas of reading, mathematics and written language.

Students with behavior difficulties tend to have the most trouble in reading and written language (Rock & Fessler, 1997). Many researchers have concentrated their efforts on reading because reading provides access to other learning and a student who is unable to read or who has

reading difficulties is highly likely to experience school failure, school dropout, unemployment and crime (National Institute of Literacy, 1998; Snow, Burn & Griffin,1998). In addition, Hinshaw (1992a) states that students with behavior challenges have had the most difficulty in the areas of decoding and reading comprehension.

Intervention Strategies in Reading and Behavior

Interventions that have been implemented for students who exhibit a comorbidity for reading and behavior difficulties take on a variety of approaches. An examination of the literature over the last decade has yielded interesting results. Some researchers examined the effect of one type of intervention (reading or behavioral) on both reading and behavior outcomes. Other researchers evaluated the effect of a combination of both a reading and behavior intervention on reading and behavior outcomes. Instructional reading strategies consisted mostly of prepackaged programs such as the Phonological Awareness Training for Reading (PATR) and the Wallach and Wallach tutoring program, which assists students with blending, segmenting, and spelling skills (Lane, 1999; Rabiner & Malone, 2004). Others have used such programs as the Reading Mastery series and the Open Court reading series which both use explicit instruction to teach decoding and comprehension skills (Miao, Darch, & Rabren, 2002; Wehby, Falk, Barton-Arwood, Lane, & Cooley, 2003). Behavioral instructional strategies included both prepackaged programs such as the Social Skills Intervention Guide along with more generalized strategies such as pre-correction (Lane, 1999; Miao et al., 2002).

Researchers who examined reading interventions in isolation, found few significant improvements associated with social behavior (Lane, 1999; Rabiner & Malone, 2004; Wehby et al., 2003). Interestingly, researchers who evaluated the effects of a reading intervention coupled with a behavior intervention, found significant increases in both reading and social behavior. The results of these intervention studies might suggest that academic interventions alone might not be

enough to fully help students who suffer from both reading and behavior difficulties. However, it is important to remember that the characteristics of challenging behaviors range along a spectrum from mild (e.g., easily distracted) to more severe challenges (e.g., aggression). The success of an intervention strategy might be dependent on the severity of the social behavior problem. Based on the evaluation of recent studies, researchers have not yet begun to take these factors into consideration when choosing participants for a study or when drawing conclusions from the results of a study.

In addition, it is difficult to conclude from the aforementioned findings that significant effects occur only in the presence of combined interventions. The reading intervention programs used in the Lane (1999), Rabiner and Malone (2004), and Wehby, Falk, Barton-Arwood, Lane, and Cooley (2003) studies may have only been significantly successful in improving reading and not behavior problems because they were not designed to serve a dual purpose. It is possible that one intervention that serves a dual purpose can have a significant impact on both reading and behavior difficulties. The use of a highly interactive computer-based reading program, for instance, could provide an impetus for both reading achievement and increased engagement which could result in a reduction in reading and behavior challenges (Kamil, Intrator, & Kim, 2000; Maddux, 2000).

Engagement and Reading Difficulties

Reading difficulties has emerged as one of the academic areas most significantly associated with behavior challenges. In fact, Kauffman, Cullinan and Epstein (1987) found that low achievement in reading is related to aggression, defiance of authority, and breaking school rules. Some researchers have found that certain behavior problems can be directly linked to reading difficulties. According to Rabiner (2000), of all the types of emotional and behavioral problems, low task engagement can most significantly be connected to reading difficulties. Low

task engagement can be defined as engaging in off task behaviors such as manipulating objects not related to academic tasks, talking to another student, looking around the room, and talking about issues unrelated to an academic task (Rieth & Semmel, 1991). In a study that involved over 200 students, Rabiner found that level of task engagement at the beginning of first grade to be a strong predictor of reading scores at the end of first grade. Students who exhibit low task engagement may display both externalizing (disruption) and internalizing (withdrawal) behavior problems. Regardless of the symptom, Rabiner has called for research that evaluates the effects of reading interventions that promote increased engagement to reading related tasks.

Engaged readers are attentive during reading instruction because they are curious about reading, they effectively use specific strategies to help them comprehend text, are confident in their reading, and use text as a means of social interaction (Guthrie, 2005). According to Guthrie and Wigfield (2000) there is a strong positive correlation between reading engagement and reading achievement. The assertions above are consistent with the Matthew Effect in reading (Stanovich, 1986). Stanovich (1986) set forth the hypothesis that good readers become better readers while struggling readers continue to read poorly. Students who read well are more inclined to be engaged during reading and are therefore more likely to become better at reading. Conversely, students who struggle with reading are more inclined to disengage and become less able readers. The challenge is to increase the task engagement of students who struggle with reading and attention during instruction.

Readers will be more engaged when reading is a more interactive process, when reading is neither too easy nor too difficult, and when reading is perceived as being a less serious and a more creative process (Reinking, 2000). Increasing the task engagement of students who struggle requires a variety of instructional models. To begin, because students become more engaged

when learning is more hands on, Guthrie and Wigfield (2000) have recommended infusing content area subjects, which usually involve more hands on activities, into reading related instruction. Guthrie and Wigfield also suggest incorporating a wide variety of texts into reading instruction (i.e. narrative and expository), providing students with strategy instruction (e.g. direct instruction, scaffolding, and guided practice) and providing students with specific praise and relevant reinforcers.

Computer Technology in Schools: A Historical Perspective

In the early 1960's, a group of researchers from Stanford University, Patrick Suppes and Richard Atkinson, developed computer-assisted instruction as an alternative for students who needed more than traditional whole-group classroom instruction (Molnar, 1997). Because the computer is able to provide individually paced instruction, immediate and corrective feedback and extensive rehearsals of curriculum materials, it quickly grew in popularity and emerged as the ideal teaching assistant (Rieth & Semmel, 1991). As a result, the number of students at the K-12 level who had access to computer technology in their schools grew from about one percent in the late 1960's to about 55% in the mid 1970's. By the late 1970's, the introduction of microcomputers revolutionized the computer as an instructional tool in classrooms across the country (Molnar, 1997).

Computer Technology as an Intervention Strategy

Technology in schools can take on a variety of forms (video cameras, digital cameras, and smart boards). Perhaps the most common is computer technology (Maddux, 2000). Over the past several decades, the use of computer technology in schools has grown tremendously (e.g., from a student to computer ratio of 125 to 1 in 1983 to a ratio of about 10 to 1 in 1996) (Maddux, 2000). The increasing trend is partly due to the hypothesized potential impact of the use of computer technology on student achievement. Since computers allow students to have an interactive

experience with school materials, they have been found to increase student motivation, interest, enjoyment, persistence and engagement with assigned tasks (Kamil, Intrator, & Kim, 2000; Laffey, Espinosa, Moore, & Lodree, 2003; Lee & Vail, 2005; Maddux, 2000; Wissick, 1996). In fact, in the presence of instruction that incorporates computer technology, students are more engaged and are more likely to recall information after instruction is complete, than they are in more traditional learning environments (Blankenship, Ayers, Langone, 2005; Kamil et al., 2000; Wilson, Majsterek, & Simmons, 1996). Because of the importance of literacy to overall school and life success, many researchers have specifically evaluated the impact of technology on students' motivation, interest, and engagement during reading related tasks and activities.

Many researchers have theorized about the possible impact of computer technology on overall student reading achievement and more specifically on the achievement of struggling readers. Because computers feature simulative and interactive environments, they have the ability to scaffold student learning, encourage self-motivation, and increase interest and productivity in both average achieving and at risk students (Blankenship et al., 2005; Hauser & Malouf, 1996; Kamil et al., 2000; Laffey et al., 2003).

Many of the naturally occurring features of computer technology that foster reading achievement, also help students with mild to moderate behavior problems. Children who experience disruptive behaviors (poor attention, hyperactivity, and noncompliance) early in their childhood are more likely to experience general academic difficulties, reading problems and school failure in later childhood (Laffey et al., 2003). The interactive nature of computer technology provides immediate feedback and engaging visuals which help to increase the task engagement of students so that they may experience academic achievement (Laffey et al., 2003).

Opportunities to Respond

When students receive more opportunities to respond (OTR) to curriculum content, the results include increased engagement, increased academic achievement and decreased rates of disruptive behaviors (Christle & Schuster, 2003; Heward et al., 1996; Sutherland, 2001). Increased OTR also allows for ongoing assessment of student progress which in turn provides information for instructional adjustments. Because of these positive outcomes, the Council for Exceptional Children (CEC) (1987) has developed a series of recommendations that outlines the optimal number of OTR teachers should provide students during instruction. According to CEC, during the presentation of new material, teachers should allow for active student responding between 4 and 6 times per minute. When reviewing information that has already been presented, opportunities for active student responding should range from 8 to 12 times per minute (CEC). Student achievement is maximized when high rates of active responding are accompanied by high rates of accurate responding (CEC).

Providing the appropriate amount of OTR to students can be difficult for teachers because much of the instruction in general education settings and increasingly in special education settings occurs in a whole-group format. This decreases the likelihood that students will receive an adequate amount of OTR (Christle & Schuster, 2003; Sutherland, 2001). Lower achieving students are at the greatest risk because higher achieving students are much more likely to volunteer responses during classroom instruction (Christle & Schuster). Teachers have attempted to increase student OTR by using a variety of strategies. Currently, some research exists on the use of class-wide peer tutoring, choral responding, and response cards as viable methods of increasing OTR (Armendiaz & Umbreit, 1999; Christle & Schuster; Greenwood, Delquadri & Hall, 1984). Some researchers have found class-wide peer tutoring to be problematic for students who lack social skills because these students have trouble maintaining consistent positive

unsupervised interactions with classmates. Other researchers have found that choral responding and response cards do not allow for consistent individualized feedback (Sutherland, 2001; Sutherland, Alder, & Gunter, 2003). Because there are weaknesses in many of the current strategies (e.g., whole-group hand raising, and class-wide peer tutoring), more research is needed to examine how best to achieve and maintain high rates of active student responding (Heward et al., 1996; Sutherland, 2001). The ideal strategy would provide students with high rates of opportunities to respond, encourage high rates of active responding, and provide consistent individual corrective feedback.

Because the computer can provide individually paced instruction to students, it can overcome many of the obstacles to OTR that are present in traditional whole-group instruction. Unlike class-wide peer tutoring, computer-assisted instruction (CAI) allows students who have social skills deficits to experience increased rates of opportunities to respond without the added need to monitor students for behavior problems among students. Unlike choral responding and response cards, the computer allows individual students to benefit from more active responding. The responses that a particular student provides are met with specific praise and/or corrective feedback. CAI scaffolds instruction for individual students based on continual assessment of individual student responses. When increased OTR is accompanied by active student responding and followed by praise or corrective feedback, this results in increases in social and academic achievement (Christle & Schuster, 2003; Sutherland, 2001) (See Figure 1-1).

Rationale for the Study

Computer-assisted instruction (CAI) may be the most viable alternative to print-based, teacher-led fluency instruction. CAI has proven effective in teaching a variety of reading skills including phonological awareness and comprehension (Blankenship et al., 2005; Hauser & Malouf, 1996; Kamil et al., 2000; Laffey et al., 2003). Limited research exists that has

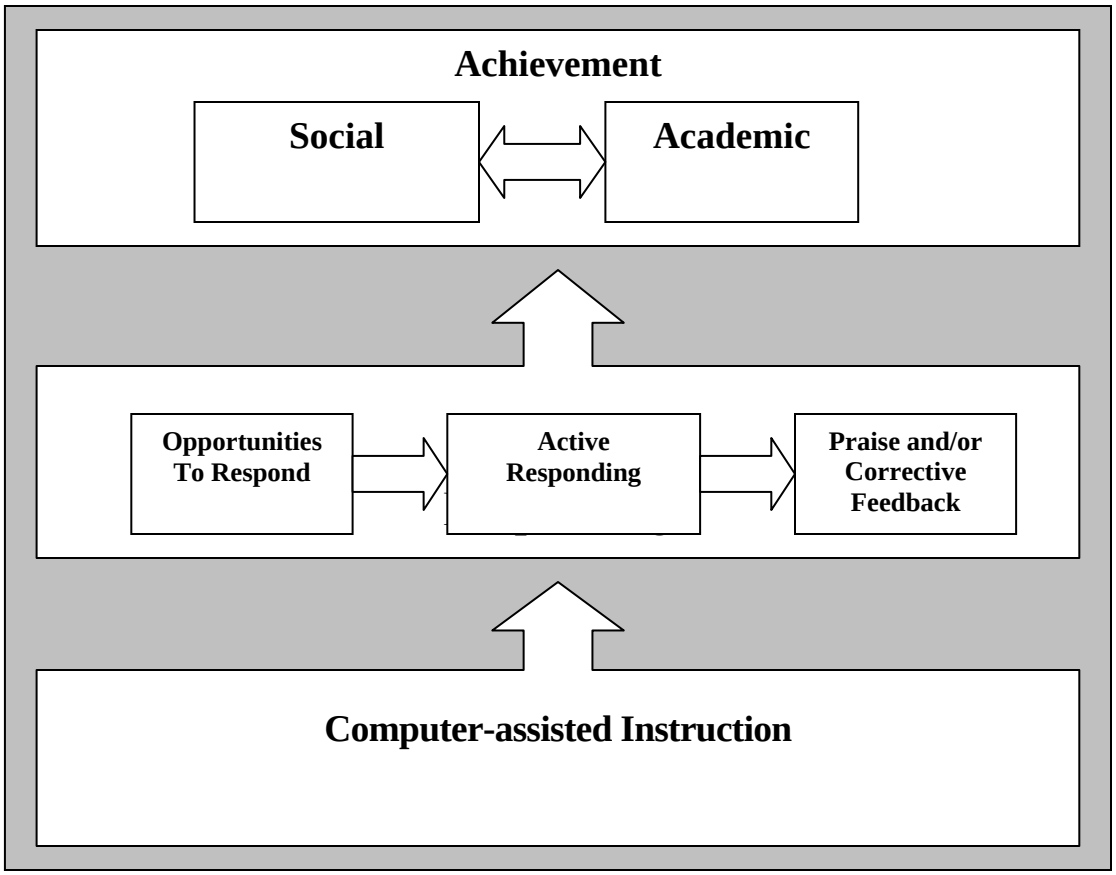

Figure 1-1. Model of the Impact of Computer-Assisted Instruction on Social and Academic Achievement

investigated whether CAI is as effective in increasing fluency as print-based teacher-led instruction. Also, very little research exists on the impact of CAI on student task engagement during instruction.

The purpose of this study was to compare the effects of print-based, teacher-led instruction and CAI on the reading fluency and overall reading skills of children with deficits in reading fluency. The study also evaluated the effects of CAI on the task engagement of a subset of the larger sample. The same fluency skills were taught in each treatment group. Some variables (e.g., fluency program) were identical while others (e.g., duration of daily instruction and number of passages instructed per day) differed. The primary difference across the treatment groups was the medium used for instructional delivery. Evaluating the results of CAI and

teacher-led instruction allowed conclusions to be drawn about the relative effectiveness of the different modes of instructional delivery. If students learn as well as or better when instructed by computer software, teachers may be justified in providing CAI as an alternative method for increasing fluency skills. Also, if students are engaged as well as or better when instructed by the computer, teachers may be justified in providing CAI as an alternative method of instructional delivery.

Summary

The purpose of this study was to determine the effects of teacher-led instruction and computer-assisted instruction on the fluency skills, reading ability and task engagement of third grade students. The literature review provides a review of the relevant literature on computer-assisted instruction. The methods section describes the procedures that were used to conduct the study and analyze the resulting data. The results section reports the outcomes of the study. The discussion section provides an evaluation of study results, study limitations, and implications for future research.

CHAPTER 2
LITERATURE REVIEW

The purpose of this literature review is to examine the existing literature on the use of computer-assisted instruction as a method for improving reading attitude, engagement and achievement in elementary school settings. Specifically, this review reports and evaluates such elements as participant characteristics, dependent measures, procedures for implementing interventions and the results of using various forms of computer-assisted instruction with elementary age children.

Methods

The following electronic databases were searched beginning in 1990 and up to the present: Academic Search Premier, ERIC, E-Journals, PsychINFO, Psychology and Behavioral Sciences Collection, and Sociological Collection using the following search terms: technology, computer technology, reading difficulties, reading disabilities, reading problems, attention problems, distractibility, hyperactivity, engagement. An ancestral search was also conducted using articles retrieved during the initial search. A hand search of the *Journal of Special Education Technology* and the *Journal of Computing in Childhood Education* was also conducted beginning in 1990 and up to the present. All articles whose abstracts discussed a connection between technology and reading or a connection between technology and engagement were collected.

Because the development of reading fluency in the elementary grades was the focus of this study, studies that featured students at the secondary level were excluded. This review only includes studies that examined the use of computer technology as an intervention tool for early childhood and elementary age students. Studies included in this review incorporated computer technology as an intervention strategy to combat either reading and/or behavior (e.g., engagement and attitude) difficulties. Studies that did not include struggling readers were

excluded from the review. Articles included observational, single subject, quasi-experimental and true experimental studies. Theoretical pieces were kept and used for background material in the introduction and discussion sections of the review.

Results

The resulting literature review included 23 studies that evaluated the use of computer technology on reading and/or behavior problems. Of the reviewed 23 studies, 14 evaluated multiple research questions. The studies were divided in the following manner: 12 examined the effects of computer technology on word recognition, while eight examined the effect of computer technology on early reading skills including phonological awareness and letter recognition, seven examined the effects of computer technology on reading fluency at the word and passage levels, four examined the effects of computer technology on text comprehension, two examined the effect of computer technology on vocabulary and decoding skills, two examined the effects of computer technology on spelling skills, one examined whether or not students use metacognitive strategies when using computer-assisted instruction, and one examined how computer technology affects overall reading achievement (Boone & Higgins, 1993).

Discussion

The discussion that follows examines the aforementioned studies through a series of six themes. Many of the studies were categorized according to more than one theme. Five studies evaluated the effects of computer-assisted instruction (CAI) on student attitude, motivation and engagement. Three studies examined the use of CAI as a form of supplemental instruction. Five studies examined the effects of CAI on students of varying ability levels. Three studies evaluated the cost effectiveness of CAI in reading instruction. Three studies examined the effects of

varying levels of speech feedback on reading achievement. Five studies compared the effects of CAI with traditional forms of reading instruction.

Attitude, Motivation and Engagement

The more students read, the better they become at reading. Students who are more motivated to read become better readers because not only do they have a positive attitude toward reading but they also tend to be more engaged during reading instruction. Poor readers, on the other hand, are often unmotivated to read and therefore do not progress (Stanovich, 1986). Because the computer can provide instruction in an interactive, multimedia, game-like format, it should easily motivate students. Several researchers have tested the above theory.

Lewin (2000) explored the effects of varying levels of computer enhancements on the motivation and self confidence of students in grades five and six. The researcher pretested students using the Salford Sentence Reading and Burt Word Reading Tests. Teachers were also asked to rate each child's motivation level on a scale from 1 (negative) to 5 (positive). Sixteen students were assigned to a "Basic" condition and 16 were assigned to an "Enhanced" condition. The students who experienced the "Basic" version of the computer program were provided with word pronunciation feedback while those who experienced the "Enhanced" version also experienced illustrations, initial sound feedback, and word meaning feedback. Intervention's occurred 15 minutes daily over the course of four weeks. Participants and teachers were posttested using the same measures as at pretest. Surprisingly, a tally of teacher ratings of students' motivation levels revealed that enhancements only positively affected students who were already motivated to read. more surprisingly, students who started the study as unmotivated readers viewed both the "Basic" and "Enhanced" computer tasks as tedious and academic.

Similarly, Wise et al. (1989) used varying levels of speech feedback with 62 students in grades three through six in an attempt to improve their word recognition abilities and their

attitude toward reading. Researchers transferred 64 stories to speech synthesizers so that speech feedback could be provided on difficult words. Students were asked to complete a questionnaire at the onset of the study which evaluated their most and least favorite subjects in school. Researchers then assigned students to one of four feedback conditions (e.g., whole word, syllable, sub-syllable, or a combination of syllable and sub-syllable). At the end of the study, students were posttested using the same questionnaire as the pretest. When researchers tallied student responses, they found that nine out of the thirty participants in the treatment group showed positive changes in their attitude toward reading. Although, these findings are more encouraging than Lewin's findings, it is uncertain as to whether a change of 30 percent across participants is enough to support the hypothesis that computer-assisted instruction can improve students' attitudes.

In a similar study, Cole and Hilliard (2006) examined the benefits of using the web-based reading curriculum program, Reading Upgrade, on the motivation and engagement of struggling third grade readers. Reading Upgrade provides practice in decoding, fluency, phonics, and phonemic awareness and is accompanied by several technological enhancements such as music and graphics.

A 12-item questionnaire was used to assess three facets of reading motivation including: avoidance (e.g., whether students view reading to be negative and subsequently make attempts to avoid it), recognition (e.g., whether students read to receive something tangible such as a treat or a grade), or satisfaction (e.g., whether students read because they enjoy acquiring information). Students were also observed so that researchers could evaluate other aspects of engagement and motivation such as percent of intervals on-task, enthusiasm, and frustration. Researchers found a correlation, although not statistically significant, between low reading performance and

avoidance and recognition motivation. This finding suggests that students who are intrinsically motivated to read reap the greatest benefits from reading. The finding also supports the theory of the Matthew Effect in reading which states that good readers get better because they are motivated to do so.

In addition to the questionnaire results, direct observations revealed that a majority of the students remained enthusiastic about the computer program throughout the study. Researchers also found that students were actively engaged during both the instructional and game portions of the study. Observers recorded the following comments made by researchers working directly with the students: "Ayana had a smile on her face… I didn't remember seeing her smile before [the first day of working with Reading Upgrade]," and "Tyrone sung along with the software very loudly. He cheered when he got an answer right" (Cole & Hilliard, 2006, p. 369). Although these findings seem to be more encouraging than Lewin (2000) and Wise et al. (1989), conclusions and comparisons must be drawn cautiously. Unlike the other two sets of researchers, Cole and Hilliard do not report specific numbers or percentages of students who were observed to be actively engaged or motivated.

In a related study, Clarfield and Stoner (2005) evaluated the effects of computer-assisted instruction on three kindergarten and first grade students experiencing trouble with reading and engagement during instruction. Each of the students was officially diagnosed with attention deficit/hyperactivity disorder. Participants were pretested using the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) as well as the Behavior Observation of Students in Schools (BOSS). The study ranged from eight to ten 30 minute sessions depending on the student. Visual analysis of changes in level and trend from baseline to intervention revealed a significant decrease in off task behaviors across all three participants. Before the study, students' off task

behaviors ranged from 24% to 49%. At the completion of the 10 session study, students' off task behaviors decreased drastically to a range of 3% to 6%.

Bangert-Drowns and Pyke (2001) examined engagement in a way that was different from all the aforementioned studies by investigating the issue of multiple levels of engagement. The researchers established a continuum that ranged from disengagement to what they consider to be the ultimate level of engagement—literal thinking. Bangert-Drowns and Pyke define literal thinking as "the conscious awareness of the cognitive processes involved with reading including the tendency to integrate personal values and beliefs while interacting with text" (p. 214). After observing 43 students during 78 half hour sessions in the school laboratory, researchers found that although students were rarely disengaged they also rarely exhibited literal thinking while interacting with the computer software. Bangert-Drowns and Pyke found that most students performed toward the middle of the engagement continuum in that students' navigational interests were dictated by the software interface as opposed to students allowing their own interests to dictate how they used the software. These findings may have been affected by the fact that many of the participants in this study were, as Cole and Hilliard (2006) suggest, exhibiting two of the three facets of reading motivation – avoidance and recognition.

Because motivation to read, attitude towards reading and engagement during reading instruction are all related concepts, one might expect similar findings across the five studies. According to Guthrie and Wigfield, 2000, attitude and motivation are intrinsically linked to engagement because they are what force us to act. One possible explanation for the disparity across the studies is the difference in age groups. Clarfield and Stoner perhaps found significance across participants because the students in their study were younger which may have decreased the likelihood that they had negative experiences with reading and were therefore more easily

affected by computer enhancements. Another possible explanation could be that the inherent quality of certain computer enhancements (e.g., speech feedback and graphics) lends themselves to increased motivation, attitude and engagement. Cole and Hilliard (2006), for instance, report using popular music to enhance text and their study yielded positive findings.

Motivation plays a significant role in reading achievement (Guthrie & Wigfield, 2000). The use of computer-assisted instruction has been linked to increased reading achievement and increased self-confidence (Mioduser, Tur-Kaspa, & Leitner, 2000). Based on all of the above findings, it seems that perhaps students in the later elementary years may not be as easily impacted by computer enhancements. More research is needed to determine if the effect of computer-assisted instruction on student attitude, motivation and engagement is affected by students' age. It also seems that the quality of technology enhancements may have an effect on student motivation, attitude and engagement. More research is needed to determine which kinds of enhancements lead to the most positive outcomes.

Supplemental Instruction

Using the computer as a supplement to traditional classroom instruction is ideal. It allows students to receive individualized rehearsal of information that has already been presented. In a longitudinal study spanning three years, Higgins and Boone (1991) and Boone and Higgins (1993) examined the impact of adapting basal readers so that computer software incorporated learning goals specific to 300 students in kindergarten through third grade classrooms. Researchers enhanced a Macmillan Basal Reader by creating software that displayed computerized pictures, animated graphic sequences, definitions, synonyms and digitized speech linked to words and pictures from the original basal text. They examined the impact of integrating computer software on decoding and overall reading achievement. The Macmillan Standardized Reading Achievement Test was used as both a pre and posttest measure.

Interventions, on average, involved 10 minute sessions over the course of a school year. An Analysis of Covariance (ANCOVA) revealed significant differences between treatment and control groups across all three years in both decoding and overall reading achievement.

Similarly, Boone, Higgins, Notari, and Stump (1996) examined the impact of adapting Macmillan basal series materials to computer software on the letter recognition skills of 143 kindergarten students. Lessons involved links from words to pictures, speech, graphics and animated sequences. Participants were pretested and posttested using the Macmillan Standardized Reading Achievement Test. After seven and a half minute sessions over three years, an ANCOVA revealed significant differences between treatment and control groups.

It would seem from the results of the above studies that the use of computer-assisted instruction as a supplement to traditional classroom instruction is worthwhile. Unfortunately, unless traditional basals provide software as part of their core programs, it would be difficult for teachers to coordinate or create computer software that supplements traditional classroom instruction. More research is needed to determine how best to go about coordinating and/or creating software to supplement traditional classroom instruction.

Students at Varying Ability Levels

Originally, computer-assisted instruction was developed as a method of remediation for struggling students (Molnar, 1997). As the use of computers grew more prevalent, schools began to vary their instructional use. Now computers are not only used for drill and practice instruction, but also for strategy instruction and simulation purposes. Developers have enhanced each of the three different types of instructional software (e.g., drill and practice, strategy, and simulation) with speech, visuals, animation, and multimedia enhancements. Many researchers have evaluated whether computer-assisted instructional enhancements have different effects on students at varying ability levels. Some of the researchers featured in this review have evaluated the use of

computer-assisted instruction with students at low, medium, and high reading ability levels. Current findings regarding the most effective computer enhancements for low achieving students are mixed.

Lewin (2000) investigated the effectiveness of a "Basic" versus an "Enhanced" version of computer-assisted instruction on 32 fifth and sixth grade students. Students in low, medium and high ability groups were randomly assigned to either of the two versions. Through the use of an ANCOVA, Lewin found that readers with the lowest ability made the highest gains in word recognition. In addition, Lewin found that the word pronunciation enhancement used in the "Basic" version of the computer program was most beneficial for struggling readers. Interestingly, Lewin also found that the extra enhancements (e.g., initial sound production and meaning) provided by the "Enhanced" version were most effective for improving word recognition skills in medium and high ability students.

Boone et al. (1996) evaluated the use of hypermedia, the use of a combination of visuals, animation, speech and multimedia software, on the letter recognition skills of 143 kindergarten students. After using an ANCOVA to compare the effect of computer-assisted instruction on low, medium, and high ability level students, researchers found no significant improvements for at risk students. Like Lewin (2000), however, middle and high ability students did exhibit significant improvements in letter recognition skills.

Like Boone et al. (1996) and Lewin (2000), Nicolson, Fawcett, and Nicolson (2000) examined the use of a computer software program on the word reading ability of 32 low, medium and high achieving readers who ranged in age from six to eight. Participants were ranked based on their scores on the Wechsler Objective Reading Dimension (WORD), matched for age and reading ability and then randomly assigned to either a treatment or control group.

The 16 students in the treatment group received the Reader's Interactive Teaching Assistant (RITA) which uses pictures, graphics and speech feedback to assist with word reading. The remaining 16 students were placed in the control group. Sessions occurred bi-weekly for 30 minutes. An ANCOVA revealed that the lowest achieving students made the least amount of progress in word reading at the conclusion of the study.

In a study slightly different study, Mathes, Torgesen, and Torgesen (2001) examined the effect of pairing Peer Assisted Learning Strategies (PALS) with additional computer-assisted instruction in phonological awareness on 183 first grade students. Students in low, average, and high ability groups were randomly assigned to receive PALS either with or without an accompanying phonological awareness software program (e.g., Daisy's Quest or Daisy's Castle). An Analysis of Covariance (ANCOVA) revealed that low achieving students gained the most benefit from PALS instruction regardless of whether they received additional computer-assisted instruction. Overall, the addition of CAI had no statistically significant effect on students' phonological awareness.

The findings across studies can be attributed to a variety of factors. To begin, the lack of improvement in the Boone et al. (1996) study could be partly attributed to the amount of time allocated, 7.5 minutes per day, to computer-assisted instruction. It is possible students needed more daily exposure to materials. In addition, the findings reported by Lewin (2000) may help to explain the results of the Nicolson et al. (2000) and Mathes et al, (2001) studies. Lewin reports that struggling readers are best served by minimal or "Basic" computer-assisted enhancements. It is possible that the extra enhancements provided to students in the Nicolson et al. and Mathes et al. studies were a hindrance to those students in the low ability group.

The above hypothesis can be supported by the findings of an observational study performed by Lewis (1999). Lewis observed six learning disabled students as they read electronic storybooks at varying enhancement levels including graphics, embedded games, and glossary features. Lewis pretested students using a word list she created. Each student used three different types of programs for two hours over the course of four days. The first set of enhancements involved six programs with high text interactivity, no embedded games, and graphics, the second involved six programs with varying text interactivity and embedded games and the third involved six programs with varying text interactivity, and glossary features. Posttests involved the original word list, a retelling of each of the stories, and responses to comprehension questions. Like Lewin (2000), Lewis found the average student gain in word recognition to be low and that students spent an average of 40% of their time interacting with the non-essential features of the computer program. Lewis concluded that struggling readers needed to engage in highly structured activities with minimal enhancements to reap benefits from computer-assisted instruction.

Cost Effectiveness

Researchers have often speculated about the cost effectiveness of computer-assisted instruction. To analyze cost effectiveness, one must take into account a variety of elements including the cost of computer hardware and software, the cost of traditional instructional curriculum materials, the amount of time it takes teachers and students to be trained to use computer hardware and software, as well as set up costs (Jones, Torgesen, & Sexton, 2001; Roth & Beck, 1987). The studies evaluated in this review were all in agreement about the cost effectiveness of computer-assisted instruction.

Torgesen, Waters, Cohen, and Waters (1988) evaluated the effectiveness of three variations of a computer program designed to increase sight word recognition in 17 learning

disabled students who were in grades one through three. Participants were pretested using a timed computerized word reading test. Torgesen et al. (1989) used the program "Words" to provide student enhancements that included graphic representation of words and speech feedback. Researchers used a multi-element design with four treatment conditions where students received either a graphic representation of words, speech feedback, a combination of graphic representation and speech feedback, or no treatment. Participants were involved in daily 15 minutes sessions for eight weeks and were posttested using the same measure used for the pretest. After being exposed to each of the four treatment groups, a tally of the change in total words read from pre to posttest demonstrated equal effects across conditions in improving the sight word recognition of students. Researchers used these findings to make decisions about the cost effectiveness of the "WORDS" program. Torgesen et al. concluded that since "WORDS" is an inexpensive program, provides pictures and sound enhancements and is easily adaptable so that more words can be added to students' lists, that this particular program was a cost effective method of computer-assisted instruction.

In a similar study, Nicolson et al. (2000) evaluated the use of the Reader's Interactive Teaching Assistant (RITA) on the word recognition of 16 students. RITA incorporates pictures, graphics and speech feedback during instruction. When researchers found significant differences in word reading between treatment and control, they performed systematic calculations of the cost effectiveness of the RITA program. Nicolson et al. factored in teacher time for both computer-assisted and traditional instruction as well as software costs and determined that RITA is more cost effective than traditional methods of support.

Jones, Torgesen, and Sexton (2001) also evaluated cost effectiveness in their study which investigated the effect of computer-assisted instruction on the individual word and text fluency

of elementary age students. Participants were pretested on their speed and accuracy on a group of target words and randomly assigned to one of two groups. Ten students were assigned to use the Hint and Hunt program which is enhanced by speech feedback and provides practice in phonological awareness. The remaining ten students were assigned to use a spelling program. After daily 15 minute sessions over the course of 10 weeks, an ANCOVA revealed that participants in the experimental group improved the speed and accuracy of their word reading. These students were also able to generalize their word reading ability to similar sets of words. Torgesen et al. used these findings to help determine the cost effectiveness of the Hint and Hunt software program. They concluded that the benefits of educational effectiveness balance the high expense ($180) of the Hint and Hunt program.

It would seem based on preliminary assessments regarding the cost effectiveness of computer-assisted instruction that the potential educational benefits either balance or out weigh the high cost of some forms of computer software. In addition, the declining cost of computer hardware and increased access to software on the internet, has led to increased growth in the use of computer-assisted instruction.

Speech Feedback

Speech feedback refers to the use of sound to deliver task instructions and to provide corrective feedback. Sound is one of the most common enhancements used for computer-assisted instruction. Speech feedback has been associated with increased engagement and word learning in elementary age students (Kim & Kamil, 2001). Several of the studies that were examined in the current review explicitly evaluated the effects of speech feedback on student progress. Researchers who have evaluated the use of speech feedback have found that, in general, it leads to increases in varying aspects of reading. Although, speech feedback can be provided at a

number of levels including the word, syllable and sub-syllable levels, inconsistencies have arisen when researchers have attempted to examine the effects of different kinds of feedback.

A study performed by Lewin (2000) compared the effects of speech feedback on the word recognition skills of 32 intermediate elementary students. Feedback included a “Basic” version which provided word pronunciation and an “Enhanced” version which, in addition to word pronunciation, included initial sound production and meaning enhancements. Through the use of an ANOVA, Lewin concluded that whole word pronunciation was most beneficial for improving student word recognition.

In contrast, when Wise et al. (1989) evaluated the effects of speech feedback on improving the word recognition and phonological awareness of 62 students in the intermediate grades, they found different results. After using an ANOVA to evaluate speech feedback at the whole word, syllable and sub-syllable levels, Wise et al. (1989) concluded that segmented speech feedback (feedback at the syllable or sub-syllable level) was most beneficial for improving phonological awareness. Because phonological awareness involves manipulating language at the syllable and sub-syllable levels, the finding is a logical one. Wise et al. made no conclusive assertions about the best method of speech feedback for the improvement of word recognition.

Finally, Chera and Wood (2002) examined the effects of whole word and segmented speech feedback on the development of phonological awareness and word reading in 30 pre-kindergarten through first grade students struggling to develop emergent literacy skills. After pretesting students using the British Ability Scales Word Test, Chera and Wood assigned fifteen of the participants to use *Bangers and Mash*, an animated multimedia talking book that provided students with both whole word and segmented speech feedback. The remaining fifteen students served as the study’s control. Participants were posttested using the same measure as the pretest.

Through the use of a Mann Whitney U test, Chera and Wood found that whole word feedback led to increases in phonological awareness and neither whole word nor segmented feedback led to increases in word reading.

Because Lewin only evaluated the use of initial sound and not segmented feedback, it is difficult to compare this study to the Chera and Wood and Wise et al. studies. Also the, Chera and Wood study differs from both the Lewin and Wise et al. studies in that Chera and Wood examined emergent readers. The literacy and computer experiences of young struggling readers could differ markedly from older intermediate readers.

In addition, it may be that the effectiveness of the different levels of feedback may vary based on the reading skills being practiced. Speech feedback at the word level may be best when practicing word recognition skills while feedback at the syllable or sub-syllable levels may be best when practicing phonological awareness. In other words, statistically insignificant findings way have resulted due to a mismatch between the type of speech feedback and the reading skill being practiced.

Computer-Assisted versus Traditional Instruction

Because of the benefits of computer-assisted instruction (e.g., individually paced instruction and extensive rehearsals) it is important to determine whether the computer is at least as good an instructional tool as effective methods of traditional instruction. The studies that have been analyzed in this review reveal consistent findings.

In a study conducted by Mioduser, Tur-Kaspa, and Leitner (2000), 46 five and six year olds at risk for reading disabilities were provided with the program “I have a secret – I can read” to help improve phonological awareness, letter naming, and word recognition skills. The program consists of two components involving both computer and printed materials. After being pretested using a standardized test of phonological awareness, word recognition, and letter

naming, participants were randomly assigned to one of three groups. Group one received both print and computer-based materials, group two received only print-based materials, and group three received regular special education programming without special reading training. After engaging in an unspecified number of session, researchers posttested students using the measures used during the pretest. Through the use of a Multivariate Analysis of Variance (MANOVA), Mioduser et al. (2000) found that the participants in the computer/print-based group made significant gains in phonological awareness, word recognition, and letter naming skills when compared to print-based and no formal instruction groups.

In a similar study, Mitchell and Fox (2001) compared the effectiveness of a computer-based method of instruction (Daisy's Castle) to a traditional teacher-led method on the phonological awareness of 72 kindergarten and first grade students. After being pretested using the Peabody Picture Vocabulary Test (PPVT-III) and the Literacy Initiative for Everyone (LIFE), twenty four participants were assigned to one of three experimental conditions. The first condition consisted of the computer-assisted instruction, Daisy's Castle, the second condition consisted of the teacher delivered instruction (e.g., explicit instruction using a phonological awareness kit) and the third condition consisted of a treatment control condition, drawing and math software. After four weeks of daily 20 minute intervention sessions, participants were posttested using the same measures as pretest. Unlike the Mioduser et al. (2000) study, an ANCOVA revealed no significant differences between the teacher and the computer groups. Both groups, however, exhibited significant improvements over the treatment control group.

Lewandowski, Begeny, and Rogers (2006) also examined the effect of a computer-assisted program and a tutor on the word recognition of a group of 63 third grade students struggling with reading. Students were pretested using a researcher created assessment of word recognition and a

curriculum based measure of reading fluency. The intervention lasted for three ten-minute sessions and consisted of practice with a list of individual words followed by a timing of connected text. Students were randomly assigned to one of three groups (i.e., computer, tutor, or control). Students in the computer group received assistance with individual words from the computer while students in tutor group received assistance with individual words from a tutor. Students in the control group were required to read the word list on their own. Posttesting involved an alternate version of the pretest. Like Mitchell and Fox (2001), Lewandowski, et al. (2006) found significant differences between the computer and tutor groups and the control group. The computer and tutor groups both experienced significant improvements in word recognition and fluency. The control group did not make significant gains.

Hinitikka, Aro, and Lynntinen (2005) compared the effectiveness of computerized versus print-based training on letter knowledge and letter sound correspondence of 44 primary age struggling readers. Students were pretested using a researcher created test of letter naming, letter sound correspondence, spelling and a standardized Finnish test of reading fluency. Participants were randomly assigned to an experimental group that received the same training in a print format. Sessions ranged from 10 to 20 minutes and were provided three times per week over a period of six weeks. After analyzing the data using an ANOVA, researchers found no significant differences in the dependent variables (letter knowledge, letter sound correspondence, spelling, and reading) between the computer and print groups.

In addition to examining the effects of web-based learning on student motivation and engagement, Cole and Hilliard (2006) also evaluated its effects on reading achievement. They studied 36 third graders who were performing at least two years below grade level in reading. The intervention program consisted of a computer-based intervention program, Reading Upgrade

which was used to enhance students' decoding, fluency, phonics and phonemic awareness skills. The control group received the schools traditional reading enrichment program. After being pretested using standardized measures of decoding, fluency, comprehension, letter and word recognition, participants were randomly assigned to either the intervention or control groups. After 180 minutes of instruction over the course of eight weeks, researchers posttested students using alternate forms of the pretest measures. A One-Way ANOVA, yielded promising results. Like Mioduser et al. (2000), Cole and Hilliard concluded that there were significant differences favoring the intervention group in the areas of decoding, fluency, phonics, and phonemic awareness. Perhaps one of the reasons the Cole and Hilliard and Mioduser et al. studies yielded results that were more favorable to CAI is because that study consisted of the appropriate amount of enhancements to maintain student engagement and increase student outcomes.

Whether computer-assisted instruction is as effective as traditional classroom instruction is an important question. Computers are more capable of providing individual attention to students. Naturally occurring elements of computer-assisted instruction such as individualized corrective feedback increases individual student accountability. This increased accountability often leads to increased engagement which in turn leads to increased achievement (Balajthy, 1989; Guthrie & Wigfield., 2000). Approximately 70% of the studies that compared computer-assisted instruction to print-based instruction found the computer to be at least as effective as print-based instruction. These findings could have a significant impact on the kinds methods used to provide reading instruction in the future.

Implications for Future Research

The use of computer-assisted instruction has increased over the last several decades. This has occurred primarily because the naturally occurring features of computer-assisted instruction allows for individually paced instruction, immediate and instructive feedback, extensive

rehearsals and repetition, teaches in small increments, and is often presented in a game like or alternative format to traditional instruction (Cotton, 2001; Rieth & Semmel, 1991). Some researchers have theorized that these features could positively impact the achievement of students who struggle, especially those who struggle with reading. A review of the literature on the use of computer-assisted instruction with struggling readers has yielded a great deal of uncertainty regarding a number of issues.

To begin, some researchers have found computer-assisted instruction to be motivating and engaging for students. More research is needed to determine the extent to which CAI helps students to be motivated and engaged during reading instruction. More research is also needed to determine the impact of this increased motivation and engagement on overall student achievement (Guthrie & Wigfield, 2000).

In addition, researchers who have evaluated the concept of cost effectiveness have only done so with respect to money. Very little research has evaluated the cost effectiveness of CAI with respect to time (i.e., the amount of time it takes teachers and students to be trained to use computer hardware and software, the amount of time the computer allows students to be exposed to materials, and the amount of time the computer can devote to individual students). Oftentimes, teachers have very little time to provide struggling readers with the type of individualized instruction and feedback that they need. More research is needed to determine how instruction in CAI compares to more traditional forms of print-based reading instruction. More specifically, more research is needed to determine whether CAI is more cost effective than traditional forms of instruction with respect to time (Jones, Torgesen, & Sexton, 2001).

Also, some researchers are unclear about the effect of the enhancements provided by computer-assisted instruction on low achieving readers. There is some evidence to suggest that a

minimal amount of enhancements may be most beneficial for struggling readers. More research is needed to determine which types of enhancements have the greatest impact on struggling readers.

Furthermore, some researchers are still unclear about how different types of speech feedback, feedback at the whole word, syllable or sub-syllable levels, affect the word recognition skills of struggling students. The development of word recognition skills is significant to fluency, comprehension and overall reading achievement skills (NRP, 2000). More research is needed to determine how best to use the speech feedback features of computers to help improve word reading skills. Although researchers emphasize the benefits of speech feedback, they also recommend that future research examine each of the different forms of feedback on students at different ages and at a variety of reading levels.

Finally, the available research that has compared computer and print-based instruction has yielded mixed results. In most cases no significant differences were found between computer and print-based instructional methods. However, there were cases in which computer-based instruction led to more significant improvements. More research is needed to compare the effects of print-based teacher-led and computer-assisted instruction. The results of this research could increase our understanding of instructional efficacy (Wilson, Majsterek, & Simmons, 1996).

Research questions for the current study, which will be presented in the chapter that follows, arose from two of the six themes examined in this literature review (i.e., attitude motivation, and engagement and computer-assisted versus traditional instruction). The first surrounds the influence of CAI on student motivation during reading instruction. The second surrounds a comparison of the effects of print-based instruction with CAI. Specifically, an evaluation of questions involving the extent to which CAI affects motivation and engagement

during reading instruction and the instructional efficacy of CAI as a method of fluency instruction are presented.

Summary of the Review of the Literature

Participants

A total of 1,644 students participated in the studies evaluated in this literature review. The number of participants in each study ranged from 3 to 300. Participants in the review were primarily elementary age students ranging from pre-kindergarten to sixth grade. Two studies included both early childhood and a primary age students (pre-k through first grade), ten studies were conducted with primary age students alone (K-3), five studies investigated students who were in both primary and intermediate grades (K-5), five studies were conducted with participants in the intermediate grades only, and two studies did not specify a particular grade level. All studies focused on the effect of computer-assisted instruction on students who were at risk for or who had already been diagnosed with a reading or learning disability. Sixteen studies focused on students who were at risk for a reading or a learning disability while seven studies used participants who had a diagnosed learning and/or reading disability (see Appendix A).

Dependent Variables and Measures

Dependent variables included phonological awareness, letter recognition, fluency, text comprehension, vocabulary, decoding skills, spelling, overall reading achievement, task engagement and attitude. Outcome assessments for these variables included standardized measures such as the Woodcock Johnson Reading Mastery Test (WRMT) and the Peabody Picture Vocabulary Test (PPVT) as well as assessments created by the researchers for a particular study. Eighteen of the 23 studies used standardized measures while the remaining five used measures created by the study's author (see Appendix A). Many of the measures created for a particular study were used to assess behavioral outcomes such as student task engagement

Interventions

Interventions varied across studies. Eight studies used a computer adapted version of traditional basal readers while the remaining fifteen used pre-packaged software programs (see Appendix A). The two most commonly used pre-packaged software programs were Hint and Hunt (incorporated into three studies) and Daisy's Quest (incorporated into two studies). Both of these programs are designed to enhance phonological awareness. All of the interventions provided either oral and/or visual feedback (see Appendix A). Oral feedback involves the computer voicing information and visual feedback involves the computer providing written information to students.

Procedures

Studies incorporated either single subject, observational, quasi-experimental or experimental designs. Two of the studies used a single subject design, five used an observational design, and sixteen studies used either a quasi-experimental or experimental design. The quasi-experimental and experimental designs consisted of either two (one treatment and one control), three (two treatment and one control), or four (three treatment and one control) conditions with the two treatment condition (12 out of 16 studies) being used most frequently (see Appendix A).

Some researchers specifically stated that they trained students to use the computer software incorporated into their study. Training ranged from a few hours to two weeks. Other researchers did not report providing training for students or reported providing students with training but did not specify the duration of the training. After training was complete, with the exception of occasional adult monitoring, students in each of the 23 studies were expected to work with the software programs individually with little adult assistance.

The amount of time spent on interventions per day in the studies reviewed ranged from 7.5 minutes to 35 minutes, with 20 minutes per day being most common (six studies) (See Appendix A). One study did not specify the number of minutes spent on interventions per day. The amount of time spent per week ranged from two hours to five days, with three days being most common (seven studies). Two studies did not specify the amount of time spent on interventions each week. The duration of the studies ranged from three days to three years. The most common study duration times included: four weeks (three studies), eight weeks (four studies), and ten weeks (three studies). Three studies did not specify their study duration time in weeks.

Most researchers used interventions that were separate from students' daily curriculum. A total of three studies reported connecting the computer-assisted intervention to the daily curriculum (see Appendix A). In all three cases the computer was used to reinforce the same or similar types of material being covered by the traditional curriculum. In one case, the intervention was even incorporated into a small-group instructional rotation (see Appendix A).

Findings

Of the 18 studies that used an experimental or single subject research design, researchers report significant overall differences between treatment and control groups or baseline and intervention phases for 15 studies (see Appendix A). In reading, researchers found significant improvements in the areas of phonological awareness, word recognition, fluency, spelling and letter naming. In behavior, researchers found improvements in student engagement and attitude towards reading. Overall, researchers concluded that explicit computer-assisted instruction involving oral and visual corrective feedback, a game-like environment, animated sequences, graphic representations, and text manipulation/interactivity, can provide effective results for students. Researchers also concluded that some of these elements were most beneficial for low achieving students.

Themes

The purpose of this chapter has been to summarize and analyze the literature examining the impact of computer-assisted instruction on reading ability. Computer-assisted instruction has grown in popularity in recent decades. This has occurred primarily because of the computer's ability to provide readers, especially those who struggle, with individualized instruction, instructive and corrective feedback, and extensive repetition and rehearsals (Rieth & Semmel, 1991; Wilson, Majsterek, & Simmons, 1996). The logistics of traditional classroom instruction requires more prevalent use of whole-group and some small-group instruction, both of which result in decreased opportunities for individualization (Cotton, 2001). Based on the aforementioned characteristics, researchers and other educational stakeholders have hypothesized that the computer has a great deal of potential to aid in the development of reading.

The dependent variables in this literature review included phonological awareness, letter recognition, fluency, text comprehension, vocabulary, decoding skills, spelling, overall reading achievement, motivation, task engagement, and attitude. Careful analysis of research results yielded a series of themes including the use of the computer as a motivational tool, the use of computer-assisted instruction as a supplement to traditional classroom instruction, the use of the computer to assist readers at varying ability levels, the cost effectiveness of computer-assisted instruction, the use of different types of speech feedback enhancements, and the use of computer-assisted instruction when compared to more traditional forms of instruction.

Based on the results of this review it is unclear as to whether the use of CAI results in improvements in the attitude, motivation and engagement of struggling readers. Results suggest that CAI is most effective when used as a supplement to more traditional forms of instruction. In addition, CAI that includes a great number of enhancements (i.e., games, animation, and sound) may be more beneficial to higher achieving readers. Results also suggest that CAI may be at

least as cost effective as traditional forms of instruction. Also, the results of speech feedback vary based the focus of reading instruction (e.g., phonological awareness versus word recognition). Finally, it is unclear as to whether computer-assisted instruction is at least as effective as traditional forms of reading instruction. The purpose of the current study, which will be presented and discussed in the remaining chapters, is to increase the research base for two of the six themes discussed in this literature review (i.e., attitude, motivation, and engagement and computer-assisted versus traditional instruction). The result of the current literature surrounding these two themes is mixed and more research is needed to provide conclusive evidence regarding the use of CAI in these areas.

CHAPTER 3
METHODS

Purpose

The purpose of this research was twofold. The first purpose was to investigate the effects of two methods of fluency instruction (i.e., print and computer) on oral reading fluency and overall reading achievement. The second purpose was to examine the effects of computer-assisted instruction (CAI) on student engagement. To accomplish these goals, two complimentary studies were designed and implemented using a mixed methods approach.

Fluency

Because of its contribution to reading comprehension and overall reading achievement, there is agreement among reading experts that reading fluency is an important component of a comprehensive reading curriculum (Kuhn, 2004/2005; Kuhn & Stahl, 2003; Rasinski, 2004). Despite the fact that it is one of the five key components of reading development, fluency instruction continues to be overlooked in the general reading curriculum (Allington, 1983; Kuhn). Leading experts in the field of reading have attributed this neglect to such factors as a failure on the part of universities and school districts to train pre-service and in-service teachers how to provide explicit fluency instruction to students, the assumption that decoding instruction automatically leads to increases in reading fluency, and questions surrounding how to provide individualized support to students (Allington; Fleisher, Jenkins, & Pany, 1979/1980; Kiley, 2005; Kuhn).

Fluency instruction is most effective when students are provided with opportunities to repeatedly read text with guidance and feedback from a fluent model (Samuels, 2002). This guidance and feedback is best provided to students individually (Osborn, Lehr, & Hiebert, 2003). Teachers and researchers are often seeking ways to provide struggling readers with

individualized support from a fluent model. Because it is often difficult to provide quality individualized guidance and feedback to students, teachers have turned to alternative forms of instructional delivery including: paired reading, tape assisted reading and computer-assisted instruction (Osborn, Lehr, & Hiebert). Because computer-assisted instruction has the capacity to provide students with individually paced instruction, extensive rehearsals, immediate and corrective feedback and distributed presentation of new material (Rieth & Semmel, 1991); it could potentially be the most viable of the three alternatives for providing students with individualized guidance and feedback which is crucial to fluency development (Cotton, 2001; Rieth & Semmel).

There is a dearth of research-based information regarding specifics of how computer-assisted instruction can impact a struggling reader (Hall, Hughes, & Filbert, 2000). Hall et al., 2000 has called for studies that evaluate the use of CAI for the instruction of each of the five key elements of reading instruction (i.e., phonemic awareness, phonics, fluency, vocabulary, comprehension). Tomlinson (2001) suggests increased evaluation of how CAI can assist teachers with differentiating instruction to meet the varying needs of students.

In this study, three groups were compared. Three groups were established instead of two because the results of a pilot study, which will be discussed later in this chapter, revealed that a simple comparison between print and computer alone may yield inconclusive results. It could have been argued that the instructional nature of the software version of the fluency program was not equivalent to the print version of the program. Therefore two computer groups were established. One group was equivalent to the print group in the amount of text presented in a given session and the other group was equivalent to the print group in the amount of time students received to complete a given session. Participants in the print group received a

print-based method of fluency instruction led by a graduate student teacher, a student completing the requirements for a master's degree in education. Participants in the text and time equivalent groups received one-on-one computer-assisted fluency instruction. The primary purpose of the proposed study was to compare the effects of computer-assisted instruction with small-group teacher-led print-based instruction on the fluency and overall reading skills of beginning third grade students who have demonstrated delayed fluency.

Task Engagement

Guthrie and Wigfield (2000) and Kuhn and Stahl (2003) have found that student engagement during academic tasks is crucial to overall academic achievement. Engagement can be defined as an "observable manifestation of achievement motivation" (Monzo & Rueda, 2000, p. 2). Students can demonstrate engagement by engaging in on-task behaviors such as maintaining eye contact, either with the teacher or with the materials being used during instruction. Just as with overall academic achievement, engagement is strongly related to reading achievement. A national research study involving students of ages nine, thirteen and seventeen revealed that more highly engaged readers demonstrated higher achievement than less engaged readers (Campbell, Voelkl, & Donahue, 1997). In fact, Guthrie, Schafer, and Huang (2001), have found that high engagement during reading can overcome such obstacles as a low income/education and family background.

For many years, researchers and practitioners have had difficulty finding ways to help increase student engagement. The individualization provided by CAI could assist teachers with increasing student engagement. In the CAI environment each student receives individualized feedback on each response. This individualization provides students with increased opportunities to respond and holds students more accountable, thus leading to increased engagement during instruction. (Balajthy, 1989). In addition to evaluating the effects of CAI on fluency skills, the

purpose of the proposed study was to also compare levels of task engagement among students who had difficulty remaining on-task during instruction using CAI and a print-based teacher-led method of instructional delivery.

Because this study directly evaluated the effects of CAI on student engagement, a single subject component was incorporated to allow for the systematic evaluation of a subset of the larger group population. The use of a single subject design was appropriate for this investigation for three main reasons. First, one of the strengths of single subject research designs is the ability to demonstrate a reliable functional relationship between dependent and independent variables with individual subjects in natural settings (Tawney & Gast, 1984). This project involved applied interventions which required that formative data-based changes be made in the levels of the independent variables. It was important to carefully monitor and account for the unique variables frequently present in applied settings. Single subject research methodology allows high levels of precision and flexibility, while at the same time, providing excellent control for threats to internal validity (i.e.,, factors that would impede the ability to demonstrate functional relationships) (Kazdin, 1982; Tawney & Gast, 1984). In addition, Baer, Wolf, and Risley (1968) noted that systematic replication of behavioral research is necessary if we are to understand the parameters associated with a particular method or procedure.

Second, single subject designs are useful when the number of available and appropriate subjects is limited. The improbability of obtaining sufficient numbers of subjects displaying both challenging behaviors and reading deficits in a single controlled setting was a major difficulty in planning group comparison designs for this investigation. These low numbers were due in part to (a) relatively low incidence rates of students who exhibit a comorbidity for low task engagement and reading deficits (U.S. Department of Education, 1994) and (b) wide variety of behavioral

topographies displayed within this population of students. However, power and effect-size conventions of traditional group research designs would dictate that much larger samples be used to achieve reliable findings (Keppel, 1991; Kraemer & Thiemann, 1987). These facts exemplify the impracticality of attempting to select and assign students to groups of sufficient size to facilitate parametric designs.

Third, although generalizations typically are limited by the small number of subjects used in single subject studies, external validity can be enhanced through the repeated demonstrations of experimental control across different subjects and settings (Kazdin, 1982; Tawney & Gast, 1984). The ability to characterize subjects for whom a given intervention is found to be effective is an important feature of the single subject methodology and a key purpose of this research project. This study evaluated the effects of CAI and teacher-led instruction on student engagement by comparing three interventions that were replicated across three individual students.

Research Questions

The processes and procedures described herein are designed to provide information to answer six specific research questions.

- **Research Question 1**: Is a computer-based method of instruction as effective as a print-based method of instruction in improving the fluency skills of children who demonstrate delayed fluency development?

- **Research Question 2**: Is a computer-based method of instruction as effective as a print-based method of instruction in improving the general reading skills (i.e., vocabulary and comprehension) of children who demonstrate delayed fluency development?

- **Research Question 3**: Is the number of sessions of instruction related to the fluency development of children who demonstrate delayed fluency development?

- **Research Question 4**: Is the number of sessions of instruction related to the reading development (i.e., vocabulary and comprehension) of children who demonstrate delayed fluency development?

- **Research Question 5**: When students are not limited in the amount of text they read, do they read more?
- **Research Question 6**: Is there a clear functional relationship between method of fluency instruction and task engagement for students who demonstrate delayed development in on-task engagement?

Data from two dependent measures (i.e., a standardized measure of oral reading fluency and a standardized measure of overall reading achievement) were analyzed to answer research questions one through four concerning the effects of the print-based, text-equivalent, and time-equivalent instruction on the oral reading fluency and overall reading skills of participants. Data provided by the fluency software program were analyzed to answer research question five concerning whether students took advantage of the opportunity to read multiple passages in a given session. Visual analysis of graphs of students' on-task engagement during reading instruction was analyzed to answer research question six concerning the existence of a functional relationship between fluency instruction and task engagement.

Design and Instructional Setting

Because the purpose of the current study was twofold, two studies were performed using a mixed methods approach. A description of both research designs is illustrated in Figure 3-1. A description of the instructional settings for both designs is also included in this section.

Experimental Design: Group

An experimental pretest – posttest design was used in this study. This design allowed for the assessment of changes in the dependent variable over time. Because this study included third grade participants who were being prepared to take statewide high stakes tests, a treatment control group was not feasible. Each of the schools that were involved in this study, planned on providing struggling students who did not participate in this study with their own forms of supplementary fluency instruction. Limitations will be discussed. Participants were randomly

assigned by school to one of the three treatment groups. Random assignment controlled for threats to internal validity including: selection and regression toward the mean (Dooley, 2001).

Experimental Design: Single Subject

A changing conditions single subject design was used to evaluate the on-task engagement of the three participants within the larger group study. This design allowed the researcher to compare participants' on-task engagement across the three treatment conditions (Kazdin, 1982). A changing treatments design allows for the comparison of multiple treatments "without associating the treatments with a particular stimulus" (Kazdin, p. 177).

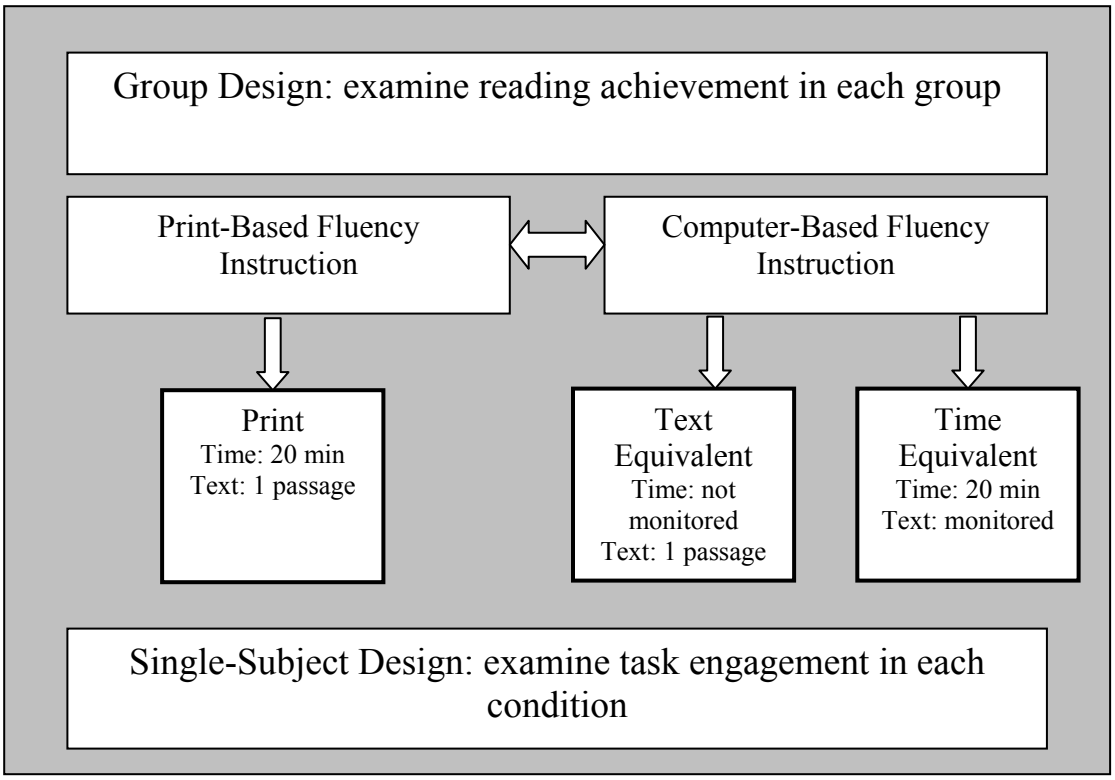

Figure 3-1. Overview of the Group and Single Subject Designs

Instructional Settings

Three elementary schools located in north central Florida were chosen as sites for this study. All three schools were chosen because a prior relationship existed between each school and the graduate student researcher. Two of the schools were also chosen because they had large

populations of students at the third grade level who also struggle in oral reading fluency. One school served primarily a rural population while the other two schools represented a more urban population. Two of the three schools served children in pre-kindergarten through fifth grade. One of the schools served a kindergarten through twelfth grade population. Table 3-1 provides descriptive statistics for the socioeconomic status of the schools and the socioeconomic status of study participants by school.

An important factor when selecting schools was the availability of adequate computer resources. This study required computers with the following minimum system requirements: Windows 98 or Mac OS X. In two of the three schools, the computer-assisted instruction groups, time and text controlled, received their instruction in the school computer laboratory. It was therefore critical that these schools had a computer laboratory with a minimum capacity of 15 students. The small-group teacher-led instruction group, group A, took place in a quiet area (e.g., the school conference room or an unused classroom) provided by each school.

Group Study

In this section, methods of subject selection, the instruments and materials, the instructional procedures, and methods of data analysis for the group design portion of the study are discussed.

Subject Selection

All third grade students in the three elementary schools were assessed using the Dynamic Indicators of Basic Early Literacy Skills (DIBELS), an individually administered standardized measure of oral reading fluency. The test was administered by the teachers and reading coaches in each of the schools. Students who scored between the 10th and 39th percentile or between 35-76 words correct per minute (wcpm) according to benchmark goals and indicators of risk provided by the test manual qualified for the study (Hasbrouck & Tindal, 1992). The 10th to 39th

percentile range was chosen because Hasbrouck and Tindal (1992) suggest that students scoring within this range on measures of oral reading fluency beginning in second grade are good candidates for interventions in oral reading fluency development. This is because students scoring at this level are more likely to have the basic foundational skills (e.g., phonemic awareness, phonological awareness, word recognition) needed to be ready for fluency instruction (Rasinski, 2004). Students who score below the 10th percentile would have needed substantial interventions beyond the scope of this study and students who scored above the 39th percentile were considered normally achieving readers (Hasbrouck & Tindal).

All other students scoring within the 10th and 39th percentile were given letters of parental informed consent explaining the purpose of the study as required by the University of Florida's Institutional Review Board (see Appendix B). The participants who returned letters of consent were included in the study. Within each research site, students were randomly assigned to one of the three experimental groups using a random number table. Each participant was assigned a number and grouped using an electronic random number generator. Because participants in the computer group worked individually, whether random assignment yielded heterogeneous or homogenous groupings was irrelevant. Participants in the print-based groups were placed in instructional groupings that were as close to homogenous as possible after the random assignment process.

Once participants were finalized, frequencies were tabulated for demographic variables (age, gender, socioeconomic status, and ethnicity) (See Table 3-1). Struggling students at school one who were not involved in the study received small group print based *Quick Reads* fluency instruction. Struggling students in schools two and three who did not participate in the study received computer based *Read Naturally* fluency instruction.

Instruments and Materials

In this section, the research instrumentation is described. This section includes information about the screening measure used to select the participants in the study. The pretest and posttest measures used to assess the effects of training are also described.

Screening measure. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS), a set of standardized measures that includes an oral reading fluency measure, has been widely used

Table 3-1. Demographic Data for All Study Participants by School

	School 1 (N = 6)		School 2 (N = 26)		School 3 (N = 21)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Age						
8	1	16	12	46	3	14
9	4	67	13	50	11	52
10	1	16	1	4	7	33
Gender						
Male	3	50	14	54	9	43
Female	3	50	12	46	12	57
SES						
Free/Reduced	2	33	21	81	18	86
Full Pay	4	66	5	19	3	14
Ethnicity						
Black	2	33	13	50	3	14
White	4	67	10	38	15	71
Hispanic	0	0	2	7	3	14
Mixed Race	0	0	1	4	0	0

across the country as a tool for screening, diagnosis and progress monitoring (Good & Kaminski, 2002). DIBELS oral reading fluency (ORF) is a measure that is individually administered beginning in the winter semester of first grade. It is used to measure the accuracy and rate at which students are able to read connected text at their grade level. Students' performance is reported as the number of words read correctly in one minute. It consists of a set of three timed standardized reading passages that students read orally. Errors include omissions, substitutions, and hesitations of more then three seconds. Self corrections within three seconds are counted as

accurate. The median score among the three passages comprises the student's oral reading fluency score. Students are usually tested approximately three times per year (e.g., fall, winter, spring).

The most observable manifestation of skillful reading is the speed at which text is transferred into spoken language (Adams, 1990). It is therefore not surprising that oral reading fluency is highly correlated with overall reading achievement (Fuchs, Fuchs, Hosp, & Jenkins, 2001). In fact, Fuchs et al. (2001) have found oral reading fluency to be more strongly associated with the ability to read and respond to text than more direct measures of reading comprehension. In addition, student performance on measures of oral reading fluency in the early grades is highly predictive of later overall reading achievement (Good, Simmons, & Kame'enui, 2001). DIBELS was chosen as the screening instrument in this study because it has been shown to be a reliable and valid measure for identifying children at risk for reading failure.

The reliability of the screening instrument used in this study is important to ensure consistent measurement of the skills being studied (Salkind, 2004). There are four types of reliability including: test-retest, parallel forms, internal consistency, and interrater reliability (Salkind). Two of the four types of reliability have been established for DIBELS: test-retest and alternate forms reliability. Both of which are quite high. The test-retest reliability for elementary age students ranges from .92 to .97; and the alternate forms reliability ranges from .89 to .94.

The validity of the screening instrument used in this study is important to establish to ensure that the assessment tool measures the construct that it claims to measure (Gay & Airasian, 2000). There are four types of validity including: content, criterion-related, construct, and consequential validity (Gay & Airasian). One of the four types of validity has been established for DIBELS: criterion validity. The criterion validity ranges from .52 to .91.

Outcome measures. In addition to using DIBELS as a screening tool for students at risk for reading failure, it was also used as an outcome measure for oral reading fluency. Pretest (i.e., fall assessment scores) and posttest (i.e.,. winter assessment scores) data were compared. DIBELS was chosen as an outcome measure because it has been shown to be a reliable and valid instrument for predicting student response to training in fluency skills.

Because DIBELS is not designed to serve as a comprehensive reading assessment tool (Good, Simmons, & Kame'enui, 2001), the Gates MacGinitie Reading Test Level three—Fourth Edition was also used as an outcome measure for overall reading achievement. The Gates MacGinitie is a group administered assessment that, at the third grade level, specifically assesses vocabulary and comprehension. The vocabulary portion consists of 45 questions and is timed for 20 minutes. The comprehension portion consists of 48 questions and is timed for 35 minutes. In the vocabulary portion, students are provided with a sentence or phrase that consists of a target word. The sentence or phrase and target word are followed by a list of possible synonyms for the target word. Students are required to choose the synonym that matches the target word within the context of the sentence. In the comprehension section, students are provided with a short passage followed by a list of questions related to the passage. Two of the four types of reliability that have been established for the Gates MacGinitie Reading test include: internal reliability and alternate forms reliability. The internal reliability ranges from .88 to .96; and the alternate forms reliability ranges from .74 to .95.

Materials. *Quick Reads* is an instructional program used to build oral reading fluency (Hiebert, 2005). The program uses controlled grade level appropriate vocabulary. The books are based on non-fiction science and social studies topics and are thematically grouped. The program consists of four levels: A-F (see Appendix D-1). Each level consists of three books and each

book contains 30 texts (90 texts per level). Text length corresponds to grade level reading rate for one minute. *Quick Reads* comes in both a print and a software format. Both formats involve the same passages. See Table 3-2 for the steps that guide the print version of the *Quick Reads* program.

The software version of the program allows students to receive speech feedback on the vocabulary of pre-selected words in a passage, speech feedback on the pronunciation of all words in a passage, and also comes equipped with voice recognition software so that students may read passages to the computer and receive feedback. The software places the locus of

Table 3-2. Quick Reads Steps: Print

Step Number	Action
1	The teacher begins by browsing the title, picture and caption with students.
2	The teacher uses a graphic organizer to help students to make predictions about what might occur in the passage (see Appendix H-1).
3	The teacher then reads the passage as students follow along silently.
4	Students then choral read the passage.
5	Students practice the passage by reading with a partner.
6	The teacher then times the student for one minute.
7	The teacher and student chart the number of words read correctly per minute.
8	As students wait to be time, they respond to the comprehension questions that accompany a particular passage. Review the comprehension questions with students.

control with the student so that the student is in charge of the order of the steps for instruction. The student can choose to have the computer read first or the student can choose to read first. In the print-based version of instruction, the order is pre-set. No matter the order, the computer requires that (1) the student be read to by the computer at least twice, (2) that the student read to the computer at least twice, and (3) that the student answer the comprehension questions that accompany the passage before moving to another passage. See Tables 3-3 and 3-4 for the steps that guide the computer versions of the *Quick Reads* program. Appendix I provides screen shot examples of the software version of the *Quick Reads* program.

Each passage of both versions of the program includes an introduction page which shows a figure and an accompanying caption which is designed to be used as a pre-reading activity. In the print version of the program, the fluency passage is on the adjacent page. In the software version, the fluency passage is hyperlinked to the introduction page. Comprehension questions also accompany both versions of the program. In the print version, questions can be found at the end of a series of passages. In the software version, questions appear after two readings of the same passage have been completed. In the print version, a page to chart student progress appears at the very end of a book. In the software version, the charting page appears after each reading.

Table 3-3. Quick Reads Steps: Computer: Text-equivalent

Step Number	Action
1	The student logs into the program.
2	The student tests the microphone.
3	The student logs into the reading passage.
4	The student chooses at least two vocabulary words.
5	The student chooses to have the computer read or to read to the computer.
6	The student chooses to have the computer read or to read to the computer.
7	The student chooses to have the computer read or to read to the computer.
8	The student chooses to have the computer read or to read to the computer.
9	The student responds to comprehension questions.
10	The student begins a math program.

Instructional Procedures

In the following sections, procedures for planning and delivering instruction are described. The training of graduate students who served as instructors of the print group and as supervisors of the computer-assisted instruction groups is discussed. A description of the computer-assisted and teacher-led instruction interventions is also provided.

Personnel training. Graduate students in education were trained to supervise the students in the computer-assisted groups and to teach students in the teacher-led instruction group. All three graduate students were able to commit enough time to the study to supervise both the computer-assisted and the teacher-led groups.

Training for the graduate students who taught the teacher-led group was conducted by the researcher. The graduate students received a review of the concept of fluency and its relationship to reading. Fluency skills were defined and demonstrated, and interventions were explained. Scripts for up to 30 lessons were provided to each of the graduate students (see Appendix D-2). The number of sessions for this study varied based on such circumstances as start date and end date of the study, holidays, and student absences. The researcher modeled procedures for one lesson. The graduate students practiced in pairs until they became comfortable using the scripts. The researcher observed each graduate student and provided corrective feedback on all procedures as needed.

The training of the graduate students who supervised the computer-assisted groups was conducted by the researcher. The researcher taught the graduate students how to operate the *Quick Reads* (2005) software program. The graduate students were allowed to view the tutorial and to practice navigating through different sections of the program.

Table 3-4. Quick Reads Steps: Computer: Time-equivalent

Step Number	Action
1	The student logs into the program.
2	The student tests the microphone.
3	The student logs into the reading passage.
4	The student chooses at least two vocabulary words.
5	The student chooses to have the computer read or to read to the computer.
6	The student chooses to have the computer read or to read to the computer.
7	The student chooses to have the computer read or to read to the computer.
8	The student chooses to have the computer read or to read to the computer.
9	The student responds to comprehension questions.
10	The student moves on to another passage (if time).

Participant training: computer-assisted instruction. Participants in the CAI groups were trained to use the *Quick Reads* software program before the study began. Participants were allowed to view the tutorial that accompanied the software program. Then participants got an opportunity to practice several procedures that were necessary for daily use of the program

including: accessing the menu of stories, accessing the individual stories, testing and using the microphone, requesting speech feedback on the vocabulary of target words, and pronunciation of individual words.

Pilot Study

A pilot study was conducted over the course of three weeks during a summer reading enrichment program. All 12 students involved in the study scored within the 10th and the 38th percentile (i.e., 48-89 wcpm) on the end of the year 2nd grade DIBELS ORF. Six students were randomly assigned to receive print-based Quick Reads instruction and six students were randomly assigned to receive computer-based Quick Reads instruction. Students received instruction over the course of three weeks for five days per week at 30 minutes per day. There were no significant differences in increases in means across both groups. Appendix E-1 displays individual and average increases from pretest to posttest (i.e., end of the year scores to end of summer program scores) for both groups.

The six students in the computer group varied in the number of fluency passages read in each allotted 30 minute session. Some students were only able to complete one passage in a session while others averaged over two passages in a session. In the pilot study, it was difficult to draw conclusions about the differences between the print and computer groups because of the confounding variables associated with the number of passages participants in the computer group were able to read in a given session. The result was the establishment of two computer groups for the current study.

Description of intervention: teacher-led instruction. Participants were grouped based on their DIBELS ORF scores. Participants with similar ORF scores were placed in the same group. Once grouped, the researcher again used DIBELS scores to determine the *Quick Reads* level at which to begin instruction. The researcher used a specified DIBELS ORF percentile range to

determine the level at which to begin instruction (see Table 3-5). Students in this study were either placed in *Quick Reads* level A or in level B. *Quick Reads* Level C is meant to be used with students who are reading on a third grade level. *Quick Reads* Levels D-F are meant to be used with students who are reading above a third grade level. Group size ranged from three to five students. Students began the study at the beginning (i.e., the first story) of each level and continued within that level throughout the entirety of the study. The fact that there are three books in each *Quick Reads* level with over 20 stories in each book prevented any student from increasing to a higher level within the intervention period.

As a method of insuring procedural integrity, the researcher provided graduate students with scripts to follow to ensure consistency across the teacher-led instructional groups (see Appendix D-2). Each lesson involved eight steps (see Table 3-2) and took approximately 20 minutes per day to complete. Students completed one passage per day and received instruction for three days per week across a period of ten weeks. Instructional time in this study reflected the fact that effective fluency instruction must be frequent (i.e., between three to five times per week) (Johns & Berglund, 2002). Posttests (DIBELS ORF Winter) were administered by the researcher and the graduate students within one week after the completion of the study.

Table 3-5. Percentiles and Matching Levels

DIBELS ORF Percentile	Quick Reads Level
10th-28th	A
29th-39th	B

Description of intervention: text-equivalent computer-assisted group. Similar to the teacher-led group, DIBELS percentile ranges were used to determine the *Quick Reads* level at which to begin instruction for the CAI group. Each student in the text-equivalent CAI group began in either level A or level B. The *Quick Reads* software allows students to request speech feedback on the definitions of pre-selected words and on the pronunciation of individual words

throughout the passage. However, the software program requires that participants have the computer read the passage to them at least twice, that participants read to the computer at least twice, and that participants respond to the comprehension questions that accompany the passage. Once these requirements have been fulfilled then participants can choose to move to another passage or choose to read to the computer again to try to improve their score.

Several controls were implemented to limit the differences between groups to the variables of interest. Because participants in the teacher-led group engaged in predicting to activate prior knowledge, participants in the text-equivalent CAI group were required to request speech feedback on at least two target vocabulary words. This requirement helped to serve as a pre-reading activity for participants in the text-equivalent group. In addition, because participants in the teacher-led group only had the opportunity to hear a fluent model twice and to read the text twice before an official timing and charting of their scores then participants in this group were not be allowed the option of listening to the computer more than twice or reading to the computer more than twice. Once participants completed the requirements for a given session including: requesting at least two target vocabulary words, listening while the computer read twice, reading to the computer twice, and completing the comprehension questions that accompany the passage; participants were required to complete their session. A completed session meant that practice of a particular passage was complete. Participants in this group were only allowed to complete one passage in a given daily 20 minute instructional session.

Description of intervention: time-equivalent computer-assisted group. Similar to the teacher-led group and the text-equivalent computer-assisted group, DIBELS percentile ranges were used to determine the *Quick Reads* level at which to set the instruction for participants in the CAI time-equivalent group. Recall that the *Quick Reads* software program allows students to

request speech feedback on the definitions of pre-selected words and on the pronunciation of individual words throughout the passage. Also, the program requires that participants have the computer read the passage to them at least twice, that participants read to the computer at least twice, and that participants respond to the comprehension questions that accompany the passage. Once these requirements have been fulfilled then participants can choose to move to another passage or read to the computer again to try to improve their score.

Just like participants in the teacher-led and text-equivalent CAI groups, participants in the time-equivalent CAI group were required to request speech feedback on at least two target vocabulary words. This requirement helped to serve as a pre-reading activity for participants in the time-equivalent group. Also like the participants in the teacher-led and the text-equivalent groups, participants in the time-equivalent group were not be allowed the option of listening to or reading to the computer more than twice. Similar to conditions in the text-equivalent group, once participants completed the requirements for a given session including: requesting at least two target vocabulary words, listening while the computer reads twice, reading to the computer twice, and completing the comprehension questions that accompany the passage; participants were required to complete their session. To investigate the full effects of using CAI during fluency instruction, if participants in this group completed a passage within the allotted 20 minute instructional period, they were allowed to move to another passage. However, to ensure that students had fulfilled all the completion requirements, participants in this group were required to check in with a graduate student before moving on to a new passage. The graduate student ensured that participants fulfilled all of the requirements that were needed to complete a session and move to the next passage.

Treatment integrity. Because this research study was conducted in three different schools, it was important to ensure that instructional content was delivered reliably across schools. The procedures implemented to ensure consistency of instruction throughout the study are discussed. Treatment integrity is the extent to which an intervention is implemented as planned (Gresham, 1989). Examining treatment integrity was important in this study because it helped to decipher whether the intervention did or did not work due to the actual intervention and not because of variations in how the intervention was implemented.

Treatment integrity in this study involved an observer rating scale (see Appendix F-1 and F-2). This method of collecting treatment integrity helped to avoid the bias of a self report and also helped the researcher to determine not just whether each step was implemented but also the degree to which each step was implemented. The researcher observed each graduate student teacher using the observer rating scale at least once per week or the equivalent of approximately 30% of the instructional sessions. The rating scales were tailored to match the requirements for conducting print and computer groups. For the print group the focus was on the graduate student teacher's ability to follow each scripted step of the program and to also maintain student focus throughout each session. For the computer group the focus was on the graduate student teachers' ability to prepare and manage the software and to also assist students in navigating the software. Each observation was followed by a debriefing where graduate students were informed about how they performed on each aspect of the treatment integrity rating scale. If necessary, debriefings were followed by re-teaching and modeling. Re-teaching and modeling was led by the primary researcher.

Data Analysis

The purpose of this study was to compare CAI with small-group teacher-led instruction in fluency for third grade students with below average skills in fluency. To evaluate the effects of

computer delivered and teacher-led instruction, six hypotheses were constructed. At the end of the study, all pretests were re-administered to all participants in the group design. Because students in the single subject design were experiencing all three conditions, it was not possible to compare the effects of the treatments on their fluency or reading achievement (i.e., vocabulary and comprehension).

An Analysis of Covariance (ANCOVA) approach was used to evaluate differences in oral reading fluency across the three groups. ANCOVA was used in this study to remove predictable individual differences from the dependent variable (i.e., pretest scores) which, in turn, provided a more precise estimate of experimental error than a repeated measures ANOVA (Shavelson, 1996). ANCOVA removes selection bias which strengthens internal validity.

"Any variable that is correlated with the dependent variable can be controlled for using covariance" (Gay & Airasian, 2000, p. 501). In the case of the current study, the ANCOVA adjusted posttest scores for initial differences in pretest scores and compared the adjusted scores. The use of an ANCOVA was an attempt to diminish the variation in posttest scores that can be attributed to other variables not related to the treatment. The pretest is called the covariate.

The data was analyzed to determine if main effects existed. Main effects refer to whether the independent variable (i.e., instructional method) has a significant effect on the outcome or dependent variables (i.e., oral reading fluency and overall reading achievement). It was also analyzed to determine if treatment effects, whether the separate effects of levels of the independent variable (i.e., print-based instruction versus computer-based instruction) had an impact on the dependent variable (e.g., oral reading fluency and overall reading achievement), existed. Post hoc tests which included Tukey's HSD and Scheffe's method were used to measure

significant treatment effects. Both tests allow for comparisons of pairs of means and of complex combinations (i.e., more than two) of means.

Single Subject Study

Methods of subject selection, the instruments and materials used, the instructional procedures used, and methods of data analysis for the single subject design portion of the study are discussed in this section.

Subject Selection

At the onset of the study, the researcher asked teachers of students who qualify (hereafter known as participant teachers) for the larger group study to nominate from among those students, individuals who also had difficulty remaining engaged during instruction. Engagement was defined as "an overt interaction with an instructional task" (Rieth & Simmel, 1991) such as a verbal response, reading aloud, or writing an answer on a piece of paper. All teacher nominated students received letters of parental informed consent explaining the purpose of this portion of the study as required by the University of Florida's Institutional Review Board. The participants who returned the letters of consent were included in this portion of the study. The participant teachers were asked to complete a behavior rating scale (see Appendix C-1) to determine the extent to which the teacher nominated students actually had difficulty remaining engaged during reading instruction. The purpose of the behavior rating scale was to act as a second level of screening and provide teachers with the specific target behaviors that were to be evaluated in the study. Completing the behavior rating scale clarified for some teachers the nature of the target behaviors. In fact, after viewing the rating scale, some teachers removed several students from the initial nomination list because they exhibited disruptive but not off task behaviors. The rating scale required participant teachers to rate students on a scale of zero to three with three representing whether the student "always" performed a specified activity and zero representing

whether the student “never” performed a specified activity. The activities on the rating scale included: paying attention, listening to directions, remaining on-task while working independently, and actively participating. Students with the lowest scores on the rating scale qualified for the single subject portion of the study. Each nominated participant was also observed by the researcher using an observation protocol. Because the logistics of this portion of the study were somewhat complex, all participants were chosen from the same school. Five students were initially selected to participate in this portion of the study, however, one participant was eliminated during baseline observations because he already exhibited very high rates of engagement during whole-group instruction and independent seat work. The remaining four students were randomly assigned to each of the three treatment groups. One of these four students was eliminated toward the end of the study due to a large number of absences. A description of each of the remaining three students follows.

Daryl

Daryl was a 10 year old white male enrolled in a general education third grade classroom. He spent approximately 40% of the school day in a special education resource room. Daryl often engaged in off task behaviors which hindered his reading development. These off task behaviors included distracting others, leaving his assigned seat during independent academic work, failing to pay attention during whole-group instruction, failing to listen carefully to directions, failing to remain on-task during independent work, and failing to complete independent academic work.

Sam

Sam was a 9 year old Hispanic male who was enrolled in a general education third grade classroom. Sam often engaged in off task behaviors which hindered his reading development.

These off task behaviors included: failing to pay attention during whole-group instruction and failing to complete independent academic assignments.

Jay

Jay was a 9 year old white male who was enrolled in a general education third grade classroom. He often engaged in off task behaviors which hindered his reading development. These off task behaviors included distracting others, leaving his assigned seat during independent seat work, and inappropriate use of assigned materials.

Instruments and Materials

In this section, the research instrumentation for the single subject portion of the study is described. This section includes information about the screening measure used to select the participants for this portion of the study, the outcome measures used to assess the effects of the changing conditions, the materials used to capture student behavior, the methods used to train personnel, and a description of the intervention.

Screening measure. An observation protocol created by the researcher (see Appendix C-2) was used to determine the extent to which the teacher nominated students actually had difficulty remaining engaged during reading instruction. Target behaviors on the observation protocol used for screening students included: eyes on the teacher, eyes on the text, hand raised to contribute to a lesson, pointing to the text, reading the text, responding to a question, writing responses to questions, and asking the teacher or other students questions about the lesson.

Outcome measure. In addition to being used as a screening tool, the researcher created observation protocol was also used as an outcome measure. The percentage of intervals in which on-task behavior was observed was tabulated during each condition of the study. Average on-task behavior percentages for each of the three conditions are presented for all participants in Table 3-6.

Table 3-6. Average On-task Behavior

Student	% of On-task Behavior Baseline	% of On-task Behavior Print	% of On-task Behavior Text-Controlled	% of On-task Behavior Time-Controlled
Daryl	34.0	73.3	89.5	85.3
Sam	40.3	78.0	75.1	86.0
Jay	47.6	51.8	63.8	93.8

Materials. In addition to the materials used in the group design portion of the study, a video camera was used to capture each of the three students to provide a permanent record from which engagement data was collected at a later time. The researcher and a trained graduate student used the tapes for training and the development of interrater reliability.

Personnel training. One of the graduate students provided assistance during the single subject design portion of the study. Personnel training for this portion of the study consisted of teaching the graduate student how to set up the video camera to capture the target students and how to assist the researcher in observing for the presence of on-task engagement behavior.

To train the graduate student how to observe target students, the researcher provided the graduate student with an operational definition of the target behavior (i.e., engagement). The graduate student was trained on the definition of the target behavior and then practiced using written examples of the target behavior. The graduate student then used knowledge of the target behavior to practice by watching and coding videotapes of classroom scenarios comparable to those that were experienced during actual coding. The graduate assistant practiced with the researcher using the tapes until 80% inter-observer agreement for three consecutive sessions was reached.

Description of intervention. During the baseline condition, students were observed during whole-group reading instruction. During the treatment conditions, when students were in the print group, they were observed during small-group instruction, and when they were in the

computer group, they were observed during one-on-one reading instruction. During baseline, the researcher observed each of the selected participants for 20 minutes at ten second intervals using a researcher created observation protocol on three different occasions during reading instruction. It is best practice in single subject design to collect at least three stable data points during baseline (Kazdin, 1982). Data recording sheets consisted of twenty minute sessions divided into ten second intervals (see Appendix C-2 and C-3). For each ten second interval, the researcher recorded a check (√) to represent on-task behavior or a dash (—) to represent off task behavior. The researcher used partial interval recording to measure task engagement. Participants were recorded as off task if they exhibited off-task behaviors at any time during the 10-second interval. Partial interval recording was used for this intervention program because it provides a more accurate estimate of low rate behaviors and provides a simple conversion into a percentage which can be easily communicated to others (Kazdin).

The intervention period of the study employed a changing conditions design with the three treatment conditions (print-based, text-equivalent CAI and time-equivalent CAI) alternated on successive weeks. In a changing conditions design participants are exposed to a number of different treatments within the intervention phase to determine if a clear functional relationship exists between a particular treatment (i.e., print-based, text-equivalent CAI and time-equivalent CAI) and the target behavior (i.e., task engagement). Counterbalancing occurred so that approximately one third of the participants received print-based instruction and one third received instruction in each of the other two conditions. Originally, the researcher had planned for participants to be exposed to the three conditions in succession for two cycles, so that they could experience each condition at least twice. However, time constraints only allowed each participant to be exposed to one of the three conditions at least twice.

During the treatment conditions, the definition of on-task engagement varied somewhat based on whether students were in the print or in one of the computer groups. For the print group, the definition of on-task behavior included: eyes on the teacher during instruction, eyes on another student if that student was actively participating in group discussion, active participation in group discussion, eyes on the text, or engaging in a written product during independent academic work. For the computer groups, the definition of on-task behavior included: eyes on the computer screen, active interaction with the computer (i.e., speaking into the microphone), or hand-raising to signal teacher assistance.

Data Analysis

Percentage of time on-task was calculated by dividing the total number of intervals that each student remained on-task by the total number of observed intervals. The data was also analyzed to determine whether any changes in trend, variability, and/or level existed. Visual inspection was used to examine changes in trend (i.e., accelerating and decelerating) and variability across treatment conditions. Evaluating changes in trend allows researchers to examine the direction of data points within each phase and across phases (Kazdin). The concept of variability is important because it allows the researcher to draw conclusions about the treatment (Kazdin). Less variability in the data allows for increased confidence on the part of the researcher about the kinds of conclusions that can be made. To evaluate changes in level, the researcher compared an average of the data points in the baseline condition with an average of the data points in the intervention conditions (i.e., print and computer). Evaluating changes in level helps to determine whether the data, from one condition to the next, has continued on the same general level as was seen in the last phase or has suddenly jumped to a distinctly different level (Kazdin, 1982).

Summary

The purpose of this study was to compare the effects of teacher-led and computer-assisted instruction on third grade students who demonstrated delayed development of fluency skills and on-task engagement. Six hypotheses regarding the acquisition of fluency skills and the on-task engagement of struggling students were tested through complementary studies using a mixed design (i.e., group and single subject). All participants qualified for both studies by scoring between the 10th and 39th percentiles on DIBELS ORF. Participants in the group design were randomly assigned to one of three groups. Participants received a print or software version of *Quick Reads*, a fluency instruction program. Teachers and students received training led by the researcher on how to use study materials. Participants in the print group received small-group teacher-led instruction in fluency. Participants in the text-equivalent group received instruction equivalent to the print group in the amount of text presented in a given 20 minute session. Participants in the time-equivalent group were equivalent to the print group in the amount of time allotted to instruction for each session. Dependent measures of instructional effectiveness were statistically examined to compare the effects of group on the fluency and reading skills of the students. In addition, to being initially qualified for the group design study through the use of DIBELS, students in the single subject design study also qualified based on teacher nomination. Unlike in the group design, students in the single subject study experienced each of the three conditions. Dependent measures of social effectiveness were visually analyzed to compare the effects of group on on-task engagement. A timeline of the study is attached (Appendix G-1 and G-2).

CHAPTER 4
RESULTS

A description of preliminary analyses (i.e., equivalency of groups and within group analyses) is included in this section. Results of the analyses of each of the six research presented in the previous chapter are also presented.

Preliminary Analyses

Statistical analyses were conducted to examine the initial equivalency of the three intervention groups. Within group analysis was also conducted to determine whether participants in each of the groups exhibited significant differences from pre to posttest on each of the three dependent measures.

Equivalency of Instruction Groups

Pretest means on the dependent measures (i.e., fluency, vocabulary, and comprehension) for all groups were calculated. An ANOVA was used to make comparisons across the three groups. No statistically significant differences were found on the Gates MacGinitie vocabulary and comprehension subtest pretest measures. There were, however, statistically significant differences found on the DIBELS ORF pretest measures [F (2,49) = 3.281, p = .046]. Tukey's HSD revealed that pretest differences existed between the print and text-equivalent groups (p = .032) and the print and time-equivalent groups (p = .045). Despite random assignment, the print group scored significantly lower that both the text and time-equivalent groups on the DIBELS ORF pretest measure. Specifically, the print-based groups scored approximately nine points below the text-equivalent and time-equivalent groups on the standardized measure of oral reading fluency.

Within Group Analysis

Analysis of posttest scores reveal a significant main effect for method of instruction on DIBELS ORF [$F(1,49) = 42.349$ $p < .001$], the Gates MacGinitie vocabulary [$F(1,49) = 67.675$ $p < .001$] and the Gates MacGinitie comprehension [$F(1,49) = 18.554$ $p <. 001$] subtests.

Research Questions

The primary research questions in this study asked whether a computer-based method of instruction is as effective as a print-based method of instruction in improving the fluency, overall reading achievement (i.e., vocabulary and comprehension), and engagement of children who demonstrate delayed fluency development. To answer these questions, each student in the study was pre and posttested using alternate forms of two measures of reading (i.e., DIBELS ORF and the Gates MacGinitie). The resulting data were analyzed. Descriptive statistics for all three groups are reported in Tables 4-1, 4-2, and 4-3. Scores for fluency, vocabulary, and comprehension were analyzed using an analysis of covariance with group (i.e. print, text-equivalent, and time-equivalent) as the independent factor and the mean posttest scores on DIBELS and the Gates MacGinitie as the dependent factors.

Table 4-1. Descriptive Statistics by Group

	Print (N=17)			Text-equivalent (N=17)			Time-equivalent (N=16)		
		Mean			Mean			Mean	
	Pre	Post	Increase	Pre	Post	Increase	Pre	Post	Increase
ORF	52.94	69.59	16.65	61.19	82.59	21.40	61.63	83.56	21.93
Vocabulary	417.12	439.53	22.41	433.30	441.35	8.05	429.19	453.88	24.69
Comprehension	409.94	432.24	22.30	407.41	425.06	17.65	404.44	429.75	25.31

Table 4-2. Comparison of Pretest Means by Group

Dependent Measure	Print Group	Text-equivalent Group	Time-Control Group	F	df	p
Fluency	52.94	61.19	61.63	3.28	2	.389
Vocabulary	417.12	433.30	429.19	0.96	2	.742
Comprehension	409.94	407.41	404.44	0.30	2	.046

Research Question 1

Is a computer-based method of instruction as effective as a print-based method of instruction in improving the fluency skills of children who demonstrate delayed fluency development?

Posttest fluency scores were analyzed across the three groups through an ANCOVA using the pretest scores as the covariate. No significant differences were found across the three groups, [F (2, 49 = 1.08, p = .350.]

Table 4-3. Comparison of Posttest Means by Group

Dependent Measure	Print Group	Text-equivalent Group	Time-Control Group	F	df	p
Fluency	69.59	82.59	83.56	1.08	2	.350
Vocabulary	439.53	441.35	453.88	3.76	2	.031
Comprehension	432.24	425.06	429.75	1.06	2	.357

Research Question 2

Is a computer-based method of instruction as effective as a print-based method of instruction in improving the general reading skills of children who demonstrate delayed fluency development?

Posttest Gates MacGinitie subtest scores (i.e., vocabulary and comprehension) were analyzed across the three groups through an ANCOVA using pretest scores as the covariate. No significant differences were found across the three groups on the comprehension subtest [F (2,49) = 1.06, p=.357]. However, significant differences were found on the vocabulary subtest [F (2,49) = 3.76, p = .034]. A post hoc analysis was subsequently performed using Tukey's HSD. Post hoc analysis revealed that significant differences in vocabulary existed between the text-equivalent and the time-equivalent computer groups (p = .034) with the differences favoring the time-equivalent group.

Research Question 3

Is the number of sessions of instruction related to the fluency development of children who demonstrate delayed fluency development?

The number of instructional sessions ranged from 12 to 23. In general, students missed sessions because they were absent from school, because of school functions (e.g., plays and pep rallies), or because they were required to remain in their homerooms to take standardized state practice tests. Number of instructional sessions were categorized into three groups (See Tables 4-4 and 4-5). Posttest scores were analyzed using an ANCOVA with instructional sessions used as the independent variable. No significant differences were found across sessions [F (2, 49) = 1.14, p= .330].

Table 4-4. Frequency of Grouped Number of Sessions

Number of Sessions (Grouped)	Number of Students
12-15	7
16-19	15
20-23	27

Table 4-5. Participant Number of Sessions Across Groups

	Sessions		
	12-15	16-19	20-23
Print Group	0	4	13
Text-equivalent Group	4	7	6
Time-equivalent Group	3	5	8

Research Question 4

Is the number of sessions of instruction related to the reading development (i.e., vocabulary and comprehension) of children who demonstrate delayed fluency development?

Posttest scores on the Gates MacGinitie were analyzed across instructional sessions using an ANCOVA. No significant differences were found in vocabulary [F (2,49) = 1.08, p = .348], or in comprehension across sessions [F (2,49) = 2.59, p = .089].

Research Question 5

When students are not limited in the amount of text they read, do they read more?

Students in the time control group ranged from 1 to 2.4 passages on average per day. Forty-six percent of students averaged two or more passages per day. The number of passages read in the time-equivalent group averaged 1.9.

Research Question 6

Is there a clear functional relationship between method of fluency instruction and task engagement for students who demonstrate delayed development in on-task engagement?

The results presented here for each student describes the percent of intervals within each condition that the student was on-task. Anecdotal comments will also be made regarding any changes in the data related to trend, level, or variability. For graphic representation of this data see Figures 4-1, 4-2 and 4-3.

Daryl

During three days of baseline data collection, Daryl's on-task behavior remained low and was approximately 34% (range 30 to 40%). When moved to the time-equivalent group, Daryl exhibited an increased change in the level in his rate of responding. His average percentage of intervals on-task in the time-equivalent condition was approximately 87% (range 82 to 93%). When placed in the print group, his average rate of responding decreased to approximately 73% (range 53 to 91%). Upon being placed in the text-controlled condition, his average rate of responding improved to a stable rate and averaged approximately 90% (range 85 to 95%). Daryl's average rate of responding when returned to the time-controlled group decreased but was relatively stable at 84% (range 80 to 88%).

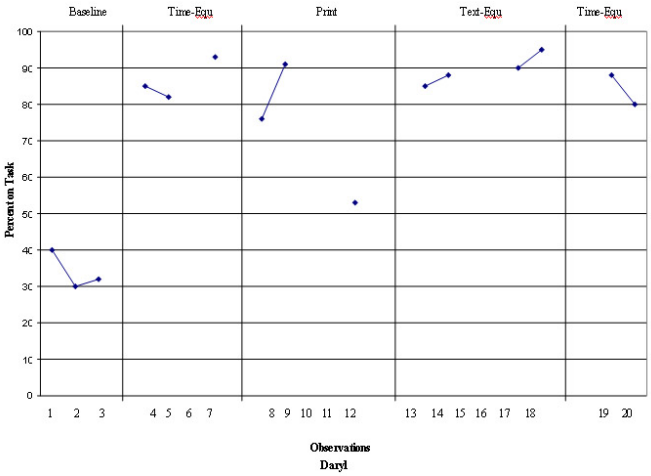

Figure 4-1. Daryl's Percentage of Intervals On-Task Across Baseline and Treatment Conditions

Sam

During three days of baseline data collection, Sam's on-task behavior averaged approximately 48% (range 43 to 53%). Sam completed the baseline condition on a downward trend and began the text-equivalent condition with an increased change in level. He averaged approximately 73% (range 63 to 87%) during the text-equivalent condition and ended on an upward trend. Sam experienced the highest average rate of responding during the time-equivalent condition at 86% (range 78 to 92%). When placed in the print condition, his average rate of responding decreased slightly to 78% (range 60 to 96%). His behavior was also more variable during the print condition than during other conditions. Finally, when he was again placed in the text-equivalent condition, Sam's average rate of responding averaged approximately 77% (68 to 91%) and he ended the condition on an upward trend.

Jay

During the three days of baseline data collection, Jay's on-task behavior averaged approximately 40% (range 23 to 53%). Upon placement in the print group, Jay's rate of responding immediately increased but steadily decreased on subsequent days within the print

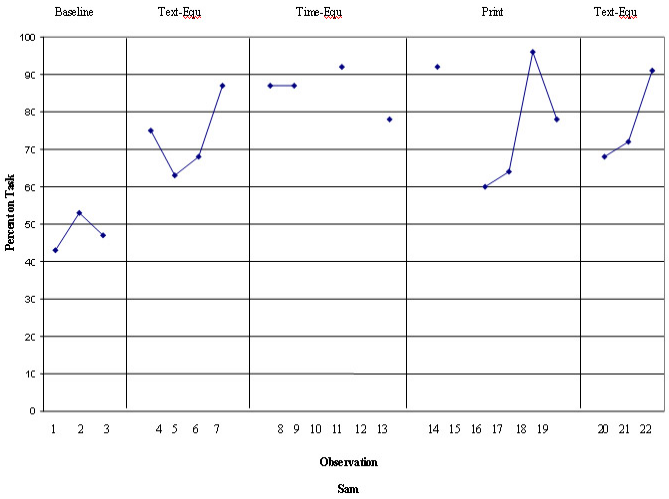

Figure 4-2. Sam's Percentage of Intervals On-Task Across Baseline and Treatment Conditions

intervention condition. Jay's average during the initial print group condition was just slightly higher than baseline at 50% (range 32 to 68%). When placed in the time-equivalent condition, Jay's behavior increased significantly and remained stable resulting in a positive change in level and trend in the data points. His rate of responding during the time-equivalent condition averaged approximately 94% (range 90 to 97). When Jay moved to the text-equivalent condition his average rate of responding decreased to approximately 64% (range 48 to 78%). The move from the time-equivalent to the text-equivalent condition resulted in a negative change in level and trend in the data points. Finally, when placed in the print condition, Jay's percentage of intervals on-task decreased even further to 54% (range 44 to 63%).

Interobserver agreement. Interobserver agreement was assessed on 30% of the behavioral observations for each of the three participants. See Appendix C-1 for a list of the target behaviors that guided the behavioral observations in this study. The primary observer was the researcher while the secondary observer was a trained graduate student. Interobserver agreement was calculated on an interval by interval basis by dividing the number of agreements

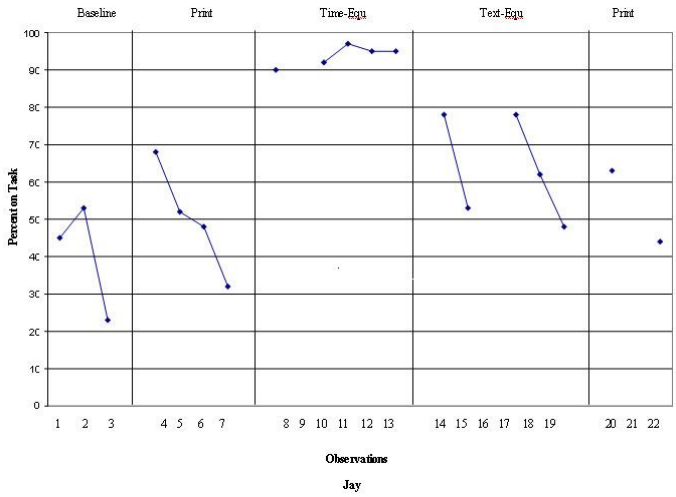

Figure 4-3. Jay's Percentage of Intervals On-Task Across Baseline and Treatment Conditions

by the total number of intervals, with the dividend multiplied by 100%. Interobserver agreement is important in single subject design because it minimizes the biases that any individual observer may have. It also helps to ensure that the target behavior is well defined (Kazdin, 1982). Traditionally, acceptable levels of agreement begin at 80% (Kazdin, 1982). The overall mean agreement in this study was 95.1% with a range of 88% to 97%.

Summary

The results of statistical and visual data analyses from this study have been presented in this chapter. Preliminary analyses with regard to equivalency across the three instructional groups revealed that despite random assignment, participants in the print group scored significantly lower on the pretest oral reading fluency measure than those in the text and time-equivalent groups. Examination of within group differences yielded significant increases from pretest to posttest on all outcome measures across all treatment groups. Also, each of the six research question were addressed. There were no significant differences across the three treatment groups from pretest to posttest for two of the three dependent variables (i.e., oral reading fluency and comprehension). Significant differences across treatment groups on

vocabulary posttest scores were discovered. Visual analysis of the data from the three students who participated in the single subject portion of the study yielded mixed results. Two of the three participants exhibited increased rates of on-task behavior in all three treatment conditions. The remaining student only exhibited consistent increased rates of on-task behavior when placed in the time-equivalent condition. Conclusions and implications for these findings will be discussed in the subsequent chapter.

CHAPTER 5
DISCUSSION

The purpose of this discussion is to evaluate the results of the findings in the current study. The six research questions regarding the effects of print and computer-based methods of a fluency instructional program on student reading and task engagement will be used to guide the discussion. Implications for future research and study limitations are also presented.

Fluency

Reading fluently means reading effortlessly, accurately, and with proper expression (Meyer & Felton, 1999). As students become more fluent readers, their ability to comprehend text increases (Johns & Berglund, 2002; Kuhn, 2004/2005). Comprehension is the ultimate reason for reading so creating interventions to help those students who are struggling with reading fluency is worthwhile. Johns and Berglund and Rasinski (2006) suggest that the interventions that are used to help improve reading fluency should be explicit and systematic. A comprehensive fluency instructional program includes multiple opportunities for students to hear text read by a fluent model, multiple opportunities to read the same text, and to measure the rate at which they are reading text.

The fluency program used in this study, *Quick Reads*, consisted of all the components of a comprehensive fluency instructional program. Both the print and software versions provided students with several opportunities to listen to a fluent model and to re-read text. The program even provided comprehension questions at the end of each passage. In fact, in the software version of the program students were prevented from advancing to the next passage before completing the accompanying comprehension questions.

Computer-Assisted Instruction

Whole-group instruction remains a common grouping practice in today's classrooms. This is due in part to a lack of time and a lack of resources (i.e., additional personnel). During whole-group instruction, it is difficult to meet the needs of diverse learners. In this setting, students are less likely to receive multiple opportunities to respond and frequent individualized feedback. Increased opportunities to respond and specific feedback and correction have been highly correlated with increased academic achievement (Christle & Schuster, 2003; Heward et al., 1996; Sutherland, 2001). Computer-assisted instruction decreases the ratio of students to teacher. The results include increases in opportunities to respond, active responding, praise and/or corrective feedback, and school and post-school outcomes. These characteristics should allow CAI to meet the needs of struggling and diverse learners in a more efficient way than larger grouping formats.

The purpose of the current study was to determine whether a computer-based version of a fluency program would be as effective as a print version of the same program. Students were randomly assigned to one of three treatment groups: a print-based, time equivalent, and a text-equivalent group. The print-based group received small-group fluency instruction led by a graduate student teacher. Students in text-equivalent group received computer-assisted instruction and completed the same amount of text as the print-based group. Students in the time-equivalent group also received computer-assisted instruction and spent the same amount of time receiving instruction as the print-based group. Students were pre and posttested on a measure of oral reading fluency and a measure of reading achievement. The primary goal of the study was to determine whether CAI could provide a viable alternative to whole and small-group methods of fluency instruction.

Discussion of Findings

In this section of the discussion and the findings of each research question will be examined.

Research Question 1

Is a computer-based method of instruction as effective as a print-based method of instruction in improving the fluency skills of children who demonstrate delayed fluency development?

The computer-based methods were found to be as effective as the print-based teacher-led method. The results of this study is similar to the results of other studies performed by such researchers as Mitchell and Fox (2001), Lewandowski et al. (2006), and Hinitikka et al. (2005). These results support the notion that CAI is a viable alternative method of instruction to print-based teacher-led instruction. The consistent occurrence of no significant differences across print and computer-based groups in various studies may be attributed to a variety of factors. Best practice in fluency instruction dictates that students hear text read by a fluent model. The nature of teacher-led fluency instruction is such that students may be more likely to listen to the text being read in the presence of an actual person than in the presence of a computer because the computer is unable to provide verbal redirection to maintain on-task behavior. Best practice in fluency instruction also dictates that students be provided with multiple opportunities to practice re-reading passages. The one-on-one nature of computer-based fluency instruction allows for more opportunities for individual students to practice re-reading passages. It is possible that the positive and negative aspects of both forms of instruction lead to a balance (i.e., no significant differences) in student outcomes.

Research Question 2

Is a computer-based method of instruction as effective as a print-based method of instruction in improving the general reading skills of children who demonstrate delayed fluency development?

The results of this study showed significant differences between the text-equivalent and time-equivalent groups in the area of vocabulary with the time-equivalent group surpassing the text-equivalent group. To better understand why a difference in vocabulary could have occurred between these two groups, it is necessary to examine the fundamental differences between the treatment conditions. In both the text and time-equivalent groups students were required to access at least two vocabulary words before beginning a new passage. This was an attempt to provide the students in the CAI group with a pre-reading activity similar to the kind of activity that was provided to students in the print group. Students in the text-equivalent group, however, were only allowed to read one passage per session whereas students in the time-equivalent group were not restricted as to the number of passages they could read in a given session. The study's design allowed for the participants assigned to the time-equivalent condition to receive more exposure to vocabulary words than the participants in the text-equivalent condition. Baumann and Kame'enui (2004) and Beck, McKeown, and Kucan (2002) have found that increased exposure to vocabulary words leads to increased vocabulary knowledge.

No differences in vocabulary were found between the time-equivalent and print groups. This may have occurred because the pre-reading activity in the print group involved discussion of target words. Baumann and Kame'enui (2004) and Beck, McKeown, and Kucan (2002) have found that vocabulary instruction is most effective when students are provided with the opportunity to interact with and discuss words. The fact that the time-equivalent group experienced increased exposure to words may have been tempered by the fact that the print

group received more meaningful exposure to words. Because the students in the print group had the opportunity to engage in pre-reading discussions that involved a graphic organizer and discussions during and after the readings, these students received more in-depth exposure to text.

Research Question 3

Is the number of sessions of instruction related to the fluency development of children who demonstrate delayed fluency development?

Based on the results of this study, no differences in posttest fluency scores can be attributed to the number of instructional sessions the participants received. More specifically, there were no mean differences on the DIBELS oral reading fluency outcome measure between participants who received 12 to 15 sessions, 16 to 19 sessions, and 20 to 23 sessions. There are several possible reasons for the lack of differences across sessions. First, lack of differences may have occurred due to a lack of equality in the number of participants in each category. There were almost three times as many students, for example, who received 20 to 23 sessions than students who received 12 to 15 sessions. It is always best to maintain equal numbers across groups because this ensures "greater sensitivity of tests of significance and because potential distortions due to departures from assumptions underlying such tests are minimized" (Pedhazur & Schmelkin, 1991, p. 473). One solution to this could have been to categorize the number of sessions according to halves instead of thirds (e.g., 12 to 17 and 18 to 23 sessions). This solution, however, would not have rectified the issue of inequality because one half would still consist of twice as many participants as the other half.

Closer examination of the data yielded an interesting finding that could also account for the lack of differences across sessions. No participants in the print condition fell into the lowest category of number of sessions (i.e., 12 to 15 sessions). Over 75% of the participants in the print group received more than 20 sessions. Conversely, over half of the students in both the

text-equivalent and time-equivalent conditions received less than 20 sessions. It seems, at least based on the results of this study, even though students in the CAI groups received, on average, less instruction than students in the print group this did not have a significant effect on students' fluency skills.

Research Question 4

Is the number of sessions of instruction related to the reading development (i.e., vocabulary and comprehension) of children who demonstrate delayed fluency development?

Based on the results of this study, no differences in posttest scores in vocabulary and comprehension can be attributed to the number of sessions participants received. In other words, there were no mean differences on the Gates MacGinitie vocabulary and comprehension outcome measures between participants who received 12 to 15, 16 to 19, or 20 to 23 sessions. As in the case of oral reading fluency, lack of differences may have occurred due to a lack of equality in the number of participants in each category. Differences could also be attributed to the fact that many of the participants who received fewer sessions were receiving computer-assisted instruction. It is possible that students in the CAI conditions did not need as many sessions to make significant gains in the areas of vocabulary and comprehension.

Research Question 5

When students are not limited in the amount of text they read, do they read more?

Students in the time-equivalent group were allowed to read as many passages as they could, under the guidelines of the study (e.g., reading to the computer twice and being read to by the computer twice), within the allotted 20 minute session. Approximately half the students in this were able to take advantage of the opportunity to read multiple passages in a session. There are a variety of reasons why the remaining half of the students were unable to complete multiple passages in a given session including: technological problems, arriving late to the lab,

distractions in the lab, and the motivation to complete multiple passages. In addition, there were several students who were assigned to the text-equivalent group who, if the given the opportunity, would have completed multiple passages in the allotted time. Ideally, in a less structured research setting, students who could take advantage of reading multiple passages would be given the opportunity to do so. Interestingly, those students who averaged multiple passages scored higher on average on all posttest outcome measures than those students who averaged less than two passages per session.

Research Question 6

Is there a clear functional relationship between method of fluency instruction and task engagement for students who demonstrate delayed development in on-task engagement?

Daryl experienced high average rates of responding across all the treatment conditions. Although his data points were more stable during the CAI conditions, decreases in rates of responding during the print condition occurred after consecutive days of absences. Perhaps missing school for an extended period of time affected Daryl's ability to re-settle into daily school routines. Overall, based on the data it seems that Daryl benefited from both small-group print-based instruction and computer-assisted instruction.

Sam, like Daryl, benefited from both CAI and print-based instruction. Sam's data was most stable and his highest average rates of responding occurred during the time-equivalent condition. Variable rates of responding in the text-equivalent condition may have occurred because when in this condition, Sam was surrounded by others in the same condition. To assist the graduate student in charge of monitoring the participants in the lab to keep track of how to direct students, the lab was organized so that students in the text-equivalent condition were placed in one part of the room and students in the time-equivalent condition were placed in

another part of the room. When students in the text-equivalent condition complete the requirements for one passage they are required to spend the rest of the session working on a math program. In many instances, Sam became distracted by the math program being played by his neighbors.

Jay experienced a downward trend in his rate of responding throughout the study with the exception of when he was placed in the time-equivalent condition. In this condition, he experienced a significant increase in rate of responding. It seemed the print condition was the least effective at maintaining Jay's engagement. While observing Jay during the print condition, the researcher found him to be easily distracted and unfocused on the print material both in and out of the presence of the graduate student teacher. When Jay was placed in the text-equivalent condition he was able to focus more on the software version of the program, however, he experienced frequent fluctuations in his rate of responding. This was in large part because similarly to Sam, Jay often became distracted when his neighbor was playing a math program. This had an effect on the stability of Jay's rate of responding during the text-equivalent condition. During the time-equivalent condition, Jay was surrounded by others who remained focused on the *Quick Reads* program throughout the entire session. All of these variables may have had an impact on the differences in Jay's rate of responding.

In general, across all three participants, the highest and most stable rates of responding occurred during CAI conditions. This may have occurred because during these conditions these students worked individually with the computer which created less opportunity for distracting stimuli. Daryl and Sam also experienced increased rates of responding during the print condition. For them the close teacher proximity and increased teacher attention that resulted from small-group instruction was enough to lead to increased rates of responding. Researchers have

theorized that small-group instruction when compared to whole-group instruction increases student rates of opportunities to respond which decreases the likelihood of off task behaviors (Kamps, Dugan, Leonard. & Daoust, 1994; Malmgren, 1999; Wolery, Ault, Doyle, & Gast, 1992). Interestingly, Daryl and Sam experienced higher average posttest scores across the three outcomes variables (i.e., fluency, vocabulary, and comprehension) than Jay did.

Interpretation of Findings

The results of the current study are consistent with the results of similar previous studies (Cole & Hilliard, 2006; Lewandowski, Begeny, & Rogers, 2006; Hinitikka, Aro, Lyyntinen, 2005; Mioduser, Tur-Kaspa, & Leitner, 2000; Mitchell & Fox, 2001). Implementing CAI resulted in increases in varying aspects of reading achievement including reading fluency, comprehension, and vocabulary.

More specifically, the current study yielded similar findings and can be compared to the study performed by Lewandowski et al. (2006). Although Lewandowski et al. only included one computer-based groups, both studies examined the effects of CAI on third graders struggling with reading, examined fluency as an outcome variable, and compared the same program for both software and print-based versions. The results across the two studies suggest that CAI can be as effective as traditional teacher-led instruction in providing fluency instruction to struggling readers.

The current study was also similar to the study performed by Cole and Hilliard (2006) in that both studies examined the effects of CAI on the fluency of struggling third grade readers. However, the findings of the current study differed from Cole and Hilliard's findings. Cole and Hilliard discovered significant differences, favoring CAI, between the CAI and print groups on fluency outcomes. There are several reasons why this could be. First, Cole and Hilliard may have used more sensitive measures. Also, Cole and Hilliard made comparisons between two different

instructional programs as opposed to different versions of the same program. In this case, the software program may have been inherently more powerful an intervention (e.g., engaging, intensity, appropriate enhancement levels, appropriate levels of speech feedback) than the print-based program. The authors do not provide details regarding similarities and differences between the two programs.

Positive Aspects of Computer-Assisted Instruction

Computer-assisted instruction can be used with students who have a variety of learning needs. It seems that CAI would be most beneficial for students who have needs toward the more extreme ends of the learning continuum (e.g., students who struggle or students who are advanced). CAI can be tailored to students with learning rates that differ from average learning rates. Conventional instruction primarily focuses on the needs of students with average learning rates (Cotton, 2001). Because CAI provides individualized instruction, students can work at their own pace, receive consistent specific feedback, and feel a sense of control over their own learning. CAI also lacks some human characteristics that a can be detrimental to students' learning. Unlike humans, the computer is "infinitely patient, never gets tired, and never gets frustrated or angry" (Cotton, 2001, p.4).

The *Quick Reads* software program used in this study provided the necessary accommodations to promote the success of struggling readers. Once trained, students were expected to follow a series of procedures including logging into the program, testing the microphone that accompanies the software, accessing the correct passage, and selecting two or more highlighted vocabulary words. Unlike the students who received the small-group print version of the program. Students who received the software version were given the flexibility to begin and end the study on different fluency passages. Logistically, students in each small-group had to remain on the same fluency passage. To achieve parity, some standardization had to be

established across groups, however, beyond the scope of this study any student in the CAI group who wanted to read the same passage across multiple sessions or to read multiple passages in a given session could do so. Although both the print and software versions allowed students to chart their reading progress, the charting in the software version was much more elaborate. Students in the CAI condition received feedback after each reading of a passage. The software's built in timing mechanism allowed students to receive immediate and specific corrective feedback on words read correctly, words read incorrectly, and words read correctly per minute. This allowed students to chart their progress several times in a given session. This increased feedback can be extrinsically rewarding to students which is a crucial ingredient for keeping struggling students engaged during instruction (Cole & Hilliard, 2006). Unlike the students in the software condition, students in the print condition could only receive one timing at the end of each session. Finally, the software version of the program provided more opportunities for individual students to respond. Students who received instruction in small-groups had to share opportunities to respond. Increased opportunities to respond that result in active responding have been correlated with increased student achievement (Christle & Schuster, 2003; Sutherland, Alder, Gunter, 2003).

Positive Aspects of Print-Based Instruction

Although CAI seems to be tailor made for students who struggle, there are several limitations, most of which are connected to the fact that CAI lacks human attributes. To begin, in the current study, there was no way for the software version of the program to equate the kinds of pre-reading activities that the print-based teacher-led groups experienced. Pre-reading activities assist in activating background knowledge. Activating background knowledge is crucial to enhancing comprehension of text (Adams, 1990; Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989). Also, the quality of the interactions that occurred between the

teacher and students during pre-reading activities could not have been duplicated by the software version. In addition, although the voice recognition technology used to create the software seemed quite advanced, students who deviated from the norm in their speech (e.g., had a speech impediment or an accent) were often erroneously corrected by the computer. A human would be better able to differentiate between whether a word was said correctly or incorrectly. Finally, increased use of CAI could result in reduced student interactions with peers. One of the goals of schooling is to help students to master social interactions. School success is not only determined by the ability to achieve academic success, but also by the ability to achieve social success (Wager & Rutherford, 1993).

Limitations and Delimitations

Delimitations

Participants were third grade students identified by a standardized measure of oral reading fluency as having deficiencies in fluency skills. Students who scored between the 10th and 39th percentile on DIBELS ORF and whose parent or guardian provided permission for participation in the study were admitted to the study and pretested on a measure of overall reading achievement. Participants were randomly assigned to one of three groups. All three groups received instruction in fluency from either a teacher or via the computer. Because this study involved working with third grade students and third grade students are heavily involved in high stakes testing, a control group was not feasible for this study. Also, a subset of the larger sample was observed to examine the effect of CAI and teacher-led instruction on task engagement. These students were used to evaluate differences in task engagement and were not evaluated for differences in fluency. The research settings included three elementary schools in north central Florida.

Limitations

Because of the nature of conducting applied research in schools, several limitations are noted within this section. To begin, the findings of this study are only generalizable to the 50 third grade students in the three elementary schools who participated in the study. In addition, students in all three groups made improvements on all measures from pre to posttest. Despite these results, with the study's lack of control group, it is difficult to determine whether the increase can be attributed to the *Quick Reads* program, to time, or to a combination of both. Because participants were struggling readers at a critical stage in their reading development, establishing a control group would have been difficult. In addition, comparisons to non-study participants would have proven complex because all participating schools provided intervention instruction to a majority of the struggling readers who were not involved in the study. The aforementioned factors made it difficult to draw conclusions about the efficacy of the interventions used in this study. In the absence of a control group, comparisons can be made to average growth norms in fluency. According to Fuchs, Fuchs, Hamlett, Walz, & Germann (1993), with instruction, normally achieving readers gain an average of 2.5 words correct per week. The struggling readers in this study gained an average of 1.6, 2.0, and 2.1 words correct per week in the print, text, and time-equivalent groups respectively. The methods of instructional delivery used in this study garnered similar increases for struggling readers in words correct per week as normally achieving readers.

In addition, the effects of the software program used in this study may not be generalizable to other software programs because of such effects as instructional design and delivery. The print-based, teacher-led condition took place outside of the regular classroom environment and thus the results of the print-based group may not be generalizable to instruction that may take place within regular classroom environments. In addition, because of the short duration of this

study, ten weeks, it is difficult to extrapolate and make assumptions about the longitudinal effects of the intervention. This intervention period may have also been negatively affected by such realities of everyday schooling as holidays, school plays, practice tests in preparation for statewide assessments, make up tests related to the regular curriculum, and early release days. As a result, the maximum number of instructional sessions was only 23. The original goal for the study was 25 to 30 sessions. It is possible that the reduction in the number of sessions may have negatively impacted one or all outcome measures. Also, issues of school effects may have had an impact on this study. A pre-existing relationship between the researcher and teachers in schools one and two decreased the likelihood that students in these schools missed sessions due to school factors within teachers' control (e.g., scheduled activities such as standardized exam practice or chapter tests). These pre-existing relationships also were important with regard to student absences. Teachers in schools one and two were flexible in permitting make-up sessions. Without a pre-existing relationship with the teachers in school three, there was less teacher "buy-in" to the study. This resulted in more scheduling difficulties, and school three was more reluctant to provide alternative days and times for make-up sessions.

Text factors may have added a limitation to the study. The genre of the fluency passages used during *Quick Reads* instruction may have had an impact on students' DIBELS scores. Given that DIBELS passages are in a narrative format, practicing with *Quick Reads*' expository passages may not have prepared students to perform well on DIBELS. Use of an expository fluency measure might alleviate this limitation.

Several technology problems may have hindered students' ability to use the software program as prescribed (i.e., three days per week, 20 minutes per day). These problems included the computer erroneously correcting student dialect as well as challenges testing the software's

microphone. The software does not allow students to begin working with fluency passages until they have tested the microphone. There were several instances when it took students several minutes to check the microphone. This task should only take a few seconds. These issues may have impacted the lack of differences between the print and computer-based groups.

In addition, through recruiting, approximately 80% or 53 out of 64, of the identified population were placed in the study. Fifty-three participants is still only a moderate number and a larger sample size may have yielded more conclusive results. Increased sample sizes increases the power of a study (Pedhazur & Schmelkin, 1991; Shavelson, 1996). Also, additional outcomes measures may have yielded more conclusive results. Measurements such as the *Woodcock Johnson* vocabulary and comprehension subtests or the *Qualitative Reading Inventory* which is a one-on-one comprehension measure, although more time consuming may have provided more precise measures of the dependent variables.

Finally, the single subject portion of the study was compromised in several ways because of the need to operate within a larger group study. In some instances because the large group design had established a routine schedule it was difficult to maintain the integrity of the changing treatments design of the smaller study. For example, the print and computer-based groups received instruction at different times of the day. When a student switched from the print to the computer condition or vice versa conflicts with special education services such as speech language or occupational therapy would arise. The legal ramifications of preventing students from receiving these services coupled with the already established schedule of the large group design led to decreases in the number of sessions received by students in the single subject portion of the study. Also, students in the single subject portion of the study were exposed to two changes after the baseline condition (i.e., a small group and then a one-on-one condition). This

may have impacted some of the changes that occurred in the treatment conditions. Results are less conclusive when more than one change is made from baseline to intervention phases (Kazdin, 1982).

Implications for Future Research

The portion of this study that examined engagement suggests that not all students are impacted in the same way by computer-assisted instruction. Two of three students in the single subject portion of the study exhibited increased rates of responding in both the small-group print and CAI conditions. Additional research is needed to determine whether certain characteristics predispose students to be engaged during CAI. Also, in the current study, the issue of cost effectiveness arose. When evaluating cost effectiveness many researchers focus on the issue of money but more research is needed to determine how the issue of time impacts the difference in cost between print and computer-based programs.

Finally, the current study compared the print-based version of a fluency program to a computer-based version. However, researchers suggest that it might be most beneficial to combine print-based with computer-assisted interventions (Boone & Higgins, 1993; Boone, Higgins, Notari, Stump, 1996;). More research is needed to determine the most effective way to do so.

Characteristics of Study Participants

The current study focused on meeting the needs of struggling readers. Surprisingly, only a small percentage of previous studies in the literature focused on students who struggle. In fact, for the literature review presented in chapter two, over half the studies that were initially collected were later excluded because they only include average and above average learners. More research is needed that focuses on how best to use CAI to meet the needs of diverse learners.

All the studies that have focused on students who struggle have assumed that struggling students would respond in a positive way to computer-assisted instruction. But students who struggle respond to CAI in different ways (e.g., some students may be completely engaged while others may be disengaged) (Bangert-Drowns & Pyke, 2001). There are several examples of this in the current study. First, on average, only about half the students in the time-equivalent condition took advantage of the ability to read multiple passages. One of the reasons for this may be that they were not engaged during CAI instruction. Second, only one of three students in the single subject portion of the study exhibited a discernible preference for the CAI condition. As discussed in chapters one and two there are aspects of the computer that can improve engagement (e.g., interactivity and animation) but these same aspects can also prove to be distracting to students. There has been some research that has evaluated the kinds of enhancements that are best for readers who struggle (Torgesen, Waters, Cohen & Torgesen, 1988; Lewin, 2000). There has, however, been a lack of research that has evaluated the characteristics of students who can most benefit from CAI given the appropriate levels of enhancements. It seems from this current study that students who need minimal redirection from adults and who become easily engrossed with information presented via the computer would be best served by CAI. However, more evidence is needed to support this theory. Perhaps engaging in inquiry that evaluates the effect of providing struggling students with a choice as to how they receive instruction may increase the knowledge base that exists about how students' learning preferences relate to how they engage during CAI instruction.

Cost Effectiveness

In the current study, approximately 17 students received the print version of the *Quick Reads* program. The remaining 33 students received the software version. The print version of this program costs approximately $600 for a complete classroom set of 24. If materials would

have been purchased for this study, $1,200 would have been spent to supply the print group because both levels “A” and “B” would have been purchased. The software version of the program costs approximately $1,200 for a stand alone package of 12. Therefore, it would cost approximately $4,800 to purchase levels “A” and “B” for 33 students. The fact that both forms of instruction yielded similar outcomes coupled with the obvious difference in price for the materials suggests that the print version would be the more cost effective choice. It is important to remember that money is only one factor in determining cost effectiveness and once the issue of time is taken into consideration, the more cost effective choice becomes less apparent.

For the current study, several graduate students were hired to teach the print groups and to supervise the CAI groups. It took each graduate student at each of the larger schools an average of one hour to work with six to seven participants because the graduate student had to work with participants in small-groups. That same graduate student spent an average of half an hour working with 15 students on average in the CAI groups because students could all be in a large computer lab at one time. It is therefore important to consider that the extra time spent with students in small-groups also translated into more money paid to instructors. With the added cost in time and money required to run the small-groups, the cost of the print version could begin to rival the cost of the software. There was one large drawback for the computer with regard to time. The program required some training before participants could begin to use it. With this particular program it is possible to lose up to two or even three sessions to training students. Because students in the print version can begin working immediately, this is an important factor when considering cost effectiveness.

If the *Quick Reads* program were used under real world school conditions, questions of cost effectiveness could be answered more conclusively. Consider that for both the print and

Table 5-1. Estimated Quick Reads Per Pupil Expenditures Per Year

Costs	Year 1 Teacher Led (4 students)	Year 1 Computer-Assisted (15 students)	Year 2 Teacher-Led (4 students)	Year 2 Computer-Assisted (15 students)
Materials per student per year	$125.00	$333.33	$125.00	$0.00
Teacher time per student per year	$756.77	$201.78 *$80.23	$756.77	$201.78 *$80.23
Total cost per student per year	$881.77	$535.11 *$413.56	$881.77	$201.78 *80.23

*Cost with paraprofessional conducting implementation

software groups, in an entire school year, two sets of level "A", "B", and one set of level "C" books would need to be purchased. This number should cover students progressing through an average of one level during a school year. This would result in a total of $3,000 spent on print materials and $8,000 spent on software materials. The difference between the two figures appears significant until one considers that the print materials are consumable (i.e., a new set must be purchased for the next group of students), while the software materials are reusable. Table 5-1 displays per pupil expenditures for materials for both print and software groups. Also, in 2007 the average teacher in the U.S. will earn $45,400. The average paraprofessional in the U.S. will earn $18,052 (Roza, 2007). Table 5-1 displays per pupil expenditures for teacher time for both print and software groups. When taking into consideration materials and teacher time, the total annual per pupil expenditure for the program is approximately $300 less for the software group than the print group (See Table 5-1). When one considers the fact that a paraprofessional can monitor the software group, that savings increases to $400. During the second year of using the *Quick Reads* program, the annual per pupil savings increases to between $600 and $800 depending on whether a paraprofessional is involved (See Table 5-1). The information above is speculative, however, and more research is needed that systematically examines the differences in materials, time and money between print-computer led instruction.

Computer-Assisted Instruction as Supplemental Instruction

Researchers have found that when CAI is used as a supplement to traditional teacher-led instruction it is more effective than when either is used alone (Boone & Higgins, 1993; Higgins & Boone, 1991). To use CAI as a supplement, the software would have to mirror the skills being covered during traditional instruction. Unfortunately, most traditional basal programs do not provide software to accompany their core programs. Without the availability of software that has already been made to accompany a program, teachers would be hard pressed to find generic software that serves the same purpose. The *Quick Reads* program would provide a good opportunity to add to the research on CAI as supplemental instruction. Students could work in small-groups with a teacher and use the software version to practice current and previous passages. Researchers could compare the combined condition to the CAI and print conditions alone. The results could add to the literature and perhaps help increase the number of software supplemental programs that accompany traditional core programs. The use of CAI as a form of supplemental instruction also has practical implications. Because many computer-based programs are accompanied by built in training programs this could help ease the difficulty of introducing it as a literacy center and in turn promote increases in the amount of small group instructional delivery that occurs in the classroom. Availability of supplemental software that directly accompanies core programs could also lead to the increased purposeful use of CAI in classrooms.

Summary

Six research questions regarding the effects of a computer-based version of a fluency program and a print-based version of the same program were explored using statistical analyses. Results are in agreement with much of the previous research in that CAI and print conditions yielded no significant differences in the areas of oral reading fluency and comprehension.

Significant differences were found across treatment conditions in the area of vocabulary in favor of the time-equivalent condition. Differences may have occurred because students in this condition receive more exposure to vocabulary words.

Students in the single subject portion of the study who experienced all three treatment conditions exhibited increased rates of responding during all three treatment conditions. Rates of responding across all three students were variable, however, during the print-based version of the program. Future research should focus on discovering which students would benefit most from CAI, systematically evaluating the cost effectiveness of CAI, and examining the effects of CAI as a form of supplemental instruction.

Because advancements in computer technology are increasing at an alarming rate and the cost of technology continues to decrease, the increased use of computer technology in schools seems promising. It is currently unclear, however, exactly how the aforementioned factors will affect the use of computer technology in classrooms. Based on the results of the group design portion of the current study and the results of other similar studies, it seems that a balance exists in the benefits and drawbacks between CAI and traditional forms of instruction. CAI, specifically the *Quick Reads* program, could therefore be effective if used either instead of or as a supplement to traditional forms of instruction. In addition, the single subject portion of this study has raised questions surrounding the theory put forth by many researchers regarding the effects of CAI on task engagement. It is now less certain as to whether students who experience difficulties remaining on-task actually benefit from CAI. When compared to whole group instruction, small group instruction allows for similar benefits to CAI such as increases in individualized corrective feedback and increases in opportunities to respond. It seems small group instruction may be just as effective as CAI in promoting task engagement for some

students. The issue is further complicated by the fact that print-based, teacher-led instruction is accompanied by an actual person who can redirect students during instruction which in turn should lead to increases in task engagement. There are those students, however, who are more responsive to CAI than either whole or small group instruction. It is therefore important to evaluate which student characteristics correlate with increased task engagement in the presence of CAI. Increased exposure to CAI for students who are more engaged during CAI than during any other forms of instruction (i.e., whole or small group) could lead to increased reading achieveme

APPENDIX A
SUMMARY OF STUDIES

Table A-1 Summary of Reading and Technology Studies in Elementary Settings

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Bangert-Drowns & Pyke, 2001	Document instances of "high" literacy when using different kinds computer software.	N= 43 Grades= pre-k to 6th Ability level= varying ability levels	"High" literacy (metacognition) as measured by researcher observations.	Observed students during weekly half hour visits to school computer laboratory.	Researcher 's observed for 78 sessions. Field notes included student software interactions, contextual factors, and observer reflections.	Very rarely were students completely disengaged. Students experiences many instances of engagement but observers observed no instances of "high" literacy.
Barker & Torgesen, 1995	Investigate the effects of CAI on phonological awareness.	N= 54 Age= 6 -7 Grade= 1st Ability level= at risk for reading difficulties (40th percentile or lower on word identification subtest of Woodcock Johnson Mastery Test)	Phonological awareness, word recognition as measured by the Word Identification subtest of the Woodcock Johnson Reading Mastery Test and the Sound Categorization Subtest.	Phonological awareness training programs (e.g., Daisy 's Quest and Daisy's Castle Phonological decoding program (e.g., Hint and Hunt 1.	Group 1: phonological awareness training program. Group 2: Same as group 1 except software designed to train alphabetic decoding skills. Group 3: Control group spent equal time on computer using math (Alien Addition and Math Rabbit) software.	Phonological awareness training groups made significant improvements on measures of phonological awareness and word recognition when compared to other groups.
Boone & Higgins, 1993	Longitudinal study to investigate the effect of hypermedia on the development of reading skills, participation in reading-related classroom activities and yearly achievement gains in language skills.	N= 300 Grades= K-3 Ability level= some students at risk for being referred to special education classes.	General reading achievement as measured by the Macmillan Standardized Reading Achievement Test.	Basal Reader: Macmillan Basal Reader; Hypermedia pre-reading lessons: involves links from words and pictures, digitized speech, graphic representations, and animated sequences.	Students used hypermedia basal lessons independently either before or after a teacher directed activity. The basal was adapted by researchers in the study so the software incorporated learning goals specific to the classroom.	Most effective for low achieving students

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Boone, Higgins, Notari, & Stump, 1996	Longitudinal study to investigate the effect of CAI on letter recognition skills.	N= 143 Grade= K Ability level = some students at risk for referral to special education	Letter recognition skills as measured by the Macmillan Standardized Reading Achievement Test.	Basal Reader: Macmillan Basal Reader; Hypermedia pre-reading lessons: involves links from words and pictures, digitized speech, graphic representations, and animated sequences.	Hypermedia pre-reading lessons used as a supplement to teacher directed instruction. Each hypermedia lesson took an extra 7.5 minutes per day.	Low performing students in experimental group outperformed low performing students in control group in letter identification.
Chera & Wood, 2002	Investigate the effect of CAI on phonological awareness.	N= 30 Age= 3 to 6 Grade= pre-k-1st Ability level= struggling in aspects of emergent literacy.	Phonological awareness, word reading as measured by the British Ability Scales Word Reading Test.	Bangers and Mash: animated multimedia talking books. Involved onset/rime manipulation. Involved both whole word and segmented speech feedback.	15 students received intervention. 15 served as control Ten sessions lasting 10 minute over 4 weeks	Intervention group showed significantly higher increases in phonological awareness than control.
Clarfield & Stoner, 2005	Investigate the effect of CAI on oral reading fluency and task engagement.	N= 3 Age/Grade= K-1 Ability level= at risk for reading difficulties. Students also identified with Attention Deficit/Hyperactivity Disorders (ADHD)	Oral reading fluency as measured by DIBELS ORF; Task engagement.	Headsprout Reading Basics: consists of fluency building exercises, segmenting and blending strategies, explicit instruction in building sight word vocabularies and recognizing and using punctuation cues. Students observed twice during the baseline condition and three times a week for the first three weeks of the experimental condition. Then every other week for the rest of the study.	Students work sequentially through 40 animated lessons, each lasting approximately 20 minutes.	The CAI intervention produced higher mean levels of oral reading fluency from the baseline to experimental condition.

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Cole & Hilliard, 2006	Examine the benefits of using a web-based reading curriculum program on reading achievement and motivation	N= 36 Grade= 3 Ability level= readers who were performing 2 or more grade levels below level in reading.. 9% of students identified with a disability	Decoding, fluency, comprehension as measured by the Developmental Reading Assessment (DRA). Letter and word recognition as measured by the Wide Range Achievement Test, 3rd Edition (WRAT-3). Motivation as measured by a 12 item questionnaire adapted by the researchers.	*Reading Upgrade*, a program used to enhance decoding, fluency, phonics, and phonemic awareness. Instruction occurred in a computer lab twice per week.	Intervention group: 180 minutes of instruction before school for 8 weeks. Students also observed for percent of intervals on-task for 20 minutes for 40% of the sessions.Control group: received the school's conventional reading enrichment program, one hour, three times per week for eight weeks.	Students exhibited high levels of enjoyment and involvement and enthusiasm. Experimental group made gains equivalent to one grade level. Significant differences between web-based and traditional groups on both the DRA and the WRAT-3 favoring the web-based group.
Fuchs, Fuchs, Hamlet, Powell, Capizzi, & Seethaler, 2006	Pilot study to assess the potential for CAI to enhance reading.	N= 33 Grade= 1 Ability level= at risk for reading failure.	Spelling as measured by the Test of Written Spelling. Word Identification as measured by the Woodcock Identification Mastery Test-Revised), Passage Reading Fluency as measured by the Comprehensive Reading Assessment Battery.	*Spelling FLASH* involves words flashing on the computer screen for .8 seconds. After the word disappeared. The student typed the word. Words came from the first 200 words from Dolch sight word list including pre-primer, primer, and 1st grade levels.	Research assistants supervised FLASH sessions three times per week, 10 minutes per session. Students worked individually on computers. There were 50 ten minute sessions over 18 weeks. Group 1 received math CAI; Group 2 received spelling CAI.	Significant effects of treatment for spelling FLASH group. Students out performed math FLASH group. Effects transferred to another list of high frequency words with similar magnitude. No statistically significant differences on word id and fluency.
Higgins & Boone 1991	Investigate the effect of CAI on decoding.	N= 175 Grade= K-5 Ability level= some struggling readers.	Vocabulary and decoding as measured by the Macmillan Standardized Reading Achievement Test.	Computerized pictures, animated graphics, definitions, synonyms and digitized speech, links to words and pictures from the original basal text. Macmillan Basal Reader enhancements related to vocabulary and decoding	Hypermedia integrated into small-group rotation lesson duration varied across grade levels. K-7.5 minutes, 1st-10 minutes, 2nd-15 minutes Control- no access	Experimental group outperformed control in K, 2 and 3 not 1st however; Low performing students scores saw especially significant improvements

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Hinitikka, Aro, & Lyytinen, 2005	Evaluate the effect of computerized training on letter knowledge and letter sound correspondence.	N= 44 Age range= 81 to 104 months Ability level= struggling readers	Letter naming and spelling as measured by a researcher created assessment. Reading fluency as measured by as standardized Finnish measure *Likilasse*.	The *Literate* computerized training program. Designed to enhance the accuracy and fluency of letter sound correspondence. Game like format provided speeded practice.	Experimental Group: 10-20 minute intervention session three times per week over a period of six weeks. Control group: Students exposed to pen and pencil tasks in phonological awareness, letter knowledge, and reading.	No statistically significant differences between intervention and control groups in letter sound correspondence, letter naming , and letter spelling although not No statistically significant differences in reading fluency.
Irausquin, Drent, & Verhoeven, 2005	Investigate the effect of computer on word recognition and comprehension	N= 28 Ages= 7-10 Ability level= problems with beginning reading (score at the lowest 25th percentile on the CVC Word Reading Test and a maximum of card 3 out of 4 on the Text Reading Test).	Word identification and comprehension as measured by the CVC Word Reading Test, Text Reading Test, Cluster Word Reading Test, and Reading Comprehension Test.	Speed group: flash words, picture word matching, speeded sentence correction, speeded passage correction. Context group: cloze exercise at sentence level, cloze exercise at the passage level, picture sentence matching, picture passage matching.	Participants matched based on number of words correct on CVC Word Reading Test and placed in a speed group and a context group. Training took place three sessions a week for 15 minutes per session for two months.	The speed group showed higher gains in reading performance than the context group in decoding at both the word and text levels. No effects found in reading comprehension.
Jones, Torgesen, & Sexton, 2001	Investigate the effect of CAI on fluency (word and connected text).	N= 30, Age/Grade range= elementary, Ability level= low (school identified learning disabled), average reading rate (words in isolation) 40 words/min or less.	Speed and accuracy of words in isolation and oral reading of connected text.	Hint and Hunt I: practice five short vowels and four vowel diagraphs and dipthongs. Program divided into 10 levels. Hint—vowel sounds introduced and practiced using digitized speech. Hunt—game format to provide extensive speed oriented practice.	10 LD experimental, 10 LD computer experience control (spelling program), and normal no treatment comparison students. 10 weeks, 15 minutes per day, five days per week. Posttest administered when mastery of a level of the CAI program occurred.	Experimental group; improved in both speed and accuracy of word reading. Students able to generalize to similar set of words. Improved speed of paragraph reading. Average increase in word reading; experimental group—20%, control group—4%.

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Lewandowski, Begeny, & Rogers, 2006	Examine the effects of a tutor or computer-assisted word recognition in a sample of third grade children.	N=63 Grade= 3 Ability level= struggling readers, 14 ESE students.	Fluency and word recognition as measured by a researcher created word list and curriculum based reading passages.	Word recognition training using a list of 100 words selected from the word frequency book. *American Heritage Word Frequency Book*.	Three ten minute sessions. Each session consisted of two practice exposures to a list of words followed by an oral timed readings of the list. CAI group: computer read words to students. Tutor group: tutor read words to student. Control group: students read words on their own.	Computer and tutor groups significantly improved in word recognition and fluency. Control group did not make significant gains.
Lewin, 2000	Investigate the effectiveness of an "Enhanced" design of computer-assisted instruction on word recognition and identification skills, Explored the effects on levels of motivation and self confidence	N= 32, Age range= 5-6, Grade= Kindergarten, Ability level(s)= low, medium, high.	Word recognition and identification as measured by the Salford Sentence Reading and the Burt Word Reading Test Self confidence and motivation.	Basic version included: coaching through reading cues (word pronunciation) Enhanced version included: coaching through reading cues (initial sound, illustration, word identification meaning and syntax).	Students read text independently. Instructed to only request help from CAI as needed. 16 students assigned to "basic", 16 assigned to "enhanced". 15 minutes daily over a period of 4 weeks	No overall significant differences between "basic" and "enhanced" groups. Both groups made mean gains of 3 months on – Salford Sentence Reading test.
Lewis, 1999	Observe students as they engage in unstructured interactions with talking storybooks. Examined how the level of text support affects reading gains	N= 6 Age/Grade = elementary age Ability level= learning disabled students.	Student engagement/ interaction, Gains in individual word reading.	Six computer programs with high text interactivity no embedded games or activities; Six with varying interactivity and games; with varying interactivity and definitions or glossary features.	Each student interacted with each of the three different programs for a total of two hours over a period of four days. Students were observed and videotaped.	Student with learning disabilities did not see significant gains in reading skills (an average of 2.4 words from pretest to posttest).

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Mathes, Torgesen, & Allor, 2001	Examined the effectiveness of peer assisted learning strategies for first grade readers with and without additional computer- assisted instruction with phonological awareness.	N= 183 Grade= 1st grade Ability level= low, average, and high performing students.	Phonological awareness measured by the Comprehensive Test of Phonological Awareness (CTOPP), word reading accuracy as measured by the Test of Word Reading Efficiency (TOWRE) and Woodcock Reading Mastery Test, alphabet knowledge as measured by the Test of Early Reading.	Peer assisted learning strategies with and without CAI (Daisy Quest and Daisy's Castle). CAI was a supplement rather than a replacement of the pre-existing program.	Students received three 35 minute sessions per week for 16 weeks. Students worked in pairs for two 15 minute sessions. Students took on both student and teacher roles. Students in CAI condition received 8-10 hours more phonological awareness instruction via the computer.	Low achieving students gained the most benefit from this instruction with or without additional CAI instruction. CAI had no statistically significant effects on students' phonological awareness.
Mitchell & Fox, 2001	Examine the effectiveness of CAI on phonological awareness, compare CAI to teacher delivered instruction.	N= 72 Age= 5-8 Grade= K-1 Ability level= at risk for reading difficulties. K below grade level in three of five subtests of Literacy Initiative of Everyone (LIFE). 1st below grade level on five of seven subtests of LIFE.	Phonological awareness as measured by the Peabody Picture Vocabulary Test (PPVT-III) and the Literacy Initiative for Everyone (LIFE).	Daisy's Quest and Daisy's Castle (practice in rhyme identification, segmenting, blending). Teacher delivered (explicit instruction with phonological awareness kit, then practice using picture cues, manipulatives, or games).	Three experimental conditions (CAI, teacher, treatment control- drawing and math software). 24 children in each treatment group. 20 minute session, 5 days per week, four weeks.	Both CAI and teacher group showed increases in phonological processing over control.
Mioduser, Tur-Kaspa, & Leitner, 2000	Compare effects of computer-based instruction to conventional modes of instruction (teacher instruction with textbooks) on early reading acquisition.	N= 46 Age= 5-6 Grade= K Ability level= at risk for reading disabilities (scored 55 points or below out of 122 possible points on the Phonological Awareness Test.	Phonological awareness, word recognition, and letter naming skills as measured by the standardized measures of phonological awareness, word recognition, and letter naming.	"I have a secret – I can read" = program for early reading acquisition developed for special education. It consists of booklets for individual work and computer materials.	Participants were randomly assigned to one of three groups: special intervention with computer-assisted instruction, print only, or no special intervention.	Children at risk for reading disabilities who received the computer reading intervention, significantly improved their phonological awareness, word recognition, and letter naming skills compared to those who received a print-based reading intervention program.

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Nicolson, Fawcett, & Nicolson, 2000	Compare the use of computer-assisted instruction with traditional instruction on word reading.	N= 32 Ages= 6-8 Ability level= struggling readers	Word reading as measured by the Wechsler Objective Reading Dimension (WORD) Reading and Spelling Tests.	Reader's Interactive Teaching Assistant (RITA)= uses pictures, graphics and speech feedback. The teacher can specify activities based on the child's current progress.	32 lowest ranked students on the Wechsler objective Reading Dimension (WORD) were matched for age and reading. 16 students placed in treatment (used RITA). 16 students placed in control (no intervention).	Treatment group made significantly more progress than the control. Overall standard scores increased from 84.9 to 89.7 for treatment from pretest to posttest and 80.3 to 81.9 for control group from pretest to posttest
Reinking & Schreiner, 1985	Investigate the effect of CAI on reading comprehension.	N= 104 Grade= 5th – 6th Ability level= some struggling readers	Comprehension as measured by comprehension probes and the comprehension subtest of the Nelson Reading Skills Test	All passages taken from Science Research Associates (SRA).	Participants worked once per week to complete two passages over a period if three weeks. Participants had to respond to six comprehension questions after reading the passage. To continue to the second passage, students had to get four out of six questions correct.	For both high and low difficulty passages, participants who were required to view all of the available text manipulations, scored higher than the other computer groups.
Roth & Beck, 1987	Investigate the effects of computer-assisted instruction on word recognition/decoding skills and effects of improved decoding on comprehension.	N= 108 Grades= 4th Ability level= low achievement in reading (mean grade equivalent score on California Achievement Test Total Reading Score of 3.7).	Accuracy , speed of word recognition and comprehension as measured by the Woodcock Reading Mastery Tests (subtests= word attack) and the California Achievement Test (subtests= vocabulary and comprehension)	Construct-A-Word (CAW and Hint and Hunt (HH).	Students in the experimental group used CAW for about 10 weeks beginning in the fall and HH for about 10 weeks beginning in the spring. There were three 20 minute sessions per week.	Substantial increases in word recognition/decoding skills.

Table A-1 continued.

Citation	Purpose	Participants	Dependent Variable(s) and Measure(s)	Intervention/ manipulation	Procedures	Findings
Torgesen, Waters, Cohen & Torgesen, 1988	Evaluate the effectiveness of three variations of a computer program designed to increase sight word reading vocabulary.	N= 17 Grades= 1-3 Ability level= identified with a learning disability (full scale IQ above 70 and a significant discrepancy (one standard deviation difference) between level of general intelligence and reading level).	Accuracy and speed of reading individual words at pre- and posttest	The computer program used was called "WORDS." Word sets consisting of 10 words each were practiced on versions of the computer program that employed either graphic representation of words alone (visual alone), graphic plus synthetic speech (visual auditory, or synthetic speech alone (auditory alone). The treatment control group worked on a math program.	A multi-element baseline design with four treatment conditions (auditory-visual, auditory-only, visual-only, and no treatment) was used. Treatment conditions were alternated on successive weeks. Counterbalancing was used so that approximately one fourth of the subjects learned the first word list in the auditory-visual condition, one fourth responded to the same list in each of the other three conditions.	All three instructional conditions were equally effective in teaching the subjects to read the list of words. Pretest average word reading accuracy= 17%, Posttest average word reading accuracy= 70%.
Wise, Olson, Anstett, et al., 1989	Explore effect of computer-assisted instruction on word recognition ability and attitude about reading.	N= 62 Grade= 3-6 Ability level= children with average verbal or performance classified as reading disabled.	Word recognition ability as measured by the Peabody Individualized Achievement Test for word recognition, a 220 item timed word recognition test developed b y the authors and a non-word 43 item reading test created by the authors. Attitude about reading as measured by an attitude questionnaire created by the authors.	81 books and 64 stories transferred to computers and linked to speech synthesizers so that speech feedback could be provided on difficult words at the whole-word, syllable, or sub-syllable levels.	Participants assigned to feedback conditions: 1. whole-word, 2. syllable, 3. sub-syllable, 4. a combination of first sub-syllable and then syllable feedback. Participants read 25 minutes for at least four times per week. After being trained for two weeks on how to use the program, students worked independently.	Not much difference across treatment groups. All experimental participants showed significant improvements in timed word recognition-tasks from comparison to control. 30 participants were given open ended questions about most and least favorite school subjects, 9 showed positive changes in attitude toward reading.

APPENDIX B
INSTITUTIONAL REVIEW BOARD DOCUMENT

1. TITLE OF PROTOCOL: Effects of Computer Assisted Instruction and Small Group Teacher Led Fluency Instruction for Third Grade Students at Risk for Reading Failure

2. PRINCIPAL INVESTIGATOR(s):

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Doctoral Candidate
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3. SUPERVISOR (IF PI IS STUDENT): *(Name, campus address, phone #, e-mail & fax)*

Holly Lane, Ph.D.
PO Box 117050
G315 Norman Hall
Gainesville, FL 32611-7050
Office Telephone: (352) 392-0701, ext. 246
E-mail address: hlane@coe.ufl.edu
Fax: (352) 392-2665

4. DATES OF PROPOSED PROTOCOL: From September 15, 2006-September 15, 2007

5. SOURCE OF FUNDING FOR THE PROTOCOL: None

6. SCIENTIFIC PURPOSE OF THE INVESTIGATION:
The scientific purpose of this study is to understand how computer assisted instruction compares to teacher led instruction in oral reading fluency and in on task engagement.

7. DESCRIBE THE RESEARCH METHODOLOGY IN *NON-TECHNICAL* LANGUAGE.
According to Kiley (2005), the ability to read quickly, accurately and with expression is a defining characteristic of good reading. Several researchers have discovered that a strong correlation exists between reading fluency and overall reading achievement (Rasinksi, 2006). Direct instruction in fluency is most beneficial, especially for students who struggle, to increase not only reading fluency but also overall reading achievement (Rasinski, 2003).

Participants will become eligible for this study through their Fall scores on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). DIBELS is a measure of oral reading fluency (See attached sample). The state of Florida mandates that schools assess Kindergarten through grade three students using DIBELS between three and four times per year (e.g. Fall, Winter and Spring). Students scoring between the 10th and the 39th percentile or between 35 and 76 words correct per minute will be eligible to participate in this study. Students scoring within this range on measures of oral reading fluency beginning in second grade are good candidates for interventions in oral reading fluency development (Hasbrouck & Tindal, 1992).

80 participants will receive 20 minute lessons in fluency instruction three times per week for eight weeks. Instruction will either be teacher led (i.e. print based) or computer led (i.e. software based). The same fluency instructional program will be used for both print and software based instruction. Participants will be randomly assigned to receive either teacher led fluency instruction or computer led fluency instruction. Once parental consent has been received and participants have been placed into groups, a standardized group measure of reading achievement, the Gates Maginitie will be administered to participants by the doctoral student researcher (See attached sample). Results from the winter administration of DIBELS will be used to help determine whether differences exist between the teacher led and the computer led groups. The Gates Maginitie will also be re-administered at the end of the study by the doctoral student researcher to determine whether differences exist in overall reading achievement across the teacher led and the computer led groups. Teacher led groups will be taught by a trained graduate student. Computer led groups will be monitored by a trained graduate student.

In addition, six participants who fall between the 10th and the 39th percentile in oral reading fluency and who also exhibit high incidences of off task behavior will also be involved in this study. These participants will receive instruction in both the teacher led and the computer led groups. They will be observed during each fluency lesson at 10 second intervals using the attached observation protocol to determine whether differences exist in task engagement across the teacher led and the computer led groups.

Pretest and posttest DIBELS scores and pretest and posttest Gates Maginitie scores will be analyzed using the *Statistical Package for the Social Sciences* (SPSS) to determine whether differences exist in oral reading fluency and in overall reading achievement across the teacher led and computer led groups. Visual analyses of graphical displays of task engagement will be used to determine whether differences exist in task engagement across the teacher led and computer led groups.

8. POTENTIAL BENEFITS AND ANTICIPATED RISK.
No more than minimal risk is involved in participating in this project. Participants in this study could benefit through increases in oral reading fluency as a result of exposure to direct instruction in reading fluency and as a result of increased engagement during instruction.

9. DESCRIBE HOW PARTICIPANT(S) WILL BE RECRUITED, THE NUMBER AND AGE OF THE PARTICIPANTS, AND PROPOSED COMPENSATION (if any):
Third grade students in two schools, one in Alachua County and one in Levy County, will be recruited to participate in the study. Parents of the participants who score between the 10th and the 39th percentile on the DIBELS oral reading fluency will be asked to provide consent to allow their child to receive either teacher led or computer led instruction in fluency (See attached letter). Instruction will be provided between September and December of 2006. Each third grade teacher will also nominate students who exhibit both high and low engagement during reading instruction. Parents of both high and low nominated students will also be asked to provide consent to allow their child to be observed to determine participants actual level of task engagement during reading instruction (See attached letter). The six students (three from each school) with the highest percentage of off task engagement will be selected to participate in the study. No compensation will be provided to any of the participants.

10. DESCRIBE THE INFORMED CONSENT PROCESS. INCLUDE A COPY OF THE INFORMED CONSENT DOCUMENT (if applicable).
Parents of students who score between the 10th and 39th percentile on DIBELS oral reading fluency will be given letters of parental informed consent explaining the purpose of the study. Also, parents of students who exhibit low on task engagement during reading instruction will also be given letters of parental informed consent explaining the purpose of the study. Letters are attached.

Please use attachments sparingly.

_____ _____
Principal Investigator's Signature Supervisor's Signature

I approve this protocol for submission to the UFIRB:

_____
Dept. Chair/Center Director Date

Informed Consent

Protocol Title: Effects of Computer Assisted Instruction and Small Group Teacher Led Fluency Instruction for Third Grade Students at Risk for Reading Failure

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study: The scientific purpose of this study is to understand how computer assisted instruction in reading fluency compares to teacher led instruction in reading fluency.

What you will be asked to do in the study: To allow your child to receive instruction in oral reading fluency via a teacher or a computer for three days per week and 20 minutes per day over the course of eight weeks during the Fall semester of 2006. If you allow your child to participate, the same fluency instructional program will be used in the teacher led and in the computer led groups. If you allow your child to participate, your child will be removed from the classroom during a scheduled intervention block so your child will not miss any regularly scheduled class material. Your child was selected for the study based on the most recent administration of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). In addition to DIBELS which will be administered by your child's school, you are also being asked to allow your child to take a standardized measure of reading achievement called the Gates Maginitie. If you agree, the Gates Maginitie will be administered twice, once at the beginning of the study and again at the end of the study. Teacher led groups will be taught by a trained graduate student. Computer led groups will be monitored by a trained graduate student.

Time required: 20 minutes per day for three days per week for eight weeks.

Risks and Benefits: No more than minimal risk is involved in participating in this project. Participants in this study could benefit through increases in oral reading fluency as a result of exposure to direct instruction in reading fluency.

Compensation: There is no compensation for participating in this study.

Confidentiality: Your identity will be kept confidential to the extent provided by law. Only the researcher will have access to the DIBELS and Gates Maginitie measures. The final results will be included in a Doctoral Dissertation, which may be presented at a conference and may be submitted to educational journals for possible publication.

Voluntary participation: Your participation in this study is completely voluntary. There is no penalty for not participating.

Right to withdraw from the study: You have the right to withdraw from the study at anytime without consequence. You do not have to answer any question you do not want to answer.

Whom to contact if you have questions about the study:
Nicole Fenty, M. Ed., Doctoral Candidate, PO Box 117050, Gainesville, FL 32611-7050 (352) 392-0701 ext. 243

Holly Lane, Ph. D., PO Box 117050, G315 Norman Hall, Gainesville, FL, 32611-7050, (352) 392-0701, ext. 246.

Whom to contact about your rights as a research participant in the study:
UFIRB Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; ph 392-0433.

I have read the procedures outlined above. I voluntarily agree to participate in this study and have received a copy of this description.

Participant's signature and date:

_____

Principle investigator's signature and date:

_____

Dear Parent:

I am a doctoral student in the College of Education at the University of Florida. I am conducting research to determine how computer assisted instruction compares to teacher led instruction in the oral reading fluency of third grade students. Your child was selected for participation in this study based on his/her scores on the most recent DIBELS Oral Reading Fluency measure. The results of this study may help teachers to better understand how to best deliver fluency instruction to students. With your permission, I would like to ask your child to volunteer for this research.

Participating students will receive 20 minutes of reading fluency instruction three times per week over the course of eight weeks. Students will receive either teacher led or computer led instruction. The same fluency instructional program will be used in the teacher led and in the computer led groups. If you allow your child to participate, your child will be removed from the classroom during a scheduled intervention block and so your child will not miss any regularly scheduled class material. In addition to DIBELS which will be administered by your child's school, you are also being asked to allow your child to take a standardized measure of reading achievement called the Gates Maginitie. If you agree, the Gates Maginitie will be administered twice, once at the beginning of the study and again at the end of the study. Teacher led groups will be taught by a trained graduate student. Computer led groups will be monitored by a trained graduate student.

The identity of your child will be kept confidential to the extent provided by law. Only I will have access to the data collected, and students will be assigned coded letters and numbers on all data collection sheets. The data collected will be destroyed at the completion of the project.

There is no known risk for your child's participation in the study. You are free to withdraw consent to allow your child to participate in this study at any time. There is no compensation for participation in this study.

If you have any questions regarding the progress of this study, please contact your child's teacher or the school's principal, _____ at _____.
If you have any questions about this research protocol, please contact my faculty advisor, Dr. Holly Lane, at 392-0701. Questions or concerns about your child's rights as a research participant may be directed to the UFIRB office, University of Florida, Box 112250, Gainesville, Fl 32611-2250; phone (352) 392-0433.

Please sign and return this copy of the consent letter in the enclosed envelope. A second copy is provided for your records. By signing this letter, you give me permission to report your child's assessment and results anonymously in the final manuscript to be submitted by me as part of my course work.

Sincerely,

Nicole S. Fenty, M.Ed

I have read the procedure described above for the study. I give permission for my child to participate in the study.

_____ _____
Parent Date

Dear Parent:

I am a doctoral student in the College of Education at the University of Florida. I am conducting research to determine how computer assisted instruction compares to teacher led instruction in the oral reading fluency and on task engagement of third grade students. Your child was selected for participation in this study based on his/her scores on the most recent DIBELS Oral Reading Fluency measure and based on teacher nomination regarding on task engagement during reading instruction. The results of this study may help teachers to better understand how to best deliver fluency instruction to students. With your permission, I would like to ask your child to volunteer for this research.

Participating students will receive 20 minutes of reading fluency instruction per day for three times per week over the course of eight weeks. Students will receive either teacher led and computer led instruction. The same fluency instructional program will be used in the teacher led and in the computer led groups. If you allow your child to participate, your child will be removed from the classroom during a scheduled intervention block and so your child will not miss any regularly scheduled class material. In addition to DIBELS which will be administered by your child's school, you are also being asked to allow your child to take a standardized measure of reading achievement called the Gates Maginitie. If you agree, the Gates Maginitie will be administered twice, once at the beginning of the study and again at the end of the study. With you permission, I would also like to observe your child using an observation protocol to determine if any differences exist in on task engagement across the teacher led and the computer led groups. Teacher led groups will be taught by a trained graduate student. Computer led groups will be monitored by a trained graduate student.

The identity of your child will be kept confidential to the extent provided by law. Only I will have access to the data collected, and students will be assigned coded letters and numbers on all data collection sheets. The data collected will be destroyed at the completion of the project.

There is no known risk for your child's participation in the study. You are free to withdraw consent to allow your child to participate in this study at any time. There is no compensation for participation in this study.

If you have any questions regarding the progress of this study, please contact your child's teacher or the school's principal, _____ at _____.
If you have any questions about this research protocol, please contact my faculty advisor, Dr. Holly Lane, at 392-0701. Questions or concerns about your child's rights as a research participant may be directed to the UFIRB office, University of Florida, Box 112250, Gainesville, Fl 32611-2250; phone (352) 392-0433.

Please sign and return this copy of the consent letter in the enclosed envelope. A second copy is provided for your records. By signing this letter, you give me permission to report your child's assessment and results anonymously in the final manuscript to be submitted by me as part of my course work.

Sincerely,

Nicole S. Fenty, M.Ed

_____ _____
Parent Date

Volunteer Recruitment Script

My name is (researcher states name) and I am a graduate student in the College of Education at the University of Florida. I am a doctoral student conducting a study to understand how computer assisted instruction compares to teacher led instruction in the oral reading fluency and in the on task engagement of third grade students.

I need third grade students who are struggling in oral reading fluency. Specifically, I need students who fall within the 10th and the 39th percentile on the Dynamic Indicators of Basic Early Literacy Skills. If you agree to participate, I would like to ask the permission of the parents of these students to provide either teacher led or computer led instruction in oral reading fluency. At the beginning and again at the end of the study, I would also like to administer a standardized measure of overall reading achievement called the Gates Maginitie to students. Teacher led groups will be taught by a trained graduate student. Computer led groups will be monitored by a trained graduate student.

Additionally, you will be asked to nominate a subset of students from your reading class who not only experience difficulty with oral reading fluency but who also experience difficulty remaining on task during reading instruction. These students will receive instruction in both the teacher led and the computer led groups. These students will be observed daily to determine whether differences in task engagement exist across groups.

Students' identity will be kept confidential to the extent provided by law. Only I will have access to the data collected through standardized measures of oral reading fluency, reading achievement and the on task engagement observation protocol. The final results will be presented at a conference and may be submitted to educational journals for possible publication.

No more than minimal risk is involved in this study. Participants in this study could benefit through increases in oral reading fluency as a result of exposure to direct instruction in reading fluency and as a result of increased engagement during instruction. You and your students' participation in this study is completely voluntary. There is no penalty for not participating. You have the right to withdraw from the study at anytime without consequence.

Would you like to allow your students participate?

Child Assent Script/Form

I want to see if you would be willing to help me with a research project. I am from the University of Florida and I am trying to help your teacher figure out how to teach students to learn to read better. If you decide to be take part in the project, you will be taught reading by a teacher and/or by a computer. If you decide to participate, you will be taught for 20 minutes per day for three times per week of eight weeks.

It is okay if you do not want to take part in the project. If you say yes to taking part, you can stop being apart of project at any time. Your parent(s) know that I am asking you to take part in the project.

Do you have any questions? Would you be willing to do the project with me?

APPENDIX C
DATA COLLECTION FORMS

Table C-1. Sample of Behavior Rating Scale For Study Pre-Qualification
Teacher: _____
Student: _____

Activity					Total
Pays attention	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	
Listens carefully	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	
Listens attentively	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	
Listens to directions	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	
Remains on-task during independent work	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	
Actively participates	Always 3 points	Often 2 points	Sometimes 1 point	Never 0 points	

Table C-2. Sample of Data Collection Sheet Used During Baseline Condition

Student Code Name: Date:

Intervals	Target Behaviors			
1	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
2	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
3	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
4	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
5	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
6	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
7	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
8	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
9	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions
10	asking a question about the lesson	eyes on the teacher	eyes on the text	hand raised to contribute to the lesson
	pointing to words in the text	reading the text	responding to a question	writing responses to questions

Percent On-task: _____

Table C-3. Sample of Data Collection Sheet Used During Treatment Conditions
Student Code Name:
Observer (Primary/Secondary):
Print or Computer (Circle one):
Date:

	10	20	30	40	50	60
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Percent On-task: _____

APPENDIX D
SUMMARY OF THE QUICK READS PROGRAM

Table D-1. Overview of the Quick Reads Program

	High Frequency Words	Projected Words Read Per Minute	Phonics Patterns
Level A (2nd grade curriculum)	300 most frequently used words	Book 1: 80 words Book 2: 90 words Book 3: 100 words	Single syllable words with regular short and long vowel patterns and consistent spelling patterns
Level B (2nd grade curriculum)	500 most frequently used words	Book 1: 90 words Book 2: 100 words Book 3: 110 words	Single syllable words regular short and long vowel patterns, r-controlled vowels, and consistent spelling patterns
Level C (3rd grade curriculum)	1,000 most frequently used words	Book 1: 100 words Book 2: 110 words Book 3: 120 words	Vowel patterns in single syllable words
Level D (4th grade curriculum)	1,000 most frequently used words	Book 1: 110 words Book 2: 120words Book 3: 130 words	Multi-syllable words with inflected endings
Level E (5th grade curriculum)	2,500 most frequently used words	Book 1: 120 words Book 2: 130 words Book 3: 140 words	Multi syllable word with inflected endings
Level F (6th grade curriculum)	5,000 most frequently used words	Book 1: 130 words Book 2: 140 words Book 3: 150 words	Multi syllable words with inflected endings

Sources: Carroll, J.B., Davis, P., and Richman, B. Word Frequency Book. Boston, MA: Houghton Mifflin, 1971. Zeno, S.M., Ivens, S.H., Milliard, R.T., & Duvvuri, R. (1995). The Educator's Word Frequency Guide. New York: Touchstone Applied Science Associates, Inc.

Table D-2. Sample Quick Reads Script for Print-based Instruction

Step 1: The teacher begins by browsing the title, picture and caption with students.

Teacher says: "Before we read this new passage lets think about this topic. First let us begin by reading the title. Now let us look at the picture and the caption that accompanies it."

Step 2: The teacher uses a graphic organizer to help students to make predictions about what might occur in the passage (see Appendix H-1).

Teacher says: "Do you have any predictions about what this passage might be about? Let us write down some of your predictions. We will come back to your predictions at the end of the passage."

Step 3: The teacher then reads the passage as students follow along silently.

Teacher says: "Please read along silently as I read the passage aloud. Be sure that you are showing me that you are following along by using your pointer finger or a pencil to point to the words as I read."

Step 4: Students then choral read the passage.

Teacher says: "Now we will read the passage together. Be sure to use your pointer finger or a pencil to point to each word as we read."

Step 5: Students practice the passage by reading with a partner.

Teacher says: "Now you are going to read this passage with your partner. Remember, you are to help your partner with the words that they have trouble with and provide your partner with a compliment about their reading when they are finished."

Step 6: The teacher then times the student for one minute.

Teacher says: "Now it is time to do your one minute timing. If you are waiting to be timed you may go ahead and work on the questions that accompany this passage at the end of the unit."
To student who is being timed: "We are going to do a timing of the passage we have practiced today. Be sure to do your best reading... ready... begin."

Step 7: The teacher and student chart the number of word correctly per minute.

Teacher says: "That was wonderful reading. Let us turn to the back of the book and mark how many words you read today."

Step 8: As students wait to be time, they respond to the comprehension questions that accompany a particular passage. Review the comprehension questions with students.

Teacher says: “Now let us review the questions that accompanied this passage. Let us read the first question together. What is the correct answer to that question? Let us read the second question together. What is the correct answer to that question? Let us read the third question together. What is the correct answer to that question?”

APPENDIX E
RESULTS OF PILOT STUDY

Table E-1. Pilot Study

Student	DIBELS Pretest	DIBELS Posttest
1	70	73
2	55	56
3	52	74
4	42	53
5	77	63
6	60	94
7	63	72
8	80	104
9	51	61
10	83	79
11	75	not available
12	89	not available
Group	Average DIBELS Pretest	Average DIBELS Posttest
Print-based	63	71.6
Computer-based	63.6	74.2

APPENDIX F
TREATMENT INTEGRITY SCALES

Table F-1. Treatment Integrity Scale for Teacher-led Print Group
Teacher:
Date:
Treatment Integrity Rating Scale (Print Group)
No = Implementation does not match with expected activity and method in most ways.
Yes = Implementation matches well with expected activity and method in most ways.

Step	Rating		Comment
1. The teacher begins by browsing the title, picture and caption with students.	Yes	No	
2. The teacher uses a graphic organizer to help students to make predictions about what might occur in the passage.	Yes	No	
3. The teacher then reads the passage as students follow along silently.	Yes	No	
4. Students then choral read the passage.	Yes	No	
5. Students practice the passage by reading with a partner.	Yes	No	
6. The teacher then times the student for one minute.	Yes	No	
7. The teacher and student chart the number of word correctly per minute.	Yes	No	
8. As students wait to be time, they respond to the comprehension questions that accompany a particular passage. Review the comprehension questions with students.	Yes	No	

Table F-2. Treatment Integrity Scale for Teacher-led Computer Group
Teacher:
Date:
Treatment Integrity Rating Scale (Computer Group)
No = Implementation does not match with expected activity and method in most ways.
Yes = Implementation matches well with expected activity and method in most ways.

Step	Rating		Comment
1. Teacher has software and microphone headphone ready before students enter the room.	Yes	No	
2. Students know what to do upon entering the room.	Yes	No	
3. Teacher monitors to ensure that students remain on-task.	Yes	No	
4. Teacher redirects students to ensure that students remain on-task.	Yes	No	
5. Teacher directs time-equivalent group to continue to the next passage.	Yes	No	
6. Teacher directs text-equivalent group to go on to a math program.	Yes	No	

APPENDIX G
STUDY TIMELINE BY MONTH AND WEEK

Table G-1. Study Timeline by Month

Month of…	Activity
July/August 2006	Establish relationship with target schools
Early September 2006	DIBELS pretest
Mid September 2006	Analyze DIBELS scores and select participants
Mid September 2006	Send home consent letters
Mid September 2006	Randomly assign participants
End of September 2006	GATES MacGinitie pretest
Beginning of October 2006	Begin Instruction
Beginning of December 2006	Gates MacGinitie posttest
Beginning of December 2006	DIBELS posttest

Table G-2. Study Timeline by Week

Week of…	Activity
August 28th	Finalize relationships with schools, recruit graduate student teachers
September 4th	DIBELS pretest, recruit graduate student teachers
September 11th	DIBELS pretest, have teachers nominate students with engagement problems, select students within the 10th and the 39th percentile
September 18th	Send home consent letters, Train graduate student teachers
September 25th	Observe teacher nominated students, administer Gates MacGinitie pretest, randomly assign students, decide on small-group configurations for students in the print-based groups, train students
October 2nd	Instruction begins, begin treatment integrity
October 9th	Instruction, treatment integrity, watch and code video
October 16th	Instruction, treatment integrity, watch and code video
October 23rd	Instruction, treatment integrity, watch and code video
November 6th	Instruction, treatment integrity, watch and code video
November 13th	Instruction, treatment integrity, watch and code video
November 20th	Instruction, treatment integrity, watch and code video
November 27th	Instruction, treatment integrity, watch and code video, Gates MacGinitie posttest
December 4th	DIBELS posttest, Gates MacGinitie posttest

APPENDIX H
GRAPHIC ORGANIZER FOR PREDICTIONS

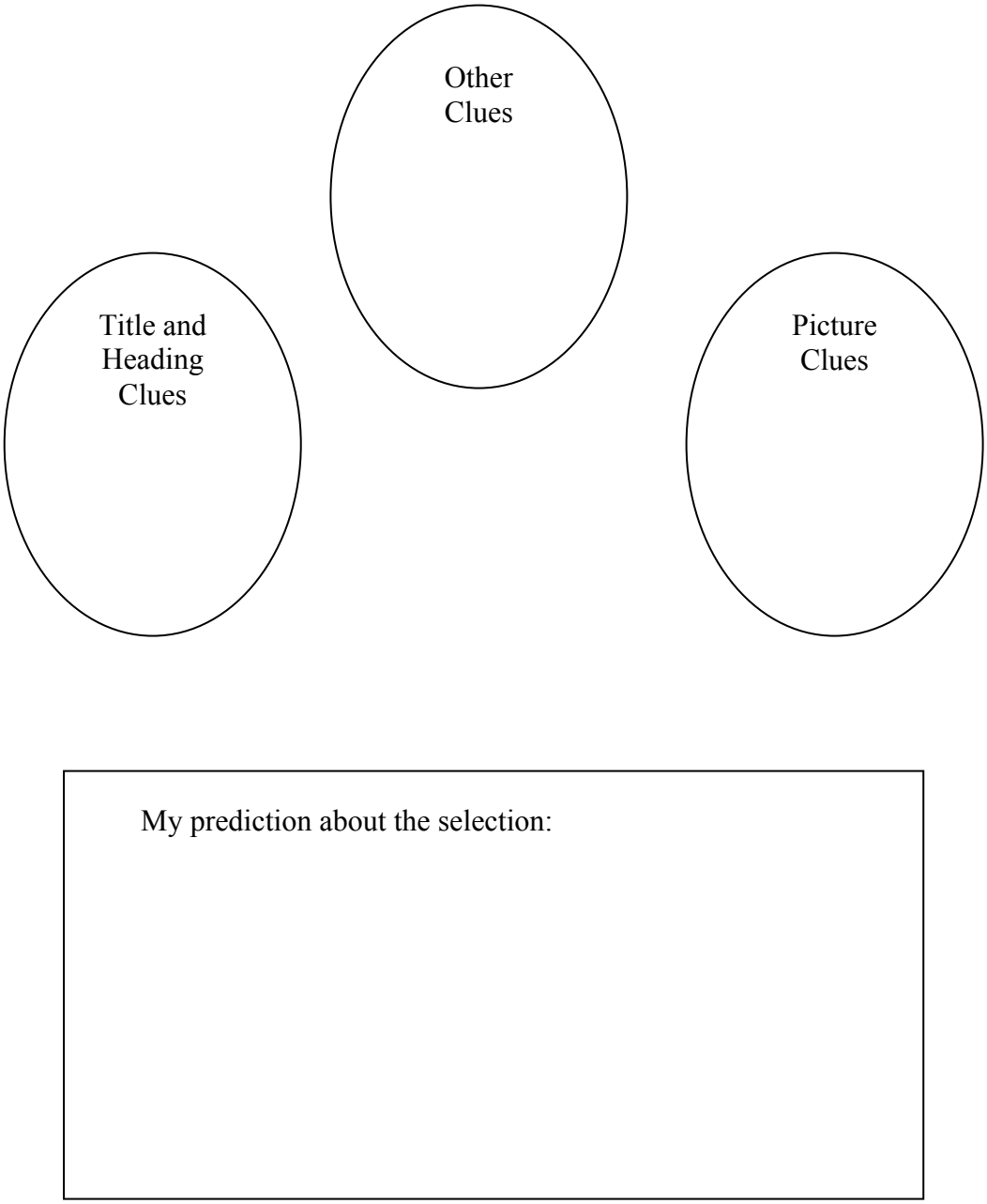

Figure H-1. Graphic Organizer for Pre-reading Discussion.[Reprinted with permission from Mailbox Books]. Mailbox Books (2006) Graphic Organizers: Over 50 Easy to Adapt Reproducible Graphic Organizers, p. 5. The Mailbox. Greensboro, NC.

APPENDIX I
SCREEN SHOT EXAMPLES OF QUICK READS

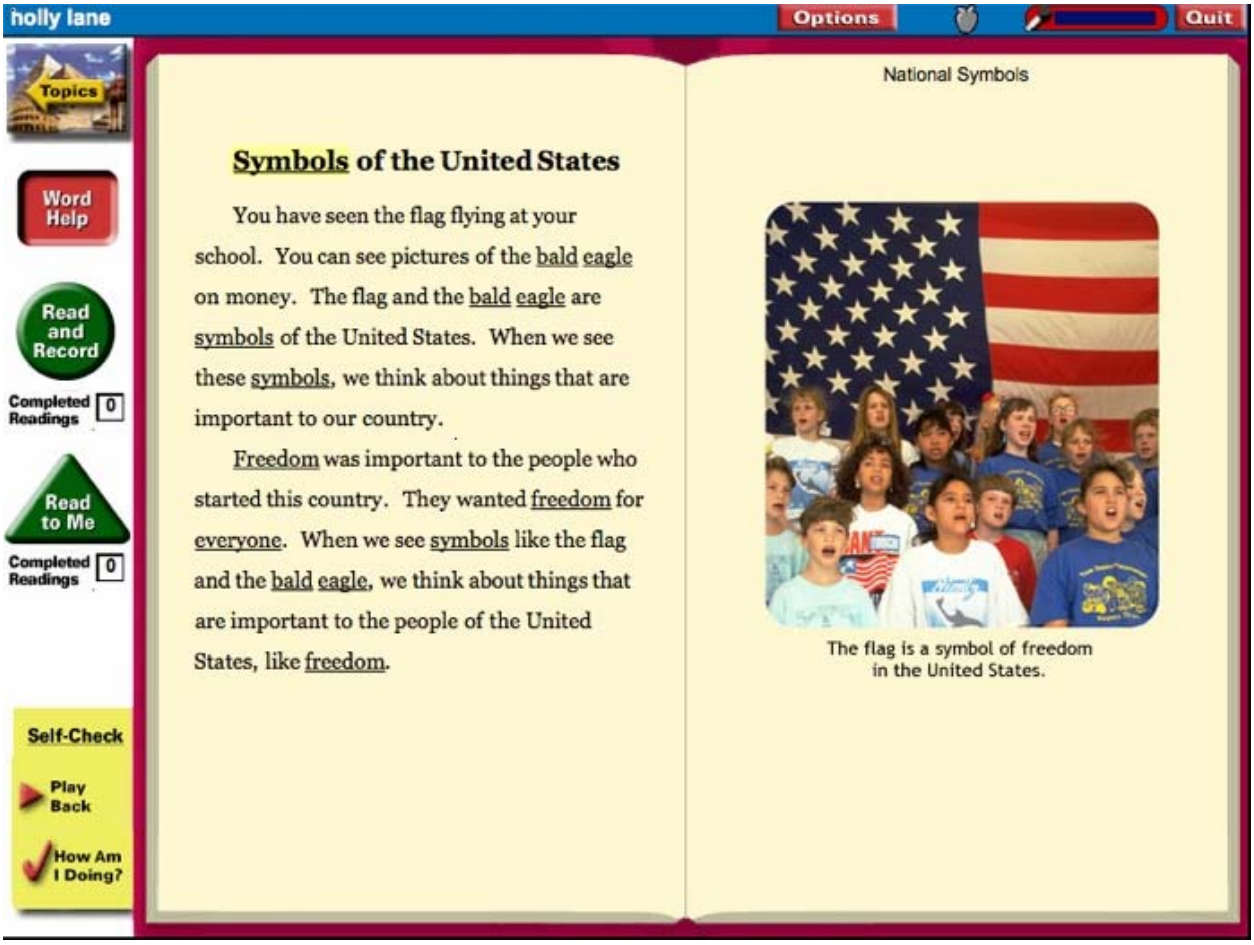

Figure I-1. Quick Reads Title Screen Page. [Reprinted with permission from Pearson Education Inc].Hiebert, E.H. (2005). Quick Reads Technology Edition Version 3: Student Charting Page. Pearson Learning Group. Parsippany, NJ.

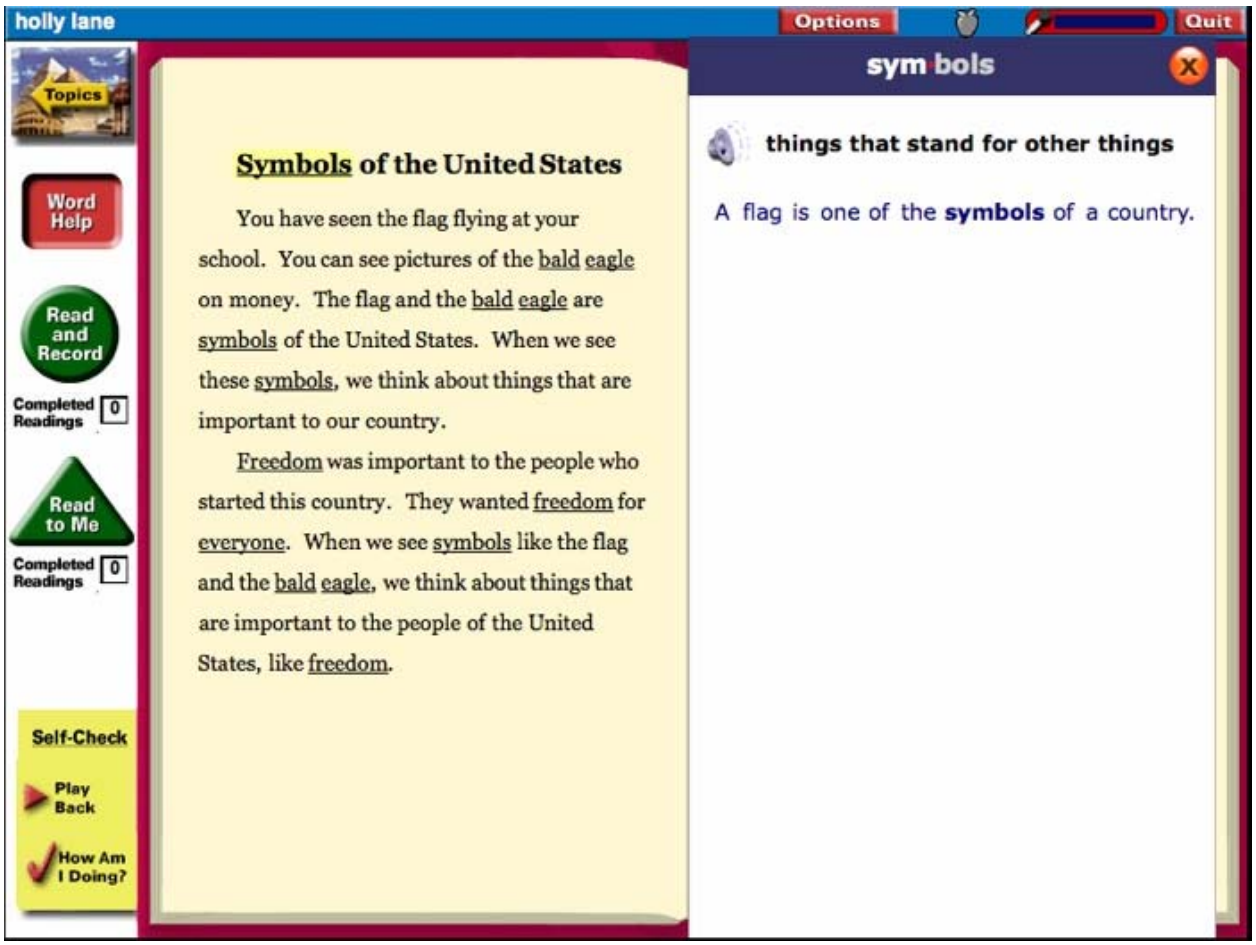

Figure I-2. Quick Reads Definition Page. [Reprinted with permission from Pearson Education Inc].Hiebert, E.H. (2005). Quick Reads Technology Edition Version 3: Student Charting Page. Pearson Learning Group. Parsippany, NJ.

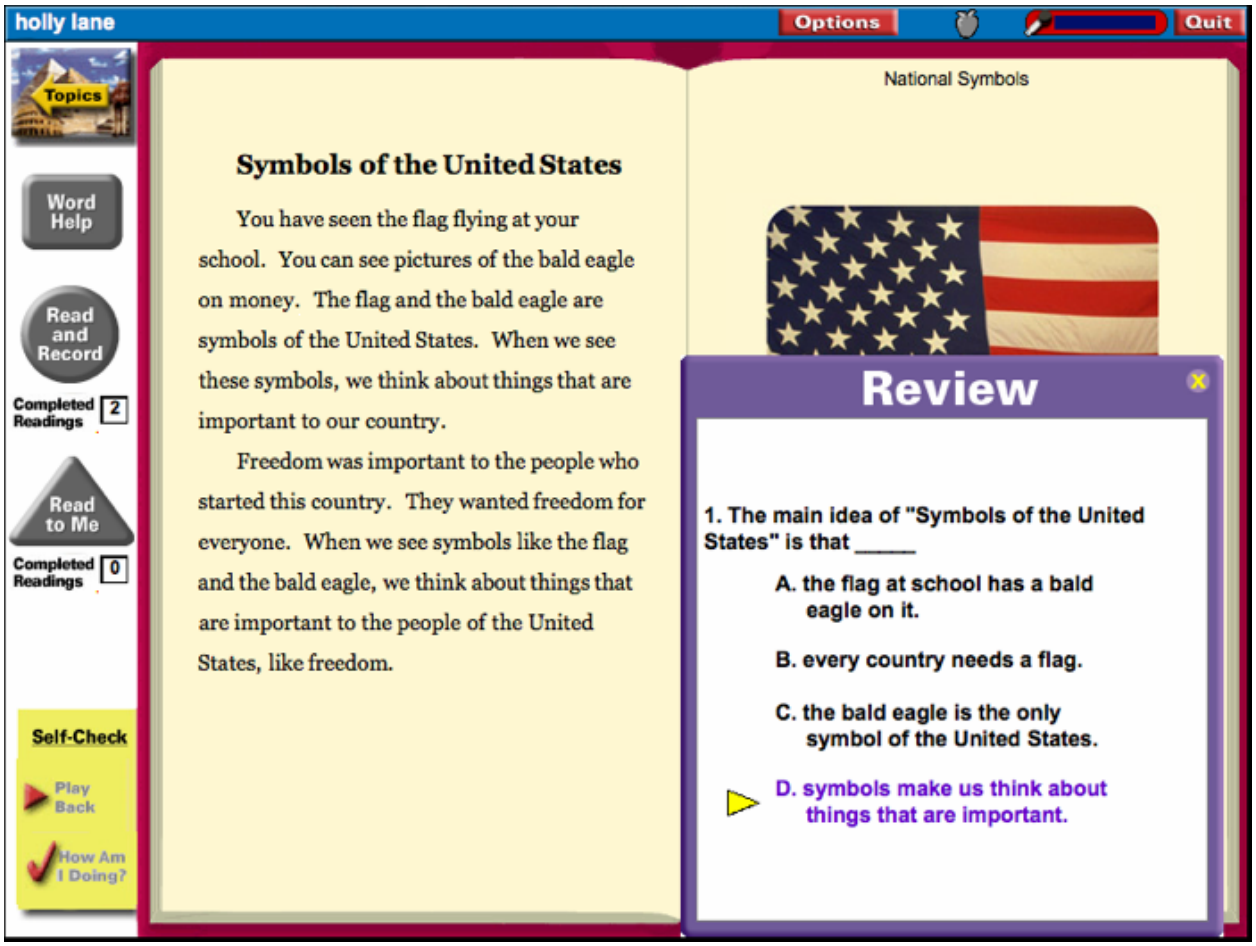

Figure I-3. Quick Reads Comprehension Questions Page. . [Reprinted with permission from Pearson Education Inc]. Hiebert, E.H. (2005). Quick Reads Technology Edition Version 3: Student Charting Page. Pearson Learning Group. Parsippany, NJ.

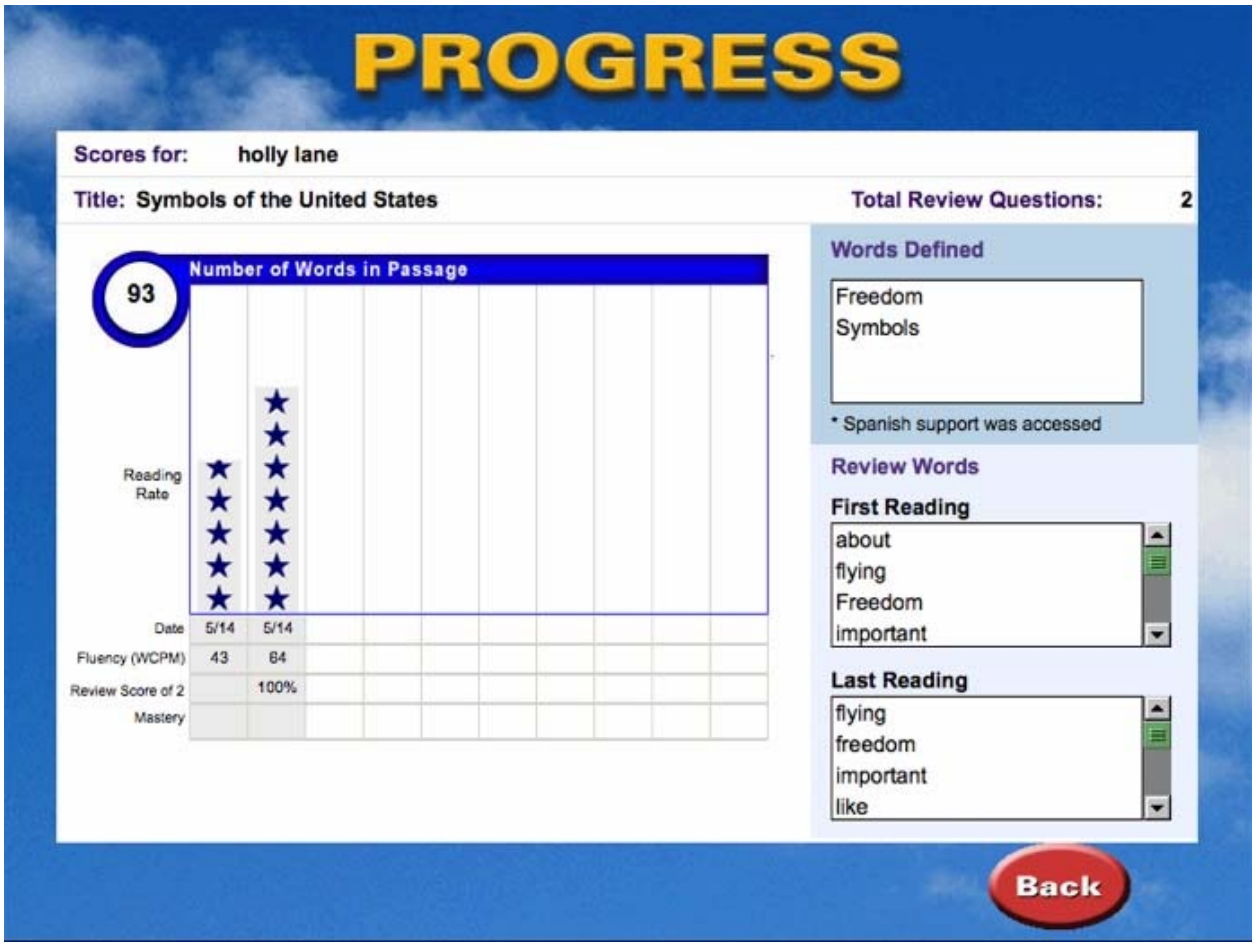

Figure I-4. Quick Reads Progress Monitoring Page. [Reprinted with permission from Pearson Education Inc]. Hiebert, E.H. (2005). Quick Reads Technology Edition Version 3: Student Charting Page. Pearson Learning Group. Parsippany, NJ.

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BIOGRAPHICAL SKETCH

Nicole Scarlett Fenty was born on January 4, 1979, in Jamaica, West Indies. She moved to the Lauderdale Lakes, Fl with her parents at age nine and graduated from Boyd Anderson High School in 1996. She earned her bachelor's degree in psychology from the University of South Florida in 2000 and her master's degree in special education from the University of Florida in 2003. She has served as a child care attendant, teacher's aide and teacher of students with learning disabilities for over 4 years in Hillsborough and Alachua counties.

Nicole began her doctoral studies in 2003, with a focus in reading and behavior difficulties. She was supported by two federally funded grants, including an EBD leadership grant and Project PASS: Promoting Academic and Social Success.

Upon completion of her doctoral program, Nicole and her husband will relocate to Louisville, Kentucky where she will begin her career as an Assistant Professor of Special Education at the University of Louisville. Nicole has been married to her husband, Sean Fenty, for four years.