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Emergent literacy skills of young children with autism: A Comparison of teacher-led and computer-assisted instruction

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EMERGENT LITERACY SKILLS OF YOUNG CHILDREN WITH AUTISM: A COMPARISON OF TEACHER-LED AND COMPUTER-ASSISTED INSTRUCTION

by

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ABSTRACT

Emergent Literacy Skills of Young Children with Autism: A Comparison of Teacher-Led and Computer-Assisted Instruction

by

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Young children with autism often are identified as experiencing problems in language, social, and behavioral development. Current research typically focuses on these three areas with little attention paid to the academic learning of these children. Because of this, young children with autism often do not engage in typical early literacy experiences (e.g.., emergent literacy activities). This can result in these children being at risk for developing poor literacy skills. It is important that researchers begin to explore systematic literacy instruction for young children with autism to not only increase literacy learning, but also facilitate the inclusion of these children in the school setting and beyond.

This study focused on teaching alphabet skills to young children with autism. Two instructional conditions were compared, traditional teacher-led group instruction that used alphabet books and multimedia computer-assisted instruction. Data were compared to determine the effects on alphabetic skills acquisition and maintenance. The effects on student attentive behavior and engagement in problem behavior in each intervention condition also were compared. Teacher opinions of computer-assisted instruction in self-contained preschool classrooms for children with autism were evaluated prior to and at the conclusion of the study.

The results of this study indicate that both interventions were effective for improving the students' alphabet recognition skills. The children in both interventions also maintained their learning over the maintenance periods. In both intervention groups, the children had high rates of attention to task and low rates of undesirable behavior. The participating teachers reported positive attitudes and beliefs toward computer-assisted instruction prior to and following the study.

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Dedicated with love to my brother,

Robert Curtis Travers, Junior.

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CHAPTER 1

INTRODUCTION

In 1997 the United States Congress mandated a panel of experts to examine various aspects of literacy. The National Reading Panel (NRP) was charged with reviewing, evaluating, and describing the current state of the scientific reading literature. The goal was to identify the quality and efficiency of instructional practices and possible improvements. The NRP reported their findings in 2000. The final report included quantitative and qualitative data emphasizing: (a) prevention of reading failure for at-risk populations, (b) diverse instructional approaches to enhance phonemic awareness, phonics, and reading mastery, and (c) the need for scientific literature to inform practice (National Institute of Child Health and Human Development [NICHHD], 2000).

Over the years, society has continued to reinforce the value of literacy. Recently, over six billion dollars was allocated to state education agencies through the *Reading First Program* (No Child Left Behind Act of 2001). This unprecedented educational funding underscores the societal value of reading. Acquiring information from written words or symbols is essential for success in today's world (Adams, 1990; Copeland, 2007; Higgins, Boone, & Lovitt, 2002; Street & Lefstein, 2007). Similarly, Federal legislation has emphasized accountability measures to ensure that all children have access to adequate academic instruction (No Child Left Behind Act of 2001; Individuals with Disabilities Improvement Act of 2004).

The literature is indicative of the complexity of defining literacy, describing its benefits, and ascribing literacy theory (Bartlett, 2008). Traditionally, literacy is conceptualized as a series of progressive skills partially determined by physical and cognitive stages of development (Bartlett, 2008). The global benefits of literacy are tied

to rational thought and intellectualism, social progress, and economic mobility (Street, 1984). A direct correlation exists between the strength of a society's literacy and the ability to compete in a global economy (Adams, 1990). Literacy is vital for school success as well as satisfaction in life (Adams, 1990; Anderson, Hiebert, Scott, & Wilkinson, 1985; Copeland, 2007; Higgins, Boone, & Lovitt, 2002; Street & Lefstein, 2007).

In more specific terms, individuals benefit from literacy skills in a number of ways. Individuals who are literate experience increased self-esteem, have greater confidence, and experience higher levels of personal empowerment (Education for All Global Monitoring Report Team [EFA], 2005). Literate adults typically are healthier, better able to care for their children, and more likely to value and support education (EFA). Importantly, correlative effects between individual economic outcomes and literacy skills have been identified; the better one is able to read and write, the better their economic outcomes (EFA). Thus, poor literacy skills may lead to: (a) low self-esteem and general dissatisfaction with life, (b) poor physical healthcare for self and dependents, (c) cyclical patterns of low educational outcomes, and (d) greater risk of an impoverished lifestyle (EFA).

People with autism are particularly at risk for developing poor literacy skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005). Autism is characterized by pervasive delays in language and communication skills, marked impairment in social development, and engagement in narrow, restrictive, and stereotypical behaviors (APA, 2000). Poor or complete lack of development in language and communication often results in an absent foundation for literacy skills (Morrow, 2001). Complicating language delays are the existence of social impairment and reliance on behaviors that often obstruct typical

learning experiences (National Research Council [NRC], 2001). Poor social skills result in decreased interactions during literacy opportunities (Coleman-Martin et al., 2005). Engagement in narrow and stereotyped behaviors (e.g., rocking, hand-flapping, spinning objects) results in decreased meaningful interaction with the environment, thereby impairing learning (NRC, 2001). This triad of impairments may produce limited engagement in the typical learning experiences that contribute to emergent literacy skills. Thus, reducing stereotyped (i.e., self-stimulatory) and non-compliant behaviors, and increasing attention and motivation are typically the priority of intervention teams as these behaviors directly impact the future learning of students with autism (Koegel, Koegel, Frea, & Smith, 1995).

Emergent Literacy Development in Young Children

The National Association for the Education of Young Children (NAEYC) maintains that literacy begins during infancy and is enhanced in literacy rich environments (NAEYC, 1997). Literacy is acquired initially via oral language and develops exponentially during the preschool years with exposure to various media, people, and experiences in rich educational environments (Morrow, 2001). If children are to understand alphabetic principles, they must first understand that spoken sounds are paired with letters (Adams, Foorman, Lundberg, & Beeler, 1998). This concept commonly is identified as phonemic awareness. Phonemic awareness is the understanding that every letter is symbolic of a spoken sound (Yopp, 1992). Phonemes are the units of spoken language that have alphabetic meaning (Adams et al., 1998). Typically, an emergent reading approach is used during the preschool years to instill basic alphabetic principles, specifically the principle that words are comprised of letters

and sounds that share systematic relationships (Adams, 1990). This is the foundation for phonics instruction (Thompkins, 2003). Researchers maintain that phonemic awareness and being able to identify letters of the alphabet are predictors of future reading achievement (Adams, 1990; Committee on the Prevention of Reading Difficulties in Young Children, 1998; Simmons et al., 2002).

The most fundamental information children learn in early reading is the identification of the alphabet (Tompkins, 2003). Pinnel and Fountas (1998) indicate that children must master the use of seven different skills in order to decode words. These are: (a) letter names, (b) formation of letters in upper and lower cases, (c) distinguishing features to differentiate letters, (d) the direction of letters, (e) the sound the letter represents in isolation, (f) the sound the letter produces in combination with other letters, and (f) the sound the letter produces in the context of a word. Learning the names of letters requires numerous and varietal experiences with written letters while capitalizing on the interests of the child (McGee & Richgels, 2004). Typical learners often acquire knowledge about letter names prior to entering first grade. Through various strategies (e.g., reading stories aloud, using rich language, encouraging drawing and prewriting, establishing a library center in the classroom, exposing students to computers), teachers embed informal early reading activities to expose children to letters and words to promote literacy throughout the school day, making rapid learning of reading skills more likely (Thompkins, 2003).

Emergent Literacy Development in Young Children with Autism

Autism is characterized by pervasive delays in language and communication skills, marked impairment in social development, and engagement in narrow, restrictive,

and stereotypical behaviors (APA, 2000). People with autism are at risk for developing delays in early literacy (Coleman-Martin, Heller, Cihak, & Irvine, 2005). Communication delays impact other areas of development and have direct implications for social development and reliance on behavioral modes of communication (NRC, 2001). Difficulty communicating directly impacts the quantity and quality of peer relationships (Scheuermann & Webber, 2002). Similarly, communication deficits often result in the use of socially inappropriate behavior for basic communication of wants and needs that may lead to further isolation from peers, school personnel, and members of the community (Bondy & Sulzer-Azaroff, 2002; Prior & Ozonoff, 2007). Additionally, intellectual development for these students can be depressed (Prior & Ozonoff, 2007; Volkmar & Lord, 2007). These factors suggest that academic development for students with autism is likely to be delayed due to the pervasive nature of their disability.

Oral language is a fundamental aspect of literacy development (Morrow, 2001). Since spoken language is foundational to literacy, interventions designed to improve communication skills directly impact literacy skills (de Valenzuela & Tracey, 2007). Through typical linguistic experiences, children learn conversational skills, pragmatics, and syntax of language. The triad of impairments in autism (e.g., communication, social, and behavioral deficits) make student acquisition of language via typical experiences unlikely (Prior & Ozonoff, 2007). Consequently, treatment focused on remediation of language often is prescribed (Paul, 2007). However, universal technologies for the treatment of children with autism have not yet been discovered and/or implemented (NRC, 2001).

People with autism often are characterized as having superior ability to process visual stimuli (Happe, 1999; Prior & Ozonoff, 2007; NRC, 2001). However, research

indicates that approximately 10% to 20% of children with autism are hyperlexic (Grigorenko et al., 2002). Hyperlexia is the precocious ability to decode words while demonstrating an inability to comprehend what is read before the age of five (Silberberg & Silberberg, 1967). Thus, 80% to 90% of children with autism require literacy instruction to promote decoding and all require instruction to develop reading comprehension skills (Grigorenko et al., 2002). Researchers have not explored the utility of systematic literacy instruction provided to children without disabilities, instead they have focused on reading comprehension for hyperlexic students or sight-reading skills for this population (Koppenhaver & Erickson, 2003).

The IDEA (2004) mandates that students with autism receive their education in the general education classroom to the maximum extent possible. Thus, between 1998 and 2004 the number of students with autism ages 6-21 years old who accessed the general education environment for 40% or more of the school day increased by 122% (U.S. Department of Education, 2000; 2006). However, it is unknown if students with autism readily acquire reading skills via the general education curriculum or the instructional interventions that are needed for success in this environment. Similarly, it is unknown if withholding typical literacy instruction for young students with autism results in constricted literacy instruction in later school years or the use of literacy skills in adult life. Conflating this issue are difficulties supporting and educating individuals with autism who exhibit high rates of problem behavior in school, home, and community environments.

Students with autism are characterized as having behavioral excesses and deficits that interfere with development (APA, 2000). Non-compliant behaviors (e.g., refusing to stay in a designated area, not following directions), stereotyped behaviors (e.g., hand-

flapping, rocking) and attention deficits (e.g., shifting attention, disengaging from tasks, and sustaining attention) often are observed in students with autism (Prior & Ozonoff, 2007). These behaviors are difficult to manage and likely result in exclusion from participation in general education in favor of more restrictive educational environments (Prior & Ozonoff). Ironically, these placements may result in further delay of adequate literacy instruction instead of providing remediation (Koppenhaver & Erickson, 2003; Mirenda, 2003).

Because of the pervasive nature of the disability, emergent literacy instruction may not be viewed as a priority of intervention teams or teachers (Koppenhaver & Erickson, 2003). Instead intervention may focus on basic communication skills, behavioral excesses and deficits, and social skills development (Koegel et al., 1995). These common needs may result in poor emergent literacy skills in students with autism as they enter the primary school years. Thus, many students with autism may be viewed by their teachers as being unprepared for reading instruction because they lack prerequisite skills for reading (Mirenda, 2003). Because most typically developing children have acquired basic alphabetic principles (e.g., letter identification) by first grade (Morrow, 2001), and because literacy skills often are not a priority of teachers of students with autism (Mirenda), opportunities for students with autism to participate in the general education reading curriculum may be unlikely. Placement in specialized classrooms with teachers who do not view their students as ready to learn reading skills may result in inadequate literacy instruction (Yoder, 2001). Students with autism may be more apt to access the general education reading curriculum if they demonstrate typical emergent literacy skills (e.g., letter recognition).

Some educational systems justify their failure to provide effective literacy instruction to students with severe disabilities by classifying the students as incapable of learning literacy skills (McGill-Franzen, 1991). Stereotypes and discrimination against students with severe disabilities have prompted advocates to identify literacy skills as a civil right (Yoder, 2001; Yoder, Erickson, & Koppenhaver, 1997; National Joint Committee for the Communication Needs of Persons With Severe Disabilities [NJC], 1992). Despite these demands, researchers have not explored the letter recognition skills of students with autism. The limited literature specific to literacy for students with autism indicates that this topic has been largely underemphasized (Alberto & Heflin, 2007). This lack of literature and research may be the reason educators fail to view students with autism as being ready, or even capable, of learning to read. Additionally, educators are left to make their own decisions about what works without scientifically-validated instructional methods or strategies to promote early literacy for students with autism.

The Use of Computer Technology with Young Children

Computer technology has become ubiquitous in society and is vital to completing everyday tasks related to communication, information retrieval, and socialization. The National Association for the Education of Young Children (NAEYC) recognizes the important role technology will have on subsequent generations of young children (NAEYC, 1996). Drawing from the scientific literature, the NAEYC (1996) issued a policy statement supporting the integration of technology indicating that: (a) all children, regardless of ability, should have access to computer technology, (b) the integration of computers into everyday learning environments is essential, and (c) appropriately used computer technology can augment the cognitive and social skills of young children.

Computer technology supports early literacy development, basic and developmentally advanced mathematics concepts and applications, creativity and critical thinking skills, communication, and social development for young children (Clements, 2002; 1997; Freeman & Somerindyke, 2001; Haugland, 2000; Yelland, 2005).

Computers are capable of providing children with opportunities to explore and manipulate digital objects that otherwise are not available in classrooms (Gillespie & Beisser, 2001). For instance, students from urban areas may explore various aspects of rural farming equipment, chores, or agriculture that would be unavailable. Additionally, computer software often requires the student to direct their learning, allowing them to assume an active role in their own learning (McCarrick & Li, 2007). This often is achieved via multimedia software that presents manipulative images, sounds, animation, music, and text to provoke and reinforce desirable learning behaviors. Active exploration of environments is consistent with dominant principles and theories of early learning proposed by Piaget (1974), Erikson (1963), and Vygotsky (1978). Consequently, when children are exposed to novel multimedia stimuli via computer technology, and they are encouraged to freely explore and manipulate stimuli without fearing potentially negative consequences (e.g., corrective feedback), motivation to learn increases (McCarrick & Li, 2007; NAEYC, 1996).

Some authors argue against the use of computer technology in early childhood classrooms (Alliance for Childhood, 2004; Cordes & Miller, 2000). The criticism regarding potentially negative social consequences of computer technology in classrooms focuses on: (a) reduced child interactions with peers and adults, (b) use of technology to manage children instead of using it for learning, and (c) impediments in cognitive and linguistic development (Alliance for Childhood; Cordes & Miller). However, the

NAEYC (1996) supports integrating computers into early childhood classrooms. In their review of the literature on computer technology in early childhood classrooms, McCarrick and Li (2007) suggested that the arguments against integrating computers in early childhood classrooms are unfounded and that the existing research, although limited, indicates computer technology has primarily positive effects on child development.

Computers have become an integral part of the literacy experiences of young children at home and at school (Labbo & Reinking, 2003). However, little is known about the effects of computer technology on early literacy skills and even less is known about the effects computer technology has on various aspects of literacy across the lifespan (NICHHD, 2000). The NRP found 92 studies that used experimental or quasi-experimental designs in their search of the literature on computer technology and literacy (NICHHD). Of these, only 21 studies met the inclusion criteria for a meta-analysis and only three of the 21 studies included participants who were kindergarten or preschool age, prompting a request for more research (NICHHD). Blok, Oostdam, Otter, and Overmatt (2002) used broader criteria for a comparable meta-analysis, but in agreement with the NRP, concluded that more research is needed. The limited literature that is available indicates positive findings regarding literacy and computer-assisted instruction (CAI) in: (a) exploration of computer capabilities, (b) word processing tasks, (c) comparisons of computers with conventional tasks, and (d) literacy learning (Blok et al.; NICHHD). These findings likely are due to the capability of computer technology to provide instructional literary opportunities to students in multimedia formats and for longer periods of time than conventional instruction (NICHHD).

With the advent of the personal computer in the 1980s, researchers began to explore computer technology to enhance learning in early elementary grades, primarily with the implementation of drill and practice software (Alexander, 1983; Barnes & Hill 1983; Bradley, 1982; Krendl & Williams, 1990; Slavin, 1991). When computerized multimedia technology improved during the early 1990s, researchers shifted towards examining the integration of computer technology into the classroom literacy curriculum (Labbo & Reinking, 2003).

The Use of Computer Technology for Students with Autism

Murray (1997) suggests that people with autism have a natural and positive disposition towards computer technology. In making a case for the vitality of interactive multimedia as an instructional tool for students with autism, Moore and Taylor (2000) emphasize the utility of multimedia-delivered instructional content to provide systematic and individualized instruction in ratios often not possible in school settings (e.g. one-on-one lessons). Computer software is capable of delivering multimedia instruction in an individualized manner (Higgins & Boone, 1990; 1991; Moore, McGrath, & Thorpe, 2000; Moore & Taylor, 2000). Individualized instruction is necessary for students with autism (NRC, 2001) and can be achieved with a variety of instructional software or multimedia authoring programs (Higgins & Boone, 1996).

Computer-assisted instruction (CAI) for students with autism was researched sporadically during the 1970s, 1980s, and 1990s (Bernard-Opitz, Sriram, & Sapuan, 1999; Chen & Bernard-Opitz, 1993; Colby, 1973; Frost, 1981; Hedrbing, 1985; Heimann, Nelson, Tjus, & Gillberg, 1995; Panyan, 1984; Strickland, Marcus, Mesibov, & Hogan, 1996). Recently, research examining the use of computer technology with students with

autism has increased. Bernard-Opitz, Sriram, and Nakhoda-Sapuan (2001) taught students with autism social problem solving skills using animated models of problems presented via computerized multimedia. Bosseler and Massaro (2003) developed and implemented a computer-animated tutor to increase the vocabulary and grammar skills of students with autism. Moore and Calvert (2000) also increased the vocabulary of preschool students with autism by using stimulating multimedia (e.g., animation, sounds, colors, and music). The retention of words taught correlated to measured increases in attention and motivation during CAI. Other recent reports identify CAI as an effective tool for teaching students with autism (Cafiero, 2008; Goodwin, 2008; Herrera et al., 2008; Mitchell, Parsons, & Leonard, 2007). These repeated and successful demonstrations of CAI have led researchers to describe CAI as a successful learning tool for students with autism (Bernard-Opitz, Sriram, & Nakhoda-Sapuan; Bosseler & Massaro; Chen & Bernard-Opitz; Colby; Frost; Hedrbing; Heimann, Nelson, Tjus, & Gillberg; Higgins & Boone, 1990; Higgins & Boone, 1991; Moore, McGrath, & Thorpe, 2000; Moore & Calvert; Moore & Taylor, 2000; Murray, 1997; Panyan; Strickland, Marcus, Mesibov, & Hogan).

Students with autism often demonstrate stimulus overselectivity, or difficulty attending to relevant stimuli, and an overreliance on irrelevant cues from the environment (Frith, 1989; Lovaas, Koegel, & Schreibman, 1979; Lovaas, Schreibman, Koegel, & Rehm, 1971). Tjus, Heimann, and Nelson (1998) emphasize the use of strategies in which competing stimuli are reduced to facilitate information processing and storage in long term memory when teaching students with autism. Light, Roberts, Demarco, and Griener (1998) suggest that the characteristic strengths in visual processing by students with autism simplifies the acquisition of information presented by CAI multimedia. Williams

et al., (2002) indicate that the use of software for CAI may promote learning because the presentation of stimuli on a computer screen can be minimized. Well-designed software delivered via CAI provides delivery of relevant cues to direct the learner at a manageable rate (Boone & Higgins, 2007), thus increasing learning by reducing distracting and irrelevant environmental information.

Providing a highly structured learning environment with consistency, routines, and predictability is considered to be best practice for students with autism (National Research Council [NRC], 2001). This concept can be extended from the typical reliance on daily routines to CAI (Williams et al., 2002). Well-designed software presented to students via CAI is consistent and predictable and allows the learner with autism to acquire important information by reducing anxiety and confusion associated with minor differences in teacher-led instruction (Williams et al.). Tjus et al. (1998) identify these necessary qualities as “launching conditions” (p. 140), which enable the child to focus attention and to recognize new structures that are critical to form and store knowledge. Additionally, consistent application of behavioral techniques (e.g., positive reinforcement, instructional cues, and well-defined prompting procedures) is an established characteristic of an effective intervention program for students with autism (Lovaas, 1987; NRC). Despite their best efforts or intentions, teachers may inconsistently deliver instructional cues, reinforcement, or supportive prompts (Goodman, Brady, Duffy, Scott, & Pollard, 2008). The delivery of corrective feedback as well as positive reinforcement (e.g., sound effects, animation) without fatigue or inconsistency is a quality of well-designed instructional software (Boone & Higgins, 2007).

Failure to stimulate student interest during learning opportunities negatively impacts attention and motivation to complete tasks (Williams et al., 2002). Tjus et al.

(1998) identify “adjustment conditions” (p. 140), specifically motivation, teacher support and guidance, and internal factors like self-esteem and emotional recognition as being necessary for learning to occur in students with autism. Practitioners have long recognized the motivating qualities computers have on students with autism and have primarily relied on it as a reward for task completion (Higgins & Boone, 1996). The interest students with autism have in computers is advantageous in that lessons can be highly motivating and supportive while providing necessary guidance built into the software, two characteristics of well-designed instructional software (Boone & Higgins, 2007).

Further support for the use of CAI with students with autism is provided by Light et al. (1998). They suggest that instead of relying on traditional instructional techniques (e.g., teacher delivery to a passive recipient), CAI requires the student to be an active learner. Tjus et al. (1998) identify “readiness conditions” (p. 140) that include knowledge as well as interest and motivation to learn new information as characteristics of active learning and as a vital component of instruction for students with autism.

The scientific examination of traditional emergent literacy instruction for students with autism has been largely ignored (Koppenhaver & Erickson, 2003). However, attempts to address other literacy skills via the use of CAI have yielded positive results. Williams, Wright, Callaghan, and Coughlan (2002) found that children spent more time engaged in literacy activities when they were exposed to combined conditions that included traditional and digital books when compared to traditional books alone. They also found that five of eight students in the computer condition were able to consistently identify three words from the digital text. Coleman-Martin, Wolff, Heller, Cihak, and Irvine (2005) used CAI to promote sight reading skills to students with severe language

impairments (only one participant was diagnosed with autism). All three participants demonstrated an ability to identify words taught during the computer conditions.

In their attempt to measure more complex reading behaviors in children with autism, Heimann, Nelson, Tjus, and Gillberg (1995) used a specially designed multimedia computer software to determine if it could produce gains in word identification and sentence creation. Their study involved the use of quasi-experimental design to measure global and specific reading skills prior to and after the computer intervention. The results indicated that CAI could produce statistically significant gains in the areas of phonological awareness and global reading assessment scores. These findings were consistent with a replication study by Basil and Reyes (2003). However, these researchers also found that the use of software increased the student's ability to spell words presented in the software as well as novel words despite years of failed attempts to teach similar skills using traditional methods.

Koppenhaver and Erickson (2003) observed that when a computer was accessible and turned on, the frequency and quality of student engagement in literacy activities increased. They suggested that the incorporation of a computer into a natural early literacy area of a preschool classroom for students with autism may lead to more frequent initiations in early literacy activities (Koppenhaver & Erickson).

These six studies provide support for the efficacy of CAI to teach literacy skills to students with autism. However, the limited research cannot provide definitive conclusions. Practitioners are required by IDEA (2004) to utilize scientifically-validated practice when teaching students with autism. The positive findings in the limited literature provide clear indication that further scientific examination is warranted.

Statement of the Problem

Reading is a skill that is vital to independence, employment, and daily living (EFA, 2005). Without adequate and efficient literacy instruction, students with autism will mature into adults with insufficient skills vital to gainful employment, adaptive daily living, and enjoyable social, recreation, and leisure activities. By acquiring even the most fundamental literacy skills, people with autism will experience greater success in school, achieve greater independence, and have more opportunities to participate in their community (Copeland, 2007). Students with autism have significant delays in language and communication skills that act as barriers to literacy (Copeland). Additionally, behavioral characteristics of autism often result in more restrictive education placements (Prior & Ozonoff, 2007) and decreased access to literacy curricula (Mirenda, 2003). Failure to learn to read can negatively impact quality of life is several ways. Illiterate students with autism may experience limited academic achievement and social opportunities, while being forced to depend on others for increased levels of support.

Everyone is entitled to quality instruction to facilitate literacy (Yoder, 2001). If students with autism are not provided with opportunities to learn to read and are not taught by educators who support a right to literacy, then poor outcomes will continue (Mirenda, 2003). The notion that students with autism typically are viewed as not needing instruction in literacy (Mirenda) is an indication that researchers have not done enough to guide practitioners. There is no research base for educators to rely on for developing effective and efficient reading curriculum for students with autism. Very little research exists that examines the implementation of CAI designed to teach literacy skills, including basic letter identification, to students with autism. Instead, researchers primarily have focused on reading comprehension for hyperlexic children with autism

and purely functional approaches to reading (i.e. sight reading) (Koppenhaver & Erickson, 2003). This work, although useful, has resulted in deficient knowledge concerning the effects of emergent literacy curricula on children with autism and the impact technological innovation can have on literacy curricula and strategies for these students.

Additionally, researchers have not yet identified instructional delivery models that are superior in effectiveness and efficiency for students with severe disabilities (Yoder, 2001). The use of CAI for students with autism has demonstrated positive effects (Bernard-Opitz et al., 2001; Bosseler & Massaro, 2003; Chen & Bernard-Opitz, 1993; Hagiwara & Smith-Myles, 1999; Heimann et al., 1995; Moore & Calvert, 2000; Williams, 1985; Williams et al., 2002). However, the examination of CAI as a mode of delivering reading instruction to students with autism is lacking. Further, no researcher has examined directly the differences in student behavior under traditional teaching methods (i.e., teacher-led instruction) and CAI for literacy instruction, preventing progress in identifying effective and efficient instructional delivery models.

Letter recognition is a foundational skill vital to future reading success (Tompkins, 2003). Students learn to identify letters best when actively engaged in instruction, when repeatedly exposed to letters, and when highly motivated (McGee & Richgels, 2004). Theories regarding the effectiveness of CAI correspond with identified best practices associated with teaching letter recognition skills. Computer-assisted instruction requires students to be active learners, is motivating, and can repeatedly expose children to different letters to ensure mastery.

The purpose of this study was to examine if students with autism learn to identify letter names more efficiently using traditional teacher-led lessons or CAI. Additionally,

this study measured the behavior of students with autism during teacher-led lessons and CAI to determine what differences, if any, were observed across teacher-led instruction and CAI conditions. Specifically, the study addressed the following questions:

Research Question 1: Do the letter recognition skills of students with autism increase with the use of computer-assisted instruction when compared to teacher-led instruction?

Research Questions 2: Are the letter recognition skills of students with autism better maintained after the use of computer-assisted instruction when compared to teacher-led instruction?

Research Question 3: Do the behaviors of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

Research Question 4: Does the attention to task of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

Research Question 5: What attitudes do preschool special education teachers of students with autism have regarding computer-assisted instruction prior to and after the intervention?

Significance of the Study

More children are being diagnosed with autism than in previous decades (CDC, 2007). These students are at risk for poor academic development due to the pervasive nature of their disability (NRC 2001). As more children with autism enter schools, the cost associated with providing meaningful and individualized instructional programming will become increasingly more difficult to provide due to financial and practical constraints. One way to alleviate this problem may be through the use of CAI. Computers

can deliver instruction during the school day and reduce the amount of staff-related resources necessary to provide intense individualized instruction (Williams et al., 2002). The limited amount of research exploring the effectiveness of CAI to teach literacy skills to students with autism warrants further examination. Additionally, the literature has not reported a comparison of the efficiency of instruction using CAI versus a teacher-led approach. In this study, students were taught letter recognition skills using teacher-led instruction and a computerized approach to determine the efficacy of both instructional methods as well as differences in undesirable behaviors, student time on task, and teacher satisfaction with the interventions.

The available CAI research has led to theoretical constructs of its effectiveness. Factors including motivation, attention, consistency, repetition, animation, sound, and active versus passive learning have all been suggested as support for the effectiveness of CAI. Typical letter identification instruction is most successful when students repeatedly are exposed to letters and when motivation to learn letters is elevated (McGee & Richgels, 2004). By exploring the effectiveness of letter identification, the present study contributes to the limited research literature examining reading instruction for students with autism. The findings also add to the knowledge-base of CAI for students with autism by exploring if the use of computer technology can: (a) increase early reading skills in students with autism, (b) positively impact behavior, (c) increase time on task, and (d) meet teacher satisfaction.

Students with autism may be viewed as unable, not ready, or not needing to learn reading skills (Mirenda, 2003). While some researchers have evaluated reading instruction for students with autism, knowledge about various aspects of early reading are lacking (Koppenhaver & Erickson, 2003). To date, no researchers have examined letter

recognition skills, a key early literacy skill, for students with autism. Educators have no way of knowing if their instructional approaches are effective or efficient because a sound literature base does not exist. This study serves as a starting point for researchers to begin exploring reading instruction for students with autism.

Definitions

Active learning. The use of activities requiring the learner to gather information, interact, respond to changes in circumstance, make decisions, or deal with consequences (Hoberman, Mailick, & Ebert, 1994).

Alphabet Books. An easel-style book designed to teach students to identify and name a letter through the use of illustrations and operant conditioning.

Alphabetic principle. Understanding that letters are individual components that, when combined, form words (Adams, 1990).

Attention to task. For this study, attention is defined as sitting in seat and looking at the source of instruction under typical instructional circumstances.

Autism. A disability that: (a) significantly affects the verbal and nonverbal communication and social skills of a person and often is characterized by repetitive activities and stereotyped movements, resistance to changes in environment or daily routine, and responding to sensory experiences in an unusual manner, (b) is usually apparent before age three, and (c) adversely affects the educational performance of a pupil causing significant delays or irregular patterns in learning, or both (Nevada Administrative Code, 2005).

Computer-assisted instruction. The use of a computer to deliver instructional material, often including the use of multimedia (Williams, Wright, Callaghan, & Coughlan, 2002).

Emergent literacy. Early, unconventional attempts to read and write as a result of awareness of print in the environment (Morrow, 2001).

Hyperlexia. The precocious ability to decode words while demonstrating an inability to comprehend what is read before age five (Silberberg & Silberberg, 1967).

Literacy. The mastery of language in written and spoken, and natural or augmented forms that enable a person to use language to communicate for a variety of purposes (Foley, 1994).

Motivation. The influence that one's desire and need has on one's behavior (Slavin, 2000).

Multimedia. The use of technology for presenting material using combinations of text, images, animation, video, and sound in order to convey information (Mayer, 2001).

Non-compliance. Avoidance of a requested response by substituting an alternative (Clark & Rutter, 1977).

Passive learning. Learning via activities that do not require the learner to gather information, interact, respond to changes in circumstance, make decisions, or deal with consequences (Hoberman, Mailick, & Ebert, 1994).

Phonemic Awareness. The ability to hear and understand that words consist of sequences of individual spoken sounds (Morrow, 2001).

Phonics. A reading strategy that teaches alphabetic principles of language and knowledge of the relationships between specific letters and sounds (Morrow, 2001).

Phonemes. Individual sounds that are orally produced and represented by individual or combinations of letters (Morrow, 2001).

Reading comprehension. Actively interpreting and constructing meaning about text based on previous experience and knowledge (Morrow, 2001).

Self-stimulatory behavior. Repetitive behaviors often in the form of rocking, hand flapping, light filtering, or other similar repetitive movements or patterns that do not appear to have a functional relationship with environment and that also interfere with learning (Simpson & Myles, 1998).

Stimulus overselectivity. An impaired learning trait considered to be a characteristic of students with autism that impacts the ability to attend to relevant and complex environmental stimuli (Lovaas, Schreibman, Koegel, & Rehm, 1971).

Sustained attention. The ability to maintain focus on incoming information long enough for effective cognitive processing while filtering out responses to other incidental or irrelevant stimuli (Raymond, 2004).

Teacher-led instruction. The presentation of information by a teacher to passive recipients of information who are required to demonstrate understanding.

Typical instructional circumstances. The daily occurrences of the preschool classroom, including transitions, instruction, distractions, interruptions, center activities, large group activities, small group activities, and individual activities.

Undesirable behaviors. For this study, undesirable behaviors are defined as self-stimulatory behaviors (e.g., hand-flapping, finger flicking, rocking, staring, or similar self-stimulatory behaviors), self-injurious behaviors (e.g., hitting self, pulling own hair, biting self, scratching self, smacking self, or similar self-injurious behavior), aggressive behaviors (e.g., hitting others, kicking others, scratching others, pulling hair, biting

others, or other similar aggressive behaviors), or tantrum behaviors (e.g., hitting objects, throwing objects, screaming, crying, flopping on floor, kicking floor, or similar tantrum-like behaviors).

Limitations

The limitations of this study were:

1. The limited sample size used to collect data makes generalizations to the entire population of students with autism difficult. A larger sample size may affect the results.
2. The heterogeneous nature of the participants makes generalizing findings to other students with autism difficult. Thus, practitioners should apply similar interventions cautiously.
3. The data were collected in self-contained classrooms for students with autism. The methods used in this study may not produce the same effect for students with autism who are in inclusive settings.
4. The short length of time the interventions were implemented during the study may limit generalization.
5. Classrooms were selected based on convenience. The findings of the study may not generalize to other classrooms.

Summary

Developing literate citizens is essential to societal development in the areas of intellectual, social, and economic progress (Street, 1984). Additionally, literate individuals: (a) experience greater self-esteem and satisfaction with life, (b) better physical health for self and dependents, (c) increased educational performance, and (d) decreased risk of an impoverished lifestyle (EFA, 2005). People with autism are

characterized by deficits that have a direct negative impact on literacy skills (Erickson & Koppenhaver, 2003). Despite advocacy to establish literacy as a basic civil right (Yoder, 2001; Yoder, et al. 1997; NJC, 1992), the characteristics of autism may result in the misperception that young children with autism are incapable of or not ready to learn literacy skills (Mirenda, 2003). Complicating the lack of access to literacy instruction for this population is the lack of scientific literature regarding the effectiveness and efficiency of literacy strategies for students with autism (Alberto & Heflin, 2007). Computer-assisted instruction may be one strategy for delivering emergent literacy instruction (i.e., alphabetic principles) to young children with autism.

Emergent literacy is vital to building a foundation for future literacy learning. Typically developing children acquire many emergent literacy skills, including alphabetic principles, via informal interactions with their environment during the preschool years (Morrow, 2001). Young children must master the use of various skills, including distinguishing and labeling letters of the alphabet, prior to learning how to decode words (Pinnel & Fountas, 1998). Young children best learn these and other related skills when highly motivated and afforded a variety of formal and informal experiences with letters (McGee & Richgels, 2004). However, simply providing students with autism various opportunities to learn early literacy skills may not be successful due to the nature of their disability. Students with autism often exhibit behaviors that have a direct, pervasive, and negative impact on their learning. Educators and interventionists spend considerable time modifying behaviors of students with autism, perhaps at the expense of other areas of instruction (e.g. emergent literacy). The use of computer-assisted instruction (CAI) may provide some solutions.

The literature supports the use of CAI to teach various skills to students with autism (Bernard-Opitz et al., 2001; Bosseler & Massaro, 2003; Chen & Bernard-Opitz, 1995; Colby, 1973; Frost, 1981; Hedrbing, 1985; Heimann et al., 1995; Moore & Calvert, 2000; Panyan, 1984; Strickland et al., 1996). These findings have prompted the development of a theoretical framework of CAI (Light et al., 1998; Tjus et al., 1998; Williams et al., 2002). When students with autism assume active roles in their learning, and if provided with a highly structured and predictable environment that presents information in multiple modalities, then motivation, attention to task, and long-term memory increases (Light et al., 1998; Tjus et al., 1998; Williams et al., 2002). The current theoretical framework supporting CAI is indicative of the challenge teachers of students with autism face every day when incorporating all of these aspects into daily instruction (Tjus et al., 1998). Fortunately, CAI can easily incorporate each of these factors using multimedia software to provide additional learning opportunities for students with autism.

While the limited literature is consistent regarding the utility of CAI, it is not clear if emergent literacy skills, specifically letter recognition, can be taught to students with autism using CAI. Additionally, the effects of CAI on the behavior of students with autism is unclear. A multimedia approach in conjunction with traditional methods used to teach alphabet instruction may augment student ability to learn letter names more efficiently and, consequently, decrease undesirable behaviors that typically interfere with the learning of students with autism.

Researchers indicate that CAI utilizing multimedia software is an effective strategy for providing instruction to students with autism (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001; Bosseler & Massaro, 2003; Chen & Bernard-Opitz, 1995;

Heimann, Nelson, Tjus, & Gillberg, 1995; Higgins & Boone, 1990; Higgins & Boone, 1991; Moore, McGrath, & Thorpe, 2000; Moore & Calvert, 2000; Moore & Taylor, 2000; Murray, 1997; Panyan, 1984; Strickland, Marcus, Mesibov, & Hogan, 1996). This study was designed to examine the effects of CAI on letter recognition skills and the behaviors of preschool students with autism in traditional teacher-led lessons and CAI lessons delivered via multimedia software.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Prior to the 1980s, the widely accepted view of literacy held by educators and researchers was consistent with the reading readiness model developed by Dolch and Bloomster (1937). This model maintained that reading should begin when children were ready to receive literacy instruction, usually by the chronological age of seven (Adams, 1990). However, a major shift occurred in the 1980s and 1990s as researchers explored the behaviors of preschool children engaged in informal reading (Sulzby & Teale, 1991). A landmark book on early literacy by Teale and Sulzby (1986) marked a shift to the developmental perspective of early literacy. This perspective maintained that language and vocabulary development, environmental print, concepts of print, prewriting, shared book reading, alphabetic skills, and phonological and phonemic awareness were vital to formal literacy success in the elementary school years. Currently, early learning specialists maintain that literacy begins at infancy with language and print awareness/exploration and progresses into increasingly complex literary behaviors acquired through multiple and varied learning opportunities (NAEYC, 2009).

The effects of various reading approaches on typically developing children and children at-risk have been reported in the literature (Blachman, Ball, Black, & Tangel, 1994; Bryne & Fielding-Barnsley, 1991; Johnston, 1997; Justice & Ezell, 2002; National Institute of Child Health and Human Development [NICHHD], 2000; Wasik & Bond, 2001; Vukelich, 1994). Researchers have examined direct-instruction models, play-based intervention, environmental modification and enrichment, small group instruction, parent training for home-based literacy instruction, and computer-based interventions. The goal is to better understand the immediate and long-term effects of curricula and strategic

interventions on the literacy skills of typically-developing children, children at-risk, and children with disabilities. While the literature pertaining to literacy in young typically-developing children is abundant and continuously reported, less is known about early literacy in young children with disabilities and virtually nothing is known about early literacy in young children with autism.

Autism is a developmental disability characterized by impairment in language development, social skills, and engagement in stereotyped or rigid behaviors (APA, 2000). These deficits make children with autism at risk for developing poor reading skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005). However, teachers of children with autism typically do not provide literacy instruction until the child has demonstrated reading readiness via improved language, behavior, and social skills (Mirenda, 2003).

Computer-assisted instruction (CAI) is a reading intervention that appears to be effective for typically-developing young children (Johnston, 1997). Many researchers maintain that CAI also is effective for children with disabilities and for children who are at-risk (Cassady & Smith, 2004; Johnston, 1997; Segers & Verhoven, 2003). Although less frequently reported, CAI has been effectively used to promote early literacy skills in students with autism (Koppenhaver & Erickson, 2003). This may be because children with autism have a natural disposition for computers (Murray, 1997). Theoretical support for CAI suggests that CAI can deliver instructional content in a variety of ways (Tjus, Hiemann, & Nelson, 1998; Light, Robert, Demarco, & Griener, 1998; Williams, Wright, Callaghan, & Murphy 2002) and that children with autism benefit from well-designed education software (Boone & Higgins, 2007; Higgins & Boone, 1996). While the challenging behaviors characteristic of students with autism often interfere with learning (NRC, 2001), it appears that CAI may alleviate these interfering behaviors, thereby

enhancing student learning (Williams, Wright, Callaghan, & Murphy 2002). Computer-assisted, early instruction for young children with autism may provide much-needed emergent literacy instruction.

Emergent Literacy

Emergent literacy is the early, unconventional attempts of a child to read and write as a result of awareness of print in the environment (Morrow, 2001). This is a multifaceted process and is comprised of language and vocabulary development, environmental print, concepts of print, prewriting, shared book reading, alphabetic skills, and phonological and phonemic awareness (Teale & Sulzby 1986). These skills are essential to successful acquisition of reading and writing in the elementary school years (Adams, 1990).

Typically Developing Children

Typically-developing children acquire emergent literacy skills beginning at birth and throughout the preschool years via exposure to literacy rich environments (NAEYC 1997). Literacy begins with oral language and expands to other areas with repeated exposure to various media, people, and environments (Morrow, 2001). The experiences children have with various media and environments have a direct effect on literacy success of a child in the subsequent school years (Thompkins, 2003). The premise that emergent literacy is a foundation for formal literacy has led researchers to explore the impact of various interventions for typically-developing young children.

Wasik and Bond (2001) investigated the effects of shared book reading coupled with extension activities on the language development of preschool children. Four teachers were trained to use open-ended questions combined with concrete

representations of words during large-group reading instruction to improve vocabulary. The study occurred in four Title I preschool classrooms that served 4-year-old children. The participants were 127 children. The four classrooms were randomly assigned to the treatment or control condition and the *Peabody Picture Vocabulary Test–III (PPVT–III)* (Dunn & Dunn, 1998) was administered. The teachers in the control classroom continued their typical literacy instruction, while the two teachers in the treatment classrooms were trained to: (a) teach words and definitions during book reading, (b) encourage children to use the new words, and (c) ask open-ended questions about stories. The teachers were provided materials (e.g. books, objects representing items or activities from the story) and asked to increase the amount of time for children to talk during story time. The 15-week intervention concluded with a posttest.

The posttest included the *PPVT–III* (Dunn & Dunn, 1998) and two similarly designed assessments created by the authors. Data were analyzed using an ANOVA (at the classroom and individual student levels) to determine the effect of the interventions. The findings indicate that the students in the treatment classrooms had significantly greater posttest scores on receptive and expressive vocabulary. Additionally, the teachers who received training made significantly more references to vocabulary than the teachers in the control condition.

Wasik and Bond (2001) concluded that the book reading, materials, and extension activities had a positive effect on the vocabulary of the children. The teachers reported that the children became more comfortable with asking questions about unknown objects or words during and after story time, indicating an increased interest in words and their meanings. Wasik and Bond maintained that preschoolers can increase their vocabulary

through interventions that combine book reading in large groups with stimulating extension activities.

Vukelich (1994) explored the use of play-based instruction on student ability to recognize environmental print. Specifically, she examined the effects of dramatic play activities (with and without adult facilitators) on the environmental print awareness of preschoolers. Three kindergarten classes, with a total of 56 children, participated in the study. Five dramatic play settings were conducted in two classrooms. The classrooms contained objects and environmental print (e.g. a shoe store setting included sale signs, prominent credit card signs, enter and exit signs, etc.). One of the two intervention classrooms had an adult who facilitated child attention and the use of environmental print during play. A second classroom used the same dramatic play settings, but an adult did not serve as a facilitator. In this classroom, children were told to ask peers for help or information, not the adults. The third classroom did not use the dramatic play and served as a control group.

A pretest-posttest, split-plot factorial ANOVA design was conducted for the three assessment measures in the study. The *Concepts About Print Test (CAP)* (Clay, 1979) as well as two other environmental print assessments created for the study were used to examine student ability to read environmental print in contextualized (e.g. photographs of a setting) and decontextualized (e.g. from a list) formats. Pretest analysis indicated no significant difference between the three groups. Posttest results indicated a significant improvement in the group of children who received adult-facilitated play in print-enriched settings when compared to the group that received the print-enriched settings without adult facilitators and the control group that received the traditional curriculum.

The students who received the print-enriched setting without adult facilitators performed significantly better than the control group.

Vukelich (1994) concluded that the role of adults in early literacy instruction is important and that children do not readily incorporate existing knowledge nor do they acquire new knowledge of environmental print on their own in independent dramatic play. Instead, children should be provided with an environment that makes use of environmental print as well as a knowledgeable teacher who facilitates skill acquisition to produce greater gains in this early literacy skill.

Justice and Ezell (2002) conducted a study to examine the use of a print awareness intervention with 30 at-risk preschool children. A pretest-posttest design with random assignment of age-matched children to treatment and control groups was used. The assessments included the *PPVT–III* (Dunn & Dunn, 1998), the *Expressive One-Word Picture Vocabulary Test–Revised (EOWPVT)* (Gardner, 1990), and six other informal assessments that, when combined, yielded a composite score for print awareness.

The intervention lasted eight weeks and consisted of storybook readings with scripted prompts to direct the children to the various features of print in the books (e.g., directionality, features of words, letter names). The control group was read the same book, but prompts were used to direct the children to the illustrations in the books. The books were read to small groups of children for 5-7 minutes each day. Praise and feedback were provided to the children as well as comments to boost enthusiasm (e.g., “What a great book!”). Posttests were conducted following the intervention and the scores were analyzed using a MANOVA.

A significant improvement was found between groups when analyzed using composite scores from both posttest measures. Specifically, the subtest results from the

treatment group indicated significant improvements in alphabet knowledge, print recognition, words in print, and composite scores. However, no difference was found between groups on measures of letter orientation/discrimination, print concepts, and knowledge of literacy terms. Pretest analyses conducted after the intervention indicated that the treatment group had significantly higher pretest scores despite random assignment. After analyses were conducted that excluded the data from the highest performing students in the treatment group, Justice and Ezell (2002) found a significant difference in support of the intervention for the previously insignificant subtest scores (e.g. print recognition, words in print, print awareness composite). Thus, Justice and Ezel concluded that prompting the children to attend to the print in the storybook did increase acquisition of print awareness, but suggested that the language skills of some of children in the treatment group may have influenced the performance of other children who received the intervention. They also concluded that simply reading to children may not produce robust results in print awareness and that reading books with explicit print awareness interventions is necessary to achieve desired affects. Justice and Ezell suggest that future research include the use of standardized assessments and examine interventions for children with limited pre-literacy and language skills.

Bryne and Fielding-Barnsley (1991) evaluated the effects of a multi-component intervention designed to teach emergent literacy skills to preschool-age children. Phonemic awareness and letter knowledge were taught in order to determine if both were vital to mastery of the alphabetic principle. A total of 126 children were divided into treatment and control groups. A pre-posttest design was implemented using two standardized and four informal assessments. The *PPVT-III* (Dunn & Dunn, 1998) and the *CAP* (Clay 1975) were administered along with four assessments created for the study to

measure knowledge of letter names, letter sounds, rhyme recognition, and environmental print (e.g., brand names of familiar objects or locations). The treatment and control groups scored similarly on pretest measures.

The intervention consisted of specific instruction using posters of images with labels that began or ended with targeted letters and phonemes (e.g., cat ends with the /t/ sound; t says /t/) followed by a guided worksheet activity. The children also participated in card and domino games that required them to recognize and match phonemes at the beginning or ending of words. The treatment group received small group instruction (4-6 children) for 20-30 minutes per week for 12 weeks. The children in the control group received similar interventions using the same techniques for the same amount of time each week for 12 weeks that taught semantic concepts instead of phonemes.

Data were analyzed using an ANOVA to compare phoneme identification from pretest to posttest. The results from the ANOVA indicated significant gains in phoneme identification for both groups, however the gains of children in the treatment group (as measured by the identification of /s/, /m/, /t/, /l/, and /p/ in the initial and medial position) were substantially greater. Additional analyses of letter name knowledge and phoneme identity confirmed that knowledge of letter names had a positive influence on student ability to recognize letter sounds. Bryne and Fielding-Barnsley (1991) concluded that understanding both letter names and letter sounds is necessary for achieving the alphabetic principle, but also maintained that phoneme identity and letter name knowledge may not be the only factors related to mastery of the alphabetic principle. Bryne and Fielding-Barnsley call for additional research that explores the utility of rote memorization of phoneme identity as well as higher-level cognitive instruction (e.g., the use of sound segmentation, sound blending) in early literacy.

The literature supports the use of emergent literacy interventions that are child directed and teacher directed, as well as a combination of both. Children learn emergent literacy skills when provided with highly motivating play activities in enriched environments. Highly-structured interventions that capitalize on student interests also can be as effective as amorphous child-directed interventions to promote emergent literacy skills in young typically-developing children.

Children with Disabilities

Children with disabilities experience delays in one or more area of development (e.g., motor, language, cognitive, social/behavioral) (Cook, Klein, & Tessier, 2008). Because all areas of development are interdependent, it's likely that a child with a significant delay in one area will experience a delay in other areas (Hooper & Umanksy, 2009). Children with developmental delays or disabilities achieve better literacy outcomes when afforded opportunities to engage in literacy-related activities in literacy-rich environments (Cook, Klein, & Tessier, 2008). Researchers have begun to explore the effects of various interventions on the development of literacy skills in children with disabilities in order to identify effective and efficient literacy interventions.

Katims (1991) examined whether young children with cognitive, physical, emotional, and behavioral delays would make gains in emergent literacy skills after being engaged in a structured, print-rich environment on a daily basis for an entire school year. A group of 24 children in two preschool classrooms participated. The children were taught in self-contained classrooms at two elementary schools. The students in one classroom were assigned to the treatment group ($n = 14$) with the other class serving as the control group ($n = 10$). The age of the children ranged from 4 years and 1 month to 6 years and 1 month. The children were diagnosed with intellectual disabilities, learning

disorders, or behavioral disorders. All children were assessed on their emergent literacy skills using the *CAP* (Clay, 1979) at the beginning of the school year and again at the conclusion of the study (i.e. the end of the school year). There was no significant difference between the two groups' performance at pretest.

The children in the control group and the treatment group received the same developmental classroom curriculum during the school year, but Katims (1991) did not provide further information on the curriculum used. In addition to the developmental curriculum, the treatment group received a multifaceted intervention that incorporated the daily use of a library center, a writing center, and storybook readings. While in the library center, the children were scored on four reading behaviors (e.g., browsing at books, studying illustrations, pretending to read, and conventional reading). The type of book selected (e.g. familiar or unfamiliar, predictable or not predictable) also was recorded. The writing center was incorporated into the daily schedule. While in the writing center, children were encouraged to write about the stories read to them or that they had read/browsed in the library center. The student products were scored according to the complexity of the child's writing (e.g., vertical lines, scribbling, wavy horizontal lines, wavy horizontal lines with no or some resemblance to letters, lines with shapes, and lines that most resembled letters). In addition to the centers, the classroom teacher or assistant read stories to the children and asked questions about the story during small group sessions (i.e., circle time) .

Independent *t*-tests were used to compare the pretest-posttest results of the two groups. The results from the *CAP* (Clay, 1979) posttest indicated that the children in the treatment group significantly improved their emergent literacy skills when compared to children in the control group. Additionally, Katims (1991) found that the *CAP* (Clay) raw

scores from children in the treatment group improved from 21% at pretest to 44% at posttest (an increase of 23%). The children in the control group scored 24% at pretest 37% at posttest (an increase of 13%). Katims also reported that 78% of children in the treatment group showed a higher degree of writing complexity (e.g., from scribbling to wavy lines) in the spring when compared to the previous fall. No data from the control group or a comparison between groups for writing skills were reported. Katims did not provide data comparing reading behaviors between the groups, but a within groups analysis indicated that the children in both groups engaged more frequently in higher levels of reading behavior (i.e., pretend and conventional reading) in the spring when compared to the previous fall, and concluded that the comprehensive intervention was likely the cause of the increased performance.

Katims (1991) concluded that young children with disabilities in a self-contained classroom benefit from the incorporation of daily literacy activities and suggested that future research replicate the study to confirm this finding using broader participant samples, more classrooms, and longer periods of time. He also suggested that researchers explore the developmental profiles of child participants, including type of disability, to determine the impact of specific disabilities and the interventions that impact literacy development.

Johnston, Davenport, Kanarowski, Rhodehouse, and McDonnell (2009) conducted a study to examine the effectiveness of an intervention designed to teach letter-sound correspondence as well as consonant-vowel-consonant (CVC) spelling to young children who used augmentative or alternative communication in inclusive preschool settings. Two 4-year-old children, one with cerebral palsy and another with pervasive developmental disorder, participated in the study. Both were capable of

pointing and following simple directions. Each child demonstrated deficits in emergent literacy, including letter-sound correspondence, and CVC spelling according to formal and informal assessments conducted by the IEP team.

A within-participants, multiple-probe across behaviors (e.g., three letters and three CVC words) design was employed. The study was conducted in the literacy center during free-play in the preschool classrooms. The intervention consisted of: (a) incorporation of highly motivating games and toys in the literacy center as reinforcement for child responses, and (b) a notebook with letters for the child to point to when asked to identify letters that corresponded with a given sound or CVC word. Both children were given five opportunities to identify the letter associated with a spoken sound or to spell a CVC word during each session. As reinforcement, a child was given an opportunity to engage in the motivating activity in the center, contingent upon making a correct response on the first attempt. Successful attempts, subsequent to an incorrect or nonresponse, were reinforced with social and/or verbal praise only. Maintenance and generalization probes, using alternative stimuli (i.e., a keyboard layout) and requiring spelling (e.g., spelling words comprised of the same sounds already taught), also were conducted.

Visual inspection of the graphed data indicated the children increased their ability to associate letters with sounds as well as to spell CVC words. The data also indicated that the child with cerebral palsy was able to accurately spell words during generalization. The child with pervasive developmental disorder chose the appropriate initial sound of the word, but could not spell it correctly. Johnston et al. (2009) concluded that the intervention was effective for promoting letter-sound correspondence, but suggested further replications with larger sample sizes to determine the generalizability

of the findings. They also suggested that future researchers examine the effectiveness of the intervention to teach other letter sounds and CVC words, phonological awareness, and communication skills using various materials and stimuli.

Blischak, Shahl, Lombardino, and Chiarella (2004) examined the effects of phoneme-grapheme correspondence and phonemic awareness instruction for three young children with severe speech impairments. The goal of the study was to explore whether or not explicit instruction in letter name and letter-sound correspondence, when delivered individually and followed by phonemic awareness instruction, increased the ability to spell real and pseudo CVC words. Generalization and maintenance also were a focus of the study. A single-subject, multiple-probe across behaviors and participants design was used.

Three children participated in the study. Larry was 5 years old, Jane was 6 years old, and Gabe was 7 years old. The study was divided into two phases. The first phase involved phoneme-grapheme correspondence training. This skill was considered a prerequisite skill for the second phase of the study. The children were taught to point to one plastic letter in a field of 10 that corresponded with a phoneme pronounced by one an adult. The intervention occurred in one-to-one instructional settings outside of their classroom for 20 minutes a day until the child achieved 90% accuracy for three days. In the second phase, the children were taught to segment words by phoneme, manipulate phonemes, and encode phones into pseudo words. Segmentation of CVC words was taught using manipulatives that the child used to demonstrate the number of phonemes in a spoken word (e.g., the child placed a checker on a sheet of paper for each sound heard in a given word). Phonemic manipulation was taught with letter tiles that required the child to change the word by replacing one tile (i.e., phoneme) with a different tile to

produce a new word (e.g., changed fog to dog). Encoding of pseudo words was taught by providing the child with plastic letters to use when given a CVC word (e.g., choose the letters *c*, *a*, and *t* after hearing the spoken word cat).

Results were graphed and analyzed using visual inspection. The two older children, Jane and Gabe, achieved criterion in Phase One and moved into Phase Two. Despite demonstrating skills required to participate during screening, Larry (the youngest child) never achieved criterion and did not progress to the second intervention. The intervention in Phase Two also was successful for Jane and Gabe. They achieved criterion for segmenting phonemes, phoneme manipulation, and encoding as well as demonstrated maintenance of the skills in three follow-up probes.

Blischak et al. (2004) discussed several variables that might have influenced the results including: (a) age and development of the children, (b) classroom instruction that may have complimented (e.g., phonics instruction for the older children) or countered (e.g., instruction in names of letters only for the youngest child) the intervention, (c) and inherent difficulties with phonological processing frequently observed in children with severe speech and language impairment. Despite Larry's poor performance, the authors concluded that the intervention may be useful for children with profiles similar to Jane and Gabe. Blischak et al. suggest that future large-scale studies explore the effects of interventions that teach other phonological awareness tasks. They also suggest that research continue to explore the effects of phoneme awareness on the reading comprehension skills of children with severe speech impairments.

Justice, Chow, Capellini, Flanigan, and Colton (2003) conducted a study to ascertain the effectiveness of an explicit literacy intervention and an existing intervention, with established empirical support, on the emergent literacy skills of 18 children who

were at-risk. The children were between ages five and six years, eligible for Head Start services due to economic status, and had either: (a) normal language development with speech production difficulties, (b) poor language development with speech production difficulties, or (c) poor language development and speech production without speech production difficulties.

The children were divided into Group A (*n* = 6) and Group B (*n* = 12). Screening assessment results indicated similar ages, speech production, and oral language skills between groups prior to intervention. The two groups of children received both interventions during a 12-week period. Group A received the experimental explicit literacy intervention for six weeks followed by the established intervention program for six weeks. Group B received the established intervention program for six weeks followed by the experimental intervention for six weeks (i.e., the interventions were counterbalanced). The experimental intervention targeted concepts of print by providing explicit instruction in: (a) writing name, (b) reciting the alphabet, and (c) phonological awareness games. The established intervention consisted of implicit strategies that engaged the children in literature-related activities with an emphasis on language by: (a) having an adult read a story, and (b) having the child retell the story. All teaching sessions were conducted by a speech/language pathologist and a reading specialist lasted for 30 minutes, and occurred once daily.

Repeated measures of emergent literacy skills were conducted before the study began, at the conclusion of the first intervention phase, prior to the second intervention, and at the conclusion of the study. Five criterion-referenced assessments, devised by the researchers, were conducted in a standardized method to ensure fidelity and assessment accuracy. The assessments measured alphabet knowledge, print awareness, name writing,

phonological segmentation, and rhyme production. To obtain a profile of student behaviors, in both intervention conditions, a behavioral observation checklist was completed at the conclusion of each intervention for both groups.

The results of the pretest, midpoint, and posttest measures were analyzed using a repeated measures MANOVA to detect differences in emergent literacy between groups with the intervention program as the primary factor. Additionally, a within-subjects repeated measures MANOVA was conducted with time as the primary factor. Analysis of the posttest results indicated that all children improved their emergent literacy skills after receiving the interventions; however, improvement in all areas of student performance was greater after receiving the explicit (i.e., experimental) intervention when compared to modest gains on the assessments after the established (i.e., implicit) intervention. Justice et al. (2003) noted that the children identified as having language impairments performed somewhat lower than children without language impairments.

Justice et al. (2003) concluded that children who are at-risk and have speech and language difficulties benefit from explicit emergent literacy interventions rather than interventions that are implicit in nature. They also concluded that the relatively lower performance of the children with more severe language impairments may require "qualitatively and quantitatively different approaches" (p. 329) in order to achieve better literacy-related outcomes. Justice et al. indicated that the assessment techniques used in the study may not produce similar results as ecological assessments. The lack of an assessment of language ability before and after the interventions also prohibited the exploration of the effects of the interventions on the language abilities of the children. Thus, Justice et al. suggest that future studies rely on various forms of literacy assessment

to produce a more accurate depiction of literacy skills in natural environments as well as the exploration of literacy interventions on the language development of children.

When interventions are combined with activities that are interesting, motivating, stimulating, and guided by an adult, gains in emergent literacy skills are achieved by children with disabilities (Cook, Klein, & Tessier, 2008). Research also supports literacy instruction that incorporates active learning for children with disabilities. Current researchers call for more investigation of emergent literacy interventions for children with disabilities in order to better understand the effects of student learning profiles and their impact on intervention qualities.

Children with Autism

Language development is directly linked to early literacy skills (Bellon, Ogletree, & Harn, 2000). Children with autism are characterized by severe deficits in language development (APA, 2000). The pervasive language delay in children with autism puts them at a significant risk for poor literacy development (Coleman-Martin, et al., 2005). Identifying the effects of various interventions on early literacy skills for children with specific learning characteristics is a key area that warrants empirical investigation (Johnston, Davenport, Kanarowski, Rhodehouse, & McDonnell, 2009). Researchers have begun to explore the impact of multifaceted, naturalistic interventions on emergent literacy development (Koppenhaver, et al., 2003), as well interventions designed to improve specific literacy skills (e.g., letter sounds) (Bellon, et al., 2000; Johnston, Buchanan & Davenport, 2009; Kopenhaver, 2001) in young children with autism.

Bellon et al. (2000) explored the effectiveness of repeated storybook reading coupled with scaffolding procedures to facilitate the spontaneous language of a young boy with autism. The boy was 3 years 10 months old, partially verbal, and attended a

preschool program that included typically developing peers. The intervention involved the use of books that had an ordered or a reactive sequence. In order to be included, the books had to include a setting, a specific sequence of actions, and a subsequent result/resolution. Manipulatives that related to the story also were used with the scaffolding procedures. The books were read for two consecutive sessions with an emphasis on half of the book in each of the two sessions (i.e., the first session of a book focused on the beginning half of the book and the second session emphasized the second half). The scaffolding procedures included cloze procedures, binary choice of utterances, expansions, and constituent questions.

A single-subject ABA design was used over seven weeks, with one 45-minute treatment session per day. Baseline data were collected via transcriptions of sessions prior to treatment. The percentage of echolalic and spontaneous utterances were recorded for baseline and intervention sessions. Results from baseline data were stable with echolalic utterances ranging between 62% and 71% of all utterances and spontaneous utterances between 29% and 38%. Eight intervention sessions indicated a gradual and substantial increase in spontaneous utterances and a corresponding decrease in echolalic utterances, with convergence occurring in the third treatment session. The greatest increase in spontaneous utterances (58%) and the greatest decrease in echolalic utterances (43%) was observed in the fourth treatment session. Similar data throughout the intervention were recorded. The return to baseline resulted in data similar to initial baseline data.

Bellon et al. (2000) concluded that the intervention decreased the percentage of the boy's echolalic utterances and increased the number of his spontaneous utterances. However, several limitations of the study were discussed, including the use of a single

participant, short duration of the treatment, and lack of comparative treatment. Suggestions for further research include exploration of repeated storybook reading in conjunction with scaffolding procedures for children with autism who have some verbal ability as well as studies that include specific methods of scaffolding to determine their effects on student acquisition of language and literacy skills.

Johnston, Buchanan, and Davenport (2009) examined the use of two types of stimulus arrays to develop the phonemic awareness of two preschool children with autism. The students used augmentative and alternative communication (AAC) devices. The boys, ages 4 years 10 months and 5 years 4 months, did not demonstrate an understanding of letter-sound relationships during the pretest and were taught the sounds of letters using discrete trial teaching in their classroom. Large laminated cards with printed letters were used for student responses to requests to point to the letter that made a given sound. Two different arrays were constructed for the students to use when responding. The fixed array consisted of the target letter and seven distracting stimuli (i.e., other letters). The expanding array was comprised of the target letter presented with an increasingly larger number of distracting stimuli as the intervention session progressed. A within-subjects, alternating treatment design across participants was used to determine if the students learned the target letter sounds more efficiently when taught with a large fixed array or an array that gradually increased in the number of distracting stimuli.

Baseline data confirmed pretest results that the participants did not know which letters corresponded to a spoken sound. Each student was presented with the arrays that included the target and distracting letters in random locations and were asked to point to the letter that matched the given sound. Correct and incorrect responses were recorded

using a data collection sheet. Both children achieved criterion (80% accuracy across two sessions) more efficiently when responding using the fixed array than with the expanding array. Both students demonstrated maintenance of the skill.

Johnston et al. (2009) concluded that the large fixed array was a more efficient approach than the expanding array. However, they discuss several limitations to the study, including the small number of participants, the attendance of the two children in the same preschool classroom, and the two target letters used (e.g., /t/ and /m/). Suggestions for further research include identification of the aspects of efficient literacy instruction (e.g., strategies, emergent literacy-related skills) and the ways in which students may respond when assistive technology is used.

Koppenhaver et al. (2001) examined whether assistive technologies could improve the frequency and quality of labeling (e.g. pointing to alternative or augmentative communication symbols or using the voice output devices during the appropriate time) and the interactions between child and parent during storybook reading for six young girls with Rhett syndrome. The six girls were between three- and seven-years-old, had severe communication deficits, and had severe intellectual disabilities. All of the mothers indicated that they read to their child at least twice per week.

Six mother-child dyads were used in a multiple baseline, across participants design. The study had five phases. Phase one was the baseline phase. Dyads were videotaped twice a week during storybook reading. Phases two and three introduced a resting hand splint on the child's non-dominant hand and assistive devices (e.g., picture symbols associated with the stories, voice output communication devices, eye-gaze frames). Koppenhaver et al. (2001) noted that children without disabilities and their mothers engage in dialog while reading a book together and they wanted to explore how

using the hand splints and assistive devices could be used to facilitate a similar dialogue between mothers and their children with significant motor and communication disabilities. After data were collected on the effectiveness of the assistive devices, parents were trained to use strategies (e.g., acknowledging attempts to communicate, prompting the use of communication devices, providing sufficient time and support) to enhance the quality and frequency of communicative behaviors during story time.

Data regarding the frequency of mother-child interactions were recorded during each phase of the study. Frequency of communicative attempts of the children to label pictures, make comments, or respond (as defined by each child's modality) to *wh* questions was measured using videotaped observations of storybook interactions. The frequency of labeling items was divided by the number of minutes in the reading session to determine the rate of labeling. Individual and group results were reported. The results indicated that the girls substantially increased their labeling only after the assistive devices were combined with the parent training.

Koppenhaver et al. (2001) concluded that merely blocking self-stimulatory behavior via splints did not sufficiently increase child communication with their mothers during storybook reading. Koppenhaver et al. also maintained that increased parent awareness of their child's communicative behaviors, in conjunction with individualized assistive technologies, yielded better emergent literacy results. They suggest that further research focus on interventions delivered by family members as well studies that examine the expansion of basic literacy skills (e.g., labeling) to produce more communication of thoughts and emotions for young children with disabilities.

Koppenhaver and Erickson (2003) explored a naturalistic intervention focused on emergent literacy in young children with autism. The aim was to increase the emergent

literacy skills (e.g., looking at picture books, scribbling, using story language in play) of three preschool children with autism. The study used interventions designed to increase time engaged in self-selected literacy activities. The children were diagnosed with autism, three-years-old, and had communication skills consistent with children age 6-12 months of age.

A quasi-experimental, pre- and posttest design was used to measure the effect of naturalistic emergent literacy strategies in the classroom over a five-month period. Three interventions were used for 60-90 minutes per week over five months. Emergent writing supports consisted of the incorporation of two computers with word processing software, a video-painting toy, magnetic doodling and drawing toys, and art tools (e.g., crayons, paint with brushes, chalk, dry-erase bards and markers, and clay with letter shaped cookie cutters). The emergent reading supports included the addition of new books, comic books, child magazines, books on tape, and electronic books. Print was incorporated into daily routines (words on the visual schedule) and with charts when songs were sung in the classroom. Picture symbols and voice output communication devices also were available for various activities throughout the day. To support interactions, the amount of time dedicated to naturalistic instruction was increased as well as child-to-child and child-teacher literacy interactions (e.g., interactive or parallel play).

Baseline data regarding the quality and quantity of emergent literacy in the classroom were collected via observation and teacher interviews for four months prior to the intervention. Because very few opportunities existed for the children to choose literacy activities and the high degree of structure on the classroom, these data indicated that the children engaged in little or no literacy activities during baseline. Two of the three students demonstrated little attention to their teacher reading the storybook. Several

attempts were made to measure the current emergent literacy skills of the children (e.g., letter name recognition, environmental print and logos, and high-frequency word recognition). The baseline results indicated that the children had not acquired emergent literacy skills. Additional observations were made during the five-month intervention period. The data included: (a) scoring the complexity of book engagement (e.g. browsing, studying silently, pretending to read, and conventional reading), (b) scoring the amount of time the children spent in self-selected literacy activities, and (c) the quality of name writing.

The intervention occurred twice a week, for 60-90 minutes, for 5 months. During this time, the teachers would engage in a new writing activity, read a book, or play with the students at the computer. In addition to the twice a week instruction, the students were provided with a print rich environment, a variety of reading materials (e.g., board books, comic books, electronic books, newspaper, books on tape) and writing tools (e.g., computer, Etch-a-sketch, Magna-doodle, crayons, paper, pencils), and time to explore these materials with and without adult supervision. By modifying their environment, the children had increased natural opportunities to develop emergent literacy skills in the classroom. The teachers also integrated text into their daily routines (e.g., labeling centers and text with songs).

Results indicated that the interventions had a positive effect on the amount of time the children spent in self-selected literacy activities. Overall, the students spent a total of 170 minutes engaged in literacy activities during unstructured time (Baseline = 0 minutes). The children also showed an increased willingness to engage in writing activities. Two students produced random scribbles, wavy lines, and letter-like shapes. One student wrote letters and words. Overall, the students demonstrated an increased

interest in and acquisition of emergent literacy as indicated by spontaneously saying the names of letters taught as well as other letters and words found throughout the classroom. The children also spontaneously engaged in alternative writing activities (e.g., spelling name using stamps) and spent increased time browsing. Koppenhaver and Erickson (2003) concluded that enhanced quality and frequency of natural emergent literacy opportunities can have a positive effect on children with autism. They suggested that a literacy-enriched environment that is not highly structured can produce significant gains in emergent literacy skills in young children with autism. They also suggested that further studies are needed to identify the characteristics of naturalistic environments that may best produce emergent literacy gains for young children with autism.

Children with autism experience significant language delays that can negatively impact their literacy development. Research supports the efficacy of emergent literacy interventions (e.g. repeated book reading) that provide children with autism both opportunities for self-directed learning as well as teacher-guided opportunities. It appears that behavioral-based (e.g., discrete trial instruction, stimulus presentation) interventions, both with and without the integration of assistive technology, can yield positive literacy outcomes for this population of students.

Alphabetic Skills

The alphabetic principle is the understanding that letters are individual components that, when combined, form words (Adams, 1990). This understanding that letters are associated with spoken and written language is a fundamental literacy skill (Thompkins, 2003) and is one of the strongest predictors of the future reading success of children (Committee on the Prevention of Reading Difficulties in Young Children, 1998;

NICHHD, 2000; Simmons et al., 2002). Emergent literacy instruction emphasizes methods and strategies that promote mastery of the alphabetic principle (Adams, 1990). Importantly, learning various aspects of the alphabetic principle such as letter names, letter formation, variation of form (i.e., uppercase and lowercase), directionality, and the distinguishing features of letters promotes phonemic awareness and phonics. Researchers have explored the effects of various interventions to promote mastery of the alphabetic principle for typically developing children and, to a lesser extent, children with disabilities. However, a gap in the literature concerning this principle and children with autism exists.

Typically Developing Children

Typically developing children acquire the alphabetic principle via repeated exposure and frequent engagement in literacy-rich environments (McGee & Richgels, 2004). Several strategies often are combined in early childhood classrooms including: (a) repeated storybook reading, (b) use of rich language, (c) drawing and pre-writing, (d) exploring a library center, and (e) exposure to a computer and related digital technology (Thompkins, 2003). Researchers have explored the effects of these interventions to better understand the acquisition of the alphabetic principle by typically developing children.

Molfese, Beswick, Molnar, and Jacobi-Vessels (2006) examined the development of letter knowledge and the relation of the skill to other emergent literacy skills in typical preschool children over a five-month period. Of the 57 children in the study, 31 were boys and 26 were girls. All spoke English as their primary language. The study took place in a public preschool program. Students were enrolled in the preschool program according to family income eligibility or the family's ability to pay tuition.

A quasi-experimental, pretest-posttest design was used with measures of cognitive ability, phonological awareness, environmental print knowledge, and early reading measures. The *Developmental Ability Scales* (Elliot, 1990) was used for cognitive assessment. The *PPVT-III* (Dunn & Dunn, 1997) was used to assess receptive vocabulary. Other assessments used included the *Wide Range Achievement Test* (Wilkinson, 1993) to measure letter name and word decoding skills as well as an assessment created for the study to measure name writing, letters, and numerals. The children were tested once in the fall and again five months later. While all children in the classroom received the same intervention over the same period of time, a direct examination of family economic status as a factor influencing emergent literacy performance was conducted by separating the data according to tuition-based children and income-eligible children. An analysis was conducted to ascertain if the class improved on the measures as a result of the curriculum as well as the difference between economic groups.

The preschool curriculum approved by the local school district was implemented between the pretest and posttest. Components of the reading curriculum included rhyming, initial word sounds, environmental print recognition, book skills, early reading (e.g., retelling stories from pictures in a book), and alphabetic skills (e.g., letter names). The assessment results from the pre- and posttests were used to produce descriptive statistics for *t*-tests as well additional analysis using an ANCOVA to control for age and cognitive ability.

The data showed a small average increase in student knowledge of alphabet names and that these the gains correlated with gains in phonological processing, rhyming, environmental print, and early reading measures. The results also indicated that two

distinct groups emerged with respect to ability to recall names of letters. One group (*n* = 27) was comprised of children whose parents paid tuition. These students made large gains in letter recognition (recognizing 11 letters). The second group, comprised of children living in poverty (*n* = 30) demonstrated no gains in letter recognition (recognizing 0 – 3 letters). Analysis of results from within the groups yielded significant correlations between increased letter name knowledge and other emergent literacy behaviors for the tuition paying group. However, because no significant gains in letter name knowledge were found in the economically disadvantaged group, no correlation was found.

Molfese et al. (2006) concluded that explicit instruction in letter recognition skills may be beneficial to some preschool children and that the use of a narrowly conceptualized early literacy curriculum may not result in sufficient gains in early literacy skills for students living in poverty. They also concluded that reliance on a single aspect of emergent literacy (i.e., teaching letter names separate from letter sounds) may not result in improvements in other early reading skills in some children. They suggest that future research explore aspects of skill variation in preschool children to improve the timeliness and intensity of interventions to promote better literacy outcomes.

Murray, Stahl, and Ivey (1996) examined the effects of three different interventions on phoneme awareness, letter recognition, and concepts of print for at-risk preschoolers. The intervention groups were: (a) an alphabet book group, (b) a letter-name book group, and (c) a storybook control group. The focus of the study was to determine if the type of book read to children for 10 minutes per day over a three-week period had an effect on their emergent literacy. A total of 42 children, four to five years old, in three preschool classrooms participated. The children were assessed on letter-name knowledge,

phonemic awareness, and onset and rime using the *Tests of Onset Rime Awareness* (Stahl & Murray, 1994), and the *Concepts About Print* (Clay, 1985) prior to and immediately following the intervention. The *Concepts About Print* (Clay) involved a shared reading of a storybook during which children were asked questions to assess their emergent knowledge of print. The alphabet recognition task included 26 capital and 28 (*a* and *g* were repeated) lowercase letters for the child to identify. The final measure involved a puppet who spoke in segmented phonemes. The task for the child was to blend the puppet's segmented phonemes and to segment phonemes like the puppet. Each classroom was assigned to one of the three conditions. The first group received instruction with conventional alphabet books designed to teach letter names with an associated word and image (e.g., *A is for apple* with an image of an apple on the page). The second group received instruction with books specifically designed to teach letter names. These books provided letter names without associated words or images (e.g., *Z was hit by lightning*). Finally, the third group received traditional storybooks.

A mixed-model ANOVA was used to analyze the data from the pre and posttests. When posttest results were combined for analysis, the findings indicated statistically significant improvements in concepts of print, letter-name knowledge, and phoneme awareness regardless of book type when compared to pretest scores. The first group that used the alphabet books (e.g., *A is for Apple*) performed significantly better in phoneme awareness measurements than the children in the second group who were read the out of context alphabet books (e.g., *Z was Hit by Lightning*). All other comparisons across groups produced no statistically significant differences. In other words, with the exception of phonemic awareness, the intervention groups did not significantly differ

with regard to print knowledge when compared to the control group, but all groups made significant pre-post gains on print knowledge.

Murray, Stahl, and Ivey (1996) concluded that children develop phoneme awareness, at least in part, by engaging with alphabet books. As children explore the alphabet books, they encounter the phonemes and their relationships to print and the spoken word. However, Murray et al. also maintained the possibility of different, more positive effects, with an increased intervention period and point out that alphabet books can be easily adapted and used with a more direct-instruction approach. They suggested that future research examine the effects of similar interventions over longer periods of time with measurements focusing on phonemic awareness and its relationship to letter name knowledge.

Piasta, Pupura, and Wagner (2009) compared the effects of two interventions on emergent literacy skills and alphabetic skills. The 63 children who participated in the study were between three- to four-years-old and were identified as having limited or no letter name knowledge. The children were grouped according to their performance on the screening assessment and randomly assigned to three conditions. The first group received combined letter-name and letter-sound instruction. The second group only received instruction in letter sounds and was not taught the names of letters. The third group acted as the control group and received numeral name instruction using a similar instructional strategy. The interventions consisted of 34 scripted lessons and were delivered during a nine-week period. Each lesson lasted between 10 and 15 minutes, with review of previously taught material provided at the end of the week. Specific details about the lessons (e.g., materials, cues, prompts, feedback, activities) were not provided.

A repeated-measures experimental design was used. Assessments of vocabulary, alphabet knowledge, word knowledge, phonological processing skills, numeral names, emergent reading, and developmental spelling skills were assessed prior to, at midpoint, and after the intervention phase. The children were administered the *Receptive One-Word Picture Vocabulary Test* (ROWPVT) (Brownell, 2000), the phonological awareness subtest from the *Test of Preschool Emergent Literacy* (TOPEL) (Lonigan, Wagner, Torgensen, & Rashotte, 2007), and an emergent reading and spelling measure that was adapted from the forced-choice word reading task (Byrne & Barnsley,1991). Emergent spelling was measured using the *Developmental Spelling Test* (DST) (Ball & Blachman, 1991) and the letter-word identification subtest of the *Woodcock-Johnson Tests of Achievement-III* (Woodcock, McGrew, & Mather, 2001). Number identification was assessed through a task adapted from Malofeeva, Day, Saco, Young, and Ciancio (2004).

A series of ANOVAs were conducted and the data indicated that the children who received the combined treatment (e.g., letter name and sound instruction) performed significantly better at producing letter sounds than the groups that received only letter-sound instruction and the control group (e.g., numeral instruction). The children who received letter-sound only instruction did not significantly outperform the children in the numerals-only condition on the letter-sound assessment tasks. No difference in letter-naming skills was found when the groups were compared. The results also indicated that the interventions had no impact on word identification, emergent reading, or developmental spelling.

Piasta, Pupura, and Wagner (2009) concluded that their findings may be attributed to the assessments used, duration and intensity of the interventions, and the lack of incorporation of other proven strategies in the intervention. They suggested that future

studies address these issues. However, they noted that children who received instruction in both letter name and sound learned approximately two more letter sounds than the comparison groups. Though this gain is not significant, the effect sizes were considered to be moderate. Piasta, Pupura, and Wagner also concluded that instruction should occur for a longer duration and with greater frequency.

Lennon and Slensinski (1999) implemented a literacy intervention for kindergarten children to determine if a research-validated reading program for first-grade children could be successfully adapted and modified for younger children. They also were interested in measuring the short and long-term effects of the intervention. The study took place in five schools. The children ($N = 176$) were divided into three groups based on their ability to name letters. The high performing children were assigned to a control group and received no intervention ($n = 40$). The remaining children were separated into low performing (Group A; $n = 80$) and mid-range performing (Group B; $n = 56$) groups. All children were assessed three times during the study (prettest, midpoint, and posttest) to measure their concept of print as well as their ability to name letters, produce letter sounds, segment sounds, decode, and sight read.

The students were asked to identify letter names from a random selection of 52 upper and lowercase letters, produce hard and soft consonant sounds, produce long and short vowel sounds from 35 graphic representations, decode CV and CVC words, and identify sight words from the 52-item Harris-Jacobsen (1972) and Eeds (1985) list of high frequency words. The assessments used were the *Yopp Singer Test of Phoneme Segmentation* (Yopp, 1995) and the *Concepts About Print* (Clay, 1985). A control group, pretest-posttest with stratified random sampling design was used.

Groups A and B received the same amount of instruction, using the same intervention strategies. The intervention consisted of 30 minutes of tutoring, with a small teacher-student ratio (1:2) five days per week. The intervention phase lasted 30 weeks. Students were paired for the tutoring sessions according to their current performance and received instruction in letter recognition, letter sounds, segmentation, basic sight words, and the alphabetic principle. A combination of informal play-based and direct instruction were used.

Correlative effects were found between the letter-name screening data and the data from the three assessment points, indicating that letter naming is an effective way to identify children who may need literacy intervention. The ability to identify letter names and sounds also was positively correlated with phoneme segmentation, sight reading, and concepts of print. The results of an ANCOVA indicated moderate-to-large effect sizes for both groups (Group A and B) in all assessed areas with significant main effects for treatment on all posttest results, indicating that children who received the tutoring did significantly better than those that did not. A two-year follow up indicated that the number of children referred for remedial reading programs or special education in the intervention schools substantially decreased to 5% of the school population compared to the district average of 15%.

Lennon and Slensinski (1999) concluded that early intensive reading intervention is appropriate for kindergartners and that the assessment of letter-naming ability may prove to be more useful for indentifying children in need of intervention than traditional discrepancy models. They discussed the limitations of the study as a lack of standardized assessment data at the two-year follow up and the use of assessment results collected by the tutors who delivered the intervention. Suggestions for future research included the

exploration of the amount of intervention based on screening and other assessment results to establish efficiency as well as teacher-student ratios during intervention. Lennon and Slensinski maintained that child behavior may have a great impact on the implementation of reading interventions.

The use of specific interventions to teach letter names and corresponding sounds has demonstrated potential for producing positive gains. However, with an enriched curriculum that provides stimulating and motivating methods to engage typically developing children in early literacy activities there is the potential to produce greater gains than those obtained with a less interesting curriculum. It appears that engaging with interesting alphabet books designed to promote letter naming skills can yield widespread gains in emergent literacy skills including phonemic awareness, a major predictor of later reading success (NICHHD. 2000). Furthermore, a combination of interventions that incorporate direct instruction and play-based literacy learning increases letter recognition as well as other emergent literacy skills in typically developing preschool children

Children with Autism

A search for literature examining the effects of interventions designed to teach letter names to children with autism was conducted. The EBSCO and Educational Resource Information Center (ERIC) databases were searched to identify relevant research. The EBSCO database was chosen because it encompasses a substantial portion of smaller education-related databases (e.g., PsycInfo, PsycArticles, Academic Search Premier). The ERIC is a continually updated database that provides an index of article abstracts published in peer-reviewed journals from 1966 to the present. Various combinations of relevant search terms including alphabet, alphabetic, letters, phonemic awareness, early reading, early literacy, and emergent literacy were combined with the

terms autism, autistic, and autism spectrum disorder. Search results were examined to determine appropriateness for inclusion in this review. Additionally, references in the retrieved articles were analyzed for other potentially relevant articles. To be included in this review, an identified study was required to: (a) include an intervention that directly or indirectly taught the names of letters, (b) include participants that were preschool-aged children with autism, and (c) did not use facilitated communication as a component of the intervention. After an extensive search, no articles were found that directly taught and measured letter-naming skills, either exclusively or as part of another intervention, to preschool children with autism.

This finding has significant implications for literacy intervention for children with autism. Alphabetic skills are one of the strongest correlative variables related to future reading success (Adams, 1990; NICHHD, 2000). Additionally, learning the letters of the alphabet is one of the most fundamental literacy skills (Pinnel & Fountas, 2007). This significant gap in the literature specific to alphabetic skills for children with autism indicates that practitioners and interventionists have no reliable source to turn to when choosing and designing interventions to teach alphabetic skills to these children. With legislation mandating the use of research-based educational practices (No Child Left Behind Act of 2001), it is necessary to establish a research base for professionals to use when making crucial decisions related to implementing a literacy intervention program. Another implication is that practitioners are likely to attempt to provide an intervention that may be ineffective and/or inefficient, costing intervention teams or families resources that could otherwise be better spent. Similarly, because early intensive interventions for children with autism produce the best outcomes (National Research Council, 2001), dedicating time to literacy-related interventions to teach alphabetic skills without an

established research base may result in an unrecoverable loss of precious intervention time.

Computer-Assisted Literacy Instruction

Computer-assisted instruction is the use of a computer to deliver instructional material, often including the use of multimedia (Williams, Wright, Callaghan, & Coughlan, 2002). When used appropriately, computer technology can augment the cognitive and social skills of young children (NAEYC, 1996). Computer technology can facilitate early literacy development, basic and advanced math concepts and applications, creativity and critical thinking skills, communication, and social development in young children (Clements, 1997, 2002; Freeman & Somerindyke, 2001; Haugland, 2000; Yelland, 2005).

Typically Developing Young Children

Computers have become an integral part of the literacy experiences of typically developing young children at home and school (Labbo & Reinking, 2003). However, little is known about the effects of computer technology on early literacy skills and even less is known about the effects computer technology has on various aspects of literacy across the lifespan (NICHD, 2000). While there is consensus by experts that computers have positive effects on child development when used appropriately, little is known about how to use CAI to promote literacy skills in typically developing children. However, some researchers have begun to explore the utility of CAI to teach emergent literacy skills to typically developing preschool children.

In many circumstances, reading books to a large group of children in the classroom inevitably results in some children being isolated from the book due to seating distance, thus affecting opportunities to interact with reader or the book (Johnston, 1997).

In an attempt to provide one solution for this problem, Johnston examined the effects of interactive, computer-based storybooks on the verbal development and other emergent literacy skills of 60 kindergarten students considered at-risk because of economic status. The 60 children were assigned randomly to treatment and control conditions, pretested on their verbal ability, and trained in the use of a computer mouse prior to receiving the intervention. Verbal ability was assessed with the verbal scale of the *McCarthy Scales of Children's Abilities* (McCarthy, 1972). The verbal scale includes measures of pictorial memory, word knowledge, verbal memory, verbal fluency, and opposite analogies.

Children in the control condition received their traditional classroom reading curriculum. The intervention group received three sessions per week of interacting with the storybook software for seven weeks: The number of minutes spent using the software was not reported. Each week the computer-based storybook was replaced with a new story.

After the seven-week period, a posttest was administered and the results were analyzed using an ANCOVA. After adjusting the analysis to eliminate some participant data due to their significantly fewer opportunities to interact with the software (because of absences, power failure, field trips, etc.), significant improvement in verbal abilities were found for the experimental group when compared to the control group. A major finding was the importance of time spent engaging in the computerized intervention. Depressed results were observed when students had limited interactions with the software.

Johnston (1997) concluded that to be effective, children must use computer interventions consistently (e.g., daily) in order to benefit from the intervention. Suggestions for future research include examining the time spent with CAI as a variable

of skill acquisition and maintenance as well as consistency in instructional delivery via CAI as a factor influencing student performance.

Computer-assisted instruction has been used to deliver instruction designed to increase phonological awareness. Lonigan et al. (2003) compared the effects of a computer software program designed to teach early reading skills (e.g., oral language, print knowledge, and phonological sensitivity) in the context of an adventure game for 41 children attending Head Start. The children were assigned randomly to treatment and control conditions and were administered pretests. The assessments were the *Peabody Picture Vocabulary Test - Revised* (PPVT-R) (Dunn & Dunn, 1981); the *Expressive One-Word Vocabulary Test* (EOWPVT-R) (Gardner, 1990), *the Clinical Evaluation of Language Fundamentals - Preschool* (CELF-P) (Wiig, Secord, & Semel, 1992); the copying, bead memory, and pattern analysis subtests of the *Stanford-Binet- IV* (*SB-IV*) (Thorndike, Hagen, & Sattler, 1986); the *Woodcock Reading Mastery Test-Revised* (WRMT-R) (Woodcock, 1987) as well decoding tasks of high frequency words, letter-name, and letter-sound assessments.

The children in the treatment group received CAI designed to promote phonological awareness including rhyming, matching words with the same initial sound, matching words with the same final sound, and matching words based on medial sounds. The treatment group participated in 15-20 minute sessions, for 4-5 days per week, for eight weeks. The children in the control group received the required Head Start reading curriculum and did not receive direct instruction. At the end of the intervention period both groups were assessed again. The results were analyzed using an ANOVA.

The analyses of assessment data indicated that children in the treatment group demonstrated significantly greater gains in phonological awareness than the control

group. Additional support for the CAI was indicated by the relatively stagnate scores for all children on pre- and posttest measures of skills not targeted by the intervention, suggesting that the CAI was directly responsible for the gains in phonemic awareness skills taught to the treatment group. However, because the control group did not receive similar instructional content (i.e., they did not receive specific phonological awareness instruction), the authors were unable to determine if the CAI has superior instructional qualities than that of other forms of instruction, including traditional teacher-led instruction.

Lonigan et al. (2003) concluded that using CAI with preschool children at risk for reading difficulties in phonological sensitivity is not only effective, but an enjoyable experience for students. The children who received the CAI made significantly larger gains than the children who did not receive the CAI. Lonigan et al. suggest that preschool teachers supplement their current phonics instruction with additional phonological CAI. Suggestions for future research addressed the importance of providing balanced training of the phonological skill areas (i.e., rhyming, blending, segmentation) as well as the need for longitudinal studies that examine the maintenance and generalization of the gains made by students.

Some researchers have explored the utility of CAI as a supplement to traditional early literacy curriculum. Macaruso, Hook, and McCabe (2006) compared the gains in early literacy of a group of first grade students who used Early Reading (Lexia Learning Systems, 2003), a commercial software program designed to teach phonological awareness and word attack skills, to a group of first graders who did not receive CAI. A quasi-experimental, pre-and-posttest design with random assignment was used. Participants were 167 first-grade students who attended 10 schools in an economically

depressed urban area. The students were randomly assigned to the treatment (CAI) (n = 83) or control condition (n = 84). Prior to the intervention, all children were assessed by the school system on their reading skills using the Initial Sound Fluency (ISF) and Letter Naming Fluency (LNF) of the *Dynamic Indicators of Basic Early Literacy Screening*, 6th Edition (*DIBELS*) (Good & Kaminski, 2003). The same assessment was administered at the end of the school year.

Both the treatment and control groups received daily reading instruction in phonics. However, the treatment group received supplementary CAI in addition to the usual first-grade curriculum. The children used the software for 20-40 minutes per session. The intervention sessions were provided for 2-4 times per week for a six-month period. The software was comprised of various multimedia activities designed to promote phonological awareness and phonics skills through lessons that gradually became more complex as the student demonstrated mastery. At the end of the school year, the children were assessed to determine their phonological awareness, phonics, and other reading skills.

The posttest results were analyzed using an ANCOVA and no statistical difference between the groups was detected. However, when the assessment scores for the Title I eligible students were analyzed independently, significantly greater gains on assessment measures were observed in the treatment group when compared to the control group. Additional analyses indicated that the Title I eligible students performed significantly lower than their non-Title I peers at pretest, but this difference was not observed in the treatment group at posttest (i.e., the Title I students who worked with the CAI performed similarly to their peers in the control group at posttest). The Title I students in the control group performed significantly lower at both pre- and posttests,

suggesting that the CAI may have played a direct role in improving phonological awareness and phonics skills of the Title I eligible students.

Macaruso, Hook, and McCabe (2006) concluded that, for lower-performing students, systematic teacher-led instruction combined with CAI allows at-risk children to progress in ways that they otherwise would not if provided with teacher-led instruction without CAI. The authors suggest that the students would have made even greater gains if they had used CAI more. They encourage future researchers to explore the relationship between the amount of CAI time and reading gains.

Cassady and Smith (2004) examined the effects of CAI used as an additional component of an existing reading curriculum in two schools. The purpose was to ascertain if kindergarten students receiving reading curriculum with consistent use of CAI that was seamlessly integrated (i.e., CAI that matched well with the current curriculum and was supported by teachers) outperformed students who received CAI that was used inconsistently and not well-matched with the curriculum. Two schools, one rural with 26 predominantly white participants and the other urban with 62 racially diverse participants, were included in the study. Analysis of pretest results indicated similar pre-intervention reading performance between the groups. The students were assessed three times during the school year (beginning, midpoint, and end of the year).

Students in both schools received the same literacy curriculum. All teachers were trained to set up lessons for students and instructed to provide 20 minutes of access to the CAI lessons each day. The students in the intervention group were given 20 minutes per day for the school year to use commercially available literacy software. The first school's administration and teachers chose software because of it's intuitive design and content augmented the literacy curricula of the school. The second group implemented the same

curriculum but selected a different CAI software because of platform incompatibility. Despite also being asked to provide the students with access for 20 minutes per day, technical problems and the cumbersome nature of the software chosen by the administration and teachers in the second school resulted in inconsistent student access to the software.

Cassady and Smith (2004) used a repeated measures design to assess student performance on the *Concepts About Print Test* (Clay, 1979) as well as an assessment of phonological awareness. The results were analyzed using an ANOVA and indicated asignificantly greater improvement in emergent literacy skills (e.g., phonological awareness and concepts of print) for students who received the integrated CAI when compared to students who received CAI that was not well integrated,

Cassady and Smith (2004) concluded that positive effects can be obtained by kindergarten students when CAI is complimentary to the existing reading curriculum and is supported by administrator and teacher commitment. Although Cassady and Smith (2004) do not make recommendations for future research, they do recommend that the materials and content of CAI should align with the classroom curriculum in order to achieve desirable literacy outcomes. They also suggest that when CAI is integrated into the daily routines of the classroom, requires little teacher guidance or support, and is implemented consistently, increased literacy outcomes are obtained. Cassady and Smith identify the possibility that teacher attitudes and beliefs may have impacted student access and performance as a potential threat to validity. They suggest that future studies incorporate measures of social validity to determine the factors that may influence the effectiveness of CAI.

Mathes, Torgesen, and Allor (2001) compared the effects of a peer-intervention strategy augmented by CAI to two groups: (a) peer-intervention without CAI and (b) a control group that only recieved the existing curriculum. Their aim was determine if the effects of an established peer-intervention strategy could be augmented by CAI. Thirty-six first-grade classrooms were used and 183 children participated. The 36 classrooms were assigned to one of the three instructional conditions. The children in the first treatment group (12 classrooms) were taught using a reading intervention in conjunction with the existing reading curriculum. The children in the second group (12 classrooms) used CAI followed by a peer-intervention coupled with the existing reading curriculum. The children in the third group (12 classrooms) received the existing reading curriculum.

A quasi-experimental, pre-posttest design with random assignment was used in the study. All students were assessed on various aspects of their reading using the *Woodcock Reading Mastery Test—Revised* (Woodcock, 1987), the *Test of Early Reading—2* (Reid, Hresko, & Hammill, 1989), the *Test of Word Reading* (Torgesen, Wagner, & Rashotte, 1999), and subtests from the *Comprehensive Test of Phonological Proceses* (Wagner, Torgesen & Rashotte, 1999). Curriculum-based assessments also were used throughout the study to measure student phonological awareness and reading fluency.

The children were classified as high-, average-, or low-achieving students based on a 1-minute oral reading probe prior to the start of the interventions. The high-achieving students were reading 20 or more words per minute. Average-achievers were reading 8 to 4 words per minute. Low-achieving students were reading less than 8 words per minute. Analysis of demographic information and reading performance conducted prior to the study indicated that the groups were relatively similar, with the exception of

the performance of low-achieving students assigned to the peer-intervention with CAI group. Although classrooms were randomly assigned, the students classified as low achieving in the CAI group performed significantly lower than the low-achieving children in the peer-intervention only and comparison groups.

The children in the two treatment groups (24 classrooms) received the peer intervention. The peer intervention involved a low-achieving reader being paired with a classmate rated as a high- or average-achieving reader. The classmates worked in these pairs for two 15-minute sessions daily. The 15-minute sessions emphasized word recognition skills and included activities to teach letter-sound recognition, sounding out words, reading passages, and story sharing. Half of the treatment classrooms ($n = 12$) additionally received the CAI intervention prior to and throughout the peer tutoring. The children in this group received 20-30 minutes of CAI using research-supported software designed to promote phonological awareness, three times per week, for four weeks prior to the start of the peer interventions and throughout the four-week-long peer-intervention period (for a total of eight weeks of CAI). The children in the 12 control group classrooms were not given either intervention and only received the existing reading curriculum. To determine the effects of the interventions, the formal assessment data (pretest and posttest results) as well as curriculum-based assessment results were analyzed using a MANOVA, a series of ANOVAs, and post hoc analyses.

Mathes, Torgesen, and Allor (2001) found that the children who received only the peer-tutoring intervention outperformed the children in the peer-tutoring and CAI group and the control (no intervention) group. The low-achieving students made the greatest gains. However, the addition of CAI did not produce statistically significant gains when compared to the peer-tutoring only group or the comparison group (although a moderate

effect size was detected). Although these particular findings were not significantly different, the depressed scores of the low achieving students in the CAI group prior to the intervention increased after the intervention period.

Mathes, Torgesen, and Allor (2001) discussed several confounds in the study. The primary confound was the difference in pretest performance of the low-achieving students in the peer-tutor with CAI condition. These children performed markedly lower than the children in the other two conditions. Additionally, the teachers in the control groups were required by the school system to convert from a whole-language approach for literacy instruction to a more structured curriculum prior to the study. This may have produced better gains by the students in the control group than anticipated. The authors also suggest that some teachers in the control group may have attempted to boost student performance because they were not naive to the nature of the study. Also, the students who received CAI were given limited opportunities to interact with the software during the intervention (only four weeks prior to the peer-tutoring and four weeks during the peer-tutoring) during the sixteen-week-long study.

Mathes, Torgesen, and Allor (2001) concluded that while the peer intervention was successful in increasing reading performance, especially for low achieving students, they could not determine the effects of CAI on the literacy skills of the students due to confounding variables. They suggest that future studies use designs that control for these limitations while directly examining the impacts of CAI on students with specific learning profiles.

Preliminary investigations support the use of CAI as a means for delivering emergent literacy instruction to typically developing children as well as children who are at-risk. The use of CAI increases the efficacy and the ease with which individualized

instruction may be provided. Considering the wide spectrum of abilities in the classroom, the use of CAI may be an important and necessary tool to achieve performance gains in emergent literacy skills. Studies comparing the effects of CAI to other, more traditional interventions should ensure comparable groups, consistent access to CAI lessons, and effects of CAI on students with specific learning profiles.

Young Children with Autism

The integration of computers into everyday learning environments is essential for all children, regardless of ability (National Association for the Education of Young Children, [NAEYC] 1996). Despite this position, only a few researchers have explored the effects of CAI to promote literacy skills in children with autism. The majority of studies of CAI and autism emphasize skills not directly related to literacy (e.g., problem solving, social skills). However, some international researchers have explored CAI for teaching literacy to students with autism in languages other than English (Heimann, Nelson, Tjus, & Gillberg, 1995; Tjus, Heimann, & Nelson, 1998). Few studies have explored the emergent literacy of children with autism in the United States.

Chen and Bernard-Opitz (1993) conducted the first study that compared the behaviors and learning effects of CAI with Teacher Led Instruction (TLI) for children with autism. They believed that CAI would produce a greater rate of learning individualized objectives, decrease problem behavior, and increase student enthusiasm when compared to TLI. The four participants in the study were students with autism attending school in Singapore. Of these four participants, three were taught math concepts and one was taught vocabulary using images of familiar objects in both the CAI and TLI conditions. The students were four, five, six, and seven-years old.

A single subject, alternating treatments design was used. The students were taught using both interventions (CAI and TLI) and were videotaped for later analysis. Various aspects of student behavior were measured. Observers used 10-second intervals to rate student enthusiasm on a scale of 0 (negative) to 5 (positive) in both conditions. Observers also rated student behaviors on a scale of 1 (poor behavior) to 3 (good behavior) in 10-second intervals. Compliance to instructions and learning rate also were measured. Interrater agreement for these measurements was satisfactory, ranging from 81% to 91%.

Data were analyzed both within and across subjects. Both analyses yielded similar findings in favor of the CAI. The children demonstrated greater enthusiasm, better behavior, and more compliance during the CAI when compared to TLI. However, they did not demonstrate increased learning rate. Anecdotal reports indicated that two of the four children began to interact with other students while at the computer by taking turns to provide answers. Chen and Bernard-Opitz (1993) concluded that CAI does provide comparable educational benefit than teacher-led instruction for students with autism. These include vocabulary skills, and a decrease in negative student behaviors during CAI when compared to one-on-one TLI. Chen and Bernard-Opitz suggest that future studies focus on how to improve CAI so it may benefit more children with autism.

Coleman-Martin, Heller, Cihak, and Irvine (2005) used CAI to teach nonverbal reading skills to students with severe communication disabilities or autism. The authors used an ABACAD design, with Teacher Led Instruction (TLI) only, TLI combined with CAI, and CAI only as interventions. A nonverbal reading approach, in which children were taught metacognitive strategies (e.g., internal speech to decode unfamiliar words), was taught in each condition. An assessment of sight reading capability for each

participant was conducted prior to the intervention. Before the intervention, the students were pretested to eliminate words that the students already knew.

One participant in the study was diagnosed with autism, and the other two participants had severe communication deficits. All three participants demonstrated severe speech impairments, had word recognition skills between a first and third grade level, and an ability to see print. The student with autism was 12-years-old. The remaining students were 11 and 16-years-old.

The nonverbal reading intervention was delivered in three different conditions. Initially, the participants received instruction from a teacher. Flashcards were used with specific instructions and encouragement to speak the words, this was combined with the use of a metacognitive strategy to decode words using internal speech. The CAI condition used the same techniques. However, analog flashcards were replaced with digital cards using multimedia presentation software. During the TLI with CAI phase, the teacher used the analog cards to prime the students, just before the presentation of the digital cards. The CAI-only condition involved the student working directly with the software without the teacher. Words on which the students did not receive instruction were used as the targets during the baseline phase. Teacher opinions were collected using a questionnaire with Likert-type scale.

All of the students achieved the 80% criterion in the three phases of the intervention. Student performance in reversal phases was consistent with initial baseline data. The achievement of the predetermined criterion for the final CAI phase was interpreted as a success. The students completed the CAI lessons accurately and independently. Measurements of procedural fidelity and interrater agreement were within acceptable ranges. Findings from the teacher questionnaire were very positive, indicating

high social validity of the CAI intervention. Coleman-Martin et al. (2005) concluded that the students' enthusiastic responses to computers, their experience using augmentative and alternative communication devices, and the features of CAI combined with direct instruction contributed to the positive outcomes. They suggest that future studies replicate the study using larger sample sizes.

In a study designed to ascertain the specific components of literacy instruction for students with autism, Williams, Wright, Callaghan, and Coughlin (2002) explained whether literacy gains are caused by the computer software or exposure to literacy instruction that students had not received previously. In their study, Williams et al. compared a book-based, teacher-guided intervention to an equivalent CAI intervention. The study also focused on the behavior of the students and the degree of student social interaction that occurred in both interventions.

Eight children between the ages of three and six-years-old participated in the study. To ensure that all students were given access to both interventions, a crossover design was used. The children were matched according to the severity of their autism and pretested using a sight reading task. This assessment was conducted during each intervention, midpoint, and the conclusion of the study. Behavioral data (e.g., attention to task and social interactions) for each child were collected five times (every other week) throughout the study.

Each intervention phase was 10 weeks long and consisted of one 15-minute session per day, five days per week. The book intervention required the teacher to work one-on-one with the student. The books incorporated buttons for various sound effects and were read to the students. Additional instruction occurred using flashcard games. The CAI intervention used the same books that were scanned for use in the software. Similar

sound effects and digital speech used in the books also was used in the software. Other features were incorporated in the CAI book (e.g., page turning, narration, word games, cheering, and corrective feedback).

The social and communicative behaviors of the participants varied significantly in both conditions, resulting in no clear pattern of student behavior. Due to the small sample size and attrition, statistical analysis regarding behavior was not possible. However, Williams et al. (2002) indicated that some students engaged in fewer self-stimulatory behaviors and more social interactions during CAI. The analysis of the reading assessment results also was limited by the small sample size. No statistical data for the reading assessment were reported. Instead, tables of raw scores (number of words read by the children) were provided. Some students did not learn to read any words while others learned to identify up to five. Williams et al. (2002) concluded that CAI may be responsible for the decrease in some student behaviors and for some reading improvement. They suggest that large-scale studies of CAI and children with autism be conducted in the future to address the small sample size used in this study.

The preliminary investigations of the use of CAI multimedia as a means of teaching emergent literacy skills to students with autism is supported by the literature. However, it is unclear if CAI skill growth can be maintained over time. Some researchers have found evidence that suggests CAI may enhance learning by reducing problem behaviors that interfere with learning in students with autism, particularly when CAI is combined with teacher guidance, however, the literature is not consistent and further exploration is necessary.

Summary

The current philosophy in education is that young children should receive emergent literacy instruction beginning early with a focus on language and vocabulary development, the alphabetic principle and phonemic awareness, and formal literacy instruction (phonics) in the primary grades (NICHHD, 2000). However, children with autism exhibit pervasive delays in language and social development that put them at risk for developing poor literacy skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005). The literacy characteristics of children with autism are compounded by the fact that their teachers do not teach literacy until their students exhibit satisfactory prerequisite skills (e.g., compliance and attention) (Mirenda, 2003). This teaching is inconsistent with what literacy experts advocate, but may exist due to a very limited literacy research literature base for teachers of children with autism to access. Regardless, children with autism must be provided with emergent literacy instruction if they are to succeed in school and the world beyond school walls.

Alphabetic knowledge, specifically letter name knowledge, is one of the strongest predictors of reading success (NICHHD, 2000). Researchers have explored several methods and strategies designed to promote alphabetic principles and other early literacy skills in young, typically-developing children (NICHHD). It appears that teacher-led interventions (e.g., repeated book reading) promote specific emergent literacy skills (e.g., alphabet knowledge) (Justice & Ezell, 2002). When play-based literacy instruction is used, typically developing children as well as students with autism demonstrate gains in emergent literacy skills (Bryne & Fielding-Barnsley, 1991; Wasik & Bond, 2001).

Children with disabilities benefit from interventions that infuse interesting and stimulating activities with adult guidance (Johnston, Davenport, Kanarowski,

Rhodehouse, & McDonnell, 2009; Justice, Chow, Capellini, Flanigan, & Colton 2003; Katims, 1991). However, researchers continue to call for further examination of the impact of learning deficits, related to specific disabilities, on emergent literacy skills. Research also indicates that there needs to be a continued emphasis on the specific qualities of an intervention to produce effective and efficient outcomes for children with specific disabilities (e.g., autism). Because students with autism are particularly at-risk for literacy delays, an understanding of emergent literacy interventions is warranted (Coleman-Martin, Heller, Cihak, & Irvine, 2005).

The literature indicates that teacher-led instruction and CAI utilizing well-designed multimedia software improves learning in students with autism and may decrease behaviors that interfere with learning (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001; Chen & Bernard-Optiz, 1993). The use of CAI for students with autism also decreases problem behaviors that interfere with learning (Chen & Bernard-Optiz). Based on this review of the literature, this dissertation study was designed to compare the effects of CAI and teacher-led instruction to teach alphabetic skills to preschool-aged children with autism.

CHAPTER 3

METHODOLOGY

Overview

Literacy skills are essential for success in school and life (Adams, 1990; Copeland, 2007; Higgins, Boone, & Lovitt, 2002; Street & Lefstein, 2007). Students with autism demonstrate significant deficits in their social, language, and behavioral development (APA, 2000) that directly and negatively impacts learning (NRC, 2001). Computer-assisted instruction (CAI) may be one method to improve learning for students with autism (Bernard-Opitz et al., 2001; Bosseler & Massaro, 2003; Chen & Bernard-Opitz, 1993; Hagiwara & Smith-Myles, 1999; Heimann et al., 1995; Moore & Calvert, 2000; Williams, 1985; Williams et al., 2002). Some researchers suggest that students with autism have a natural disposition towards computers and that several factors associated with computer-delivered instruction may promote learning in these students (Light et al., 1998; Tjus et al., 1998; Williams et al., 2002). However, no research has directly explored the potential of CAI to provide early literacy skill instruction. Additionally, it is not clear whether or not CAI produces increased attention while decreasing problem behaviors. Identifying the effects of CAI on behavior and the acquisition of academic skills may lead to positive results in early intervention for students with autism.

This study was designed to compare the effectiveness of a traditional, teacher-led model of instruction to computer-assisted instruction for a group of preschool students with autism (N = 17). Preschool-age children with autism were taught the names of letters, an essential early literacy skill, using teacher-led lessons and lessons presented via computer-assisted instruction (CAI). *Alphabet books* were developed and software created incorporating formative evaluation in the design. Teachers of preschool students

with autism were trained to deliver the two interventions. Tests designed to measure student knowledge of letter names prior to the study were compared to results gathered during posttests and maintenance tests. The study also was designed to examine the effects of each condition on student attention and undesirable behaviors. The data from the two conditions were compared to determine differences. Students were videotaped and reviewers scored behaviors during both teaching conditions. Teachers (N = 9) completed a survey before and after the study to ascertain their attitudes concerning the use of CAI in early childhood classrooms with students with autism.

Teachers and paraprofessionals were trained prior to the start of the first intervention phase. Approximately half of the classrooms were randomly assigned to one of the two treatment conditions. The teachers and paraprofessionals of the classrooms assigned to the teacher-directed instruction first received training in the *Alphabet Books* as well as video camera set up. These teachers and paraprofessionals received training for the CAI condition after completing the first four-week treatment period. In the teacher-directed intervention, students received letter instruction by the classroom teacher using the *Alphabet books*. Teacher-led instruction occurred during group time in the special education preschool classrooms. Each week the teachers taught a new letter using a different *Alphabet Book*. In the CAI intervention, students received letter instruction from the classroom computer using the software designed for the study. Instruction occurred individually during classroom center time in the special education preschool classrooms. Each week the students learned a new letter using the software. The teachers and paraprofessional who first implemented the CAI intervention received training in setting up the computer for each student as well as video camera set up. These teachers received training in the use of the *Alphabet books* after completing the first four-week treatment

period. A posttest and two-week maintenance period occurred after each four-week intervention. Students were assessed for skill maintenance after the two-week period and immediately began receiving the alternative treatment once maintenance testing was completed (i.e., students who first received CAI then received teacher-led instruction; students who first received teacher-directed instruction received CAI). Students received instruction on a different set of four letters during each instructional phase. An additional posttest was conducted at the conclusion of the second intervention. The final assessment was conducted after another two-week maintenance period.

Research Questions

There were five research questions:

1. Do the letter recognition skills of students with autism increase with the use of computer-assisted instruction when compared to teacher-led instruction?

   It was predicted that the computer-assisted instruction condition would result in increased student ability to recognize letters when compared to the teacher-led instruction.

2. Are the letter recognition skills of students with autism better maintained after the use of computer-assisted instruction when compared to teacher-led instruction?

   It was predicted that students would demonstrate improved maintenance of letters taught in the computer-assisted condition when compared to teacher-led instruction.

3. Do the behaviors of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

It was predicted that the students would demonstrate fewer undesirable behaviors during the computer-assisted condition when compared to the teacher-led condition.

4. Does the attention to task of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

   It was predicted that students would demonstrate increased attention during the computer-assisted instruction condition when compared to the teacher-led instruction condition.

5. What attitudes do preschool special education teachers of students with autism have regarding computer-assisted instruction prior to and after the intervention?

   It was predicted that teachers would provide negative attitudes and beliefs regarding the integration of computer-assisted instruction prior to the CAI intervention condition and show an increase in positive attitudes following the CAI intervention.

Participants

Students with Autism

The students selected for this study were children attending preschool programs specifically for students with autism in a large urban school district in the Southwestern United States. The children in these programs range in age from 3 to 6 years old and were selected from nine different preschool programs. Only children whose parents provided permission by signing an informed consent for human subjects research participated in this study. A total of 17 children were recruited as participants for this study. All participants were included in the teacher-led and CAI conditions of the study (see

Table 1). Each student was assessed five times during the study to measure his or her acquisition of letter names after each intervention and maintenance periods. Additionally, all students were videotaped during the teacher-led and CAI conditions to measure their attention-to-task and undesirable behaviors.

All of the students had to meet the following criteria to participate: (a) have motor skills needed to move and click a computer mouse, (b) be able to sit in a chair for at least five minutes during assessment, and (c) be able to point to or say answers to questions. Additionally, all participants had to: (a) have qualified for special education services under Nevada's educational definition of autism, (b) have an Individualized Education Plan (IEP), (c) have attended a self-contained preschool classroom for students with autism, (d) have been 3-6 years old, and (e) have demonstrated difficulty identifying letters of the alphabet. A student qualifies for special education services for autism in Nevada if educational performance is negatively impacted by: (a) significant deficits in verbal and nonverbal communication, (b) significant deficits in social skills development, (c) repetitive activities, stereotyped movements, and resistance to changes in the environment, and (d) atypical responses to sensory experiences (Nevada Administrative Code, 2005).

Teachers

The teachers were certified to teach students with autism in Nevada and taught in self-contained preschool classrooms for students with autism. Teachers held or were currently pursuing Master of Education Degrees in Special Education and had between 0-10 years experience teaching students with autism (see Table 2). The teachers attended two training sessions focused on the delivery of the two interventions. They delivered a ten-minute letter lesson using *Alphabet books* for four school days per week for four

Table 1

Demographics of Students

	Class								
	A	B	C	D	E	F	G	H	I
Characteristics									
Gender									
Male	2	2	2	3	1	2	1	1	1
Female	1	0	0	0	0	1	0	0	0
Total	3	2	2	3	1	3	1	1	1
Age									
Mean	3.11	4.5	5.9	5.0	4.0	4.5	3.10	4.0	4.2
Range	3.11- 4.0	4.2-4.9	5.8-5.11	4.9-5.4	4.0	3.9-5.1	3.10	4.0	4.2
Ethnicity									
Caucasian	1	1	0	1	1	1	1	0	0
African American	0	0	0	1	0	1	0	0	0
Hispanic	2	1	2	0	0	1	0	1	0
Native American	0	0	0	0	0	0	0	0	0
Asian/Pacific Islander	0	0	0	1	0	0	0	0	1
Other	0	0	0	0	0	0	0	0	0
Total	3	2	2	3	1	3	1	1	1

Table 2

Demographics of Teachers

Teacher	Gender	Age	Degree	Ethnicity	Years Teaching in Autism
A	Male	54	Master of Education	Caucasian	5
B	Female	27	Master of Education	Caucasian	4
C	Female	29	Master of Education	African American	5
D	Female	31	Bachelor of Education	Caucasian	0
E	Female	54	Master of Education	Caucasian	6
F	Female	27	Master of Education	Caucasian	5
G	Female	61	Master of Education	Caucasian	10
H	Female	43	Master of Education	Caucasian	2
I	Female	57	Bachelor of Education	Caucasian	0

weeks in accordance with the teacher fidelity checklist (see Appendix A). Additionally, they provided student access to lessons delivered via a classroom computer for four days per week for four weeks. Teachers set up computer lessons for the students and videotaped the lessons. The teachers set up each computer lesson in accordance with the treatment checklist (see Appendix B). Teachers completed a survey before and after the study. The survey was designed to measure teacher attitudes and beliefs towards using computers in early childhood special education settings (see Appendix C).

Paraprofessionals

All preschool classrooms for students with autism have a full-time paraprofessional. Each paraprofessional is responsible for providing daily instructional and clerical support to the teacher. The paraprofessionals in this study participated in each teacher training session after signing an informed consent (see Table 3). The paraprofessionals attended two training sessions. Paraprofessionals were trained in teacher-led and CAI interventions. The paraprofessionals: (a) learned to set up and use the video camera to record lessons, and (b) prepared the computer for lessons.

Table 3

Demographics of Paraprofessionals

Assistant	Gender	Age	Ethnicity
Class A	Male	33	Caucasian
Class B	Female	25	Hispanic
Class C	Female	40	Caucasian
Class D	Female	70	Caucasian
Class E	Female	59	Caucasian
Class F	Female	60	Caucasian
Class G	Female	63	African American
Class H	Female	43	Caucasian
Class I	Female	28	Caucasian

Interrater Observers

Two doctoral students in special education with experience teaching students with autism were responsible for collecting student attention to task and student engagement in undesirable behaviors data for reliability checks. The first rater randomly selected and observed 25% of the videotaped sessions in each condition (e.g., teacher-led and CAI)

and scored attention-to-task behaviors using whole-interval recording (see Appendix D). The second rater randomly selected and observed 25% of the videotaped lessons in each condition (e.g., teacher-led and CAI) and scored undesirable behaviors using partial interval recording (see Appendix E). One of the interrater observers also completed the teacher fidelity checklists (see Appendices A and B). Both observers were trained individually prior to collecting data and retrained during data collection if interrater agreement fell below 80%.

Attention-to-task reliability. All videotaped sessions in both conditions (e.g., teacher-led and CAI) were observed to record student attention to task using whole-interval recording in 10-second intervals. Whole interval recording required that a defined behavior occurred throughout the specified interval in order to be scored as an occurrence (Cooper, Heron, & Heward, 2007). An interrater observer viewed 25% of randomly selected videotaped sessions for each condition (i.e., teacher-led, CAI) and recorded occurrences and non-occurrences of attention to task during each 10-second interval. Interrater agreement was calculated using the formula (interval agreements)/(interval agreements + interval disagreements) X 100 = percent of interval agreement (Cooper, et al. 2007).

Undesirable behavior reliability. Videotapes of students during teacher-led and CAI lessons were collected and analyzed. All videotaped sessions were observed to record occurrences and non-occurrences of undesirable behavior using partial interval recording in 10-second intervals. Partial interval recording required the observer to score an interval as an occurrence if the behavior happened at any time during the interval (Cooper et al., 2007). An interrater observer viewed 25% of randomly selected videotaped sessions for each condition (i.e., teacher-led and CAI) and recorded

occurrences and non-occurrences of undesirable behaviors in 10-second intervals. Interrater agreement was calculated using the interval-by-interval calculation method described by Cooper et al. (2007). Agreement was calculated by (interval agreements/(interval agreements + interval disagreements) X 100 = percent of interval agreement.

Teacher fidelity reliability. A rater viewed all videotaped instruction sessions and scored the teacher's adherence to the intervention using the teacher fidelity checklists (see Appendices A and B). A minimum of 25% of randomly selected videotaped sessions were scored by an interrater using the teacher fidelity checklists (see Appendices A and B) during each week of the intervention phases. Adherence to the treatment was measured by number of steps completed in the checklist. Reliability was calculated by [agreements/(agreements + disagreements)] X 100 = percent of agreement. Teachers and raters were provided with feedback and additional training if the percentage of agreements fell below 80%.

Setting

This study was conducted in preschool classrooms for students with autism in nine elementary schools in a large school district in the Southwestern United States. The elementary schools served students in kindergarten through grade five in general and special education settings. Additionally, some of these elementary schools provided specialized programs to serve preschool-age students with autism. The school district encompassed a large urban and rural area with diverse racial, linguistic, familial, religious, and economic groups.

Classrooms

This study was conducted in ten self-contained preschool classrooms for students with autism, ages 3-6 years. These classrooms were designed around research-based educational practices for students with autism. The purpose of the classrooms was to provide early intensive behavioral and educational interventions to promote language, social, emotional, behavioral, motor, and cognitive development. Each classroom was taught by one special education teacher and typically had two paraprofessionals. Enrollment in these programs included 4 to 6 students with autism and 1 to 4 typically developing peers. For this study, each classroom had at least one computer for students to use during the school day.

Instrumentation

Pretest, Posttest, and Maintenance Assessments

The *Brigance Diagnostic Inventory of Early Development-2* (*IED-2)* (Brigance, 2004) was used to measure student knowledge, mastery, and maintenance of letter names. The *IED-2* is a criterion-referenced assessment designed for use in educational programs for young children up to a developmental age of seven years. The *IED-2* is a comprehensive assessment of developmental and pre-academic skills. The skills included in the assessment are validated via expert review of textbooks concerning early childhood development and education as well as the scientific literature (Brigance, 2004). The *IED-2* is comprised of eleven developmental assessments covering a variety of motor, communication, behavior, social and emotional, and pre-academic skills. A subtest of the readiness assessment is designed to measure student ability to recognize and name capital

letters of the alphabet (see pages 200 to 201 in the *IED-2*). This subtest was administered during pretest, posttest, and maintenance phases. The *IED-2* provides specific stepwise instructions for measuring receptive (e.g., pointing to) and expressive (e.g., saying) letter recognition skills. Both formats were used and administered in accordance with the assessment instructions.

Behaviors

Attention to task. A whole-interval recording system was used to record student attention during treatment conditions (e.g., teacher-led and CAI). An occurrence was scored if the student demonstrated attention for the entire 10-second interval (Cooper et al., 2007). All other intervals were scored as a nonoccurrence. An observer recorded occurrences and nonoccurrences of student attention to task during 10-second intervals for the duration of all 10-minute lessons. To determine reliability, an interrater randomly selected and observed 25% of the sessions to record occurrences and nonoccurrences of student attention to task during 10-second intervals. The instrument that was used to collect whole-interval attention to task data is in Appendix D.

Undesirable behavior. A partial interval recording system was used to record student engagement in undesirable behavior during treatment conditions (e.g., teacher-led and CAI). An occurrence was scored if the student engaged in the defined behavior at any time during the interval and a nonoccurrence was scored if the student did not engage in the defined behavior during the interval (Cooper et al., 2007). An observer recorded all occurrences and nonoccurrences of undesirable behavior during 10-second intervals for the duration of each 10-minute lesson. To determine reliability, an interrater randomly selected and observed 25% of the sessions to record occurrences and nonoccurrences of

undesirable behavior during 10-second intervals for 25% of sessions during both interventions. The instrument that was used to collect the data is in Appendix E.

Teacher Fidelity of Treatment

Teacher fidelity checklists were developed for the purpose of measuring adherence to the treatment in both conditions (see Appendices A and B). An observer viewed all videotaped treatment sessions and completed the checklist to measure teacher adherence to the treatment. An interrater randomly selected and observed 25% of sessions from both treatment conditions and completed the respective checklist. Adherence to the treatment was measured by number of steps completed in the checklist. Reliability was calculated by [agreements/(agreements + disagreements)] X 100 = percent of agreement.

Teacher Attitudes and Beliefs of Computer-Assisted Instruction

A survey was adapted from the *Teachers' Attitudes Toward Computers Questionnaire* (Christensen & Knezek, 1998) and was used to measure the teachers' attitudes toward using computers in early childhood special education. Teachers completed the survey prior to the first intervention and at the conclusion of the study. The survey used a Likert-type scale to measure teacher opinions regarding the use of computers in early childhood education settings. The survey also included a semantic evaluation tool that provided two opposing adjectives separated by a marked line. Teachers placed a mark on the line and within a range to indicate their feelings regarding CAI and the given pair of adjectives (see Appendix C). Permission was obtained from the authors to use the survey in this study (see Appendix F).

Materials

Alphabet Books

The teacher-led lessons incorporated the use of alphabet books (see Appendix G). Each book focused on a specific letter of the alphabet. The teacher read each book to the students for ten minutes daily, four days per week, for four weeks. Each book had three chapters. The books were bound at the top in an easel format, providing students with a direct view of the stimuli (e.g., illustrations, target letter, distractor letters, mastered letters). The opposite side (i.e., the side facing the teacher) provided a smaller version of the student view and a script for the teacher to read.

The first chapter introduced the letter. The introduction chapter included large color illustrations with the target letter in contrasting color. The second chapter was dedicated to promoting discrimination between the target letter and distracting stimuli (e.g., numerals). Identical illustrations found in the first chapter of the book were used in the second. In the second chapter the target letter and numerals were placed around the illustrations. When asked to point to the target letter, a student had to search and discriminate between the target letters and other stimuli (e.g., illustrations and numerals) and point to the target letter. The size of the target letters and distractor numerals in the illustrations decreased in size and became less obvious as the chapter progressed. The final five pages of the second chapter provided only the target letter with numerals on the page. A within stimulus prompt (e.g., target stimuli is larger than distracting stimuli) was built into early pages in order to provide the teacher with an opportunity to reinforce students for independent and appropriate responses. Chapter two concluded with five pages of identically sized numerals with the target letter, all in different positions. The third chapter presented multiple pages of the target letter with other previously taught

letters in order to promote discrimination and mastery. Previously taught letters were randomly placed on each page and students were asked to identify the target letter or previously taught letters (see Appendix G).

Every page of the books provided an opportunity for students to point to or say the target letter. The lessons were delivered in the area of the room where small group activities were conducted (e.g., circle time area). The teachers followed the scripted lesson in each book and provided social reinforcement (e.g., praise and high fives) for correct responses. Teachers provided corrective feedback for incorrect responses (e.g., “That’s not the letter T. Try again. Point to T”).

Computer Software

The CAI condition required the installation of the software designed and created specifically for the study. The software was programmed using the software authoring program *Runtime Revolution: Media Version* (Runtime Revolution, 2008). The software was compatible with both Macintosh and PC platforms and provided instruction on capital letter names. The software was programmed to end after a 10-minute instructional time period. The software was designed around operant conditioning, using discrete-trials with opportunities to access games with stimulating qualities. The purpose of the games was to provide a reward for properly identifying letters.

A discrimination learning approach (Lovaas, 2003) was the basis of the software design. Each letter was formally introduced using massed trials (Lovaas, 2003) and an errorless learning technique (Bondy &Sulzer-Azaroff, 2002). After completing the introduction lessons (on the first day of the week), the students were required to discriminate between numerals (on the second day of the week) and other letters taught during previous introduction lessons in order to determine mastery of the letters (on the

third and fourth day of the week). Included throughout the lessons were short games designed to reinforce letter name learning (see Appendix H).

Cameras

Each classroom had a video camera to record students and teachers during both conditions (e.g., teacher-led instruction and CAI). Teacher-led lessons were recorded to measure treatment fidelity and student behaviors. Computer-assisted instruction lessons were recorded to measure treatment fidelity and student behaviors. Teachers and paraprofessionals were trained on how to set up and record sessions using the video camera. If a classroom did not have a video camera, one was provided for the duration of the study. Videotapes also were provided to each classroom.

Computers

Each participating classroom had at least one personal computer using the Windows operating system. Each computer had a mouse and keyboard. Only one student used the computer at one time, preferably during the classroom center time. Headphones were provided for the teacher upon request.

Survey

The survey consisted of 26 items that teachers rated using a Likert scale. Items were rated as: (a) strongly agree, (b) somewhat agree, (c) unsure, (d) somewhat disagree, and (d) strongly disagree. Additionally, the survey included a semantic evaluation tool. Two opposing adjectives were presented with a line separating them. The teachers placed a mark on the line to indicate their opinion of CAI as it related to the two adjectives (see Appendix C). The survey was delivered to teachers with a postage paid and addressed envelope to ensure anonymity of teachers.

Training

Teachers, paraprofessionals, and students were trained in order to capitalize on the effects of both treatment conditions. The special education teachers and their paraprofessionals attended two training sessions at the University of Nevada, Las Vegas. The first training session was three hours in duration and the second training was two hours long. Both sessions took place after school hours. All teachers and paraprofessionals were trained concerning the implementation of the teacher-led lessons, video camera set up and use, and the use of the computer software. Some paraprofessionals refused to attend despite giving informed consent to participate. Site visits also were used to further train teachers and paraprofessionals. Training regarding how to set up each computer lesson also was provided.

Special Education Teachers and Paraprofessionals

Teacher-led lessons. A three-hour training session was conducted to prepare teachers and paraprofessionals to deliver the teacher-led lessons. During the first hour of the training session, teachers and paraprofessionals were given the opportunity to become familiar with the books, to ask questions about the format and development of the books, and to watch two teacher-led lessons be modeled. The remaining two hours of training: (a) provided teachers with opportunities to practice delivering the instruction during role-play simulations, and (b) provided training for teachers and paraprofessionals on using the video camera set up guide (see Appendix I) to record sessions.

During each role-play, one teacher delivered the instruction and one paraprofessional setup the video camera to record the session. Paraprofessionals practiced setting up the video camera before each teacher role-play activity. Each teacher practiced delivering the lessons with other participants role-playing as students with autism.

Additionally, teachers were provided with training using the video camera set up guide. All questions were answered and performance feedback was provided concerning the delivery of instruction and adherence to instructional protocol. All materials were provided for the teacher-led lessons (e.g., books, treatment checklists, cameras).

Computer-assisted instruction. A two-hour training session was conducted to train teachers and paraprofessionals in the implementation of the CAI. The session involved training teachers and paraprofessionals to implement the CAI lessons. During the first hour, participants observed a demonstration of the software being used and had an opportunity to explore it in a computer lab at the University of Nevada, Las Vegas. An explanation of each step of the CAI treatment condition was provided with a demonstration of completing the treatment fidelity checklist (see Appendix B). During the last hour, the teachers and paraprofessionals practiced setting up various lessons and completing the video camera set up guide (see Appendix I) until all were able to demonstrate delivery of CAI lessons (e.g., turning on the computer, activating the software, giving directions to students, video recording students). Feedback regarding performance was provided and questions were answered. Visits to each school occurred to install the software and address concerns or questions the teachers or paraprofessionals had.

Students with Autism

Each student participated in basic computer training including: (a) moving a mouse to move a cursor on the computer screen, (b) clicking a mouse to manipulate objects on the computer screen, and (c) clicking on objects when given an auditory directive by the computer. This training occurred prior to the initiation of the CAI intervention. Students practiced daily with *Millie's Math House* (Riverdeep Interactive

Learning, 1995), a preschool mathematics software program for 10 minutes two weeks prior to receiving the CAI intervention. This software did not teach names of letters. Students practiced until each student satisfactorily demonstrated the ability to move the mouse and click on 10 objects. A checklist of skills needed by the student was used to evaluate if a student had met the criteria for successfully completing the training (see Appendix J).

Interrater Observers

Two doctoral students in special education each observed 25% of videotaped sessions across conditions (e.g., teacher-led and CAI) to collect data for reliability checks on: (a) attention-to-task behavioral data, (b) undesirable behavior data, and (c) teacher adherence to the treatment guide using the fidelity checklists (see Appendices A and B) for reliability checks. The first observer recorded attention-to-task behaviors using whole interval recording (see Appendix D) for the duration of the study. The second observer recorded undesirable behavior data using partial interval recording (see Appendix E) for the duration of the study. The second observer also completed the teacher fidelity checklist for 25% of sessions selected at random. The first interrater observer attended an individual two-hour training session. The second interrater observer attended an individual training session for 2.5 hours.

The definition of attention-to-task behavior (i.e., sitting in seat and looking at the source of instruction) was explained and discussed with the first interrater observer. An explanation and demonstration of the process required to accurately complete the data collection form in Appendix D form was provided using videotaped sessions. After the demonstration, the observer was given opportunities to score attention-to-task behaviors by viewing session videos. After each 10-minute session, the data collected by the

interrater observer were compared with data collected from the same session. Training concluded after scoring two consecutive sessions with 80% or greater interrater agreement. Interrater agreement was calculated using the interval-by-interval calculation method described by Cooper, Heron, & Heward (2007). Agreement was calculated by (interval agreements/(interval agreements + interval disagreements) X 100 = percent of scored interval agreement. Additional training using the same procedures was provided throughout the study if agreement dropped below 80%.

The second interrater observer received training to collect undesirable behavior data using the form found in Appendix E and teacher fidelity using the forms in Appendices A and B. The definition of undesirable behavior (e.g., aggression, self-injurious, self-stimulatory) was shared in conjunction with an explanation and demonstration of the process required to accurately complete the data sheet using videotaped sessions. After the demonstration, the interrater observer was provided with opportunities to score undesirable behaviors by viewing session videos. After each 10-minute session, the data collected by the interrater observer were compared to data collected from the same session. Training concluded after interrater agreement for two successive sessions was 80% or higher. Interrater agreement was calculated using the interval-by-interval calculation method described by Cooper et al. (2007). Agreement was calculated by (interval agreements/(interval agreements + interval disagreements) X 100 = percent of scored interval agreement. Additional training using the same procedures was provided throughout the study if agreement fell below 80%.

The second interrater observer also was required to complete the teacher-fidelity checklist for a minimum of 25% of all sessions. An explanation and demonstration of the process required to accurately complete the data sheet using video taped sessions from

the teacher training was provided. After the demonstration the interrater observer was provided with opportunities to teacher fidelity by viewing the CAI and TLI session videos. After each 10-minute session, the data collected by the interrater observer was compared to data collected from the same session. Reliability was calculated by [agreements/(agreements + disagreements)] X 100 = percent of agreement. Teachers and the rater were provided with feedback and additional training if the percentage of agreements fell below 80%. Training concluded after scoring four total (two CAI and two TLI) sessions with 80% or greater interrater agreement.

Teacher-led Instruction

Alphabet Book Development

The alphabet books were developed using a framework of systematic instructional procedures identified as best practice (NRC, 2001). Specifically, the books incorporated a discrete trial format combined with errorless learning technique (Bondy & Sulzer-Azaroff, 2002) to promote learning of letter names. Illustrations to aid attention and motivation also were used. The books were broken into specific chapters designed to: (a) introduce the letter, (b) promote discrimination, and (c) determine mastery (see Appendix G). To eliminate any potential confounds associated with rate and ease of acquisition of specific letters, the four target letters taught in all classrooms were chosen based on pretest results. Letters included in the study were randomly selected from a pool of letters that 80% or more of the students did not accurately identify during pretesting. The letters chosen for use in the *Alphabet Books* were R, G, T and H.

Introduction chapter. The introduction (i.e., Chapter One) of each book emphasized the target letter. The first page showed the letter in a large font. A script for

the teacher to read appeared on the page facing the teacher (e.g. “This is the letter R.”). The page facing the children included the target letter large font somewhere on the page along with an illustration. After three consecutive illustrated pages, an assessment page that only displayed the target letter was shown. These assessment pages provided students with an opportunity to practice responding to the instructional stimulus (i.e., “Point to the R.”) Students were required to respond using gestures (e.g., pointing to or touching the letter) when asked to identify the letter by the teacher (see Appendix G).

Discrimination chapter. Chapter Two included the same illustrations as Chapter One, but presented the target letter and then illustration in the presence of other distracting stimuli (i.e., numerals 2 and 7). The target letter varied in size and was strategically placed around the illustrations on the page, requiring students to find the target letter and discriminate between the target letter and the distracting numerals. All target and distracting numerals were the same font type, but varied in size. After three consecutive illustrated pages, an assessment page that displayed the target letter and the distracting stimuli was shown. Within stimulus prompts were used and gradually faded as the chapter progressed (i.e., the target letter was much larger than the distracting stimuli, but became similar in size as the chapter progressed). Chapter Two concluded with a series of similar assessment pages that did not have the within stimulus prompt (i.e., the target letter was the same size and color as the distracting stimuli). The assessment pages were designed to provide the students with opportunities to identify the target letter in the presence of distracting stimuli (see Appendix G). Students were asked to locate the letter on the pages by pointing or touching the requested letter.

Mastery chapter. In Chapter Three, students were asked to identify the current target letter or previously taught letters. The target letter was displayed along with letters

from previous lessons around the same illustrations. When asked, students were required to point to the letter. In week one the students were taught one letter (e.g., R), thus only that target letter appeared in Chapter Three of the book used during the first week. As the students progressed through the treatment, other letters were added to Chapter Three (e.g., letter R in the G book for week two; letters R and G in the T book used in week three; and letters R, G, and T, in the H book used in week four) depending on the letters taught to all students (see Appendix G).

Formative Evaluation. One *Alphabet Book* was developed for the purpose of conducting a formative evaluation. An expert in reading instruction for students with disabilities from the Department of Special Education at the University of Nevada, Las Vegas reviewed the book and provided suggestions for revisions and modification. One early childhood special education teacher, working primarily with students with autism, also evaluated the book and provided feedback using the questionnaire in Appendix K. Two preschool children ages 4 and 6 years also were observed while exploring one of the books. A protocol analysis was developed for this step (see Appendix L). The children were read the book and were asked what they liked about the book. The finalized *Alphabet Book* was used as the model for development of the entire set of letter books (e.g., one book for each letter of the alphabet) after expert, teacher, and student formative evaluation was completed.

Lessons

Books were made with letters chosen by random selection from a pool of letters that 80% or more students had difficulty identifying. The letters chosen for the teacher-led instruction were R, G, T, and H. These letters subsequently were excluded from the selection pool prior to selecting letters for the computer condition. The teacher read the

chapters of the specified book and elicited student responses to instructional cues in the teacher scripts. Each lesson was 10 minutes in length. The teacher provided students with opportunities to identify the target letter in a chapter at least three times. The teachers maintained a slow and steady pace throughout the book. Teachers also held up the book for students to see while reading and pointing to the target letter (when appropriate). In order to maintain greater consistency of treatment across conditions, a specific daily treatment program was used (see Figure 1).

Week one. On the first day of the intervention, the teacher read Chapter One of the first alphabet book (i.e., Chapter One of the book titled *"R is Radical"*). On the second day of week one, the teacher read Chapter Two of *"R is Radical".* On the third and fourth day of week one, the teacher read all chapters of the first book in sequential order. The book used in week one did not have a third chapter (i.e., mastery) because no other letters had been taught. Teachers were required to repeat the prescribed chapter(s) until they completed the instruction (e.g., 8 minutes, but not more than 12 minutes). Average instruction for the week was approximately 10 minutes per day.

Week two. On the first day of week two, the teacher read the first chapter for the second book (i.e., alphabet book "*G is Great"*). On the second day, the teacher read Chapter Two. On the third day, the teacher read Chapter Three. On the fourth day the teacher read all chapters in sequential order until the 10-minute time criteria was fulfilled.

Week three. On the first day of week three, the teacher read the first chapter for the third book (e.g., *alphabet book "T is Terrific"*). On the second day, the teacher read Chapter Two. On the third day, the teacher read Chapter Three. On the fourth day the teacher read all chapters in sequential order until the time criteria was fulfilled.

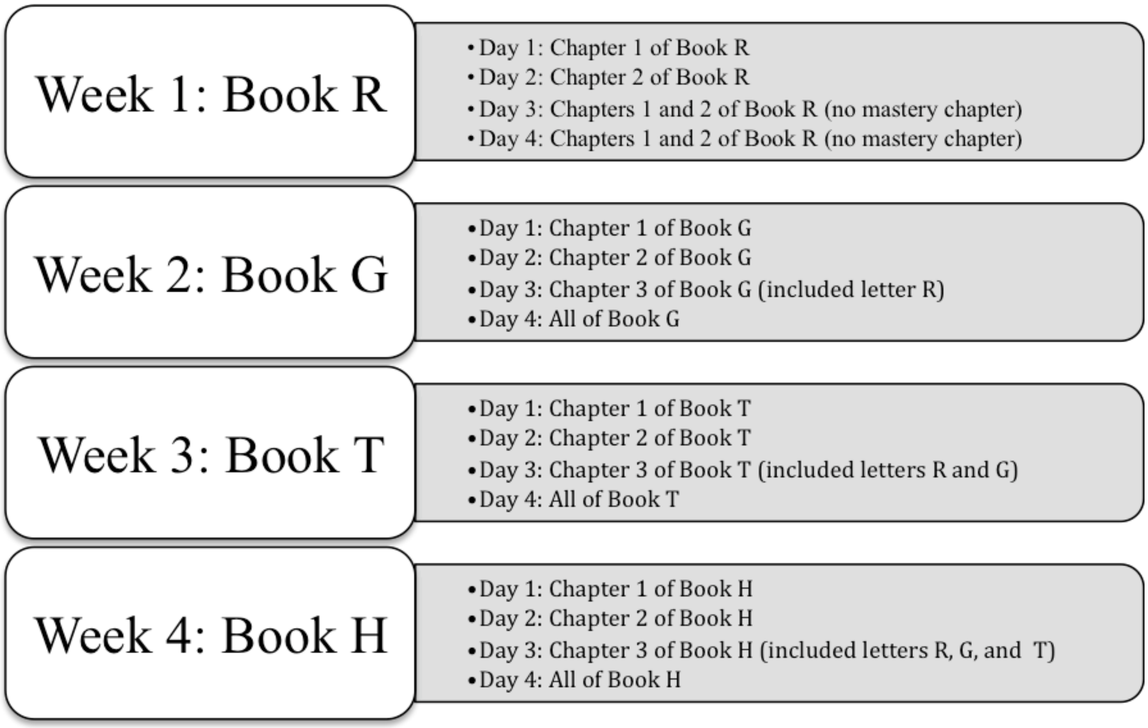


Figure 1. Treatment Prescription for Alphabet books.

Week four. On the first day of week four, the teacher read the first chapter of the fourth book (e.g., *alphabet book "Hooray for H"*). On the second day, the teacher read Chapter Two. On the third day, the teacher read Chapter Three. On the fourth day the teacher read all chapters in sequential order until the time criteria was fulfilled. A fidelity checklist had been developed to ensure teacher adherence to the prescribed treatment (see Appendix A). An observer completed the checklist for all videotaped sessions.

Asking questions and providing feedback. When indicated in the script, the teacher asked each child to point to the target letter. Each child was given 3 to 6 seconds to respond. The teacher provided immediate feedback after the student: (a) provided a correct response, (b) provided an incorrect response, or (c) provided no response after 3

to 6 seconds had elapsed since the instruction. Feedback for correct responses was enthusiastic in both tone of voice and body language. Social praise also was used (e.g., high fives). Feedback for an incorrect response or a non-response was non-punitive and corrective (e.g., "No, that's not the letter H. This is the letter H"). After an incorrect or non-response, the student was given another opportunity to make the correct response. The teacher repeated the trial by asking the question again and providing the appropriate feedback. If a second incorrect or non-response occurred, the teacher provided the proper feedback and moved on to the next child or page of the book (see Appendix G).

Data Collection

The videotaped lessons were used to collect data regarding: (a) treatment fidelity, (b) the accuracy of student responses, (c) student attention to task during the lessons, and (d) student engagement in undesirable behaviors. The videotapes were analyzed for each of the variables. Feedback corresponding to the implementation of the treatment was provided to the teachers (e.g., if a teacher deviated from the prescribed treatment).

Computer-Assisted Instruction

Computer Software Development

The computer-assisted alphabet lesson was developed, formatively evaluated, and refined according to expert feedback. The software was developed in accordance with the positive attributes of educational software for students with disabilities (Boone & Higgins, 2007). Specifically, instructional characteristics of software as outlined by Boone and Higgins (e.g., prompts, small teaching sets, correction strategies, repetition, and independent exploration) were incorporated into the software during development. Additional areas that were considered during development included: (a) directions, (b)

feedback and evaluation, (c) content, (d) interface and screen design, and (e) individualization. In addition to these positive attributes for students with disabilities, the software also included positive attributes of educational software for young children and attributes specific to students with intellectual disabilities (Boone & Higgins).

Software Characteristics

The software used three specific lesson formats similar to the three chapters in the *Alphabet books* used in the teacher-led condition (see Appendix H).. The introduction lesson emphasized repeated exposure to a letter and its name. The discrimination lesson taught the student to recognize the letter when presented with distracting stimuli (e.g., numerals). The mastery lessons measured the student's ability to recognize previously taught letter names while in the presence of each other (e.g., J, V, and U simultaneously appeared with directions to find one of the letters). Games were developed for the purpose of providing positive reinforcement, exploration, and motivation to complete the lessons. Animation, auditory instructions and feedback, short games, and sound effects were incorporated into the three lesson formats. Each lesson lasted between 8 and 12 minutes, averaging 10 minutes in length. The students interacted with the software for a four-week period. Students were provided with daily computer lessons for 10-minutes, four days per week. The teacher or paraprofessional ensured the proper lesson was loaded on the computer and that the video camera was recording when the student sat down at the computer. Specific lessons were required for each day of the treatment phase and followed the format found in Figure 2. Four letters that 80% or more children had difficulty identifying during pretesting were randomly selected for the CAI condition. The four letters taught in the teacher-led condition were excluded from the selection pool

prior to randomly selecting letters for the CAI condition. The letters selected for CAI were J, V U, and Q.

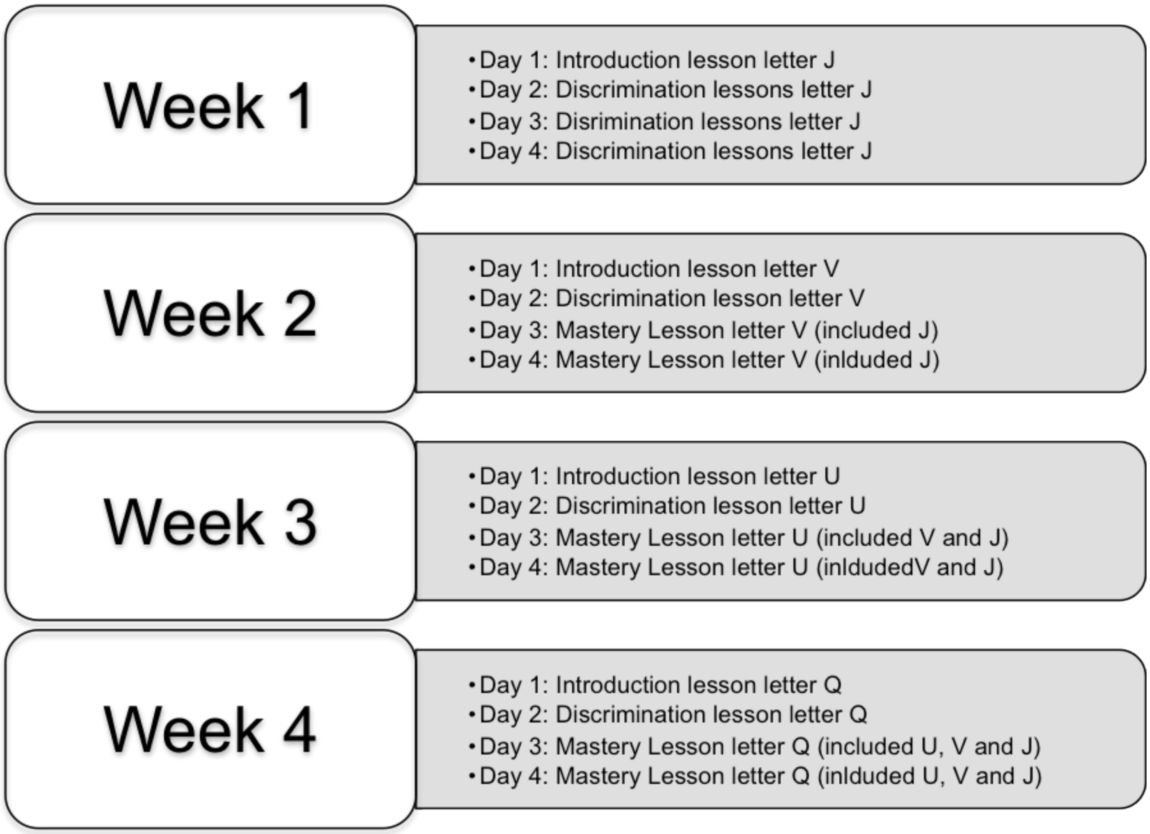


Figure 2. Treatment Prescription for Computer-assisted Instruction.

Feedback. Auditory and visual feedback was provided to promote learning during the CAI condition. Positive feedback immediately followed a student's correct response. A cartoon character appeared on the screen and delivered both visual and auditory positive feedback (e.g. "Great job! You found the letter V!"). Corrective auditory feedback (e.g., "No, try again.") was given immediately following a student's incorrect response, or when the student failed to make a selection within 10 seconds after the direction. Visual feedback (i.e., the balloon character) was not displayed so as to

reduce the potential of inadvertently reinforcing an incorrect response. Screen shots of the software can be found in Appendix H.

Introduction lessons. An introductory lesson emphasized one targeted letter. The introductory lesson was taught on the first day of each week during the CAI condition. The letter was presented to the student with auditory stimuli explaining its name. The presentation of the letter progressed systematically, beginning with an enlarged letter field and auditory instruction asking the student to select the letter. An auditory cue to click on the target letter was provided each time the lesson advanced to the next screen. Only the target letter appeared on the screen during the introduction lesson. Four opportunities to identify the letter were followed by access to one of two alternating games. The student was returned to another set of four opportunities to click on the target letter after the time allotted for the game expired and the pattern was repeated.

Discrimination lesson. On day two of each week, students completed the discrimination lesson. The discrimination lesson simultaneously presented the target letter, empty fields, and fields with the numerals 2 and 7. The numerals were same font type, but were initially smaller in size. Empty fields were initially small, but gradually increased in size until they were similar to the field with the target letter. The letter was presented to the student with auditory stimuli explaining its name. The presentation of the letter progressed systematically, beginning with an enlarged letter field and smaller distracting stimuli and auditory instruction asking the student to select the letter. Another auditory cue to click on the target letter was provided each time the lesson advanced to the next screen. Feedback was provided (e.g., “No. Try again”) when the student selected the wrong answer (e.g., clicked on the numeral or the empty field) or when the 10-second time limit expired. When selected, the correct letter animated with a highlighted effect,

the balloon character appeared, sound effects played, and auditory feedback was delivered (e.g., Way to go! You found the letter Q!”).

Mastery lessons. On days three and four of each week of the CAI condition, students completed mastery lessons. The mastery lessons incorporated the target letter for the current week as well as all previously taught letters in order to measure student ability to recognize taught letters in the presence of each other. For example, during week three (target letter U) mastery lessons, students already completed the lessons for letters J and V. The software simultaneously presented letter U with J and V and cued the child to select the proper letter. These lessons presented the letters in a similar format as the introductory and discrimination lessons. Various sized fields containing a letter were placed in random locations on the screen. The student was asked to click on a specific letter, which varied as the lesson progressed. Positive and corrective feedback was provided in accordance with student responses. The games followed four consecutive instructional opportunities. No mastery lesson was conducted during the first week because students did not have instruction on another letter, thus preventing the simultaneous presentation of more than one target (see Appendix H).

Games. Two games were developed and incorporated into the software; a balloon game and a letter hunt game. The purpose of the games was to provide a brief period of reinforcement for performance. The balloon game lasted 20 seconds. Numerous colored balloons appeared on the screen. Some were empty and others included the target letter of the week. When clicked, the balloons with letters produced a sound effect and flew off the screen. Empty balloons produced no animation or sound when clicked. The letter hunt game displayed a scene (e.g., sky and clouds, an Arabic bazaar, teddy bears playing in a meadow) along with the target letter hidden somewhere on the scene (see Appendix H).

When found (i.e., clicked) the letter flashed, auditory feedback was delivered (e.g., “There’s the letter J!”), and the letter flew off the screen before being hidden again in a different place. The software automatically returned the student to the lesson after the games. The time limit for the games was 20 seconds for the balloon game and 60 seconds for the letter hunt game. After the allotted game time had expired, the student was returned to the lesson. The same games were used for each lesson, but were specific to the targeted letter for the week (i.e., week one the games only included J; week two games included V only).

Formative evaluation. A beta version of the software had been developed based on the recommendations of Boone and Higgins (2007) for the purpose of formative evaluation. Formative evaluation consisted of three phases. First, an expert in the area of literacy for students with disabilities and an expert in educational software design evaluated the beta version. Expert feedback was used to guide the refinement of the software. The second phase of the formative evaluation provided an early childhood special education teacher with an opportunity to interact with the software before completing a questionnaire (see Appendix M). Feedback was considered when refining the software. Lastly, two preschool children ages 4 and 6 years were observed while interacting with the software. A protocol analysis was developed for this step (see Appendix N). The children were asked questions about their interactions with the software in order to guide the formative evaluation. After changes from the formative evaluation were incorporated into the software, it was considered ready for use in the study.

Data collection. The software was programmed to collect data regarding: (a) the accuracy of student responses (e.g., correct clicks, incorrect clicks, and non responses),

(b) day each lesson was implemented, (c) time elapsed between the each auditory instruction and the student response, (d) the completion of lessons, and (e) the cumulative time the student had spent interaction with various aspects of the software (e.g., the introduction lessons, discrimination lessons, mastery lessons, and games). Each student's data were collected and stored on the computer running the software. A video camera was used to record the students as they interacted with the software in order to measure attention to task and undesirable behaviors.

Design and Procedures

The study was conducted over a fifteen-week period and consisted of three phases. The phases included formative software evaluation, training, pretesting, teacher-led instruction, computer-assisted instruction, posttests, maintenance tests, and surveys. A timeline of the study is provided in Appendix O. See Figure 3 for a diagram of the phases.

Phase One

Software. The software was programmed and incorporated positive attributes of educational software as outlined by Boone & Higgins (2007). A beta (i.e., test) version of the program was developed for the explicit purpose of conducting formative evaluation. Two experts reviewed the software and made suggestions for changes to the beta version. One reviewer was an expert in the area of literacy for students with disabilities from the Department of Special Education at the University of Nevada, Las Vegas. The second reviewer was an expert in the design of instructional software for students with and without disabilities from the Department of Curriculum and Instruction at the University of Nevada, Las Vegas. An early childhood special education teacher working with

students with autism also reviewed the software and provided feedback. After making suggested changes to the software in accordance with the expert and teacher feedback, the software was again formatively evaluated with preschool students with autism.

Two preschool-age children interacted with the beta version of the software. The children were observed as they interacted with the software and information was collected about various aspects of the students' experience. A protocol analysis was used to identify the strengths and weaknesses of the software design (see Appendix N). The children were asked questions about their rationale for certain behaviors while interacting with the software (e.g., "Why did you click that?"). The information obtained from this formative evaluation was used to make necessary changes to the software.

Alphabet books. One alphabet book was designed for the purpose of conducting formative evaluations. The test book served as the model for the development of all other books. The design of the alphabet book imitated the computer software in several ways: (a) the chapters matched the lessons in the software, (b) the order and delivery of target stimuli was identical, and (c) the third chapter of each book was individualized to include target letters from previous lessons. An expert in the area of literacy for students with disabilities at the University of Nevada, Las Vegas reviewed the test book. An early childhood special education teacher who works with students with autism also reviewed the alphabet books and provided feedback using a questionnaire (see Appendix K). Two preschool age children were read the book and had an opportunity to explore it. Questions were asked using the protocol analysis in Appendix L. Feedback was considered when making alterations to the content and design of the book.

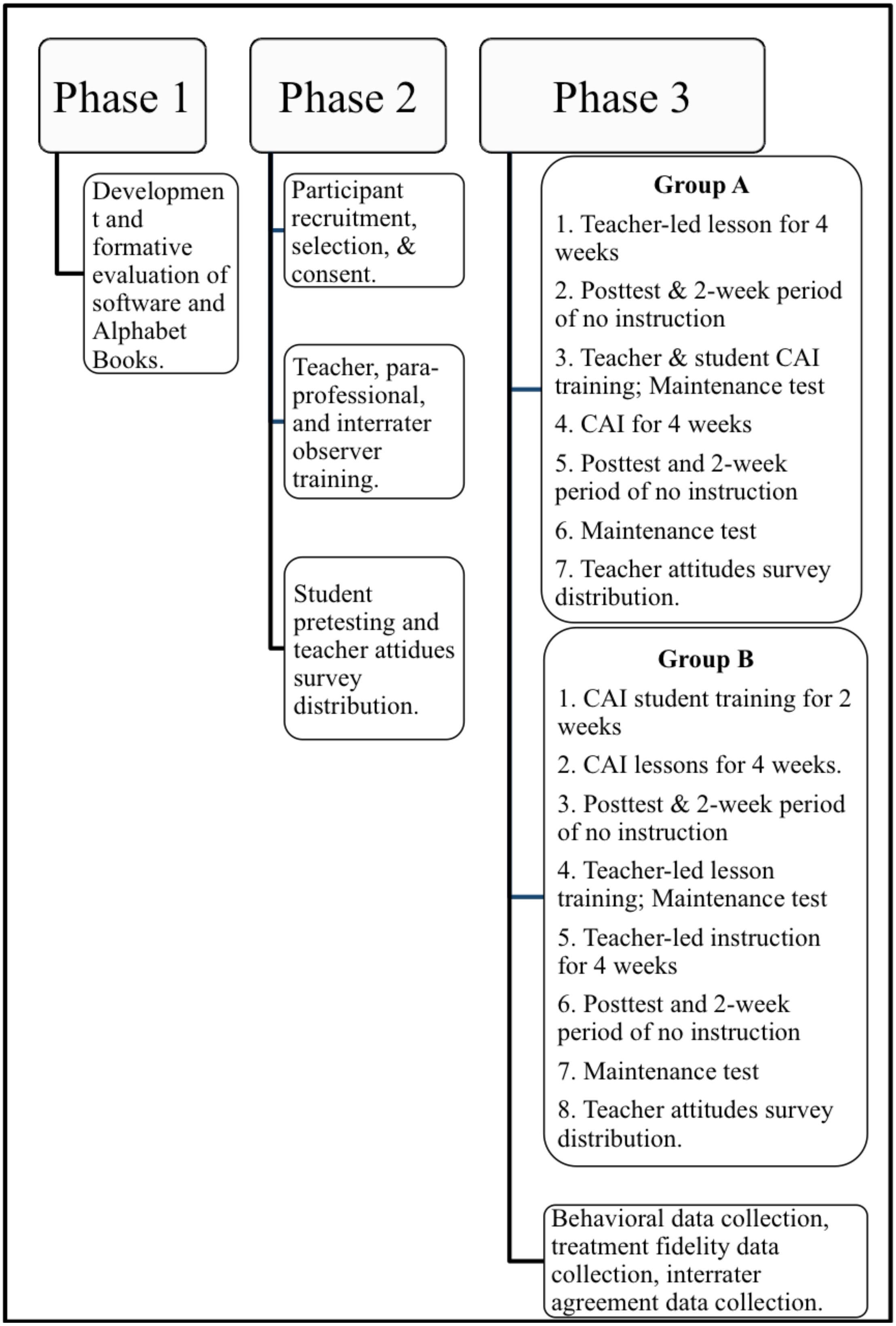


Figure 3. Diagram of study phases.

Phase Two

Phase two was the recruitment, pretest, and initial training phase. During this phase, school administrators were contacted via email, telephone, and personal contact in order to recruit potential participants. Only administrators at schools that had a preschool program for students with autism were contacted. Student, teacher, and paraprofessional participants were solicited from the preschool program. Parent consent was collected for the students. Consent from teachers and paraprofessionals also was collected. Teachers, paraprofessionals, and students were trained. Students were assessed on their knowledge of letter names.

Student selection. In order to be selected as a participant in the study, the student with autism had to: (a) qualify for special education services under Nevada's educational definition of autism, (b) have an Individualized Education Plan (IEP), (c) attend a self-contained preschool classroom for students with autism, and (d) be 3-6 years old. Students who met these criteria were excluded from the study if he or she: (a) did not demonstrate difficulty identifying any letters of the alphabet, (b) did not have motor skills necessary to move and click a computer mouse, (c) was unable to sit in a chair for at least five minutes during assessment, or (d) was not able to point to or say answers to questions. Students who did not fit the selection criteria were not excluded from either of the interventions; however, the data collected regarding their performance in both conditions was excluded from the analyses.

Consent. Informed consent forms were sent to all teachers, paraprofessionals, and parents of student participants (see Appendix P). Informed consent for students was sent home in student backpacks along with postage-paid envelopes. Only students whose parents gave consent were included as participants in the study. Consent of teachers and

paraprofessionals also was collected. The schools were randomly divided into two groups after recruitment was completed and informed consent forms were collected. Each group comprised approximately half of the student participants. The first group (i.e., Group A) received teacher-led instruction for four weeks followed by CAI. The second group (i.e., Group B) received CAI for four weeks followed by teacher-led instruction.

Teacher and paraprofessional training. Teachers and paraprofessionals were trained in the video camera set up and the intervention provided first (i.e. Group A first was trained in teacher-led instruction; Group B in CAI). Student pretest data were collected. Additionally, students first receiving CAI were given computer training. The teacher attitudes and beliefs towards computer-assisted instruction survey were distributed to the teachers.

Training for teachers and paraprofessionals began the signed informed consent forms were returned. Not all paraprofessionals gave consent. Additionally, not all paraprofessionals were able to attend training. Teachers and paraprofessionals attended two training sessions. Approximately half of the teachers first implemented teacher-led instruction (i.e., Group A) and attended the training specific to teacher-led lessons prior to the delivering of the intervention in their classroom. After the completion of the teacher-led instruction, these teachers received training for CAI. The remaining teachers (i.e., Group B) first received training for CAI followed by teacher-led lesson training after completing the four-week intervention. The teacher-led instruction training session was three hours and the CAI training was two hours. Both training sessions provided teachers and paraprofessionals with training regarding the delivery of lessons as well as video camera setup and operation.

Alphabet book lessons. The teachers were trained in the *Alphabet Book* lessons. During the first 30 minutes of the training session, teachers and paraprofessionals were given the opportunity to become familiar with the books and ask questions. The last 30 minutes of the first hour provided teachers and paraprofessionals opportunities to observe two lessons being modeled. The remaining two hours of training provided: (a) teachers with opportunities to practice delivering the instruction and (b) teachers and paraprofessionals with training on setting up the video camera to record sessions using the video camera set up guide (see Appendix I).

Teachers practiced delivering the lessons during role-playing activities with other teachers while the paraprofessionals and teachers practiced video camera set up. Demonstrations for setting up the camera using the set up guide in Appendix I were provided. Prior to each role-play, one paraprofessional or teacher setup the video camera using the set up guide before providing a cue to the teacher to start the lesson. The remaining participants role-played as students with autism. After each 10-minute simulation, questions were answered and feedback regarding camera set up and adherence to treatment was provided.

Computer lessons. The teachers were trained in the instructional software, implementation of student training, and set up and use of the video camera for CAI lessons. During the first 30 minutes of the two-hour training session, the teachers and paraprofessionals observed the software being used and interacted with the software. The next 30 minutes provided opportunities to practice setting up the video camera using the set up guide (see Appendix I). Teachers and paraprofessionals received feedback regarding software and video camera set up. The teachers took turns being recorded during role-play. Each teacher completed a lesson.

Teachers and paraprofessionals also learned to train students to use the computer with the training software. During the last 60 minutes, the teachers observed demonstrations of how to teach the students to move and click a computer mouse. The teachers then practiced delivering the lessons to a person role-playing as a student with autism.

Student Training. During the two-week period prior to receiving CAI, each student participated in training concerning basic computer skills including: (a) moving a mouse to move a cursor on the computer screen, (b) clicking a mouse to manipulate objects on the computer screen, (c) clicking on objects when given an auditory directive by the computer. Approximately half of the students (Group B) received computer training prior to receiving any intervention. The remaining students (Group A) received computer training after completing the teacher-led instruction and prior to CAI lessons. Students used *Millie's Math House* (Riverdeep, 1995) mathematics software for 10 minutes per day during the two-week period. The software used for training did not teach letter names. Students had repeated opportunities to practice until each student satisfactorily demonstrated the ability to move the mouse and click on 10 objects when directed. A checklist of needed skills was used to evaluate whether a student had met the criteria for successfully completing the training (see Appendix J). If a student did not demonstrate the skills outlined in the computer skills checklist, his or her data were excluded from analysis.

Interrater observer training. Two doctoral students in special education received individualized training on data collection for reliability checks. The first interrater observer received training to score attention-to-task behavior data using whole-interval recording (see Appendix D). The second interrater observer received training to

score undesirable behavior data using partial interval recording (see Appendix E) and teacher fidelity to treatment using the checklists in Appendices A and B.

After a demonstration of the data collection technique and a discussion of the behavior to be measured, the raters viewed two videotaped sessions. Previously scored data sheets from the same session were compared to data collected by the interrater observers and calculation of agreement was performed after each ten minute session. The results were calculated using the formula (interval agreements)/(interval agreements + interval disagreements) X 100 = percent of agreement (Cooper et al., 2007). Training concluded after two, 10-minute sessions were scored at or above 80% agreement. Additional training was provided if agreement dropped below 80% at any time during the study.

Pretesting. When student informed consent forms had been returned, the students were pretested using the *IED-2* (Brigance, 2004). The assessment protocols were collected, scored, and entered into SPSS (Version 16.0) for later analysis.

Survey. Surveys were distributed to the teachers after informed consent forms had been signed. The survey was hand delivered with an addressed postage-paid envelope. Teachers completed the survey by rating items using a Likert scale and marking agreement with adjectives describing CAI. All surveys were completed before phase three began. The data from the survey was collected, scored, and entered into SPSS (Version 16.0) for analysis.

Phase Three

The phase was 12 weeks long. During this phase of the study, students in Group A first received teacher-led instruction using the *Alphabet books.* Students in Group B first received computer training for two weeks followed by CAI for four weeks. After the

first post- and maintenance assessments were completed, the groups alternated (i.e., Group A received computer training followed by CAI and Group B received teacher-led instruction). Each treatment condition was four weeks long and both groups completed posttests immediately after the intervention period ended. A two-week period of no letter instruction occurred followed by a maintenance test prior to starting the second intervention. The teachers and paraprofessionals received their second training during the maintenance period. A second round of post- and maintenance tests followed the interventions. Surveys were distributed to teachers following the last maintenance assessment (see Figure 4).

Teacher-led lessons. Teachers provided the teacher-led lessons once a day, four days a week, for four weeks. The alphabet book lessons were based on student pretest performance. On the first day of each week, teachers read the first chapter (i.e., the introduction chapter) from the *alphabet book* (e.g., letter R during week one, letter G during week two, etc.). On the second day of each week, the teachers read chapter two (i.e., discrimination chapter) from the *alphabet book* (i.e., letter R during week one, letter G during week two, etc.). During day three of each week, the teachers read chapter three (i.e., mastery chapter) that included the target letter and letter that already taught (e.g., during week three, letters R and G were incorporated; during week four, letters R, G and T were incorporated) in the mastery chapter of the *alphabet book.* On day four of each week, the teachers began at chapter one and progressed through all chapters until the time criteria was satisfied (see Appendix G). During week one, no other letters were incorporated (i.e., there was no mastery chapter) because students had not yet been taught other letters.

Week 1	Train all teachers and paraprofessionals in first intervention to be delivered. Pretest all students. All teachers complete first survey.
Weeks 2 & 3	Group A: Begin teacher-led instruction.
	Group B: Begin and complete student computer training.
Weeks 4 & 5	Group A: Finish teacher-led instruction. Conduct posttest 1.
	Group B: Begin CAI lessons.
Weeks 6 & 7	Group A: Complete two-week maintenance period and assessment. Train teachers in CAI lessons.
	Group B: Finish CAI lessons and posttest 1.
Weeks 8 & 9	Group A: Complete student computer training.
	Group B: Complete two-week maintenance period & assessment. Train teachers to deliver teacher-led lessons.
Weeks 10 & 11	Group A: Begin CAI lessons.
	Group B: Begin teacher-led instruction.
Weeks 12 & 13	Group A: Finish CAI Lessons and conduct posttest 2.
	Group B: Finish teacher-led instruction and posttest 2.
Weeks 14 & 15	Group A: Complete maintenance period and assessment 2.
	Group B: Complete maintenance period and assessment 2. All teachers complete second survey.

Figure 4. Diagram of Phase Three.

Computer-assisted instruction. The software developed for this study was used for four consecutive weeks during this phase of the study. Each student spent ten minutes a day, for four days per school week interacting with the software. A treatment fidelity checklist had been developed to ensure adherence to the treatment (see Appendix B).

Data regarding the number of correct, incorrect, and non-responses of each student were collected and stored by the software. The software collected additional data regarding latency of response to computer generated verbal instructions, time spent on

each lesson, and rate of student response. Only letters that 80% or more students had difficulty identifying, as indicated by the pretest, were taught in the CAI condition. Letters taught in the teacher-led condition were not included in the computer-assisted instruction condition.

Attention-to-task behavior. Students were video recorded while receiving the teacher-led and CAI lessons in order to measure the amount of time each student was attending to the lesson. Attention-to-task was defined as sitting in seat and looking at the source of instruction (e.g., the teacher reading the story or a peer answering a teacher's question; looking at the computer screen) under typical instructional circumstances. Raters scored occurrences and nonoccurrences of the behavior using whole-interval recording (Cooper et al., 2007). A student was considered to be engaged in the target behavior if sitting in his or her seat while looking at the source of instruction for the entire 10-second interval. Any instance when the student was out of seat or not looking at: (a) the teacher, book, or a responding peer, or (b) the computer screen was considered a nonoccurrence. Videotapes of all students during the lessons were scored daily and the occurrence and nonoccurrence of attentive behaviors were recorded using the data collection form in Appendix D. An interrater observer viewed and score 25% of the sessions as a reliability check.

Undesirable behaviors. Students were video recorded while receiving the teacher-led and CAI lessons to measure the amount of time each student was engaged in undesirable behavior. Undesirable behaviors were defined as self-stimulatory behaviors (e.g., hand-flapping, finger flicking, rocking, staring, or similar self-stimulatory behaviors), self-injurious behaviors (e.g., hitting self, pulling own hair, biting self, scratching self, smacking self, or similar self-injurious behavior), aggressive behaviors

(e.g., hitting others, kicking others, scratching others, pulling hair, biting others, or other similar aggressive behaviors), or tantrum behaviors (e.g., hitting objects, throwing objects, screaming, crying, flopping on floor, kicking floor, or similar tantrum-like behaviors). Raters scored occurrences and nonoccurrences of the behavior using partial-interval recording (Cooper et al., 2007). An occurrence was scored if the student is observed engaging in the defined behavior at any time during a 10-second interval. A nonoccurrence was scored when the student did not engage in undesirable behavior during a 10-second interval. Videotapes of all students during the lessons were scored daily and the occurrence and nonoccurrence of undesirable behaviors were recorded using the data collection form in Appendix E. The second interrater observer viewed and scored 25% of the sessions as a reliability check.

Posttests. After each four-week period of instruction was completed, the *IED-2* (Brigance, 2004) was administered as a posttest measure. This posttest served as a pretest for maintenance as well. The posttest assessment data were collected, scored, and entered into SPSS (Version 16.0) for later analysis.

Maintenance. A two-week period of no instruction immediately followed the posttests for both intervention periods. During this phase, the teacher did not implement the teacher-led lessons or the CAI lessons, or engage in any alphabet instruction. At the end of the two-week period the *IED-2* (Brigance, 2004) was administered as a maintenance measure. The maintenance assessment data were collected, scored, and entered into SPSS for later analysis.

Survey. Teachers completed the beliefs and attitudes towards computer-assisted instruction survey at the conclusion of the second maintenance period (see Appendix C). The survey was delivered with an addressed and postage-paid envelope. Teachers

completed the survey by rating items using a Likert scale and marking agreement with adjectives describing CAI. The data from the survey were collected, scored, and entered into SPSS for analysis.

Data Collection

Pretest, posttest, and maintenance tests. The pretest, posttest, and maintenance data were collected and entered into SPSS for analysis. The data collected from the first and second maintenance tests also were collected and entered into SPSS for analysis.

Teacher fidelity. Teacher fidelity data were collected and reliability was assessed using interrater agreement. Interrater agreement on the teacher fidelity checklists was determined by [agreements/(agreements+disgreements)] x 100 = percent of agreement.

Attention to task behavior. Attention to task behavior data were collected using whole-interval recording with 10-second intervals. Percent of occurrences of undesirable behaviors from both conditions were entered into SPSS and analyzed. Interrater agreement was calculated using the formula (interval agreements)/(interval agreements + interval disagreements) X 100 = percent of interval-by-interval agreement (Cooper, Heron, & Heward, 2007).

Undesirable behavior. Undesirable behavior data were collected using partial-interval recording with 10-second intervals. Percent of occurrences of undesirable behaviors from both conditions was entered into SPSS and analyzed. Interrater agreement was calculated using the formula (interval agreements)/(interval agreements + interval disagreements) X 100 = percent of interval-by-interval agreement (Cooper, et al., 2007).

Survey. The data from pre and post teacher surveys were coded and entered into SPSS.

Treatment of the Data

Data from the pretest, posttest, and maintenance test using the *IED-2* (Brigance, 2004) were used to answer the following questions:

Research Question 1: Do the letter recognition skills of students with autism increase with the use computer-assisted instruction when compared to teacher-led instruction?

Research Question 2: Are the letter recognition skills of students with autism better maintained after the use of computer-assisted instruction when compared to teacher-led instruction?

Analysis: In order to determine if significant differences exist between the teacher-led instruction and computer-assisted instruction, an ANOVA with repeated measures was used to compare groups. Alpha was set at 05.

Data collected from videotaped sessions were used to answer the following questions:

Research Question 3: Do the undesirable behaviors of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

Research Question 4: Does the attention to task of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

Analysis: In order to determine if a significant difference exists between the teacher-led and computer-assisted instruction, Paired *t*-tests were used to compare groups. Alpha was set at .05

Data from the teacher satisfaction survey were used to answer the following question:

Research Question 6: What attitudes do preschool special education teachers of students with autism have regarding computer-assisted instruction prior to and after the intervention?

Analysis: The data obtained from the surveys were entered into SPSS. Paired samples *t*-tests were used to determine differences in attitudes and beliefs towards CAI before and after the study. Alpha was set at .05.

CHAPTER 4

RESULTS

Reading is a skill that is vital to independence, employment, and daily living (EFA, 2005). Without adequate and efficient literacy instruction, students with autism will mature into adults with insufficient skills vital to gainful employment, adaptive daily living, and enjoyable social, recreation, and leisure activities (Education for All Global Monitoring Report Team, 2005). By acquiring even the most fundamental literacy skills, people with autism will experience greater success in school, independence, and community participation (Copeland, 2007). Letter recognition is a foundational skill vital to future reading success (Tompkins, 2003), but there exists a significant gap in the early literacy research, particularly alphabetic knowledge, for students with autism.

The purpose of this study was to examine if students with autism learned to identify and maintain letter names more efficiently using traditional teacher-led instruction (TLI) or computer-assisted instruction (CAI). The literature suggests that CAI is an effective method to provide instruction to children with autism (Williams, Wright, Callaghan, & Coughlan, 2002). Computer-assisted instruction requires students to be active learners, is motivating, and can expose repeatedly children to a variety of content to ensure mastery. This study also measured the behavior of students with autism during teacher-led and computer lessons to determine the types of behavioral differences, if any, that occurred across the two instructional conditions. Materials were developed, formatively evaluated, and revised according to feedback from experts and teachers prior to the study. Seventeen students with autism participated in the study (see Table 1).

The students were assessed on their ability to recognize letters of the alphabet using the *Brigance Inventory of Early Development-II* (*IED-II*) (Brigance, 2004).

Following the pretest, classrooms were assigned randomly to conditions and the teachers completed a survey adapted from the *Teachers' Attitudes Toward Computers Questionnaire* (Christensen & Knezek, 1998) to measure their attitudes concerning the use of computers in early childhood special education classrooms.

Approximately half of the students (n = 10) received CAI for the first four weeks of the study. The remaining students (n = 7) received TLI for the first four weeks of the study. The children were videotaped to measure their attention and engagement in undesirable behaviors, as well as fidelity of treatment. After the first intervention was complete, the children were again assessed with the *IED-II* (Brigance, 2004) to measure their alphabet recognition skills. This served as the posttest for the first instructional period and pretest for the following maintenance period. All children were again assessed on their alphabet recognition skills using the *IED-II* (Brigance) at the conclusion of the two-week maintenance period.

Students who first received CAI then participated in TLI and students who were first taught by a teacher used the CAI. The children again were videotaped while receiving instruction to measure their attention and engagement in undesirable behaviors as well as fidelity of treatment. After the second four-week intervention phase was completed, the students were again administered the *IED-II* (Brigance) to assess their alphabet recognition skills. This served as the posttest for the second instruction period and pretest for the second maintenance period. Another two-week maintenance period, without alphabet instruction, was followed by the final maintenance assessment using the *IED-II* (Brigance). The teachers completed the survey adapted from the *Teachers' Attitudes Toward Computers Questionnaire* (Christensen & Knezek, 1998) at the conclusion of the final maintenance period.

All student participants were preschool children diagnosed with autism and eligible for special education according to the Nevada Administrative Code (2005). The children were between the ages of three and six years. There were 15 boys and 2 girls. All attended self-contained preschool classrooms, had individualized education plans, and had difficulty with alphabet recognition.

Fidelity to Interventions

Teacher fidelity checklists were developed to measure teacher adherence to the treatment in both instructional conditions (see Appendices A and B). Observer A viewed the videotaped sessions (TLI and CAI) and completed the checklist to measure teacher adherence to the treatment. Fidelity to TLI was calculated by (number of sessions with 100% fidelity)/(total number of sessions) x 100 = percent of TLI fidelity. A total of 127 sessions with 100% fidelity was recorded out of a possible 147 sessions. Fidelity to TLI was 88.2% (see Table 4). Fidelity to CAI was calculated by (number of session with 100% fidelity)/(total number of sessions) x 100 = percent of CAI fidelity. There were 222 sessions with 100% CAI fidelity. A total of 258 CAI sessions were scored. Fidelity to CAI was 86.0% (see Table 5). These data indicate that teachers were able to deliver both interventions with a high degree of fidelity.

Table 4

Teacher Fidelity to Teacher-Led Instruction

Source	TLI sessions with 100% fidelity	Total number of TLI sessions	Percent of Fidelity
TLI Fidelity Checklists	127	147	127 ÷ 147 = 88.2%
TLI Fidelity = 88.2%			

Table 5

Teacher Fidelity to Computer-Assisted Instruction

Source	TLI sessions with 100% fidelity	Total number of TLI sessions	Percent of Fidelity
CAI Fidelity Checklists	222	258	222 ÷ 258 = 86.0%
TLI Fidelity = 86.0%			

Interrater Reliability

Observers A and B performed interrater reliability checks on teacher fidelity to teacher-led instruction (TLI) and computer-assisted instruction (CAI) using the fidelity checklists in Appendices A and B. Interrater reliability also was conducted with observers A, B, and C to ensure reliability of scoring of child engagement in attentive and undesirable behaviors during videotaped intervention sessions.

Interrater Agreement for Fidelity of Teacher-Led Instruction

Interrater agreement for fidelity of TLI was measured using the protocol checklist found in Appendix B. Observer B viewed 25% of videotaped sessions and scored adherence to the intervention for comparison of data collected by Observer A. There were eight items on each TLI checklist. The scores for all items were compared and interrater

agreement was calculated by [agreements/(agreements + disagreements)] x 100 = percent of agreement. Interrater agreement for TLI fidelity was 100%. These findings indicate a high level of interrater agreement of fidelity of TLI. Interrater reliability scores are presented in Table 6.

Table 6

Interrater Reliability for Fidelity of Teacher-Led Instruction

Source	Observers A & B	Percent of Agreement
TLI Fidelity Checklist	32/32	(32 ÷32) X 100 = 100%
Interrater Reliability for TLI = 100%		

Interrater Reliability for Fidelity of Computer-Assisted Instruction

Interrater agreement for fidelity of CAI was measured using the protocol checklist found in Appendix A. Observer C viewed 25% of videotaped sessions and scored adherence to the intervention for comparison of data collected by Observer A. There were three items on each CAI checklist. The scores were compared and interrater agreement was calculated by [agreements/(agreements + disagreements)] x 100 = percent of agreement. Interrater agreement for CAI fidelity was 100%. These findings indicate a high level of interrater agreement related tot eh of fidelity of CAI implementation. Interrater reliability scores for CAI fidelity are presented in Table 7.

Table 7

Interrater Reliability for Fidelity of Computer-Assisted Instruction

Source	Observers A & B	Percent of Agreement
CAI Fidelity Checklist	12/12	(12 ÷12) X 100 = 100%
Interrater Reliability for CAI = 100%		

Interrater Reliability for Attention-to-Task Behaviors

To verify the accuracy of scored attention-to-task behaviors for the students, the scores from 25% of sessions scored by Observer A were compared to scores obtained by Observer B. Each session observed was approximately 10 minutes in length. The sessions were paired with a soundtrack that counted 10-second intervals. Attention-to-task behaviors were scored using whole-interval recording. The scores from Observers A and B were compared using interval-by-interval analysis (Cooper, Heron, & Heward, 2007). The obtained agreements and disagreements were calculated using [agreements/(agreements + disagreements) x 100 = percent of agreement]. Interrater reliability for attention-to-task behaviors was 82.1%. This finding indicates that an acceptable percent of interrater agreement for attention-to-task behaviors was obtained. Interrater agreement scores for attention-to-task behavior are presented in Table 8.

Table 8

Interrater Reliability for Attention-to-Task Behavior

Source	Agree/Disagree	Percent of Agreement
Attention to Task Interval Recording Data	386/84	[(386) ÷ (386 + 84)] X 100 = 82.1%
Interrater Reliability for Attention-to-task Behaviors = 82.1%		

Interrater Reliability for Undesirable Behavior

To verify the accuracy of scored undesirable behaviors, the scores from 25% of sessions scored by Observer A were compared to scores obtained by Observer C. Each session was approximately 10 minutes in length. The sessions were paired with a soundtrack that counted 10-second intervals. Undesirable behaviors were scored using partial-interval recording. The scores from both observers were compared using interval-by-interval analysis (Cooper, et al., 2007). The obtained agreements and disagreements were then calculated using [agreements/(agreements + disagreements) x 100 = percent of agreement]. Interrater reliability for undesirable behaviors was 88.4%. This finding indicates that an acceptable level of interrater agreement for undesirable behaviors was obtained. Interrater agreement scores for undesirable behavior are presented in Table 9.

Table 9

Interrater Reliability for Undesirable Behavior

Source	Agree/Disagree	Percent of Agreement
Undesirable Behavior Interval Recording Data	452/56	[(452) ÷ (452 + 56)] X 100 = 88.4%
Interrater Reliability for Undesirable Behaviors = 88.4%		

Analysis of Alphabetic Recognition Measures

The students were administered the portion of the *Brigance Inventory of Educational Development-II* (*IED-II)* (Brigance, 2004) designed to assess alphabet recognition skills a total of five times: (a) prior to receiving any intervention, (b) upon completion of the first four-week intervention, (c) after a two-week maintenance period without instruction, (d) at the completion the second four-week intervention, and (e) after

a second two-week maintenance period. The scores obtained from these assessments were analyzed to compare the effectiveness of the TLI and CAI instructional interventions on the acquisition and maintenance of letter name knowledge for students with autism. Descriptive and inferential statistics were used to compare the scores on the *IED-II* (Brigance). Descriptive statistics are presented in Table 10.

Table 10

Summary of Means and Standard Deviations for Assessments

Assessment	Mean	Std. Deviation	N
Pretest	5.29	7.423	17
Teacher-Led Posttest	15.06	7.996	17
Teacher-Led Maintenance Test	15.00	7.898	17
Computer-Assisted Posttest	13.00	8.595	17
Computer-Assisted Maintenance Test	15.65	8.154	17

Data from the pretest, posttests, and maintenance tests from the *IED-2* (Brigance, 2004) were used to answer the following questions:

1. Do the letter recognition skills of students with autism increase with the use computer-assisted instruction when compared to teacher-led instruction?

2. Are the letter recognition skills of students with autism better maintained after the use of computer-assisted instruction when compared to teacher-led instruction?

It was predicted that the computer-assisted instruction condition would result in increased student ability to recognize letters when compared to the teacher-led instruction. It also was predicted that students would demonstrate improved

maintenance of letters taught in the computer-assisted condition when compared to teacher-led instruction.

Assessments from the counterbalanced groups were combined and a one-way repeated measures ANOVA was conducted to test for significant change across time. The F test was significant [$F(4, 64) = 18.38$, $p<.001$]. This indicates that the students significantly increased their ability to recognize letters at the conclusion of the study (i.e., after having received both interventions) (see Table 11). An alpha level of .05 was set for this analysis.

Table 11

Tests of Within-Subjects Effects for the Alphabet Recognition Assessments Using the Brigance Inventory of Early Development -II

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Effect Size
Time	1265.247	4	316.312	18.384	<.001*	.535
Error (Time)	1101.153	64	17.206			

Note. *$p < .05$.

Further analysis using pairwise comparisons was conducted to determine if either intervention produced superior acquisition and maintenance of letter recognition skills. Pairwise comparisons with Sidek's correction for multiple comparisons revealed significant improvement ($p\leq .001$) from pre-test to all subsequent assessments (see Table 12). All comparisons were calculated with Alpha set at .05. Comparison of pretest scores to the posttest for TLI ($p< .000$) and CAI posttest ($p<.001$) indicted significant gains in letter recognition skills, indicating that the students significantly improved their letter recognition skills after receiving both interventions. A comparison of TLI posttest and

CAI posttest scores did not yield significant differences between the two interventions (p = .944). These findings indicate that while both interventions produced significant improvement in letter recognition skills at all assessment points, CAI was not more effective than TLI for achieving acquisition of letter recognition skills (see Table 12).

Table 12

Pairwise Comparisons of Pretest, Posttests, and Maintenance Tests

(I) Time	(J) Time	Mean Difference (I-J)	Standard Error	Sig.a
Pretest	TLI Posttest	-9.765	1.758	<.001*
	TLI Maintenance	-9.706	1.288	<.001*
	CAI Posttest	-7.706	1.521	.001*
	CAI Maintenance	-10.353	1.625	<.001*
TLI Posttest	TLI Maintenance	.059	.994	1.000
	CAI Posttest	2.059	1.729	.944
TLI Maintenance	CAI Maint. Test	-.647	1.206	1.000
CAI Posttest	CAI Maintenance Test	-2.647	.818	.051

Note. Sidak Adjustment for multiple comparisons. *p< .05

A significant difference between pretest to the TLI maintenance test (p< .001) and to the CAI maintenance (p< .001) was found, indicating the significant gains were maintained for both interventions, despite two weeks without instruction. Further indication of maintenance is evidenced by a comparison of the TLI posttest to TLI maintenance tests. This comparison indicated no significant difference (p = 1.000). Similarly, a comparison of the CAI posttest to the CAI maintenance test also found no significant difference (p = .051). These findings indicate that both interventions produced

letter recognition skills that were maintained after two weeks without instruction (see Table 12).

A comparison between the CAI and TLI maintenance tests was conducted to determine if TLI or CAI produced superior maintenance of letter recognition skills. The comparison of TLI and CAI maintenance scores revealed no significant difference ($p = 1.000$), indicating that although both interventions produced durable gains, neither intervention was significantly better for achieving maintenance of learned letters (see Table 12).

Analysis of Behavior Measures

An observer viewed and scored all videotaped sessions for student attention-to-task and undesirable behaviors for comparison between the CAI and TLI interventions. Data collected from videotaped sessions were used to answer the following questions:

3. Do the undesirable behaviors of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

4. Does the attention-to-task of children with autism differ depending on computer-assisted instruction or teacher-led instruction?

It was predicted that students would demonstrate increased attention during the computer-assisted instruction condition when compared to the teacher-led instruction condition. It also was predicted that the students would demonstrate fewer undesirable behaviors during the computer-assisted condition when compared to the teacher-led condition.

Attention-to-task and undesirable behavioral data were collected via videotape observations and were analyzed in order to determine if a significant difference existed

between the attention-to-task behaviors and undesirable behaviors according to teacher-led instruction and computer-assisted instruction. Paired samples statistics of behavioral data are provided in Table 13. The findings indicate that CAI yielded a moderately high rate of attention (65.6% of all intervals) and a very low rate of undesirable behavior (6.4% of all intervals). Similarly, TLI produced a slightly higher rate of attention (76.3% of all intervals and a lower rate of undesirable behavior (4.7% of all intervals).

Table 13

Paired Sample Statistics of Attention-to-Task and Undesirable Behaviors in Computer-Assisted Instruction and Teacher-Led Instruction

	Mean	N	Standard Deviation	Standard Error Mean
Pair 1				
CAI Attention	0.6559	17	0.1949	0.0473
TLI Attention	0.7630	17	0.1504	0.0365
Pair 2				
CAI Und. Behavior	0.0639	17	0.0766	0.0186
TLI Und. Behavior	0.0472	17	0.0658	0.0160

Paired samples *t*-tests were used to determine if there were significant differences in attention between CAI and TLI conditions, as well as undesirable behavior between CAI and TLI. The first *t*-test compared the mean of attention-to-task during CAI to the mean of attention-to-task during TLI. The findings indicate no significant difference for attention-to-task between interventions ($p = .089$); neither instructional intervention produced a superior rate of attention-to-task behavior. A second paired samples *t*-test was used to evaluate differences in undesirable behavior between the CAI and TLI interventions. The data indicated no significant difference of undesirable behaviors (p =

.554), indicating that neither intervention produced a lower rate of undesirable behaviors. The results from these analyses are in Table 14. Alpha was set at .05 for these analyses.

Table 14

Summary of Paired Samples t-Tests of Attention to Task and Undesirable Behavior in Computer-Assisted Instruction and Teacher-Led Instruction

	Paired Differences					
	Mean	Std. Dev.	Standard Error Mean	t	df	Sig. (2-tailed)
CAI and TLI Attention to Task	-0.1071	0.2438	0.1138	-1.812	16	.089
CAI and TLI Undesirable Behavior	0.0167	0.0591	0.0276	0.604	16	.554

Analysis of Teacher Attitudes and Beliefs Survey

Teacher participants completed a survey adapted from the *Teachers' Attitudes Toward Computers Questionnaire* (Christensen & Knezek, 1998) to assess their attitudes concerning the use of computers in early childhood special education classrooms prior to and at the conclusion of the study (see Appendix C). The survey consisted of 26 statements using a Likert-type scale and 10 semantic items that required the teachers to place a mark on a line between two adjectives describing CAI indicating a positive or negative attitude or belief. Likert-type items were positive statements about CAI that could be rated between 1 (strongly agree) to 5 (strongly disagree). Scores approaching 26 points (the minimum score) indicated the most positive attitudes and beliefs and scores approaching 130 points (the maximum score) indicated the most negative attitudes and beliefs. The responses to the statements from the teachers were combined and the semantic items measured to answer the following question:

1. What attitudes do preschool special education teachers of students with autism have regarding computer-assisted instruction prior to and after the intervention? It was predicted that teachers would provide negative attitudes and beliefs regarding the integration of computer-assisted instruction prior to the CAI intervention condition and show an increase in positive attitudes following the CAI intervention.

Independent *t*-tests were used to determine differences in attitudes and beliefs toward CAI before and after the study. The Likert-scale data from the surveys were used to calculate descriptive statistics for paired *t*-tests. The findings indicated positive attitudes and beliefs at pretest with a mean response to Likert-scale items of 47.22. The findings after the study indicated a slight decrease in positive attitudes and beliefs on Likert-scale items (see Table 15). A paired samples *t*-test was conducted to determine if the difference was significant. The findings indicated no statistically significant change in attitudes and beliefs on the Likert-scale items of the survey conducted before and after the interventions (see Table 16), indicating that the attitudes and beliefs of the teachers remained positive prior to and following the study.

Table 15

Descriptive Statistics of Pre- and Post Likert-Scale Survey Results

	Mean	N	SD	Std. Error Mean
Likert Pre	47.22	9	12.357	4.119
Likert Post	55.56	9	23.490	7.830

Table 16

Paired Samples Test of Pre- and Post Likert-Scale Survey Results

	Paired Differences					
	Mean	SD	Std. Error Mean	t	df	Sig. (2-tailed)
Pre - Post	-8.333	26.101	8.700	-.958	8	.366

The survey also included a semantic evaluation that required the teachers to place a mark on an 8cm line between a negative and positive adjective describing CAI (see Appendix C). The marks were measured in centimeters and combined to obtain a value. A combined score approaching 0cm was the lowest possible score and indicated the most negative attitudes toward CAI. A combined score of 40 was considered neutral. A combined score of 80cm was the highest possible score and indicated the most positive attitude on the semantic items. The results of the combined scores are in Table 15. The mean score for the semantic items prior to the study was 63.13, indicating positive attitudes towards CAI. The results collected after the study indicated a slight decline in attitude with a mean score of 61.14 (see Table 17).

Table 17

Descriptive Statistics of Pre- and Post Semantic Scale Results

	Mean	N	SD	Std. Error Mean
Semantic Pretest	63.13	9.00	14.03	4.68
Semantic Posttest	61.14	9.00	11.23	3.74

These descriptive data were used for a paired samples *t*-test to determine if there was a significant change in opinion, according to semantic items, towards CAI from before to after the study. The results were not significant [t(8) = .592, p=.570] (see Table

18). These findings indicate that although CAI appeared to increase letter recognition skills, the attitudes and beliefs of the teachers toward the integration of computer technology into their classroom did not significantly increase, but did remain positive.

Table 18

Paired Samples Test of Pre- and Post Semantic Scale Survey Results

	Paired Differences					
	Mean	SD	Std. Error Mean	t	df	Sig. (2-tailed)
Pre - Post	1.989	10.075	3.358	.592	8	.570

CHAPTER 5

DISCUSSION

Current research indicates that people with autism are at risk for developing poor literacy skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005). Without adequate and efficient literacy instruction, it is possible that children/youth with autism will become adults who lack the skills necessary for gainful employment, daily living, and social interaction (Education for All Global Monitoring Report Team, 2005). This often results in students with autism experiencing limited academic achievement and social opportunities and depending on others for life-defining levels of support (Alberto & Hefflin, 2007). By acquiring even basic literacy skills, students with autism are able to succeed in school, achieve independence, and participate in their community (Copeland, 2007). Because the behavioral characteristics of autism often result in more restrictive educational placements (Prior & Ozonoff, 2007), students with autism receive instruction focused on behavior and often receive no literacy-based instruction (Mirenda, 2003).

Current research calls for the identification of appropriate instructional delivery models that are effective and efficient for improving the educational and social of outcomes for students with autism (Alberto & Heflin, 2007). Unfortunately, the research literature pertaining to early literacy instruction for this population is limited and to date no study has examined interventions designed to teach alphabetic skills to preschool-age children with autism.

The purpose of this study was to examine if students with autism learn to identify and maintain letter names more efficiently using traditional teacher-led instruction (TLI) or computer-assisted instruction (CAI). Additionally, this study measured the behavior of students with autism during TLI and CAI to determine what differences, if any, were

observed across the two instructional conditions. It was believed that CAI would produce better acquisition and maintenance of letter names. It also was predicted that students would demonstrate higher rates of attention-to-task behavior and lower rates of undesirable behavior during CAI when compared to TLI.

The attitudes of teacher participants concerning the use of technology for instruction also was measured prior to and at the conclusion of the study using a survey. It was predicted that the teachers would increase their positive attitudes and beliefs concerning CAI from before to after the study.

This study involved 17 students with autism from nine self-contained preschool classrooms in eight public elementary schools. The schools were located in a major urban school district in the southwest. All students were between the ages of three and six years, were from diverse backgrounds, and exhibited difficulties identifying letters of the alphabet.

Classes were assigned randomly to instructional conditions and students were taught the names of letters using TLI and lessons presented via CAI for four weeks in each condition. Both interventions consisted of 16 sessions lasting 10-minutes each. Half of the students received TLI and then CAI and the remaining half received CAI followed by TLI. All intervention phases were followed by a posttest, a two-week period without instruction, and another assessment to determine maintenance of skills. The effects of each intervention on student attention and undesirable behaviors were observed via videotapes of the TLI and CAI sessions.

Acquisition and Maintenance of Alphabetic Skills

The students were administered the *Brigance Inventory of Early Development-II* (*IED-II*)(Brigance, 2004) five times throughout the study: (a) prior to the study, (b) immediately following the first intervention period (either CAI or TLI), (c) two weeks (without instruction) after the first intervention, (d) immediately following the second intervention period (CAI or TLI), and (d) at the conclusion of the second maintenance period. The students received CAI for four weeks and TLI for four weeks. The students were divided into two groups and the delivery of the interventions was counterbalanced.

Question One dealt with the comparison of the letter recognition skills of the students after receiving CAI and TLI in order to ascertain if CAI produced better skill acquisition when compared to TLI. Data from the *IED-II* (Brigance, 2004) were analyzed to ascertain if there were significant main effects (differences over time) due to the interventions and an interaction effect due to intervention type (CAI versus TLI). It was predicted that CAI would produce greater gains in the letter recognition skills of the participants when compared to TLI.

The data show that there was a significant main effect for CAI over time. This finding means that CAI successfully increased student ability to recognize letters of the alphabet. The data also indicate that there was a significant main effect for TLI over time, meaning that TLI also significantly increased student ability to recognize letters of the alphabet. However, no interaction effect between the TLI and CAI interventions was found. These findings imply that both interventions had similar, but significant effects on the alphabet recognition skills of the students.

Through the use of the software and alphabet books used in this study, young children with autism learned alphabetic skills. The effectiveness of both interventions

may be due to the process used when designing the interventions. Features of well-designed CAI for students with autism were incorporated into the creation of the software used in this study (Boone & Higgins, 2001; 2007; Williams, Wright, Callaghan, & Murphy, 2001). The specific components were: (a) multimedia, (b) stimulating sounds, (c) graphics, and (d) animation (Boone & Higgins, 2007). Other elements of instructional software for students with disabilities that were incorporated into the instructional design of the software were: (a) appropriate feedback and evaluation, (b) content specific to the learning characteristics of the student, (c) user interface, and (d) accessibility (Boone & Higgins). The positive findings concerning the CAI intervention demonstrate the importance of considering the instructional design process and components when developing software for students with autism. It appears that if these features are incorporated into the design of instructional software, then children with autism will learn the skill being taught.

The software also incorporated well-established behavioral teaching methods including: (a) consistent cues to elicit behavior, (b) affirmative and corrective feedback, (c) built-in prompts, (d) systematic prompt fading to promote independence, and (e) discrimination training (National Research Council, 2001). While this type of teaching routine is often difficult for teachers to master (Goodman, Brady, Duffy, Scott, & Pollard, 2008), it appears that the routine can be programmed into instructional software effectively. Thus, research-based instructional routines for students with autism are transferable to the digital environment and result in positive learning outcomes. It appears that when high-quality instructional software is combined with proven behavioral teaching methods, young children with autism can learn without the involvement of an adult.

Boone and Higgins (2005, 2007) maintain that formative evaluation of instructional software historically has been neglected. This study incorporated experts in reading and software design, teachers, and children in the pre-development phase of both the software and teacher-led learning materials. As a result of this formative evaluation of the CAI and the TLI interventions, several changes were made throughout the process of developing the software and alphabet books. The findings of this study are similar to the work of Boone and Higgins that show the importance of expert, practitioner, and child feedback in the development of educational material for students with disabilities. It appears that the design of effective software for students with autism must incorporate: (a) the essential software characteristics as outlined by Boone and Higgins (2005), (b) behavioral teaching routines, and (c) formative evaluation by experts, teachers, and children. It appears that this triangular approach to instructional software development results in educational improvement in children with autism.

The students in this study also learned alphabetic skills with the alphabet books created for the study. Similar features from the software (e.g., consistent cues, feedback, prompting, shaping, interesting and motivating stimuli, active student participation, and repeated exposure) were incorporated into the alphabet books used during TLI. These qualities have been identified as key elements of effective teaching for students with autism (National Research Council, 2001). However, it appears that these instructional components can be difficult for teachers to consistently implement (Goodman, Brady, Duffy, Scott, & Pollard, 2008). In this study, the teachers taught from scripted TLI materials. The TLI alphabet books directed the teacher in what to say, when to say it, and when to move forward in the book. Thus, there was little room for teacher error in implementing the instructional routine. It appears that these scripted instructional

procedures improved the consistency of instruction and may have made the teachers more effective teachers in this situation.

The alphabet books incorporated several popular characters from television and movies. The illustrations were familiar to the students and many were chosen based on teacher and child feedback during formative evaluation. Revisions of the alphabet books also were based on the feedback of the expert. Specifically, expert feedback resulted in clarification of teacher instructions, shortening of scripts, and the use of bold type in the scripts to aid the teachers in following the instructional routine. Because each alphabet book was repetitious, many teachers mastered the delivery of instruction by the second week of the instruction (e.g., consistent delivery of cues, feedback, and story lines). This suggests that teachers, when provided with a teaching routine, can provide systematic behaviorally-based instruction that results in positive learning outcomes for students with autism. It also demonstrates the importance of formative evaluation in the design and creation of instructional materials for this population of students.

It may be that both interventions were effective because they were developed using similar processes. The reliance on research during the development of both interventions as well as expert, teacher, and student formative evaluation appears to be critical to the success of the interventions. It seems unlikely that the interventions would have been successful without this process. The findings suggest that because the interventions developed for this study were research-based and refined according to expert, teacher, and child input, the students in both conditions were successful in learning the letters of the alphabet that were taught.

Question Two was concerned with the efficiency of skill maintenance following the interventions. The maintenance data obtained from the *IED-II* (Brigance, 2004) were

analyzed to ascertain if a main effects (differences over time) and an interaction effect due to intervention type (CAI versus TLI) existed for the maintenance data.

The data indicated significant main effects for both interventions after the maintenance period, indicating that both interventions produced significant gains between pretest and maintenance test (both TLI and CAI). Significant main effects were not obtained for TLI posttest and TLI maintenance test data nor CAI posttest and CAI maintenance test data. There was no interaction effect between CAI and TLI maintenance test scores. These findings indicate that both TLI and CAI produced durable gains in alphabet recognition skills and that both interventions yielded similar maintenance scores.

Early and intensive intervention is crucial to achieving positive outcomes for children with autism (NRC, 2001). The timeliness of early intervention is vital to achieving better outcomes (NRC). As a result, preschool-age children with autism often are provided with 30 to 40 hours a week of school and/or home-based intervention that focuses on: (a) promoting behaviors associated with school readiness (e.g., listening, following directions, imitating, communicating) and (b) decreasing or replacing behaviors that are counterproductive (e.g., self-stimulatory behaviors, tantrums) (Cohen, Amerine-Dickens, & Smith, 2006). Consequently, teacher emphasis on behavior and school-readiness skills may come at the cost of academic skills due to limited resources or perceptions of student ability (Mirenda, 2003).

The amount of resources required to teach school-readiness and modify behavior suggests that educators must be provided with emergent literacy interventions that are highly efficient. Specifically, teachers of students with autism need interventions that can be implemented easily and quickly, require little planning, and produce significant and

durable effects. Unfortunately, an agreed definition of instructional efficiency in special education has remained elusive (Leiber & Semmel, 1985; Yoder, 2001). The interventions in this study may be considered efficient for three reasons. First, they were designed to require very little teacher resources during implementation. Second, the students significantly improved their ability to recognize letters with only 10-minutes of instruction (TLI or CAI) per day, four days per week over two four-week periods. Third, the students maintained the skill despite two weeks without instruction, suggesting that frequent review of the skill may not be necessary.

The interventions in this study required very little teacher resources. The software was provided on a disc and easily installed. The books were prepared based on pretest results and provided to the teachers. Because the teacher participants were trained in delivering the interventions, there was no need for them to create lesson plans or otherwise prepare for the intervention. The TLI lessons were delivered to a whole group of students (versus the typical one-on-one instruction in early intensive behavioral intervention), requiring only 10 minutes of instruction. The CAI briefly required teacher time (to start the lesson for the student) and then allowed her/him to perform other duties while the students received CAI. The low demand of teacher time and resources may have contributed to the success of both interventions. The lessons were effective, easily infused into the daily routine, and required very little teacher resources.

Further support for efficiency may be the relatively small amount of instructional time dedicated to each of the two interventions. The students showed significant letter recognition in each intervention (CAI and TLI) despite only receiving 10-minutes of explicit, daily instruction, for four days a week. Although the lessons were short, they repeatedly exposed students to letter names and provided opportunities to interact with

the teacher or computer. The teacher-led lessons may be considered efficient in that the lessons were delivered to several students simultaneously and produced significant, lasting results. The CAI lessons may be considered efficient in that they were delivered to the students in the absence of the teacher while still achieving significant and durable gains in letter naming skills. Since both interventions were effective for producing robust and lasting gains in a relatively small amount of time, teachers may be afforded the luxury of choosing, perhaps on a daily basis, which method to use in the classroom.

The children in this study demonstrated gains during both interventions that were sufficiently maintained after two weeks without instruction. The lasting effects of the gains made by the children in this study suggest that when well-designed instructional interventions are implemented, students can make gains that need not be continuously revisited. Without having to frequently review content, teachers are able to dedicate resources and time to other classroom responsibilities.

Teachers may be more likely to adopt interventions that can be integrated into the classroom routine without requiring a significant reallocation of current resources or time structure. Therefore, it seems that solely relying on research and formative evaluation during the design and development process may not be enough to convince teachers to use an intervention. Instead, it also may be important to consider the ease with which the interventions can be implemented, as well as the amount of resources teachers will need for consistent implementation.

Behavioral Effects of Computer-Assisted Instruction and Teacher-Led Instruction

An observer viewed all videotaped instructional sessions to obtain scores for attention-to-task behavior and undesirable behavior. The attention-to-task and

undesirable behaviors in both intervention conditions (CAI and TLI) were collected for comparative analyses. Two separate analyses were conducted. The first compared attention-to-task between TLI and CAI. The second analysis compared undesirable behavior between TLI and CAI.

Students with autism often attend to irrelevant information from the environment (Frith, 1989; Lovaas, Koegel, & Schreibman, 1979; Lovaas, Schreibman, Koegel, & Rehm, 1971). Question Three centered on the mean rate of attention during the CAI and TLI interventions with the hypothesis that attention-to-task would be higher during CAI when compared to TLI. These data were collected from all videotaped sessions using whole interval recording of 10-second intervals. The data from the children were compared using paired samples *t*-tests.

Descriptive statistics indicated that the mean attention-to-task during TLI was 10.7% higher during TLI when compared to CAI. However, despite this finding, the data indicated that the difference in attention-to-task behavior between TLI and CAI was not significant. The rate of attention was similar during both interventions. This means that the children attended to the alphabet lessons in both instructional conditions.

The CAI and TLI interventions were designed with the intent of providing interesting and motivating stimuli. The software utilized stimulating graphics, sound effects, interactive games, and animation. The alphabet books included illustrations of popular characters from children's television programs and films. The CAI lessons provided repeated opportunities to interact with the software, requiring active learning. The TLI lessons also provided opportunities for students to interact with the book. The active participation in both instructional conditions, in conjunction with the use of the

characters in the alphabet books and the multimedia design of the software may have boosted attention during both interventions.

Several teachers reported that children, including those who were not participating in the study, demonstrated a high degree of interest in the software and alphabet books. Some teachers indicated that the initial poor attention of some students during the computer lessons was replaced with higher rates of attention. Some teachers also indicated that students requested to use the software and look at the alphabet books. Observation of the videotaped lessons found that there were many instances, during or after the lessons, when: (a) peers approached the computer to observe or interact with the user and/or software, and (b) verbal and nonverbal students were overheard saying letters, words, or phrases from both the TLI and CAI interventions. These observations seem to support the observation that the children were motivated and interested during both instructional conditions. Increasing motivation to learn is essential for students with autism because they typically have difficulty attending (Koegel, Koegel, Frea, & Smith, 1995).

It may be that the use of highly interesting character illustrations is vital for teaching alphabet skills using teacher-led instruction. It also may be that students with autism are highly motivated and interested in CAI that uses multimedia instruction and educational games. It seems likely that the motivating and interesting stimuli in both interventions played a central role in the high rates of attention exhibited by the students.

Autism is characterized by engagement in behaviors that often interfere with learning (APA, 2000). Question four explored the differences in undesirable behaviors (e.g., tantrums, self-stimulatory behaviors, aggression, self-injury) during CAI and TLI. These data were collected from all videotaped sessions using partial-interval recording of

10-second intervals. The data collected were analyzed using a paired samples *t*-test. Descriptive statistics indicated very low rates of undesirable behaviors during both CAI and TLI interventions with slightly lower rates during TLI (mean of 4.7%) when compared to CAI (mean of 6.4%). However, the paired samples *t*-test indicated no statistically significant difference of undesirable behaviors between interventions. These findings indicate that very low rates of problem behavior occurred during both TLI and CAI and that instructional method did not significantly influence undesirable behaviors. Both interventions resulted in low and similar rates of undesirable behaviors.

Because they often lack communication skills, students with autism often engage in undesirable behaviors in order to communicate a desire to escape an activity (Chandler & Dahlquist, 2010). Specifically, students with autism use tantrum, aggressive, or self-injurious behaviors to escape the demands of the teacher (Chandler & Dahlquist). In this study, very low rates of problem behavior were observed during the CAI or TLI interventions. The motivating qualities of the interventions may have influenced the rate of undesirable behavior. The students exhibited high levels of interest in the lesson, as indicated by low rates of undesirable behavior. Thus, the students in both the CAI and TLI conditions were involved in their own learning and were not attempting to escape from the learning activity through the use of undesirable behaviors. This finding is important in that the prerequisite skills of behavioral and school-readiness (e.g., communication, compliance, imitation, attending, sitting) may not be as necessary as previously thought for academic learning to occur for this population.

The low rates of undesirable behaviors and high rates of attention-to-task behaviors exhibited by the students in this study may suggest that providing well-designed, motivating, and stimulating early literacy instruction to preschool children with

autism is warranted. Withholding literacy instruction for these children may actually contribute to ongoing attention and behavior problems. Conversely, if students with autism are provided with emergent literacy interventions that are highly motivating and stimulating, increased attention, low rates of undesirable behaviors, and literacy learning may be achieved. One potential implication is that young children with autism who are capable of learning literacy skills should not be denied access to instruction (Mirenda, 2003). Some teachers believe that other skills must first be mastered before students are given access to literacy instruction (Mirenda). However, the findings in this study suggest this interpretation may be unfounded. Teaching literacy skills may result in widespread gains related to behavior, attention, and academic learning.

Teacher Attitudes and Beliefs Survey

To measure the social validity of the CAI intervention, teachers completed a survey adapted from the *Teachers' Attitudes Toward Computers Questionnaire* (Christensen & Knezek, 1998) (see Appendix C). The survey consisted of 26 Likert-type items and 10 semantic items. The data obtained from the survey administered prior to the study were compared to data collected at the conclusion of the study to determine if changes in teacher attitude occurred over time.

Question five was focused on the attitudes and beliefs held by the participating teachers toward CAI prior to and following the study. Descriptive statistics indicated positive attitudes and beliefs toward CAI prior to and after the study on the Likert-type items and the semantic items. A paired samples *t*-test was used to compare mean responses on the Likert-type items as well as the semantic items. No significant differences were found, indicting that the teachers had similar positive attitudes and

beliefs prior to and at the conclusion of the study.

The positive attitudes of the teachers may indicate that CAI in early childhood classrooms has reached a point of widespread acceptance. It may be that the time has come to no longer survey educators concerning their attitudes toward technology and its use and instead begin focusing on the specific instructional components teachers believe necessary for effective and efficient CAI. This type of inquiry would fit into the formative evaluation model of instructional design and development. Thus, teachers could provide suggestions into the development of technology-based instruction as well as more traditional book-based interventions.

Conclusions

There are nine conclusions that can be drawn from this study. They are based on the quantitative data that were collected. The limitations of this study should be considered when evaluating these conclusions.

1. Preschool-age students with autism can use CAI independently to learn an early literacy skill in self-contained autism classrooms.
2. Preschool age children with autism can learn alphabetic skills during traditional, book-based, small group instruction that incorporates behavioral teaching methods and direct-instruction.
3. Both TLI and CAI were effective interventions for promoting the acquisition and maintenance of alphabet recognition skills for preschool students with autism.
4. The alphabet books and instructional software were effective because they both were developed according to research on teaching methods for students with autism and software design for students with disabilities.

5. Formative evaluation by experts, teachers, and children yielded intervention qualities that produced positive and lasting effects on student learning and behavior.
6. The TLI and CAI were efficient interventions because they required little teacher resources, achieved desired effects in a small amount of time, and were easy to incorporate into the daily classroom routine.
7. Well-designed interventions that also incorporate interesting and motivating qualities can produce high rates of attention and low rates of undesirable behavior in preschool students with autism.
8. Preschool students with autism should have access to quality literacy interventions regardless of limits in current school-readiness skills or behaviors.
9. Teachers with positive attitudes and beliefs regarding the use of CAI in self-contained preschool classrooms can effectively implement CAI for young students with autism.

Recommendations for Future Studies

Access to literacy instruction is a civil right (Yoder, 2001), yet children with autism are at-risk for developing poor literacy skills (Coleman-Martin, et al. 2005) and often are perceived as not needing literacy instruction (Mirenda, 2003). Preschool-age children with autism often exhibit deficits in attention and behavior that negatively impact learning (NRC, 2001). With research in autism primarily focusing on early intensive behavioral intervention programs (Cohen, et al., 2006; Lovaas, 1987), there is little scientific exploration of other aspects of developmentally-appropriate early childhood education (e.g., literacy skills). Consequently, little is known about what types

of interventions are effective for teaching emergent literacy skills to children with autism. Also lacking is an understanding of the specific intervention components that may be essential to achieve desired academic effects. The following recommendations for future study are based on the results of this study.

1. A compilation of research-based, early intervention literacy instructional interventions should be constructed. From this, a checklist should be created to which developers can refer when considering the design and development of CAI instruction for students with autism.
2. Future studies should examine intervention components that educators perceive to be essential to an efficient literacy intervention for children with autism. This should consider the efficiency components that teachers need to adequately implement instruction with young children.
3. To better understand the effects of well-designed literacy interventions on student behaviors, a replication of this study should compare student baseline behaviors to student behaviors during the instructional phase. An alternating treatments design maybe appropriate.
4. It may be that a combination of TLI and CAI interventions may yield superior outcomes for acquisition and mastery of alphabetic skills. A comparison of the combined interventions to stand alone interventions should be explored.
5. A variation of this study should examine the effects of a CAI used as an advanced organizer before the TLI as well as a follow up activity to the TLI.
6. This study should be expanded to more complex early literacy skills for children with autism such as phonemic and phonological awareness.

7. A replication of this study should be conducted that incorporates the CAI used in the study combined with assistive technology (e.g. touch screens, smartboards) for students with limited motor skills (e.g., mouse, trackball).
8. Future studies should focus on the development of a valid scope and sequence of early literacy instruction for young children with autism as well as best practices for the use of digital and traditional instruction.
9. Research should explore the effects of other digital (e.g., iPads, iPods, smartboards) and traditional technologies to teach other early learning concepts (e.g., sizes, shapes, positions, body parts) to students with autism.
10. Longitudinal studies should be conducted that examine learning outcomes for students with autism to determine the type of literacy instruction (TLI or CAI) that is best suited to specific literacy skills.
11. Future studies should explore the effects of one-to-one TLI to one-to-one CAI as well as small group TLI to small group CAI for teaching literacy skills to children with autism
12. The impact that student ownership of materials should be examined to determine if ownership influences the behaviors and learning of students with autism .
13. Future studies should examine the effects of literacy interventions for students with specific learning profiles (e.g. low versus high functioning students).

Summary

Studies of early literacy with children with disabilities indicate that desirable gains are achieved when interventions infuse interesting and stimulating activities with adult guidance (Johnston, Davenport, Kanarowski, Rhodehouse, & McDonnell, 2009;

Justice, Chow, Capellini, Flanigan, & Colton 2003; Katims, 1991). This study demonstrates that preschool children with autism can achieve early literacy gains when provided with individualized computer-assisted instruction (CAI) or teacher-led instruction (TLI) delivered to small groups of children. To date, no studies have reported the effects of CAI or TLI interventions for teaching alphabetic skills to preschool-age children with autism.

Previous research has focused on the effects of multifaceted interventions with CAI and other assistive technologies to achieve specific and broad emergent literacy gains in students with autism (Bellon, et al., 2000; Koppenhaver & Erickson, 2003). This study targeted a specific skill and found that well-designed CAI, utilizing multimedia, improves learning in students with autism, maintains the learning of these students, and produces desired behaviors that are conducive to learning which is similar to other findings (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001; Chen & Bernard-Opitz, 1993). The results of this study also indicate that CAI can be used to teach a fundamental early literacy skill in preschool classrooms for students with autism and that it produces results consistent with well-designed, research-based teacher-led literacy lessons.

In this study, teachers reported positive attitudes and beliefs toward CAI prior to and after the study, suggesting that perhaps these factors may play an important role in the effectiveness of CAI in preschool classrooms for students with autism. If teachers are enthusiastic about CAI, are provided with training to implement it, and believe it to be an effective method for teaching literacy skills, they may be more inclined to incorporate CAI onto the daily classroom routine. This is important as more and more technology is included in the learning environment for young children.

Today, more and more children are being identified as having autism (Centers for

Disease Control, 2009). As these children move into the school setting, it is imperative that researchers identify academic instructional strategies, routines, and interventions that will increase the inclusion of these students into the mainstream of the school environment and society. The existing body of research acknowledges that students with autism are at-risk for literacy delays (Coleman-Martin, Heller, Cihak, & Irvine, 2005), however, this same body of research has failed to adequately explore emergent literacy for preschool age children with autism. Because early literacy ability is a predictor of later school success and life success (Adams, 1990), it is imperative that researchers and educators work together to design and develop appropriate literacy instruction for this population. Well-designed teacher-led literacy interventions as well as computer-assisted literacy instruction show promise as effective and efficient methods to achieve this goal.

APPENDIX A

TEACHER-LED INSTRUCTION FIDELITY CHECKLIST

Teacher Fidelity Checklist

Person Completing:______________________ Class ID:______
Date___________

Target Letter:_________ Mastered Letters_________

1. Was camera setup completed prior to start of lesson?	☐ YES ☐ NO
2. Were students sitting within direct line of sight of book and within 5 feet of teacher?	☐ YES ☐ NO
3. Did teacher read the book and chapter as prescribed for week and day of intervention?	☐ YES ☐ NO
4. Did teacher adhere to the scripts in the book?	☐ YES ☐ NO
5. Did all students have at least 3 opportunities to point to or say a letter?	☐ YES ☐ NO
6. Did teacher deliver the prescribed lesson for 8-12 minutes	☐ YES ☐ NO
7. Were the proper letter cards attached in random order as prescribed?	☐ YES ☐ NO

APPENDIX B

COMPUTER-ASSISTED INSTRUCTION FIDELITY CHECKLIST

Computer-Assisted Instruction Treatment
Fidelity Checklist

Person Completing:________________________ Class ID:______
Date____________

Student ID _____________________ Target Letter:_______ Mastered Letters________

1. Was camera setup completed prior to start of lesson?	☐ YES ☐ NO
2. Was proper lesson selected and started for student?	☐ YES ☐ NO
3. Was student given 8-12 minutes to interact with the software?	☐ YES ☐ NO

APPENDIX C

TEACHER ATTITUDES AND BELIEFS SURVEY

TEACHER ATTITUDES AND BELIEFS SURVEY

DATE: ________________________________

Directions: Circle the number that best describes your opinion of the statement

1 = SA: Strongly Agree
2 = A: Somewhat Agree
3 = U: Unsure
4 = D: Somewhat Disagree
5 = SD: Strongly Disagree

	SA	A	U	D	SD
1. The use of computer-assisted instruction makes the student feel more involved.	1	2	3	4	5
2.The use of computer-assisted instruction helps provide a better learning experience.	1	2	3	4	5
3. The use of computer-assisted instruction makes learning letters more interesting.	1	2	3	4	5
4. The use of computer-assisted instruction helps the student to learn more.	1	2	3	4	5
5. The use of computer-assisted instruction increases motivation to do the task.	1	2	3	4	5
6. More early childhood special education classrooms should use computer	1	2	3	4	5
7. The use of computer-assisted instruction creates more interaction between students in the classroom.	1	2	3	4	5
8. The use of computer-assisted instruction creates more opportunities for students to learn the curriculum.	1	2	3	4	5
9.Computer-assisted instruction provides better access to the curriculum.	1	2	3	4	5
10. Computer-assisted instruction is an effective means of teaching students with autism.	1	2	3	4	5
11. I prefer computer-assisted instruction to traditional methods for teaching letter names to students with autism.	1	2	3	4	5

Adapted from *Teachers' Attitudes Toward Computers Questionnaire* by G. Knezek & R. Christensen (1997).

Directions: Circle the number that best describes your opinion of the statement.

1 = SA: Strongly Agree 2 = A: Somewhat Agree 3 = U: Unsure 4 = D: Somewhat Disagree 5 = SD: Strongly Disagree

	SA	A	U	D	SD
12. Computers increase student productivity.	1	2	3	4	5
13. Computer assisted instruction will help students with autism learn.	1	2	3	4	5
14. I feel computers are necessary tools in both educational and work settings.	1	2	3	4	5
15. Computers can be a useful instructional aid in almost all subject areas.	1	2	3	4	5
16. Computers improve the overall quality of life.	1	2	3	4	5
17. Knowing how to use computers is a worthwhile skill.	1	2	3	4	5
18. Having more computers available to my students would improve my teaching.	1	2	3	4	5
19. Computers will improve early childhood education.	1	2	3	4	5
20. Computers can be used successfully with preschool students during creative activities.	1	2	3	4	5
21. Teacher training should include instructional applications of computers.	1	2	3	4	5
22. My students will need a firm mastery of computers.	1	2	3	4	5
23. I believe that it is important for my students to learn how to use a computer.	1	2	3	4	5
24. Computers increase student productivity.	1	2	3	4	5
25. Computer assisted instruction will help students with autism learn.	1	2	3	4	5
26. I feel computers are necessary tools in both educational and work settings.	1	2	3	4	5

Adapted from *Teachers' Attitudes Toward Computers Questionnaire* by G. Knezek & R. Christensen (1997).

Directions: Place an 'x' between each adjective pair to indicate how you feel about the object.

Computer-assisted Instruction is:

1.	Unpleasant	______________________________	Pleasant
2.	Suffocating	______________________________	Fresh
3.	Dull	______________________________	Exciting
4.	Unlikable	______________________________	Likable
5.	Uncomfortable	______________________________	Comfortable
6.	Bad	______________________________	Good
7.	Unhappy	______________________________	Happy
8.	Tense	______________________________	Calm
9.	Empty	______________________________	Full
10.	Artificial	______________________________	Natural

Adapted from *Teachers' Attitudes Toward Computers Questionnaire* by G. Knezek & R. Christensen (1997).

APPENDIX D

ATTENTION TO TASK DATA COLLECTION SHEET

Attention to Task Data Collection Sheet

Student ID______________________________________ Class ID_______________ Session ID________

Rater Name____________________________________ Date Rated______________________________

Attention to task behavior is defined as: sitting in seat and looking at source of instruction under typical instructional circumstances.

											Row Totals	
Time	:10	:20	:30	:40	:50	1:00	1:10	1:20	1:30	1:40	**Row Totals**	
Interval #	1	2	3	4	5	6	7	8	9	10	Scored	Unscored
Occurrence												
Time	1:50	2:00	2:10	2:20	2:30	2:40	2:50	3:00	3:10	3:20	**Row Totals**	
Interval #	11	12	13	14	15	16	17	18	19	20	Scored	Unscored
Occurrence												
Time	3:30	3:40	3:50	4:00	4:10	4:20	4:30	4:40	4:50	5:00	**Row Totals**	
Interval #	21	22	23	24	25	26	27	28	29	30	Scored	Unscored
Occurrence												
Time	5;10	5:20	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	**Row Totals**	
Interval #	31	32	33	34	35	36	37	38	39	40	Scored	Unscored
Occurrence												
Time	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	**Row Totals**	
Interval #	41	42	43	44	45	46	47	48	49	50	Scored	Unscored
Occurrence												
Time	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	**Row Totals**	
Interval #	51	52	53	54	55	56	57	58	59	60	Scored	Unscored
Occurrence												

APPENDIX E

UNDESIRABLE BEHAVIOR DATA SHEET

Undesirable Behavior Data Collection Sheet

Student ID________________________________ Class ID____________________________ Session ID___________

Rater Name_______________________________ Date Rated_________________________

Undesirable Behaviors: are **self-stimulatory behaviors** (e.g., hand-flapping, finger flicking, rocking, staring, or similar), **self-injurious behaviors** (e.g., hitting self, pulling own hair, biting self, scratching self, smacking self, or similar), **aggressive behaviors** (e.g., hitting others, kicking others, scratching others, pulling hair, biting others, or similar), or **tantrum behaviors** (e.g., hitting objects, throwing objects, screaming, crying, flopping on floor, kicking floor, or similar).

MARK "X" IF THE BEHAIVOR OCCURS IN THE INTERVAL. MARK "O" IF THE BEHAVIOR DOES NOT OCCUR IN THE INTERVAL

MARK "X" IF THE BEHAIVOR OCCURS THROUGHOUT THE INTERVAL. MARK "O" IF THE BEHAVIOR DOES NOT.

Time	:10	:20	:30	:40	:50	1:00	1:10	1:20	1:30	1:40	**Row Totals**	
Interval #	1	2	3	4	5	6	7	8	9	10	Scored	Unscored
Occurrence												
Time	1:50	2:00	2:10	2:20	2:30	2:40	2:50	3:00	3:10	3:20	**Row Totals**	
Interval #	11	12	13	14	15	16	17	18	19	20	Scored	Unscored
Occurrence												
Time	3:30	3:40	3:50	4:00	4:10	4:20	4:30	4:40	4:50	5:00	**Row Totals**	
Interval #	21	22	23	24	25	26	27	28	29	30	Scored	Unscored
Occurrence												
Time	5;10	5:20	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	**Row Totals**	
Interval #	31	32	33	34	35	36	37	38	39	40	Scored	Unscored
Occurrence												
Time	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	**Row Totals**	
Interval #	41	42	43	44	45	46	47	48	49	50	Scored	Unscored
Occurrence												
Time	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	**Row Totals**	
Interval #	51	52	53	54	55	56	57	58	59	60	Scored	Unscored
Occurrence												

APPENDIX F

PERMISSION TO USE COPYRIGHTED MATERIAL

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

March 9, 2009

University of North
Texas
Rhonda Christensen
Gerald Knezek
Texas Center for Educational Technology
1155 Union Circle #305280
Denton, Texas 76203-5017

Dear Drs. Christensen and Knezek:

I am completing a doctoral dissertation at the University of Nevada, Las Vegas entitled "Emergent Literacy Skills of Young Children with Autism: A Comparison of Teacher-led and Computer-Assisted Instruction'. I would like your permission to adapt and reprint excerpts from the following:

Christensen, R. and Knezek, G. (1998). Parallel Forms for Measuring Teacher's Attitudes Toward Computers. Proceedings of SITE 98. Association for the Advancement of Computing in Education: Charlotteville, VA, p 831-832.

The excerpts to be adapted or reprinted are items in the Teacher's Attitudes Toward Computers Questionnaire. My intervention study will use the questionnaire as a tool for measuring social validity, specifically attitudes and beliefs towards computers in early childhood special education classrooms before and after the interventions are delivered. Items are adapted to better fit the specific group of respondents. The adapted questionnaire is attached for your review.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive rights in all languages and to the prospective publication of my dissertation by ProQuest Information and Learning (ProQuest) through its UMI® Dissertation Publishing business. ProQuest may produce and sell copies of my dissertation on demand and may make my dissertation available for free internet download at my request. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that you own [or your company owns] the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me at the address below. Thank you very much.

Sincerely,

Jason Travers
Visiting Lecturer
Department of Special Education
4505 S. Maryland Pkwy
Box 453014
Las Vegas, NV 89154-3014

PERMISSION GRANTED FOR THE
USE REQUESTED ABOVE:

Rhonda Christensen

Rhonda Christensen, PhD

Date: 3/10/2009

APPENDIX G

ALPHABET BOOK SAMPLE

The cover of Book H appears to the right. Here the scripts for teachers appears next to it corresponding page. The books were made in an easel style.

Hooray for H!

H

A book of the letter H
By Jason Travers

This is the letter H. (repeat once)

- Read the line above, pointing to the letter as you read
- Read the line again while pointing

3

H

H is for House. Some people live in houses.

- Read the line above
- Ask first student to "point to H"
- Prompt or Praise
  - 1^{st} Incorrect: model & repeat
  - 2^{nd} Incorrect: Show and move on.

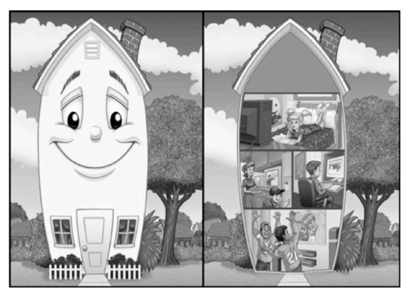
5

H

H is for house. Houses have rooms where we do different things.

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
  - 1^{st} Incorrect: model & repeat
  - 2^{nd} Incorrect: Show and move on.

7



H

Houses look different. Some houses are small.

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

9

H

Some houses are made with candy and frosting. Yummy!

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

11

H

Some houses are fun for playing with.
This doll house is her favorite toy.

- •Read the line above
- •Ask next student to "point to H"
- •Prompt or Praise
    - •1st Incorrect: model & repeat
    - •2nd Incorrect: Show and move on.

13

H

EACH CHILD WILL DO THIS PAGE

Point to the letter H.

- •Present book to next student
- •Ask next student to "point to H"
- •Prompt or Praise
    - •1st Incorrect: model & repeat
    - •2nd Incorrect: Show and move on.
- •Continue until all have had a chance to point.

15

H

- Another set of similarly designed pages with different illustrations followed these pages. They concluded Chapter 1 and were followed by Chapter 2.

END OF CHAPTER 1

- REPEAT Chapter 1 if first day of letter H.
- STOP if 10 minute time limit is up.
- If day 4, go on to next chapter.

18

Intentionally blank

Chapter Two

Letter H Discrimination

This is the letter H. (repeat once)

- Read the line above, pointing to the letter as you read
- Read the line again while pointing

21

H

H is for House. Some people live in houses.

- Read the line above
- Ask first student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

23

2

7

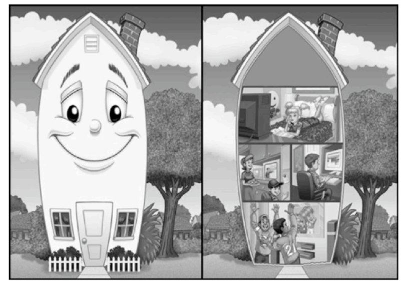
H

H is for house. Houses have rooms where we do different things.

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
    - 1st Incorrect: model & repeat
    - 2nd Incorrect: Show and move on.

25

H



7 2

Houses look different. Some houses are small.

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
    - 1st Incorrect: model & repeat
    - 2nd Incorrect: Show and move on.

27

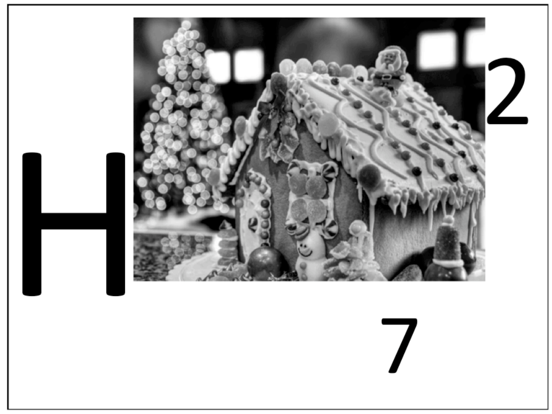
2 7

H

Some houses are made with candy and frosting. Yummy!

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

29



Some houses are fun for playing with. This doll house is her favorite toy.

- Read the line above
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

31

EACH CHILD WILL DO THIS PAGE

Point to the letter H.

- Present book to next student
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.
- Continue until all have had a chance to point.

33

2 H 7

- Another set of similarly designed pages with different illustrations followed these pages. They concluded Chapter 2 and were followed by Chapter 3.

Intentionally blank

Chapter Three

Letter H Mastery

This is the letter H. (repeat 1)

- Read the line above, pointing to the letter as you read
- Read the line again while pointing

38

H

H is for House. Some people live in houses.

- •Read the line above
- •Ask first student to "point to H"
- •Prompt or Praise
  - •1st Incorrect: model & repeat
  - •2nd Incorrect: Show and move on.

40

R

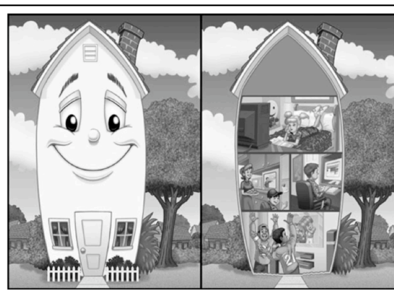
T G H

H is for house. Houses have rooms where we do different things.

- Read the line above
- Ask next student to **“point to G”**
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

42

H

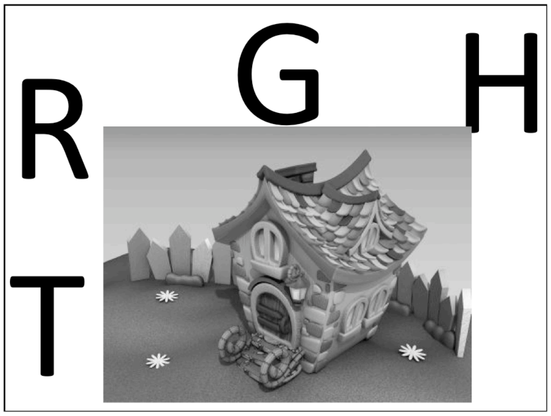


G T R

Houses look different. Some houses are small.

- Read the line above
- Ask next student to "**point to T**"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

44



Some houses are made with candy and frosting. Yummy!

- Read the line above
- Ask next student to “point to H”
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

46

Some houses are fun for playing with. This doll house is her favorite toy.

- Read the line above
- Ask next student to **“point to R”**
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.

48

H G

R T

EACH CHILD WILL DO THIS PAGE

Point to the letter H.

- Present book to next student
- Ask next student to "point to H"
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.
- Continue until all have had a chance to point.

50

R T G H

EACH CHILD WILL DO THIS PAGE

Point to the letter T.

- Present book to next student
- Read the line above.
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.
- Continue until all have had a chance to point.

52

H G

T R

EACH CHILD WILL DO THIS PAGE

Point to the letter G.

- Present book to next student
- Read the line above.
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.
- Continue until all have had a chance to point.

54

T H

G R

EACH CHILD WILL DO THIS PAGE

Point to the letter H.

- Present book to next student
- Read the line above
- Prompt or Praise
  - 1st Incorrect: model & repeat
  - 2nd Incorrect: Show and move on.
- Continue until all have had a chance to point.

56

R T

H G

EACH CHILD WILL DO THIS PAGE

Point to the letter R.

- •Present book to next student
- •Read the line above.
- •Prompt or Praise
  - •1st Incorrect: model & repeat
  - •2nd Incorrect: Show and move on.
- •Continue until all have had a chance to point.

58

H G R T

EACH CHILD WILL DO THIS PAGE

Point to the letter H.

- •Present book to next student
- •Read the line above.
- •Prompt or Praise
  - •1st Incorrect: model & repeat
  - •2nd Incorrect: Show and move on.
- •Continue until all have had a chance to point.

60

R G H T

- Another set of similarly designed pages with different illustrations followed these pages. They concluded Chapter 3.

END OF CHAPTER3

- REPEAT Chapter 3 if third day of letter T.
- STOP if 10 minute time limit is up.
- If day 4, go on to next chapter.

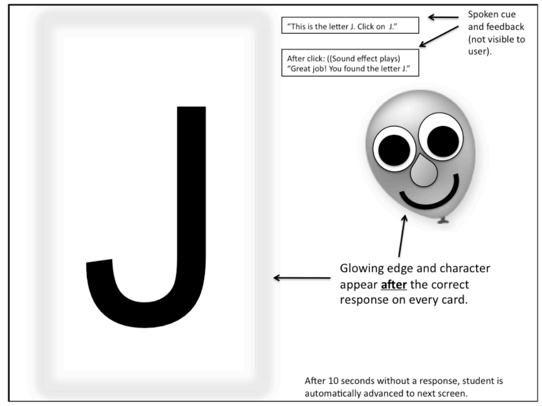
63

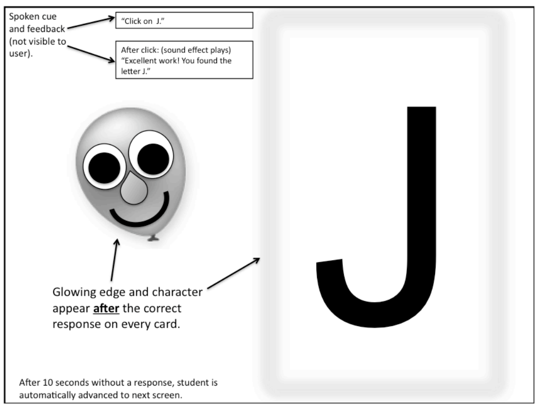
APPENDIX H

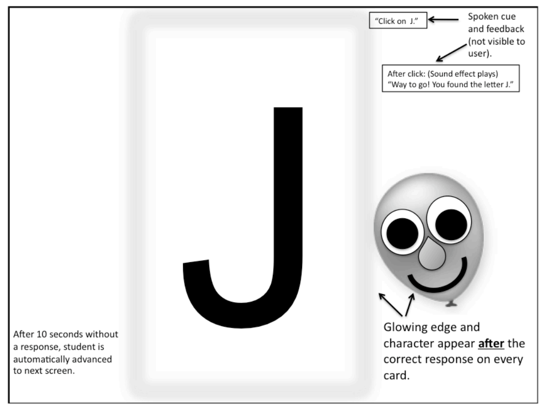
SOFTWARE SCREENSHOTS

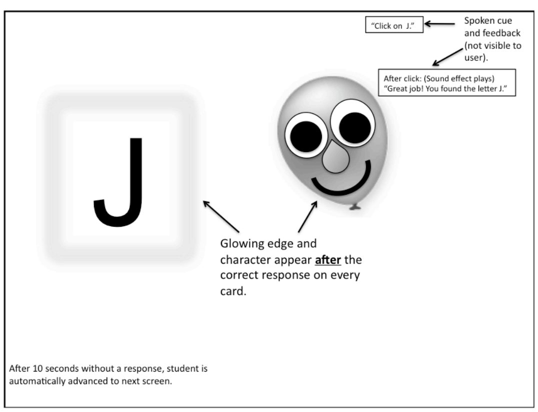
Introduction Lesson

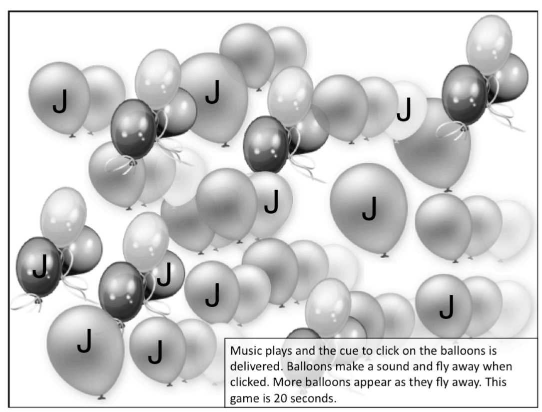
Every four exercises is followed by a game. These are the first eight screenshots of the Introduction lesson for the letter J. The second set of exercise cards are repeated after the letter hunt. The games alternate between the balloon game and letter hunt game.

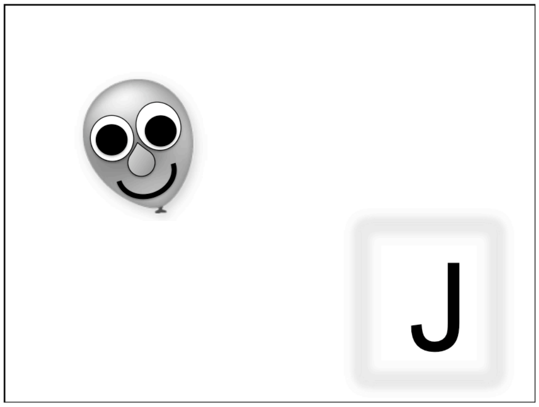


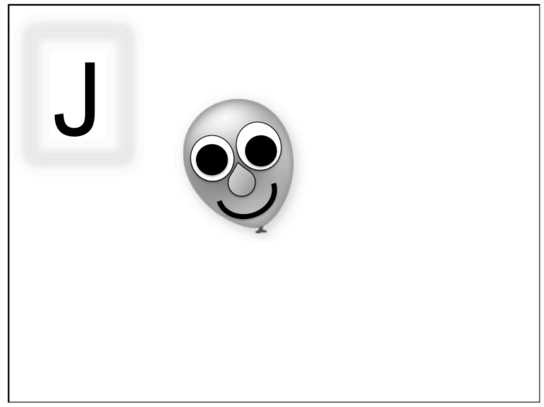


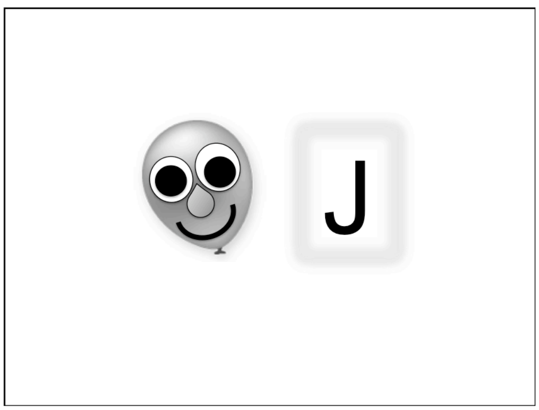


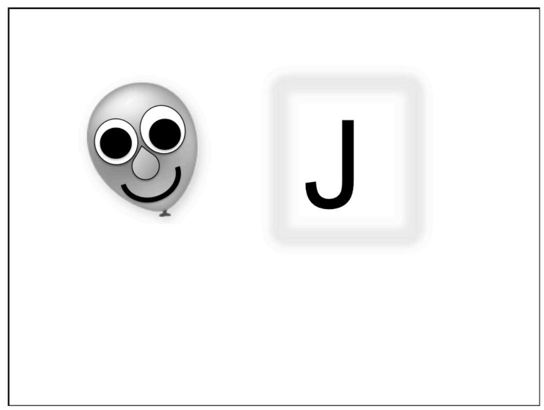


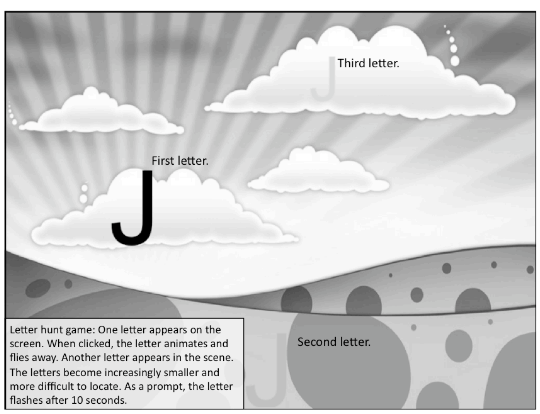


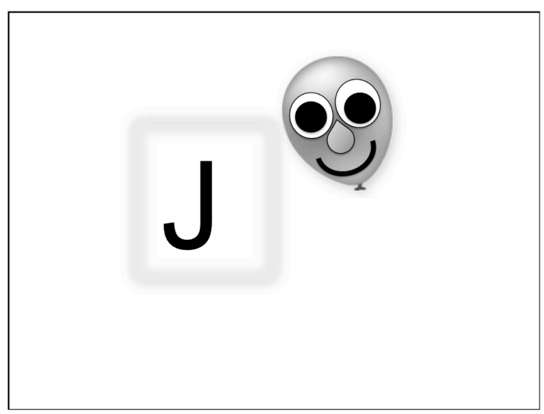

J

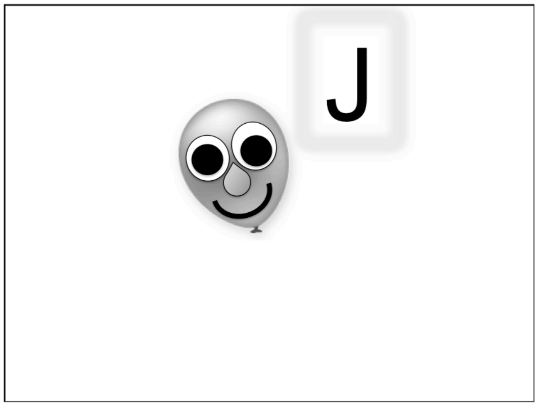

J

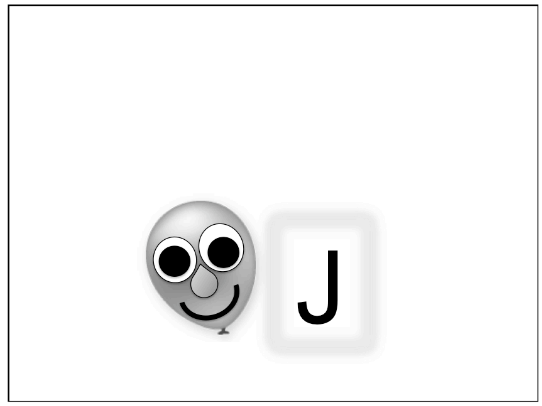

J

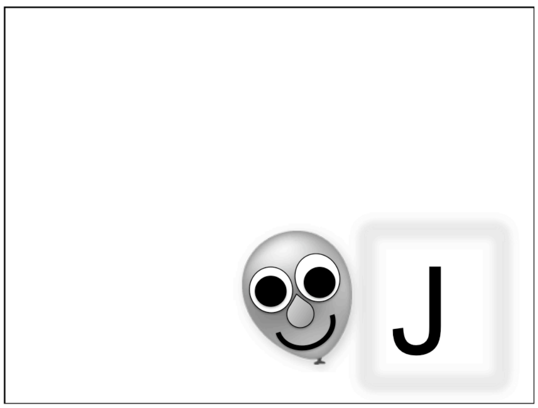

J

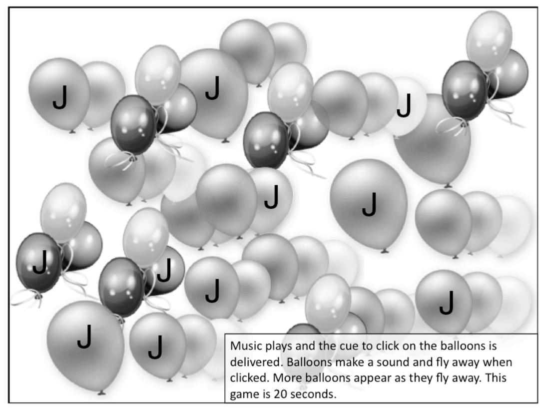

Third letter.
First letter.
J
Second letter.
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.

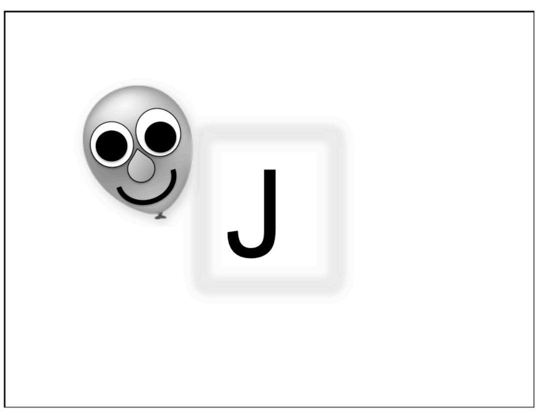

J

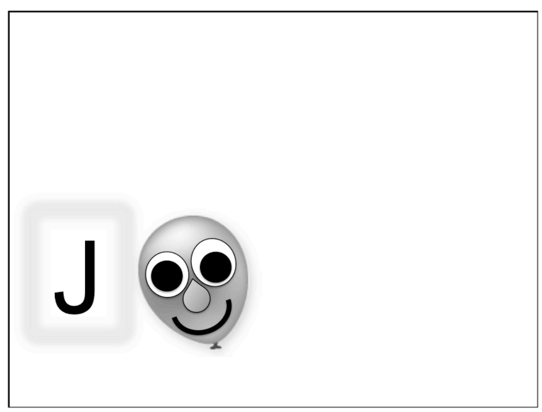

J

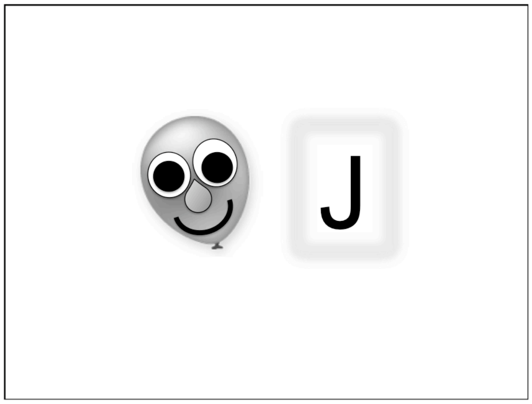

J


J

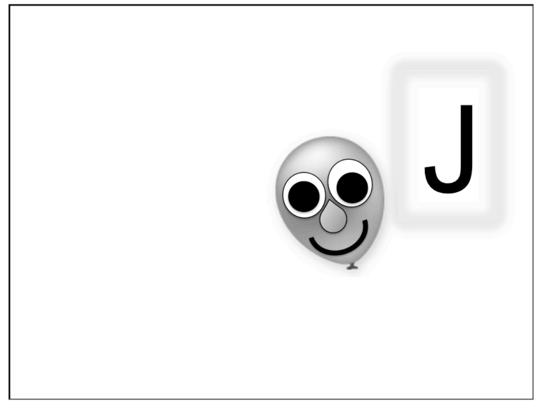

Music plays and the cue to click on the balloons is delivered. Balloons make a sound and fly away when clicked. More balloons appear as they fly away. This game is 20 seconds.


J

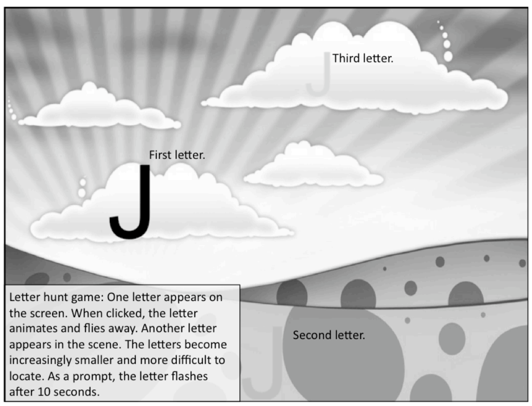

J



J



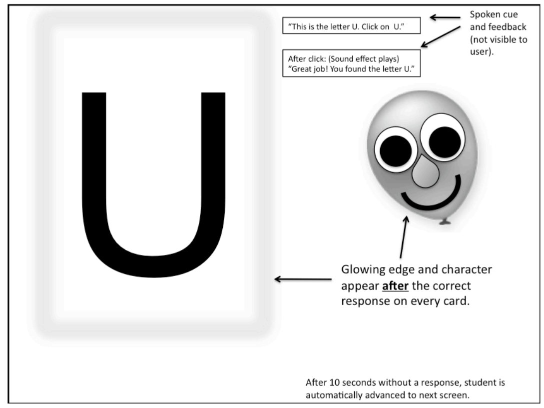
J

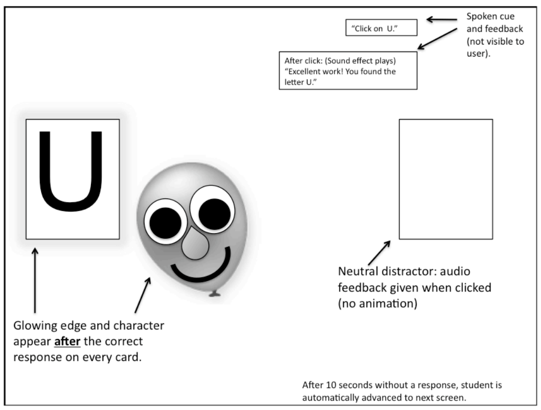


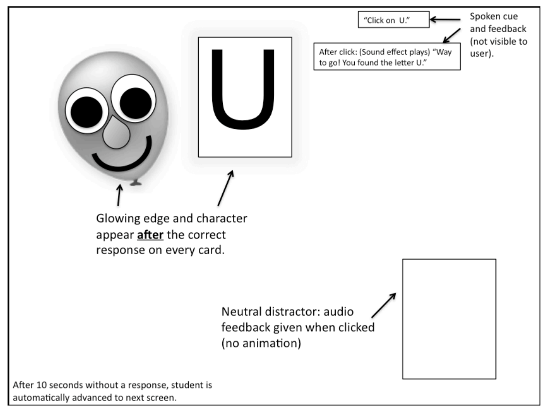
Third letter.
First letter.
J
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.
Second letter.

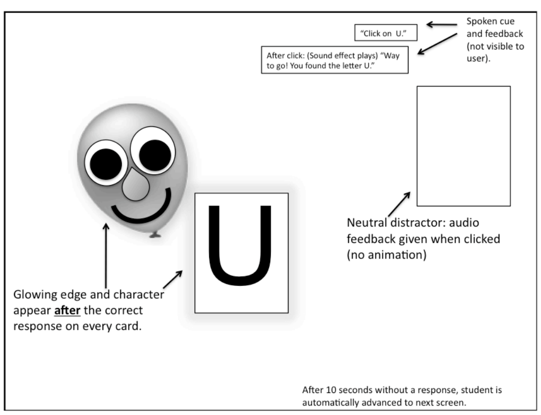
Discrimination Lesson

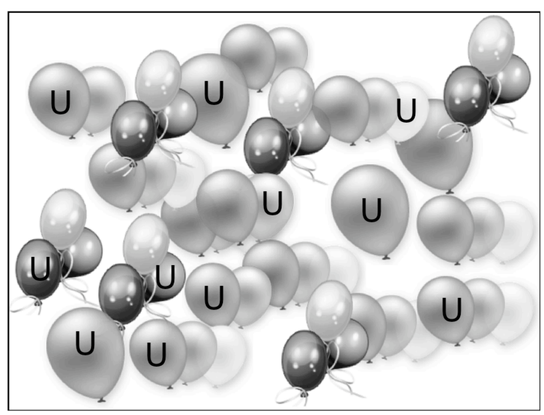
Every four exercises is followed by a game. These are the first eight screenshots of the discrimination lesson for the letter J. The second set of exercise cards are repeated after the letter hunt. The games alternate between the balloon game and letter hunt game. The neutral (blank) distractors are later filled with numerals.

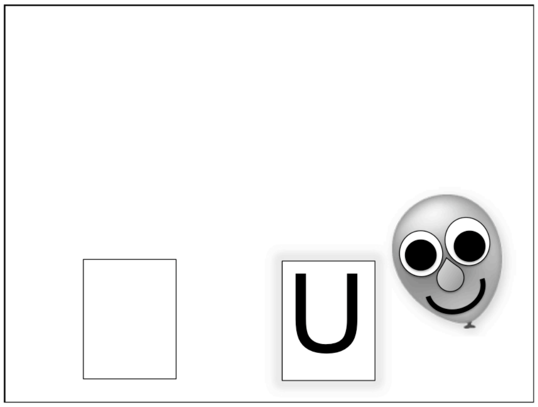


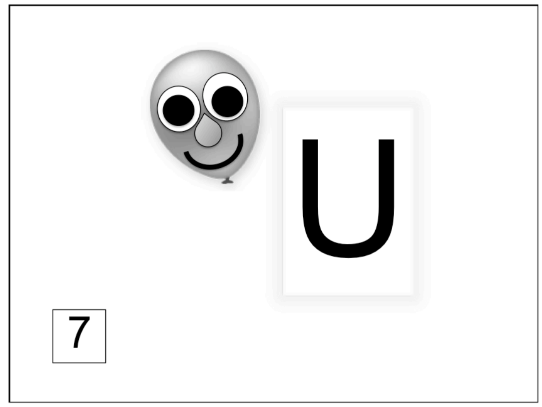


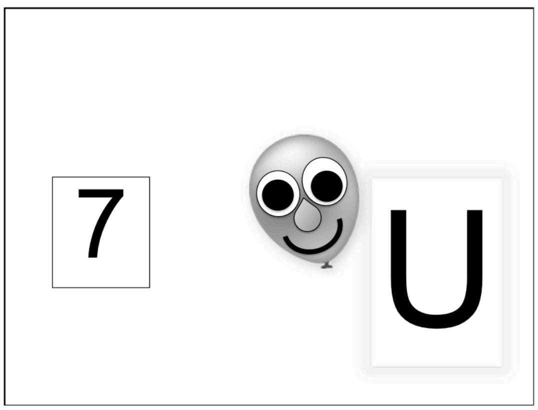


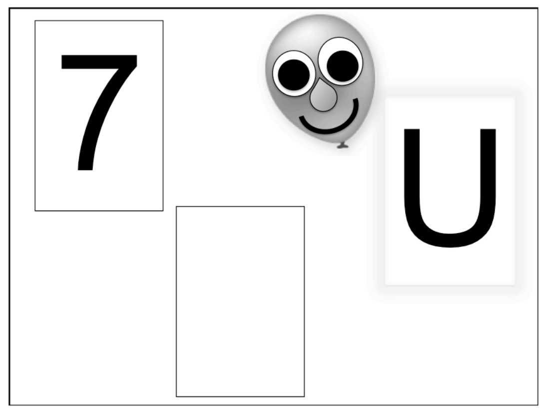


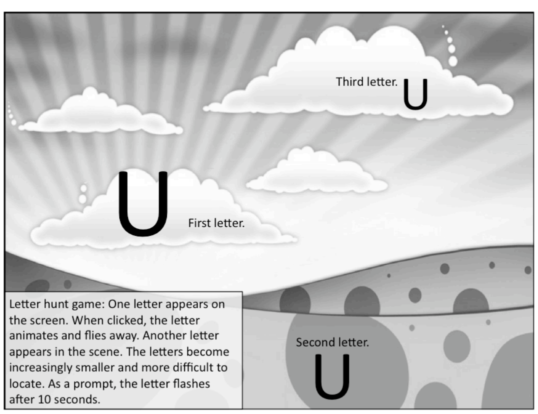


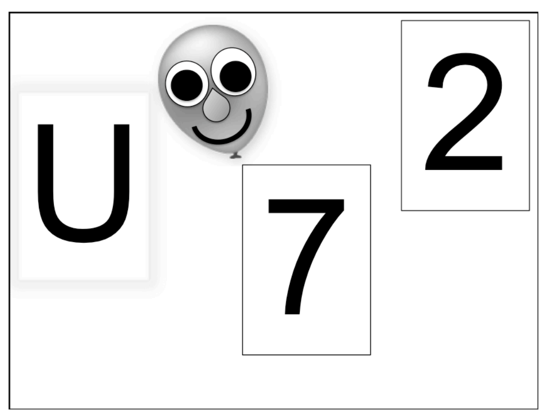

U

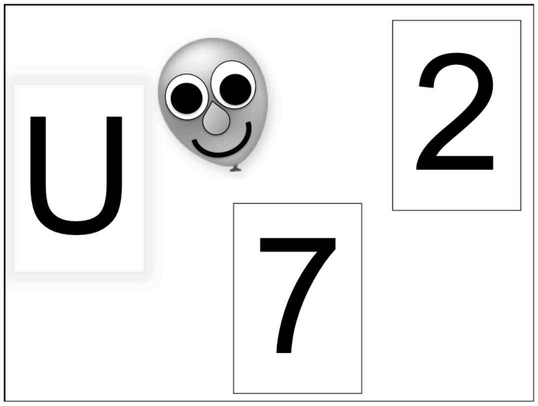

U
7

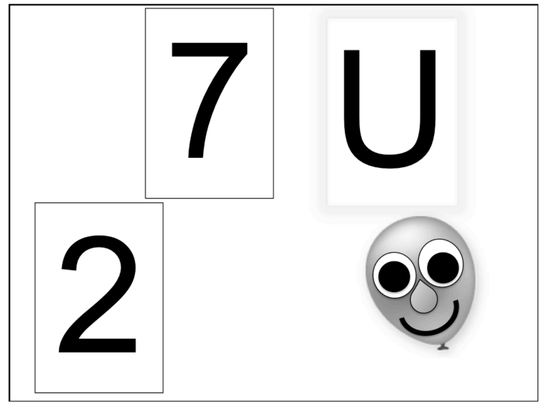

7
U

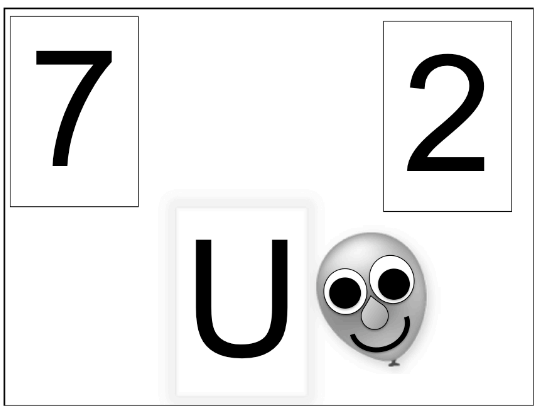

7
U

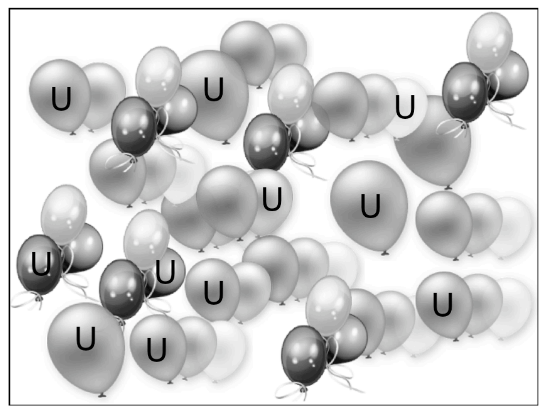

Third letter.
U
U
First letter.
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.
Second letter.
U

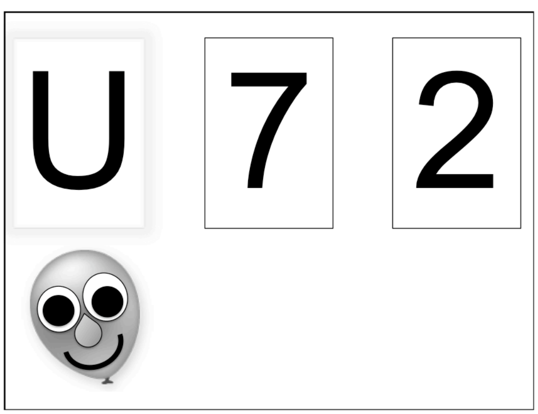

U
2
7

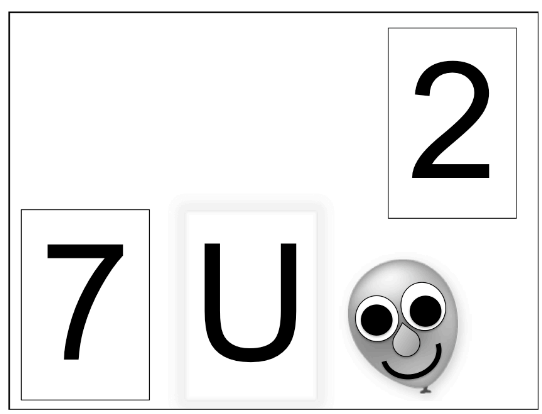

U
2
7

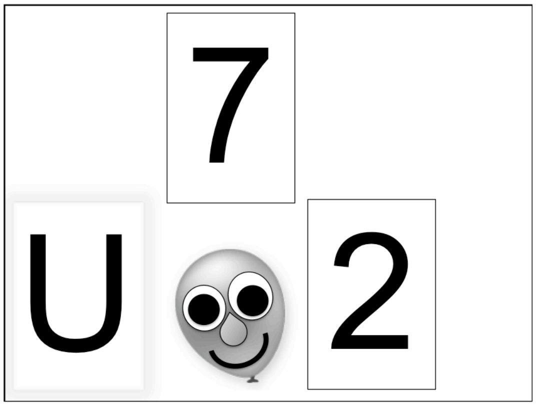

7
U
2

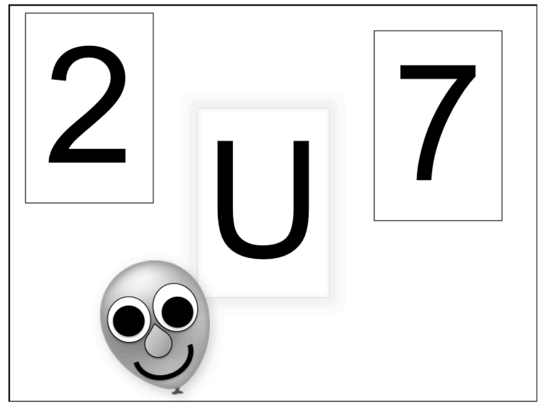

7
2
U

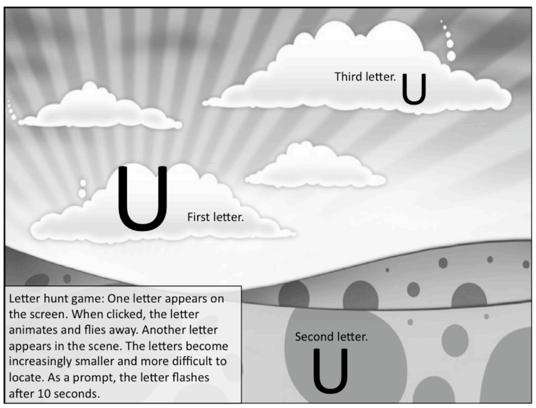



U
7
2


2
7
U

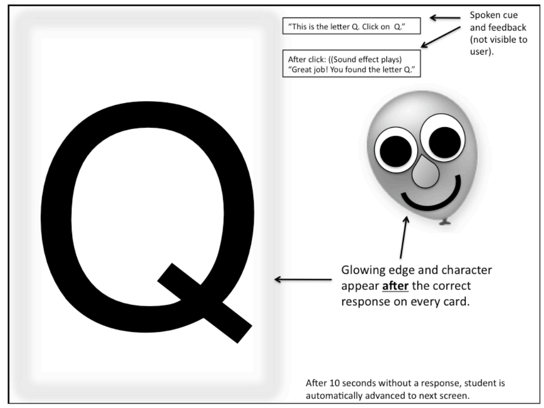

7
U
2

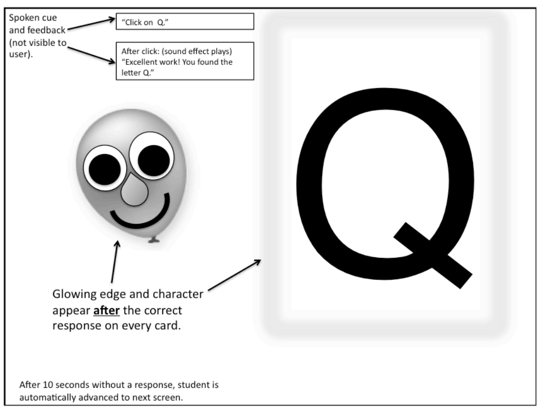

2
U
7

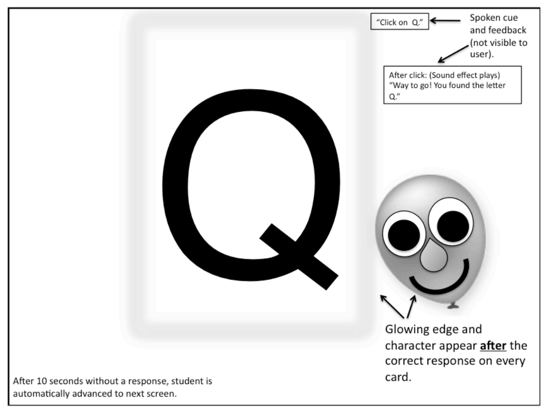

Third letter. U
U First letter.
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.
Second letter.
U

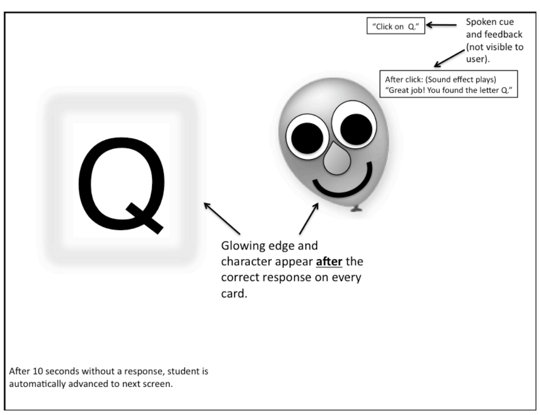
Mastery Lesson

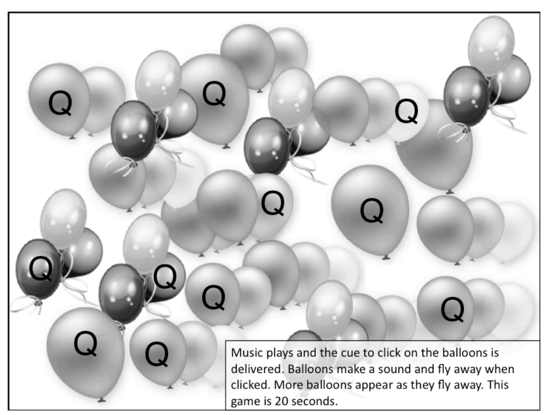
Every four exercises is followed by a game. These are the first eight screenshots of the mastery lesson for the letter Q. The second set of exercise cards are repeated after the letter hunt. The games alternate between the balloon game and letter hunt game.

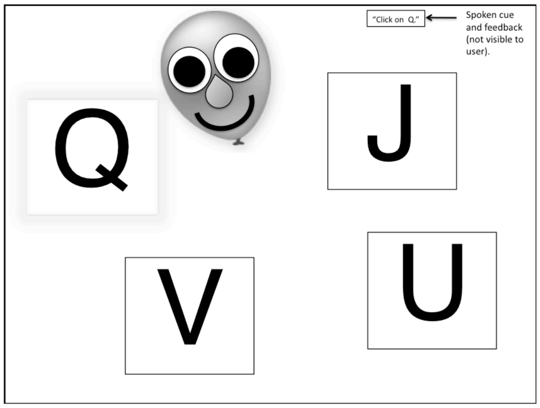


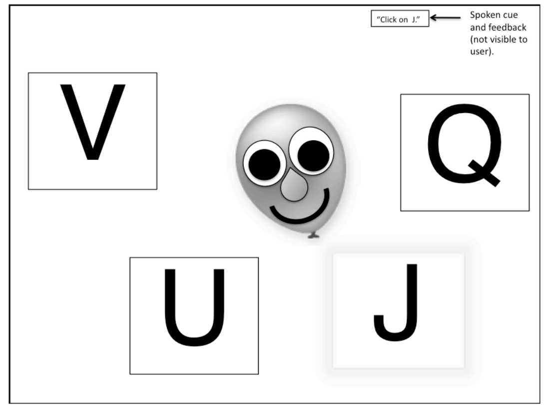


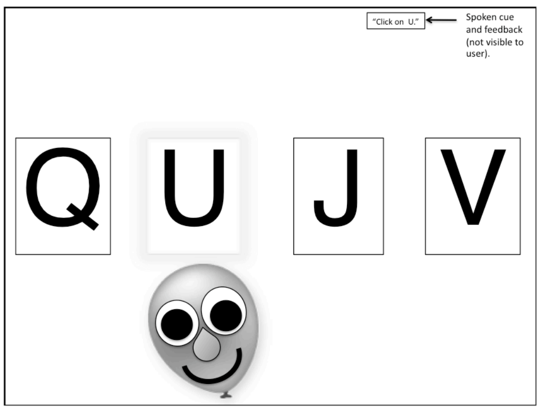


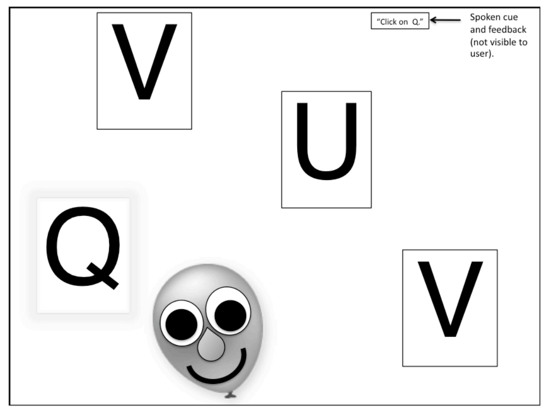


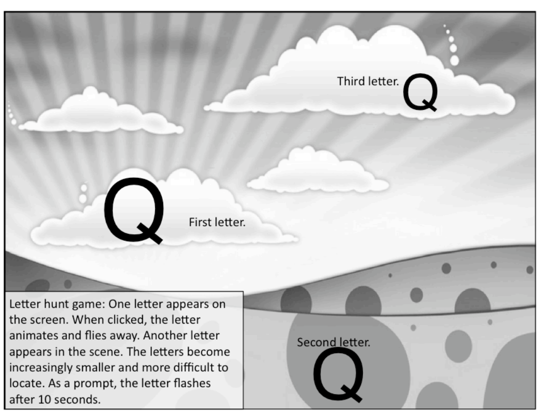


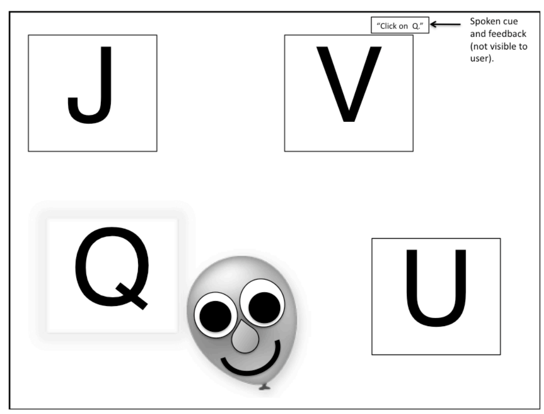

"Click on Q."
Spoken cue and feedback (not visible to user).
Q
J
V
U

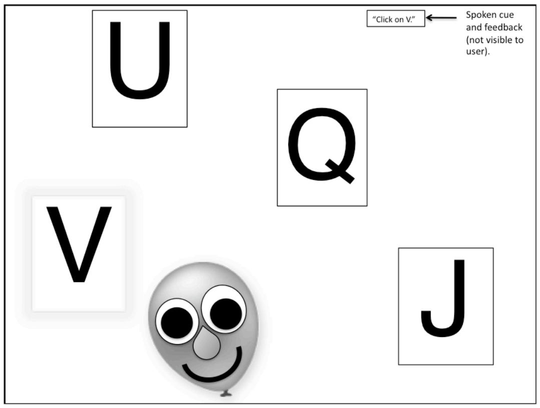

"Click on J."
Spoken cue and feedback (not visible to user).
V
Q
U
J

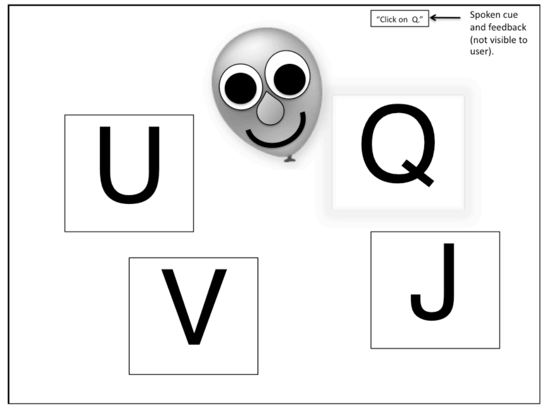

"Click on U."
Spoken cue and feedback (not visible to user).
Q
U
J
V

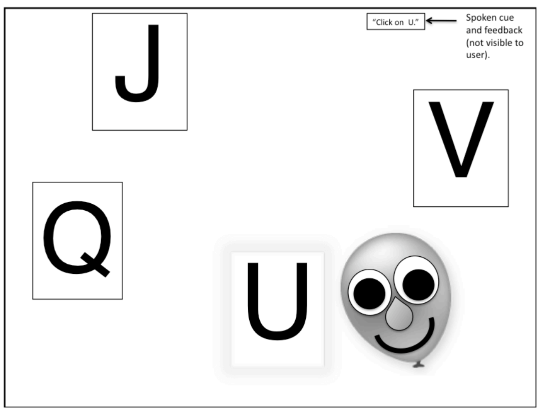

"Click on Q."
Spoken cue and feedback (not visible to user).
V
U
Q
V

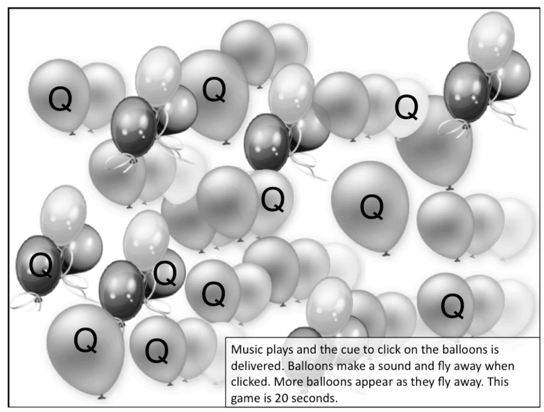

Third letter.
Q
Q
First letter.
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.
Second letter.
Q

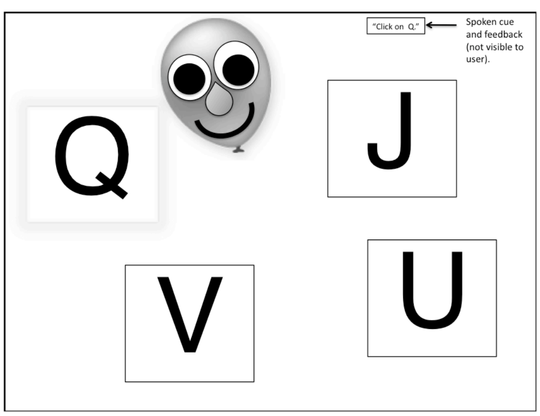

"Click on Q."
Spoken cue and feedback (not visible to user).
J
V
Q
U

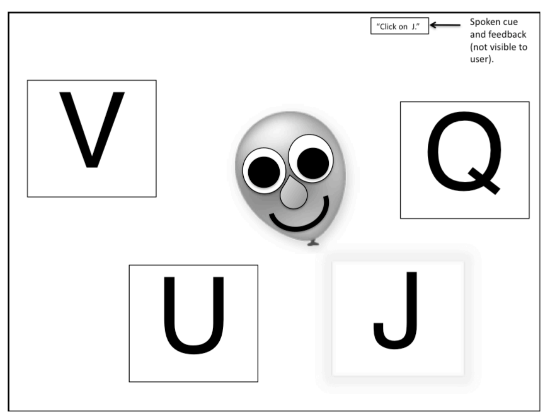

“Click on V.”
Spoken cue and feedback (not visible to user).
U
Q
V
J

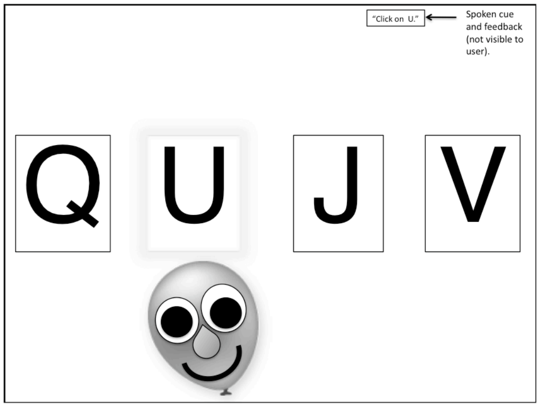

“Click on Q.”
Spoken cue and feedback (not visible to user).
U
Q
V
J

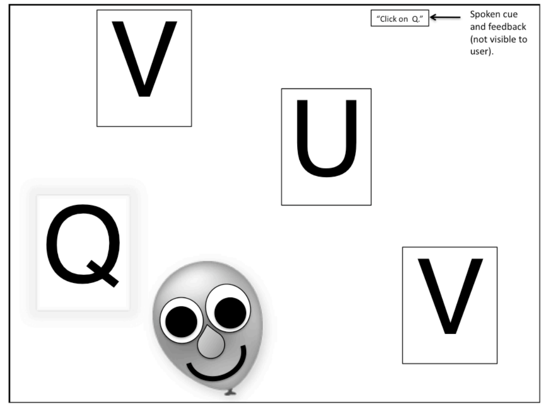

“Click on U.”
Spoken cue and feedback (not visible to user).
J
V
Q
U

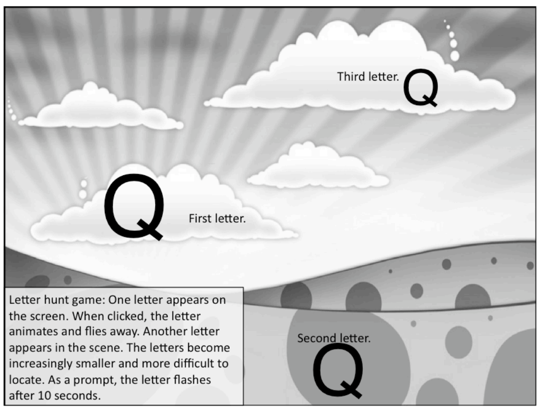

Music plays and the cue to click on the balloons is delivered. Balloons make a sound and fly away when clicked. More balloons appear as they fly away. This game is 20 seconds.

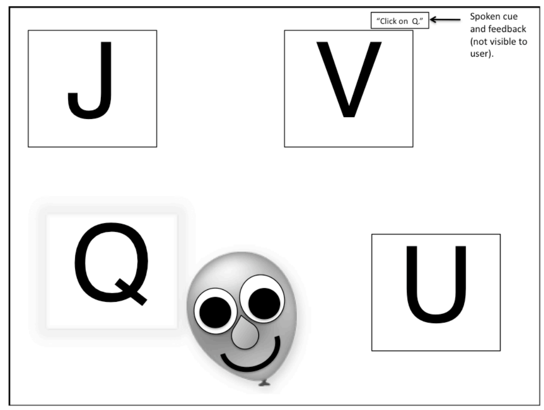

“Click on Q.”
Spoken cue and feedback (not visible to user).
Q
J
V
U

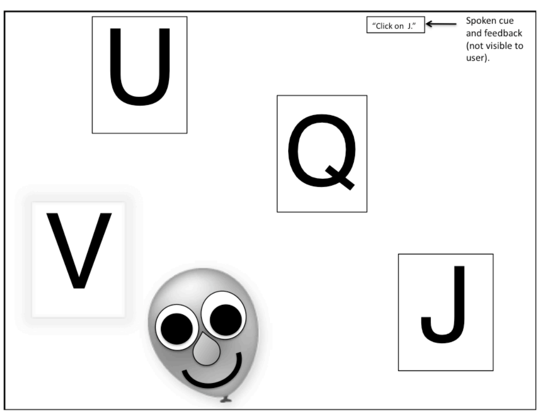

“Click on J.”
Spoken cue and feedback (not visible to user).
V
Q
U
J

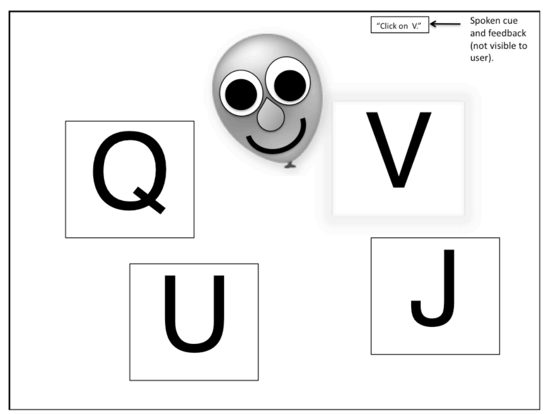

"Click on U."
Spoken cue and feedback (not visible to user).
Q
U
J
V

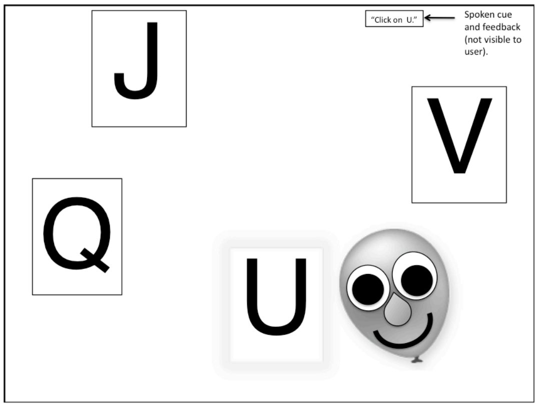

"Click on Q."
Spoken cue and feedback (not visible to user).
V
U
Q
V


Third letter. Q
Q First letter.
Letter hunt game: One letter appears on the screen. When clicked, the letter animates and flies away. Another letter appears in the scene. The letters become increasingly smaller and more difficult to locate. As a prompt, the letter flashes after 10 seconds.
Second letter.
Q

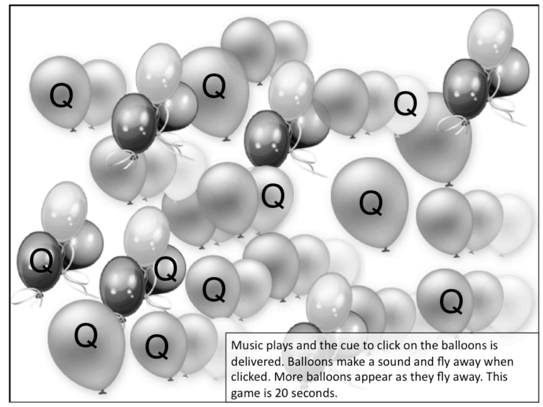

"Click on Q."
Spoken cue and feedback (not visible to user).
J
V
Q
U


"Click on J."
Spoken cue and feedback (not visible to user).
U
Q
V
J


"Click on V."
Spoken cue and feedback (not visible to user).
Q
V
U
J



J
"Click on U."
Spoken cue and feedback (not visible to user).
V
Q
U



Q
Music plays and the cue to click on the balloons is delivered. Balloons make a sound and fly away when clicked. More balloons appear as they fly away. This game is 20 seconds.

APPENDIX I

VIDEOCAMERA SET UP GUIDE

VIDEOCAMERA SETUP GUIDE

1. Ensure camera is securely attached to tripod and placed in the designated area of the classroom.
2. Ensure power is connected to camera and outlet
3. Remove lens cap and turn on camera
4. Insert video tape (if applicable).
5. Check tape to see if enough space to record students is available
    a. 10 minutes needed for a Book Lesson
    b. 10 minutes need per student for Computer Lesson
    c. REPLACE TAPE IF YOU ARE NOT SURE IF THERE IS ENOUGH SPACE TO RECORD AN ENTIRE LESSON. MARK REMOVED TAPE WITH DATES RECORDED.
6. Point camera to area to be recorded. Camera should face students and not be behind the children; record their faces.
    a. Circle time area

       <u>OR</u>
    b. Computer station
7. Pan out or zoom in to ensure all students are visible just inside the frame of the viewing screen.
8. Press the "record" button.
9. Check the viewing screen to ensure that the camera is recording.
10. Signal the teacher that the camera is recording. Do not move camera. Deliver lesson.
11. After lesson is complete, press the "record" button to stop the camera.
12. Place camera in secure area (e.g. locked file cabinet) until next day.

APPENDIX J

STUDENT COMPUTER SKILLS CHECKLIST

Student Computer Training Checklist

Student ID______________________________ Date_______________

1. Student demonstrates an understanding of mouse function by moving mouse to manipulate cursor on the computer screen.	☐ YES ☐ NO
2. Student demonstrates understanding that clicking the mouse button results in actions on the computer screen.	☐ YES ☐ NO
3. Student demonstrates the ability to complete an auditory instruction delivered by the computer software.	☐ YES ☐ NO
4. Student is able to remain at the computer station for 10 minutes without teacher reminders or redirects (e.g. escorting back to station; verbal direction to return to computer station).	☐ YES ☐ NO
5. Student is able to click on 10 objects during one 10-minute session	☐ YES ☐ NO

NOTES: ____

____

____

____

____

APPENDIX K

ALPHABET BOOK TEACHER QUESTIONAIRRE

Big Letter Book Teacher Questionnaire

1. What do you think the strengths of the book are with respect to:

a. Design

b. Content

c. Structure and organization

2. What do you think your students would like most about the book? Why?

3. What do you think your students would like least about the book? Why?

4. What do you think could be changed to make the book better?

APPENDIX L

PROTOCOL ANALYSIS FOR ALPHABET BOOKS

Protocol Analysis for Big Book Formative Evaluation

1. When given the book did the student open it and look through it? Notes: ____________________ ____________________ ____________________ ____________________	☐ YES ☐ NO
2. Does student respond to the directions by saying or pointing to letters? Notes:____________________ ____________________ ____________________ ____________________	☐ YES ☐ NO
3. When asked what parts of the book were his/her favorite, does student respond? Record student response. Notes: ____________________ ____________________ ____________________ ____________________	☐ YES ☐ NO
4. Did student become more proficient at identifying the letter during/after the lesson? Check proficiency. ☐ High ☐ Medium ☐ Low Notes: ____________________ ____________________ ____________________ ____________________	☐ YES ☐ NO
5. Did student remain actively engaged for most of the lesson? Notes: ____________________ ____________________ ____________________ ____________________	☐ YES ☐ NO

Student ID____________________ Date______________

APPENDIX M

SOFTWARE QUESTIONAIRRE FOR TEACHER

Software Design Questionnaire

1. What do you think the strengths of the software are with respect to:

a. Design

b. Content

c. Structure and organization

2. What do you think your students would like most about the software? Why?

3. What do you think your students would like least about the software? Why?

4. What do you think could be changed to make the software better?

APPENDIX N

PROTOCOL ANALYSIS FOR SOFTWARE

Protocol Analysis for Computer-Assisted

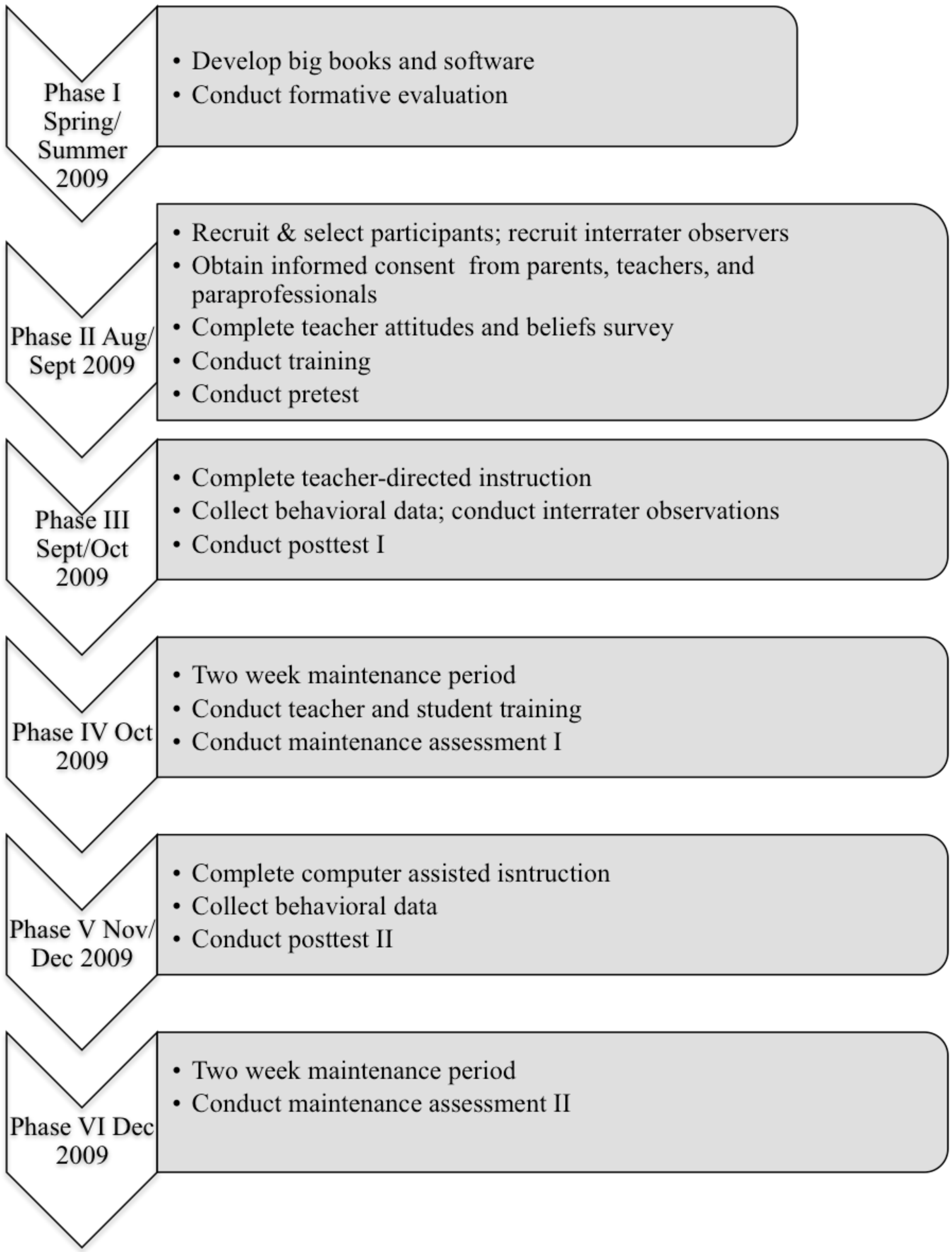
Instruction Formative Evaluation

Student ID________________________________ Date_______________

1. Is the student engaged and interested in the software/computer? Notes: ____ ____ ____ ____	☐ YES ☐ NO
2. Ask student why (s)he is or isn't clicking on objects. Does student respond? Record response. Notes:____ ____ ____ ____	☐ YES ☐ NO
3. Did the student have difficulty navigating the software? Ask student about the problems encountered. Record responses. Notes: ____ ____ ____ ____	☐ YES ☐ NO
4. Did the student appear to be enjoying the games in the software? Check level of enjoyment: ☐ High ☐ Medium ☐ Low Notes: ____ ____ ____ ____	☐ YES ☐ NO
5. Did student remain actively engaged with the software for 5 minutes? Notes: ____ ____ ____ ____	☐ YES ☐ NO

APPENDIX O

TIMELINE OF THE STUDY


Phase I Spring/ Summer 2009
• Develop big books and software
• Conduct formative evaluation
Phase II Aug/ Sept 2009
• Recruit & select participants; recruit interrater observers
• Obtain informed consent from parents, teachers, and paraprofessionals
• Complete teacher attitudes and beliefs survey
• Conduct training
• Conduct pretest
Phase III Sept/Oct 2009
• Complete teacher-directed instruction
• Collect behavioral data; conduct interrater observations
• Conduct posttest I
Phase IV Oct 2009
• Two week maintenance period
• Conduct teacher and student training
• Conduct maintenance assessment I
Phase V Nov/ Dec 2009
• Complete computer assisted isntruction
• Collect behavioral data
• Conduct posttest II
Phase VI Dec 2009
• Two week maintenance period
• Conduct maintenance assessment II

APPENDIX P

INFORMED CONSENT FORMS

INFORMED CONSENT

Department of Special Education

TITLE OF STUDY: Emergent Literacy Skills of Young Children with Autism: A Comparison of Teacher-Led and Computer-Assisted Instruction

INVESTIGATORS: Jason Travers and Kyle Higgins

CONTACT PHONE NUMBER: 895-3205

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to research the behavioral and learning effects of teacher-led instruction and computer-assisted instruction with preschool students with autism.

Participants
You are invited to participate in the study because you are currently a teacher in a self-contained special education classroom for preschool-aged students with autism.

Procedures
If you agree to participate in the study, you will be asked to do the following: (a) be videotaped and involved in traditional early literacy teacher-led instruction in small groups using large books as well as computer-assisted instruction to teach early literacy skills (about half of all teachers will first provide the computerized lessons for 4 weeks followed by the teacher-led lessons for 4 weeks. The remaining teachers will first provide the teacher-led lessons for 4 weeks followed by the computerized lessons for 4 weeks) (b) deliver a 10-minute lesson for 4 days per week, (c) attend two training meetings for a total for five hours of training to learn how to administer the lessons and set up the video camera, (d) provide the student participants with two weeks of training in the basic use of a computer mouse using research supported educational math software, (e) set up a video camera to record students during the lessons, and (f) complete a survey about your perceptions of computer instruction for your students prior to and after the study. The research team will view the videos to measure adherence to the lesson components and may provide you with feedback. It is anticipated that the study will last for 12 weeks.

Benefits of Participation
There may not be direct benefits to you as a participant. We hope to determine if computer-assisted instruction produces better acquisition and maintenance of letter names in preschool-aged students with autism.

Risks of Participation
There are risks involved in all research studies. The incorporation of accepted teaching approaches will ensure student access to literacy instruction for all students. This study involves the unobtrusive observation of students via videotapes. Because of this, there are minimal risks to the teachers from participation. Minimal risks include breach of confidentiality, however numerous steps will be taken to prevent this.

Cost of Participation
There will be no financial cost to you to participate in this study because all instruction will occur in your classrooms during the typical school day. The study will last for twelve weeks. You will not be

compensated for your time. If the computer software developed for the study is found to be effective, your classroom will receive a copy of the software for free as an expression of our gratitude.

Contact Information

If you have any questions or concerns about the study you may contact Dr. Kyle Higgins or Jason Travers at 895-3205. For questions regarding the rights of research subjects, complaints, or any comments regarding the manner in which the study is being conducted, you may contact **the UNLV Office for the Protection of Research Subjects at 702-895-2794.**

Voluntary Participation

The school's participation and your participation in this study are voluntary. You may refuse to participate in this study or any part of this study. You or your school may withdraw from the study at any time without prejudice to you or your relationship to the University. The school may withdraw form the study at any time. You are encouraged to ask questions about the study before or at any time during the research study.

Confidentiality

All information gathered for this study will be kept completely confidential. No reference will be made in any written or oral reports that could link you to the study. All records will be stored in a locked facility at UNLV for at least three years after the study is complete. All information will be destroyed after three years.

Participant Consent

I have read the above information and **AGREE TO PARTICIPATE** in this study. I am at least 18 years of age. A copy of this form has been given to me.

________________________________ ____________________
Signature of Participant Date

____
Participant Name (Please Print)

By signing below, I agree to allow myself to be videotaped during the course of the study.

____
Signature of Participant

I have read the above information and **DO NOT AGREE** to participate in this study. By signing below I indicate that I **DO NOT GIVE PERMISSION** participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

________________________________ ____________________
Signature of Participant Date

____
Participant Name (Print)

Participant Note: Please do not sign this document if the Approval Stamp is missing or expired.

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

INFORMED CONSENT

Department of Special Education

TITLE OF STUDY: Emergent Literacy Skills of Young Children with Autism: A Comparison of Teacher-Led and Computer-Assisted Instruction

INVESTIGATORS: Jason Travers and Kyle Higgins

CONTACT PHONE NUMBER: 895-3205

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to research the behavioral and learning effects of teacher-led instruction and computer-assisted instruction with preschool students with autism.

Participants
You are invited to participate in the study because you are currently a paraprofessional in a self-contained special education classroom for preschool-aged students with autism.

Procedures
If you agree to participate in the study, you will be asked to do the following: (a) be videotaped and involved in traditional early literacy teacher-led instruction in small groups using large books as well as computer-assisted instruction to teach early literacy skills (About half of all classrooms will first provide the computerized lessons for 4 weeks followed by the teacher-led lessons for 4 weeks. The remaining classrooms will first provide the teacher-led lessons for 4 weeks followed by the computerized lessons for 4 weeks), (b) attend two training meetings for a total for five hours of training to learn about the lessons and video camera operation, and (c) set up a video camera to record students during the lessons. The research team will view the videos to measure adherence to the lesson components and may provide you with feedback. It is anticipated that the study will last for 12 weeks.

Benefits of Participation
There may not be direct benefits to you as a participant. We hope to determine if computer-assisted instruction produces better acquisition and maintenance of letter names in preschool-aged students with autism.

Risks of Participation
There are risks involved in all research studies. This study involves the unobtrusive observation of students via videotapes. Because of this, there are minimal risks to paraprofessionals from participation. Minimal risks include breach of confidentiality, however numerous steps will be taken to prevent this.

Cost of Participation
There will be no financial cost to you for you to participate in this study because all instruction will occur in your classrooms during the typical school day. The study will last for twelve weeks. You will not be compensated for your time.

Contact Information
If you have any questions or concerns about the study you may contact Dr. Kyle Higgins or Jason Travers at 895-3205. For questions regarding the rights of research subjects, complaints, or any comments regarding the manner in which the study is being conducted, you may contact **the UNLV Office for the**

Protection of Research Subjects at 702-895-2794.

Voluntary Participation

The school's participation and your participation in this study are voluntary. You may refuse to participate in this study or any part of this study. You or your school may withdraw from the study at any time without prejudice to you or your relationship to the University. The school may withdraw form the study at any time. You are encouraged to ask questions about the study before or at any time during the research study.

Confidentiality

All information gathered for this study will be kept completely confidential. No reference will be made in any written or oral reports that could link you to the study. All records will be stored in a locked facility at UNLV for at least three years after the study is complete. All information will be destroyed after three years.

Participant Consent

I have read the above information and **AGREE TO PARTICIPATE** in this study. I am at least 18 years of age. A copy of this form has been given to me.

________________________________ ____________________

Signature of Participant Date

____

Participant Name (Please Print)

By signing below, I agree to allow myself to be videotaped during the course of the study.

____

Signature of Participant

I have read the above information and **DO NOT AGREE** to participate in this study. By signing below I indicate that I **DO NOT GIVE PERMISSION** participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

________________________________ ____________________

Signature of Participant Date

____

Participant Name (Print)

Participant Note: Please do not sign this document if the Approval Stamp is missing or expired.

INFORMED CONSENT

Department of Special Education

TITLE OF STUDY: Emergent Literacy Skills of Young Children with Autism: A Comparison of Teacher-Led and Computer-Assisted Instruction

INVESTIGATORS: Jason Travers and Kyle Higgins

CONTACT PHONE NUMBER: 895-3205

Purpose of the Study
Your child is invited to participate in a research study. The purpose of this study is to research the behavioral and learning effects of teacher-led instruction and computer-assisted instruction with preschool students with autism.

Participants
Your child is being asked to participate in the study because he or she is currently enrolled in a self-contained special education classroom for preschool-aged students with autism.

Procedures
If you agree to allow your child to participate in the study, he or she will be asked to do the following: (a) be videotaped while involved in traditional early literacy teacher-led instruction in small groups using large books as well as computer-assisted instruction to teach early literacy skills (about half of the students will first receive the computerized lessons for 4 weeks followed by the teacher-led lessons for 4 weeks. The remaining students will first receive the teacher-led lessons for 4 weeks followed by the computerized lessons for 4 weeks. A 10-minute lesson will be delivered 4 days per week), (b) participate in assessment of letter-recognition skills prior to the four-week computer and book instruction phases, after the four-week computer and book instruction, and after 2 two-week maintenance periods following each instruction period (to determine if students remember them over time), and (c) receive two weeks of training in the basic use of a computer mouse with research supported educational math software prior to the receiving the computer-assisted letter instruction. The special education staff in your child's classroom will conduct the computer training and deliver the teacher-led lessons. The teacher in your child's classroom will also set up a video camera to record students when the lessons are being given. The research team will view the videos to measure student behaviors. It is anticipated that the study will last for 12 weeks.

Benefits of Participation
There may be direct benefits to your child as a participant such as an improvement in their early literacy skills and improvements in behavior during instruction. We hope to determine if which type of instruction produces better student behavior and better acquisition and maintenance of letter names.

Risks of Participation
There are risks involved in all research studies. The incorporation of accepted teaching approaches will ensure access to literacy instruction for all students. This study involves the unobtrusive observation of students via videotapes. Because of this, there are minimal risks to the students from participation. Minimal risks include breach of confidentiality, however numerous steps will be taken to prevent this.

Cost of Participation
There will be no financial cost to you for your child to participate in this study because all instruction will occur in their classrooms during the typical school day. The study will require ten minutes per day and last

for twelve weeks. Your child will not be compensated for their time. If the computer software developed for the study is found to be effective, you will receive a copy of the software for free as an expression of our gratitude. *The University of Nevada, Las Vegas may not provide compensation or free medical care for an unanticipated injury sustained as a result of participating in this research study.*

Contact Information

If you or your child have any questions or concerns about the study you may contact Dr. Kyle Higgins or Jason Travers at 895-3205. For questions regarding the rights of research subjects, complaints, or any comments regarding the manner in which the study is being conducted, you may contact **the UNLV Office for the Protection of Research Subjects at 702-895-2794.**

Voluntary Participation

Your child's participation in this study is voluntary. You may refuse to allow your child to participate in this study or any part of this study. You may withdraw your child from the study at any time without prejudice to your relationship with the university. You are encouraged to ask questions about the study before or at any time during the research study.

Confidentiality

All information gathered for this study will be kept completely confidential. No reference will be made in any written or oral reports that could link your child to the study. All records will be stored in a locked facility at UNLV for at least three years after the study is complete. All information will be destroyed after three years.

Participant Parental Consent

I have read the above information and agree to allow my child to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

__________________________________ _____________________

Signature of Participant's Parent/Guardian Date

____

Participant's Parent/Guardian Name (Print)

By signing below, I agree to allow my child to be videotaped during the course of the study.

____

Signature of Participant's Parent/Guardian

Participant Note: Please do not sign this document if the Approval Stamp is missing or expired.

REFERENCES

Adams, M.J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Adams, M.J., Foorman, B.R., Lundberg, I., & Beeler, T. (1998). *Phonemic awareness in young children*. Baltimore: Brookes.

Alberto, P. A., & Hefflin, J. (2007). Literacy: Introduction to the special series. *Focus on Autism and Other Developmental Disabilities, 22*(4), 204-205.

Alexander, D. (1983). *Children's computer drawings.* Medford, MA: Tufts University.

Alliance for Childhood, (2004). *Tech tonic: Toward a new literacy of* technology. Retrieved January 7, 2009 from http://www.allianceforchildhood.net/projects /computers/index.htm.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed. text revision). Washington, DC: Author.

Anderson, R.C., Hiebert, E.H., Scott, J.A., & Wilkinson, I. (1985). *Becoming a nation of readers.* Washington, DC: National Institute of Education.

Ball, E. W., & Blachman, B. A. (1991). Does Phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly, 26*(1) 49–66.

Barnes, B., & Hill, S. (1983). Should young children work with microcomputers-LOGO before LEGO? *The Computing Teacher, 10*(9), 11-14.

Bartlett, L. (2008). Literacy's Verb: Exploring What Literacy Is and What Literacy Does. *International Journal of Educational Development, 28*, 737-753.

Basil, C., & Reyes, S. (2003). Acquisition of literacy skills by children with severe disability. *Child Language Teaching & Therapy*, *19*, 27-48.

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (1999). Enhancing vocal imitations in children with autism using IBM Speech Viewer. *Autism, 3*, 131-147.

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with autism and normal children through computer-assisted instruction. *Journal of Autism and Developmental Disorders, 31*, 377-384.

Blok, H. Oostdam, R., Otter, M.E., & Overmatt, M. (2002). Computer-assisted instruction in support of beginning reading instruction: A review. *Review of Educational Research 72*, 101-130.

Bondy, A.S., & Sulzer-Azaroff, B. (2002). *The pyramid approach to education in autism*. Newark, DE: Pyramid Educational Products.

Boone, R., & Higgins, K. (2005). Designing digital materials for students with disabilities. In D. Edyburn, K. Higgins, & R. Boone, (Eds.), *Handbook of Special Education Research and Practice*. Whitefish Bay, WI: Knowledge by Design.

Boone, R., & Higgins, K. (2007). The software √-list: Evaluating educational software for use by students with disabilities. *Technology in Action, 3*(1), 9-12.

Bosseler, A., & Massaro, D.W. (2003). Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism. *Journal of Autism & Developmental Disorders*, *33*, 653-672.

Bradley, V. N. (1982). Improving students' writing with microcomputers. *Language Arts, 50*, 732-743.

Brigance, A. (2004). *Brigance Diagnostic Inventory of Early Development-II*. North Billerica, MA: Curriculum Associates.

Brownell, R. (2000). *Receptive One-Word Picture vocabulary Test*. Novato, CA: Academic Therapy Publications.

Cafiero, J.M. 2008. Technology supports for individuals with autism spectrum disorders. *Technology in Action, 3*(3), 1-12.

Centers for Disease Control and Prevention, (2007). Autism information center: Frequently asked questions – prevalence. Retrieved January 15, 2009 from http://www.cdc.gov/ncbddd/autism/faq_prevalence.htm.

Chandler. L. K., & Dahlquist, C. M. (2010). *Functional Assessment: Strategies to prevent and remediate challenging behaviors in school settings.* Upper Saddle River, NJ: Merril.

Chen, S. H. A., & Bernard-Opitz, B. (1993). Comparison of personal and computer-assisted instruction for children with autism. *Mental Retardation, 31,* 368-376.

Christensen, R., & Knezek, G. (1998). Internal consistency reliability for the teachers' attitudes toward information technology (TAT) questionnaire. In J. Willis, J. Price, S. McNeil, B. Robin, & D. Willis (Eds.), *Technology and teacher education annual 1998*. (pp. 853-856). Charlottesville, VA: Association for the Advancement of Computing in Education.

Clark, P., & Rutter, M. (1977). Compliance and resistance in autistic children. *Journal of Autism and Childhood Schizophrenia*, *7*(1), 33-48.

Clay, M.M. (1979). *Stones-The concepts about print test*. Exeter, NH: Heinemann.

Clay, M. M. (1985). *Sand: The concepts about print test.* Exeter, NH: Heinemann.

Clements, D.H. (1997) . *Effective use of computers with young children*. Arlington, VA: National Science Foundation.

Clements, D.H. (2002). Computers in early childhood mathematics. *Contemporary Issues in Early Childhood, 3*, 160-181.

Cohen, H., Amerine-Dickens, M., & Smith, T. (2006). Early intensive behavioral treatment: Replication of the UCLA model in a community setting. *Developmental and Behavioral Pediatrics*, *27*, 145–155.

Colby, K. M. (1973). The rationale for computer-based treatment of language difficulties in nonspeaking autistic children. *Journal of Autism and Developmental Disorders, 3,* 254-260.

Coleman-Martin, M., Heller, K., Cihak, D., & Irvine, K. (2005). Using computer-assisted instruction and the nonverbal reading approach to teach word identification. *Focus on Autism & Other Developmental Disabilities*, *20*, 80-90.

Committee on the Prevention of Reading Difficulties in Young Children (1998). *Preventing reading difficulties in young children.* C. Snow, M. S. Burns, & P. Griffin (Eds.). Washington, DC: National Academy Press.

Cook, R, E., Klein, M. D., & Tessier, A. (2008). *Adapting early childhood curricula for children with special needs* (7th ed.). Upper Saddle River, NJ: Pearson Merrill Prentice Hall.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis* (2nd ed). Upper Saddle River, NJ: Pearson.

Copeland, S.R. (2007). The power of literacy. In S.R. Copeland & E.B. Keefe (Eds.), *Effective literacy instruction: For students with moderate or severe disabilities* (pp. 1-6). Baltimore: Brookes.

Cordes, C., & Miller, E. (2000). *Fool's gold: A critical look at computers in childhood.* College Park, MD: Alliance for Childhood.

De Valenzuela, J.S., & Tracey, M.M. (2007). The role of language and communication as the basis for literacy. In S.R. Copeland & E.B. Keefe (Eds.), *Effective literacy*

instruction: For students with moderate or severe disabilities (pp. 23-40). Baltimore: Brookes.

Dunn, L., & Dunn, L. (1981). *Peabody picture vocabulary test- revised*. Circle Pines, MN: American Guidance Service.

Education for All Global Monitoring Report Team, (2005). *Education for all: Literacy for life.* Paris: United Nations Education, Scientific and Cultural Organization.

Eeds, M. (1985). Bookwords: Using a beginning word list of high frequency words from children's literature K–3. *The Reading Teacher*, *38*, pp.418-23.

Elliot, C. D. (1990). *Differential Ability Scales*. New York, NY: The Psychological Corporation.

Erickson, K., & Koppenhaver, D. (2003). Natural emergent literacy supports for preschoolers with autism and severe communication impairments. *Topics in Language Disorders*, *23*, 283-292.

Erikson, E. H. (1963). *Childhood and Society* (2^{nd} ed.). New York, NY: Norton.

Foley, B. E. (1994). The development of literacy in individuals with severe congenital speech and motor impairments. In K. G. Butler (Ed.), *Severe communication disorders: Intervention strategies* (pp. 183-199). Gaithersburg, MD: Aspen.

Freeman, N. K., & Somerindyke, J. (2001). Social play at the computer: Preschoolers scaffold and support peers' computer competence. In D. D. Shade (Ed.), *Information Technology in Childhood Education Annual* (pp. 203-213).

Frith, U. (1989). *Autism: Explaining the enigma.* Oxford: Basal Blackwell.

Frost, R. E. (1981). An interactive computer environment for autistic children. In *Proceedings of The Johns Hopkins First National Search for Applications of Personal Computing to Aid the Handicapped*. Los Angeles: IEEE Computer

Society. Retrieved October, 15, 2008 from http://www2.computer.org/portal/web/csdl/doi/10.1109/MM.1982.290947.

Gillespie, C. W., & Beisser, S. (2001). Developmentally appropriate LOGO computer programming with young children. In D. D. Shade (Ed.), *Information Technology in Childhood Education Annual* (pp. 229-224).

Good, R. H., & Kaminski, R. A. (2003). *DIBELS: Dynamic indicators of basic early literacy skills* (6th ed.). Longmont, CO: Sopris West.

Goodman, J. I., Brady, M. O., Duffy, M. L., Scott, J., & Pollard, N. E. (2008). The effects of bug in ear supervision on special education teachers' delivery of learn units. *Focus on Autism and Other Developmental Disabilities, 23,* 207-216.

Goodwin, M.S. (2008). Enhancing and accelerating the pace of autism research and treatment. *Focus on Autism and Other Developmental Disabilities 23*, 125-128.

Grigorenko, E. L., Klin, A., Pauls, D., Senft, R., Hooper, C., & Volkmar, F. (2002). A descriptive study of hyperlexia in a clinically referred sample of children with developmental delays. *Journal of Autism and Developmental Disorders, 32,* 3-12.

Hagiwara, T., & Smith Myles, B. (1999). A multimedia social story intervention: Teaching skills to children with autism. *Focus on Autism and Other Developmental Disabilities 14*, 82-95.

Happe´, F. (1999). Autism: cognitive deficit or cognitive style? *Trends in Cognitive Sciences*, *3*, 216–222.

Harris, A. J., & Jacobsen, M. (1972). *Basic Elementary Reading Vocabularies*. New York: MacMillan.

Haugland, S. W. (2000). What role should technology play in young children's learning (Part 2). *Young Children,* (*55*)1, 12-18.

Hedrbing, C. (1985). Computers and autistic learners: An evolving technology. *Australian Journal of Human Communication Disorders, 13*, 169-194.

Heimann, M., Nelson, K.E., Tjus, T., & Gillberg, C. (1995). Increasing reading and communication skills in children with autism through an interactive multimedia computer program. *Journal of Autism & Developmental Disorders*, *25*, 459-480.

Herrera, G., Alcantud, F., Jordan, R., Blanquer, A., Labajo, G., & De Pablo, C. (2008). Development of symbolic play through the use of virtual reality tools in children with autistic spectrum disorders: Two case studies. *Auitsm, 12,* 143-157.

Higgins, K., & Boone, R., (1990). Hypertext computer study guides and the social studies achievement of students with learning disabilities, remedial students, and regular education students. *Journal of Learning Disabilities, 23,* 529-540.

Higgins, K., & Boone, R., (1991). Hypermedia CAI: A supplement to an elementary school basal reader program*. Journal of Special Education Technology, 11*(1), 1-15.

Higgins, K., & Boone, R. (1996). Creating individualized computer-assisted instruction for students with autism using multimedia. *Focus on Autism & Other Developmental Disabilities*, *11*, 69-78.

Higgins, K., Boone, R., & Lovitt, (2002). Adapting challenging textbooks to improve content area learning. In M. R. Shinn, H. M. Walker, & G. Stoner (Eds). *Interventions for academic and behavior problems II: Preventative and remedial approaches.* Bethesda, MD: National Association of School Psychologists.

Hoberman, S., Mailick, S., & Ebert, R. H. (1994). *Professional education in the United States.* Westport, CT: Greenwood.

Hooper, S. R., & Umansky, W., (2009). *Young children with special needs* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Individuals with Disabilities Improvement Act of 2004, Pub. L. No. 108-446, 118 Stat. 328 (2004).

Koegel, R.L., Koegel, L.K., Frea, W.D., & Smith, A.E. (1995). Emerging interventions for children with autism: Longitudinal and lifestyle implications. In R.L. Koegel & L.K. Koegel (Eds.), *Teaching children with autism* (pp. 1-15). Baltimore, MD: Brookes.

Krendl, K. A., & Williams, R. B., (1990). The importance of being rigorous: Research on writing to read. *Journal of Computer-Based Instruction, 17,* 81-86.

Labbo, L.D., & Reinking, D. (2003). Computers and early literacy education. In N. Hall, J. Larson, & J. Marsh (Eds.), *Handbook of early childhood literacy* (pp. 338-354). Thousand Oaks, CA: Sage.

Lieber, J., & Semmel, M. L. (1985). Effectiveness of a computer application to instruction with mildly handicapped learners. *Remedial and Special Education, 6*(5), 5-12.

Lexia Learning Systems (2003). *Lexia Early Reading 2.0*. Concord, MA: Lexia Learning Systems, Inc.

Light, J. C., Roberts, B., Demarco, R., & Griener, N. (1998). Augmentative and alternative communication to support receptive and expressive communication for people with autism. *Journal of Communication Disorders, 31,* 153-180.

Lonigan, C. J., Driscoll, K., Phillips, B. M., Cantor, B. G., Christopher, Athony, J. L., & Goldstein, H. (2003). A Computer-Assisted Instruction Phonological Sensitivity

Program for Preschool Children At-Risk for Reading Problems. *Journal of Early Intervention, 25,* 248-262.

Lonigan, C. J., Wagner, R. K., Torgesen, J. K., & Rashotte, C.A. (2007). *TOPEL: Test of preschool early literacy*. Austin, TX: Pro-Ed.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55,* 3-9.

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: A review of research. *Psychological Bulletin, 86,* 1236-1254.

Lovaas, O. I. (2003). *Teaching individuals with developmental delay.* Austin: Pro-ed.

Lovaas, O. I., Schreibman, L., Koegel, R.L., & Rehm, R. (1971). Selective responding by autistic children to multiple sensory input. *Journal of Abnormal Psychology, 77,* 211-222.

Malofeeva, E., Day, J., Saco, X., Young, L., & Ciancio, D. (2004). Construction and evaluation of a number sense test with Head Start children. *Journal of Education Psychology*, 96, 648-659.

Mathes, P. G., Torgesen, J. K., & Allor, J. H. (2001). The effects of peer-assisted literacy strategies for first-grade readers with and without additional computer-assisted instruction in phonological awareness. *American Educational Research Journal*, 38, 371-410.

Mayer, R. E. (2001). *Multimedia Learning.* New York, NY: Cambridge University Press.

McCarthy, D. (1972). *McCarthy scales of children's abilities*. New York, NY: Psychological Corporation.

McCarrick, K., & Li, X. (2007). Buried treasure: The impact of computer use on young children's social, cognitive, language development and motivation. *AACE Journal, 15*, 73-95.

McGee, L.M., & Richgels, D.J. (2004). *Literacy's beginnings: Supporting young readers and writers* (4th ed). Needham, MA: Allyn and Bacon

McGill-Franzen, A. (1991). Early literacy: What does "developmentally appropriate" mean? *Reading Teacher, 46,* 56-58.

Millie's Math House (Version 3.1) [Computer software]. Novato, CA: Riverdeep.

Mirenda, P. (2003). "He's not really a reader…": Perspectives on supporting literacy development in individuals with autism. *Topics in Language Disorders, 23,* 271-282.

Mitchell, P., Parsons, S., & Leonard, A. (2007). Using virtual environments for teaching social understanding to six adolescents with autistic spectrum disorders. *Journal of Autism and Developmental Disorders, 37,* 589-600.

Moore, M., & Calvert, S. (2000). Brief report: Vocabulary acquisition for children with autism: teacher or computer instruction. *Journal of Autism and Developmental Disorders, 30*, 359-362.

Moore, D., & Taylor, J. (2000). Interactive multimedia systems for students with autism. *Journal of Educational Media*, *25*, 169-177.

Moore, D., McGrath, P., & Thorpe, J. (2000). Computer-aided learning for people with autism – a framework for research and development. *Innovations in Education & Training International*, *37*, 218-228.

Morrow, L.M. (2001). *Literacy development in the early years: Helping children read and write* (4th ed.). Boston, MA: Allyn and Bacon.

Murray, B. A., Stahl, S. A., & Ivey, M. G. (1996). Developing phoneme awareness through alphabet books. *Reading and Writing: An Interdisciplinary Journal*, 8, 307-322.

Murray, D. K. C. (1997). Autism and information technology: Therapy with computers. In S. Powel & R. Jordan (Eds.) *Autism and Learning: A Guide to Good Practice.* London: David Fulton.

National Association for the Education of Young Children, (1997). *Developmentally appropriate practice in early childhood programs*. Washington, DC: Author.

National Association for the Education of Young Children (1996). *Technology and Young Children ages 3 through 8: A position statement of the National Association for the Education of Young Children*. Retrieved February 28, 2008 from http://www.naeyc.org/about/positions.asp

National Institute of Child Health and Human Development. (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). Washington, DC: Author.

National Research Council, (2001). *Educating children with autism.* Committee on education interventions for children with autism. C. Lord & J. McGee (Eds.). Washington, DC: National Academy Press.

Nevada Administrative Code. (2005). *Nevada Administrative Code, 388.028 Autism defined.*

National Joint Committee for the Communication Needs of Persons With Severe Disabilities (1992). *Guidelines for meeting the communication needs of persons with severe disabilities.* Retrieved October 28, 2008 from: http://www.asha.org/docs/html/GL1992-00201.html.

No Child Left Behind Act of 2001, Pub. L. No. 107-110, 11 Stat. 1425 (2002).

Panyan, M.V. (1984). Computer technology for autistic students. *Journal of Autism and Developmental Disorders, 14*, 375-382.

Paul, R. (2007). Communication and its development in autism spectrum disorders. In F. Volkmar (Ed.), *Autism and pervasive developmental disorders* (pp. 129-155). Cambridge: Cambridge University Press.

Piaget, J. (1974). *The origins of intelligence in children.* Guilford, CT: International University Press.

Piasta, S. B., Purpura, D. J., & Wagner, R. (2009). Fostering alphabet knowledge development: A comparison of two instructional approaches. *Reading & Writing.* Advance online publication. doi: 0.1007/s11145-009-9174-x

Pinnel, G., & Fountas, I. C., (1998). *Word Matters: Teaching phonics and spelling in the reading/writing classroom.* Cambridge, MA: Heinemann.

Pinnel, G., & Fountas, I. C., (2007). *The continuum of literacy learning, grades K-2*. Portsmouth, NH: Heinemann.

Prior, M., & Ozonoff, S. (2007). Psychological factors in autism. In F. Volkmar (Ed.), *Autism and pervasive developmental disorders* (pp. 69-128). Cambridge: Cambridge University Press.

Raymond, E.B. (2004). *Learners with mild disabilities: A characteristics approach* (2nd ed.). Boston: Pearson Allyn and Bacon.

Runtime Revolution Studio Edition (Version 4.0) [Computer software]. Edinburgh, Scotland: Runtime Revolution.

Scheuermann, B., & Webber, J. (2002). *Autism: Teaching does make a difference*. Belmont, CA: Wadsworth/Thomson Learning.

Shah, A., & Frith, U. (1993). Why do autistic individuals show superior performance on the block design task? *Journal of Child Psychology and Psychiatry,* 34, 1351-1364.

Silberberg, N. E., & Silberberg, M. C. (1967). Hyperlexia: Specific work recognition skills in young children. *Exceptional Children*. 34, 41-42.

Simmons, D. C., Kame'enui, E. J., Good, R. H., Harn, B. A., Cole, C., & Braun, D. (2002). Buidling, implementing, and sustaining a beginning reading improvement model: Lessons learned school by school. In M. R. Shinn, H. M. Walker, & G. Stoner (Eds). *Interventions for academic and behavior problems II: Preventative and remedial approaches* (pp537-588). Bethesda, MD: National Association of School Psychologists.

Simpson, R.L., & Myles, B.S. (1998). Understanding and responding to the needs of students with autism. In R.L. Simpson & B.S. Myles (Eds.), *Educating children and youth with autism: Strategies for effective practice* (pp. 1-23). Austin, TX: Pro-Ed.

Slavin, R. (1991). Reading effects of IBM's "Writing to Read" program: A review of evaluations. *Education Evaluation and Policy Analysis, 13*(1), 1-11.

Slavin, R.E. (2000). *Educational psychology* (6th ed.). Boston: Allyn and Bacon.

Stahl, S.A., & Murray, B.A. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology*, *86*, 221-234.

Street, B.V. (1984). *Literacy in theory and practice*. Cambridge: Cambridge University Press.

Street, B.V., & Lefstein, A. (2007). *Literacy: An advanced resource book*. London and New York: Routledge.

Strickland, D., Marcus, L., Mesibov, G., & Hogan, K. (1996). Brief Report: Two case studies using virtual reality as a learning tool for autistic children. *Journal of Autism and Developmental Disorders, 26,* 651-660.

Sulzby, E., & Teale, W.H. (1991). Emergent literacy. In R. Barr, M. Kammil, P. Mosenthal, & D. Pearson (Eds.), *Handbook of reading research* (2nd ed., pp. 727-757). New York: Longman.

Teale, W. H., and Sulzby, E. (1986). Emergent literacy as a perspective for examining how young children become readers and writers. In W. H. Teale and E. Sulzby (Eds.), *Emergent Literacy: Writing and Reading.* Norwood, NH: Ablex Publishing.

Thompkins, G.E. (2003). *Literacy for the 21st century* (3rd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Thorndike, R. L., Hagen, E. P., & Sattler, J. M. (1986). *Stanford-Binet Intelligence Scale: Fourth Edition (Technical Manual).* Chicago, IL: Riverside.

Tjus, T., Heimann, M., & Nelson, K.E. (1998). Gains in literacy through the use of a specially developed multimedia computer strategy: Positive finding from 13 children with autism. *Autism: The International Journal of Research & Practice*, *2*, 139-156.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of word reading efficiency*. Austin, TX: Pro-Ed.

U. S. Department of Education (2000). *To assure the free appropriate public education of all children with disabilities: Twenty-second annual report to Congress on the Implementation of the Individuals with Disabilities Education Act*.

U.S. Department of Education (2006). *Twenty-eighth annual report to Congress on the Implementation of the Individuals with Disabilities Education Act, Vol. 2.*

U.S. Department of Education, Office of Elementary and Secondary Education (2008). Reading First State Grants.

Volkmar, F.R., & Lord, C. (2007). Diagnosis and definition of autism and other pervasive developmental disorders. In F. Volkmar (Ed.), *Autism and pervasive developmental disorders* (pp. 1-31). Cambridge, MA: Cambridge University Press.

Vukelich, C. (1994). Effects of play interventions on young children's reading of environmental print. *Early Childhood Research Quarterly*, 9, 153-170.

Vygotsky, L. S. (1978). The prehistory of written language. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind Society: The development of higher psychological process* (pp. 105-119). Cambridge, MA: Cambridge University Press.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1999). *Comprehensive test of phonological processes*. Austin, TX: PRO-ED Publishing, Inc.

Wasik, B. A., & Bond, M. A. (2001). Beyond the pages of a book: Interactive book reading and language development in preschool classrooms. *Journal of Educational Psychology*, *93*, 243-250.

Wiig, E. H., Secord, W., & Semel, E. (1992). Clinical Evaluation of Language Fundamentals—Preschool. *CELF-Preschool*. New York, NY: Psychological Corporation.

Williams, J. (1985). When the classroom computer talks, handicapped students listen. *American School Board Journal, 172*(3), 43-44.

Williams, C., Wright, B., Callaghan, G., & Coughlan, B. (2002). Do children with autism learn to read more readily by computer assisted instruction or traditional book methods?: A pilot study. *Autism: The International Journal of Research & Practice*, *6*, 71-91.

Wilkinson, G. S. (1993). *Wide Range Achievement Test* (3rd ed.). Wilmington, DE: Jastak Associates.

Woodcock, R. N. (1987). *Woodcock reading mastery tests- revised examiners manual*. Circle Pines, MN: American Guidance Service.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Test*. Itasca, IL: Riverside Publishing Company.

Yelland, N. (2005). The future is now: A review of the literature on the use of computers in early childhood education (1994-2004). *AACE Journal, 13*(3), 201-232.

Yoder, D.E. (2001). Having my say. *AAC: Augmentative & Alternative Communication*, *17*, 2-10.

Yoder, D., Erickson, K., & Koppenhaver, D., (1997). Literacy bill of rights. *The Center for Literacy and Disability Studies, University of North Carolina at Chapel Hill.* Retrieved October, 18, 2008 from www.dsasdonline.org/admin/files/AT-Literacy.pdf

Yopp, H. (1992). Developing phonemic awareness in young children. *Reading Teacher*, *45*, 696-703.

Yopp, H. K. (1995). A test for assessing phonemic awareness in young children. *The Reading Teacher*, *49*, 20-29.

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Travers, J. C. (2009). Book review: Teaching Children with Down Syndrome about Their Bodies, Boundaries, and Sexuality. *Intellectual and Developmental Disabilities,* 401-402.

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