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## Using computer software to enhance instruction of early literacy skills in the kindergarten classroom

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## Using computer software to enhance instruction of early literacy skills in the kindergarten classroom

### Abstract

This review investigates skills vital to early literacy instruction, technology use in early childhood classrooms, and software available to enhance early literacy skills of kindergarten students. Letter naming, phonological awareness, concepts about print, and language development are early literacy skills vital to a student's future reading success. Studies have shown that technology has been used in early childhood classrooms as an effective teaching tool, to promote active student involvement, and as a tool for motivation, showing that computers can be utilized successfully with young students. Research indicates that early literacy software used to supplement teacher instruction has great potential to have a significant positive effect on student literacy skills at the kindergarten level.

Using Computer Software To Enhance Instruction of Early Literacy Skills in the  
Kindergarten Classroom



A Graduate Literature Review  
Submitted to the  
Division of Educational Technology  
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Master of Arts  
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by

Janann Dostal

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This Review by: Janann Dostal

Titled: Using Computer Software To Enhance Instruction of Early Literacy Skills in the Kindergarten Classroom

has been approved as meeting the research requirement for the Degree of Master of Arts.

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## Abstract

This review investigates skills vital to early literacy instruction, technology use in early childhood classrooms, and software available to enhance early literacy skills of kindergarten students. Letter naming, phonological awareness, concepts about print, and language development are early literacy skills vital to a student's future reading success. Studies have shown that technology has been used in early childhood classrooms as an effective teaching tool, to promote active student involvement, and as a tool for motivation, showing that computers can be utilized successfully with young students. Research indicates that early literacy software used to supplement teacher instruction has great potential to have a significant positive effect on student literacy skills at the kindergarten level.

## *Introduction*

Children must master the skill of reading in order to achieve success in school and throughout their lives (Kaminski & Good, 1996). Thus, the importance of reading in the elementary curriculum cannot be underestimated or overlooked. Stanovich (1986) explained that students who fall behind in the acquisition of reading skills are at risk of losing motivation, which affects all academic pursuits. “Or, to put it more simply—and sadly—in the words of a tearful 9-year-old, already falling frustratingly behind his peers in reading progress, ‘Reading affects everything you do.’” (Stanovich, 1986, p. 390). Instruction in this critical academic area is initiated during the early childhood years. Research indicates that the literate activities and experiences a child engages in during the early years of education significantly affect the child’s later performance (Kaminski & Good, 1996).

The instruction of early literacy skills is a vital academic goal of kindergarten programs across the nation. Howell, Erickson, and Stanger (2000) stated “the development of literacy skills in kindergarten and early elementary-age children has become an unquestioned national priority” (p. 5). The importance of early literacy skills in the curriculum of kindergarten programs indicates that instructors must actively seek resources with which these skills can be reinforced in the classroom.

Computers and computer software programs can be effective tools for instruction in early childhood classrooms. “Through the use of a computer, many possibilities exist for enhancing a child’s educational experiences as well as providing a flexible instructional tool for reaching a variety of educational goals” (Carlson & White, 1998, p. 143). Alloway (1994) stated that “most early childhood educators seem to be convinced that microcomputers, like any other resource, can be incorporated into the activities of early

childhood centres in developmentally advantageous ways” (p. 104). Successful attempts to incorporate computers and software into early childhood settings suggest that teachers can utilize the computer and software resources now available to enhance classroom instruction of early literacy skills.

This review will investigate the utilization of computers and software to improve early literacy skills in the kindergarten classroom. Identified skills included in kindergarten early literacy instruction will be discussed. Evidence that technology can be an effective tool when used in an early childhood classroom will be presented. Finally, results of research conducted on the use of early literacy software as an instructional aid will be presented.

Three main questions will be addressed:

1. What skills have been identified as vital to early literacy instruction for kindergarten students?
2. What research supports the use of technology in early childhood classrooms?
3. What evidence supports the use of computer software to enhance the early literacy skills of kindergarten students?

### *Methodology*

To begin the research for this literature review, the author searched the ERIC and UNISTAR databases at the University of Northern Iowa Rod Library. To ensure that quality results were achieved, the search criteria were immediately narrowed to include only professional journals. Keyword searches were then conducted. The keywords that provided appropriate results included “reading instruction” and technology, technology and education and “early childhood”, “early childhood” and literacy and technology, “reading instruction” and technology, and kindergarten and research and literacy. The search results were

analyzed for dates of publication, the journals in which they appeared, and appropriate content according to the abstracts. Because of the ever-changing nature of technology, preference was given to recent articles. Articles from a variety of professional journals were selected. The search results led the author to the stacks at the library, where the professional journals are housed. The author conducted a similar search at Loras College and Clarke College in an attempt to locate additional relevant research. A web search was conducted using the same keywords. Search results from professional journals were investigated and analyzed for content, date, and research quality. Web search results yielded few sources not acquired at one of the libraries.

After locating the articles, each one was reviewed for appropriate content. The author selected articles from a variety of professional journals for use in the literature review. The articles were discussed with a reading specialist from the author's school district. They were analyzed with a focus on authenticity of research and applicability to the kindergarten curriculum. The author and reading specialist noted that limited research had been conducted on the use of software in kindergarten classrooms for the purpose of early literacy instruction. The decision was made to include research conducted with groups of students aged four to eight years. After this meeting, articles were selected upon which this literature review is based.

After the articles had been read and their content analyzed, the core ideas of the review, along with the three stated guiding questions, were formed. Supporting information was selected for inclusion that would effectively present the information gleaned from the literature.

### *Analysis and Discussion*

This review will provide the background necessary to understand the components of early literacy skills at the kindergarten level. Included are some of the essential skills measured to assess early literacy knowledge in children. The focus will be on letter naming, phonological awareness, concepts about print, and language skills. Evidence of successful technology integration in early childhood classes will also be presented. This will include the benefits of using technology as an effective teaching tool, as a tool to promote active student involvement, and as a motivational tool for student learning. Finally, research findings, which provide evidence of improvement in kindergarten early literacy skills through the use of computers and software in the areas of letter naming, phonological awareness, concepts about print, and language skills will follow.

#### *Kindergarten Early Literacy Skills*

“One of the most critical academic tasks in the early years of school is the development of literacy” (Boone, Higgins, & Notari, 1996, p. 39). Students enter kindergarten with varied backgrounds in literacy or literate activities. Boone, Higgins, and Notari (1996) stated that home activities such as reading, experience with letter naming, and exposure to print, nursery rhymes, and phonemes are related to later literacy achievement. Research has determined that skills in the area of literacy strongly predict future student success (Tunmer, Harriman, & Nesdale, 1988; Kozminsky & Kozminsky, 1995). This suggests that kindergarten teachers should provide experiences, activities, and direct instruction involving early literacy skills.

*Letter naming.* Knowledge of letter names is one of the literacy skills first acquired by young students. The ease with which students identify and recognize letters is a strong

predictor of reading acquisition (Tunmer, Herriman, & Nesdale, 1988; Kaminski & Good, 1996; Dermott, Pinzari, Dodd, & McIntire, 1980). Boone, Higgins, and Notari (1996) indicated that “the ease or fluency of letter recognition and identification strongly predicts the acquisition of reading among beginning readers” (p. 39). They contended that a pre-reader’s knowledge of letter names is an important predictor of reading achievement.

Boone, Higgins, and Notari (1996) stated that “letter recognition is an important part of kindergarten curricula and is rated by kindergarten teachers as an essential skill for children to have at the end of the kindergarten years” (p. 40). Fluency in this task allows students to use letters as a visual aid when focusing on sounds, words, and meanings. Letter naming has been linked to other early literacy skills. Tunmer, Herriman, and Nesdale (1988) conducted research that supported a connection between letter naming and phonological awareness skills indicating that teaching these skills in tandem may increase future reading achievement. Tunmer and colleagues (1988) contended that children must have some level of phonological awareness before they can benefit from the acquisition of letter naming skills.

*Phonological awareness.* Phonological awareness refers to a person’s ability to distinguish between the phonological components of a word and to manipulate those components (Kaminski & Good, 1996). Without phonological awareness, children don’t have the necessary knowledge with which to apply letter naming skills. Children must first be aware of the phonological units of which spoken words are comprised in order to master the letter-sound correspondence that make up printed words (Kaminski & Good, 1996). When phonological awareness is lacking, letter-sound correspondence patterns will likely seem arbitrary and meaningless to children (Wagner & Torgesen, 1987). Learning to read

and write is a complicated process. In order to learn to read in English, children must develop their awareness of phonemes contained in spoken language and their knowledge of sound and letter patterns (Mitchell & Fox, 2001).

Some researchers have concluded that phonological awareness directly increases student reading success (O'Connor & Jenkins, 1999; Ball & Blachman, 1991; Mitchell & Fox, 2001). Kaminski and Good (1996) stated that "the relationship between phonological awareness and learning to read is sizable and indicates that tasks measuring phonological awareness are moderate to strong predictors of the speed with which children acquire reading skills in the early grades" (p. 217). Thus, phonological awareness is a key component of the instruction of early literacy in the kindergarten classroom and has been increasingly included in the curriculum.

Mitchell and Fox (2001) indicated that "Kindergarten children who received direct phonological awareness instruction had greater awareness than a no-training control group at the end of the Kindergarten year" (p. 317). The evidence that phonological awareness can successfully be taught to kindergarten students indicates that it should be a critical focus in early literacy programs. Researchers agree that phonological awareness instruction increases student achievement (Kozminsky & Kozminsky, 1995; Lundberg, Frost, & Petersen, 1996). Kozminsky & Kozminsky (1995) found that students who received direct phonological awareness instruction not only improved their skills during their kindergarten year, scoring higher than members of a control group, but also displayed higher reading achievement during first and third grade. The positive effect that phonological awareness instruction has on reading achievement indicates that kindergarten teachers should actively seek ways to

include instruction, practice, and reinforcement of phonological awareness skills in their classrooms.

*Concepts about print.* Children must have knowledge of concepts about print and conventions of books before they can begin to read (Keller & Shanahan, 1983; Naymark & Plaisant, 1986; Carlson & White, 1998). The knowledge that print is written from left to right, words are made of letters in a certain order, and there are a fixed number of letters are all important to early literacy learning (Naymark & Plaisant, 1986). “The knowledge of the concept of left and right is essential to the understanding of directionality of print. Students must learn that print is written and read from left to right and from top to bottom on a page” (Carlson & White, 1998, p. 144). These directional skills are necessary before a child can begin to read words on a page. Carlson and White (1998) stated that “the relevance of these directional and relational concepts to academic achievement implies that more attention should be given to teaching concepts such as right and left in the early stages of a child’s education” (p. 134). They contended that a solid understanding of these basic concepts are important for children’s future learning and academic success. Many students have difficulty with these concepts and require instruction and reinforcement in the classroom. Keller and Shanahan (1983) used a computerized toy called Big Trak to assist with the instruction of directional concepts. The researchers found that direct instruction on the concepts of left and right increased student success and that the computerized aid assisted student learning. Researchers have found that children with directional problems who are at the beginning stages of learning to read have noted difficulties and that specific training on the concepts of left and right may help them become more successful readers (Sterritt, Konty, & Padia, 1976). The concepts of directionality of print are important to the future reading

achievement of young students. Through direct instruction students can develop “concepts about print, knowledge of book structures, and other skills relevant to emergent literacy that are required for success with early literacy instruction” (Howell, Erickson, Stanger, 2000, p. 6), suggesting that instruction on these important concepts should be included in early literacy curricula.

*Language development.* “The development of language skills has long been held to be related to the development of literacy in young children” (Kaminski & Good, 1996). Language skills often develop prior to other early literacy skills. Boone, Higgins, and Notari (1996) noted that “typically, before they learn to recognize the printed symbol and the letter sound, children learn to recite and name the letters of the alphabet through informal oral language activities such as reciting the alphabet song, prior to entering school” (p. 40). Language skills of young students have been measured through picture naming, vocabulary growth, and word decoding speed. When vocabulary is used to measure language ability, a strong relationship is seen with future reading ability. Stanovich (1981), in a study involving the relationship between word decoding speed, general name-retrieval ability, and reading progress in first grade students, discovered that the number of vocabulary errors made by children correlated directly with their reading skill. Early language problems tend to continue through the school years and seem to predict future difficulties with oral and written language skills, reading, and spelling (Kaminski & Good, 1996; Liberman & Shankweiler, 1985). Language skills can be incorporated into all areas of the kindergarten curriculum to continually reinforce the important skills necessary for future reading success.

### *Technology Use in Early Childhood Classrooms*

As technology is incorporated into early childhood classrooms, it is important to analyze ways in which it can successfully be used to enhance educational goals. A majority of early childhood educators seem convinced that computers can be integrated into the activities of early childhood students in ways that are developmentally beneficial (Alloway, 1994). Technology can be used in a variety of ways to enhance instruction in early childhood classrooms while increasing student computer skills. The acquisition of computer skills at an early age has a positive effect on the future willingness of students to learn using computers (Ross, Hogaboam-Gray, & Hannay, 2001). Successful introduction and utilization of technology in the early childhood classroom requires that teachers take on the role of: instructor to guide students through the learning process, coach to facilitate appropriate technology use, model of the ways in which technology is used, and critic that evaluates and selects appropriate software for the classroom (Ediger, 1998). As students learn how to use technology, they can then explore new areas of learning on their own. Ediger (1998) stated that through increased confidence “students will become ‘infotectives,’ i.e. independent thinkers, researchers, inventors, inquirers, capable of solving problems that often required the active direction of the teacher or supervisor” (p. 141). Technology skills learned in the early childhood classroom will pave the way for future technology work throughout students’ educational careers. Ross, Hogaboam-Gray, and Hannay (2001) stated that “the adoption of an interactive literacy program in the early years of schooling provides a solid cognitive and affective foundation for student access to information technology” (p. 233). Thus, based on the research, the opportunity to develop computer skills at an early age should be provided to kindergarten students.

*Effective teaching tool.* Technology can be used as an effective teaching tool in the early childhood classroom. “It was shown unequivocally that as an interactive pedagogical tool the computer can be effectively exploited by young children” (Naymark & Plaisant, 1986, p. 168). Computers can be utilized to instruct and reinforce a wide variety of skills at the early childhood level. “Participation in activities with computers has been found to enhance cognitive skills, literacy and prereading, school readiness, language and social interaction, and self-confidence in normally developing preschool and kindergarten children” (Boone, Higgins, & Notari, 1996, p. 40).

Trudy’s Time and Place House, the program used in the study of kindergarten students conducted by Carlson and White (1998), produced a significant improvement in the number of correct answers from the pretest to the posttest for students in the experimental group. The authors reported that “research confirms that it is possible to provide students, as early as kindergarten, with the opportunity to have a favorable experience with a computer while enhancing their understanding of a particular educational concept” (p. 145). They also reported that the software program had a positive impact on the performance of the kindergarten students on the exam that was included in their study.

Boone, Higgins, and Notari (1996) found that software used in their early childhood study was “a strong pedagogical tool” (p. 58), while Ediger (1998) stated that “technology holds much promise for pupils who are developing readiness for reading” (p. 138). Teachers in early childhood settings would do well to look for ways to include technology as a teaching tool in their classrooms.

*Active student involvement.* Technology can be used to foster active student involvement in the early childhood classroom. Boone, Higgins, and Notari (1996) found

very high student involvement in their three-year study of kindergarten students using hypermedia learner-centered software. They stated that “each year . . . the students in the low group showed levels of interaction that were as high as the middle and high group students and that did not wane through weekly use over the course of the school year” (p. 59). Carlson and White (1998) found that kindergarten students participating in their study were actively involved in directing their learning progress through use of the learner-centered software program, Trudy’s Time and Place House. This research indicated that students can be actively involved in software programs as early as their kindergarten year. Pastor and Kerns (1997) conducted lessons with their kindergarten students that involved digital cameras and hypermedia software. They discovered that students became enthusiastic participants in the use of technology. Students captured real events, wrote about them, and added creative touches to their projects while becoming more confident computer users, suggesting that technology can help to engage early childhood students in learning activities that expand on curriculum.

*Student motivation.* Early childhood students can be motivated by computer software programs. Boone, Higgins, and Notari (1996) found in their study of kindergarten students that “students displayed an unexpected amount of enthusiasm in terms of remaining on task and interacting with the software” (p. 59). Carlson and White (1998) reported similar findings in their kindergarten study in which the students displayed excitement and enjoyment when using the computer software. Students who participated in this study seemed very motivated by the reinforcement provided by the program. Pastor and Kerns (1996) stated that kindergarten students expressed excitement while indicating satisfaction with their work using technology in their classroom. They indicated that “many students

who were previously intimidated by computers became active, enthusiastic participants” (p. 43).

Student motivation is an important consideration for teachers who are using technology in their classrooms. Teachers, in a study on exemplary use of technology in elementary classrooms, were asked to rate technology applications in order of importance. They rated the survey selection highest that dealt with motivation and keeping students interested (Berg, Banz, Lasley & Raisch, 1998). Teachers can strive to capture this student enthusiasm by including appropriate software programs in their early childhood classrooms.

#### *Software Utilized to Improve Kindergarten Early Literacy Skills*

Though research is limited on the use of software to enhance literacy skills at the kindergarten level, recent studies have shown that technology can be an effective teaching tool when utilized for this purpose. Ediger (1998) stated that “technology holds much promise for pupils who are developing readiness for reading” (p. 139). Other researchers have echoed this thought. Ross, Hogaboam-Gray, and Hannay (2001) suggested during discussion of their literacy software study that “the adoption of an interactive literacy program in the early years of schooling provides a solid cognitive and affective foundation for student access to information technology” (p. 231). Positive outcomes have led researchers to embrace the use of software for the purpose of early literacy instruction. “A balanced approach to early reading instruction delivered via a carefully constructed computer-based program can be highly effective in increasing a variety of critical skills in young children” (Howell, Erickson, & Stanger, 2000, p. 12). Shilling (1997) was equally positive, stating that a growing body of research supports “the use of computers as another tool through which children can construct knowledge about written language and make

discoveries about letter-sound relationships” (p. 258). Research has shown that software can be used with favorable results in several areas of early literacy instruction.

*Letter naming.* An important component of literacy development in early childhood education is letter recognition. Boone, Higgins, and Notari (1996) conducted a three-year study of six kindergarten classrooms using hypermedia student-centered pre-reading lessons based on the Macmillan Basal Reader Series. Experimental and control classrooms, each consisting of low, middle and high ability groups, participated in this study, learning a new letter of the alphabet each week. Students in the experimental classrooms completed a corresponding hypermedia letter recognition lesson designed to supplement teacher instruction each week. The control classroom received the same literacy instruction without the inclusion of the hypermedia lessons. This was the only difference in literacy activities between the experimental and control classrooms. All research was conducted in general education kindergarten classrooms with teachers of similar experience. Teachers in control and experimental classrooms taught one letter of the alphabet each week. The hypermedia lessons used to enhance direct letter recognition instruction from the teachers were presented on two Apple Macintosh Plus computers in each experimental room. Students controlled all computer functions with a mouse. Words and pictures on the screen linked students to additional information about the designated letter of the week. Information available included animated sequences, text, digitized speech, graphics, and combinations of these modes. Students guided their own progress through the activities available within the programs by following directions provided in digitized speech. Correct and incorrect selections were reinforced with sounds and graphics. Results were measured using the Macmillan Reading Achievement Test as a pretest and posttest. Research indicated that

students in the high and middle ability groups showed statistically significant benefits from the hypermedia pre-reading lessons. Members of the experimental groups achieved significantly higher test scores than their control group peers at the end of the study. Students in the low ability groups failed to achieve the success seen by the middle and high groups. The authors suggested that the time limit on software use may have affected the low ability group. Students were not allowed to return to the lesson for further practice, though they showed high interest and motivation. The authors noted that “previous research has indicated that students who are having difficulties reading may not be self-directed enough to retain a high level of interaction with software that is non-directive” (p. 52). They suggested further research on the use of hypermedia lessons that were less limited by time. The conclusions drawn from this study were positive. Boone, Higgins, and Notari (1996) stated “hypermedia pre-reading software can provide a strong pedagogical tool for developing or improving letter recognition skills in kindergarten students” (p. 53). They concluded that students at risk due to deficiencies in literacy skills may need more time to practice using hypermedia software in order to receive the benefits seen by the middle and high ability groups of students. The researchers also concluded that a hypermedia educational software program can successfully be integrated into the daily routines of kindergarten classrooms.

*Phonological awareness.* Phonological awareness is a vital component of early literacy education and a predictor of future reading success. Howell, Erickson, and Stanger (2000) conducted a study on the effects of IntelliTools Reading software on the phonemic awareness skills of students that were identified as needing early literacy skill reinforcement. Students identified at-risk for reading difficulties were selected from six states. The members of the control group were typically developing students, not identified as in need of

early literacy skill reinforcement, from some of the same classrooms. Both groups received teacher-led reading instruction for the 16-week period of the study that included phonics instruction, writing, and the reading of children's literature. Students in the experimental group received the computer-based instruction as a supplement, while the members of the control group received only the regular teacher-led instruction. IntelliTools reading software included the reading of connected text for comprehension, word study, and structured writing activities. Each unit in the software was based on a story that emphasized predictable text with corresponding pictures. Students used the program for 30 minutes each day, working at the computers four days each week. Each lesson included 15 minutes directed and supported by an adult followed by 15 minutes of independent practice. Adults worked with students in small groups at a single computer. Results were measured with pretests and posttests created by the researchers. At the completion of the study, the experimental group who had utilized the software had almost doubled its mean score and approached the performance of the typically developing students. All students who used the software in the study achieved statistically significant measurable growth in their phonemic awareness skills. The researchers were excited about the results of the study and encouraged by the great increase in literacy learning that took place during a short period of time. "Although the authors had confidence that the program would assist otherwise struggling readers in their efforts to learn how to read, such dramatic effects in the abbreviated intervention period were not anticipated" (Howell, Erickson, & Stanger, 2000, p. 12). The researchers indicated that further studies, including some of longer duration, would help to validate the benefits evidenced by their work.

Mitchell and Fox (2001) studied the effects of computer software for developing phonological awareness in low-progress readers. They focused their research on two early literacy software programs, DaisyQuest and Daisy's Castle. At-risk kindergarten and first grade students were placed in one of three groups: one group received teacher-delivered phonological awareness instruction, one group received computer-delivered phonological awareness instruction, and one group was an instructional technology control group that used computer math programs. Students were classified at-risk based on teacher observation, scores on the Literacy Initiative for Everyone evaluation, and the Peabody Picture Vocabulary Test. The study was conducted over a four-week period, during which teachers did not provide phonological awareness instruction to their classes. The Phonological Awareness Test was used to assess pretest and posttest results of the study. The group of students who received computer-administrated phonological awareness instruction used two complimentary software programs, DaisyQuest and Daisy's Castle. DaisyQuest instructed students and provided them with practice on identifying rhymes and the beginning, middle, and ending sounds of words. Daisy's Castle taught and reinforced blending and segmenting of phonemes. The software programs included oral instructions, colorful graphics, and speech components. They were highly interactive and provided frequent feedback on student performance. Both groups who received phonological awareness instruction, whether computer-delivered or teacher-delivered, significantly outperformed the technology control group in all of the phonological awareness skills measured. The researchers concluded, "the data from this study supports the idea that phonological awareness . . . can be enhanced by using computer-administered instruction" (p. 325). The researchers indicated that computer-administered instruction can be a successful method of teaching phonological awareness to

young and struggling students. Early childhood teachers, to improve phonological awareness skills in their classrooms, can effectively use computer-administered instruction to supplement and reinforce their teaching.

*Concepts about print.* Knowledge about the concepts of print is important for building early literacy skills. One of these vital skills is the ability of students to understand the concepts of left and right so that they may recognize the way print moves across a page. Carlson and White (1998) studied the effectiveness of a computer program in helping kindergarten students learn this concept. During the study, the experimental group used software entitled *Trudy's Time and Place House* to provide practice in the concepts of left and right. The section of kindergarten in which the students were enrolled established control and experimental groups. Each group was given pretests and posttests designed by the researchers. Students in the experimental group used software entitled *Trudy's Time and Place House* for ten minutes each day. After a two-week intervention period, the students had spent 100 minutes individually using the program. The software provided students with enjoyable goals and frequent reinforcement as they performed the designated tasks. The researchers found that there were statistically significant improvements in the scores of the students utilizing the software from pretest to posttest. They also discovered a significant positive difference in the performance of students in the experimental group when compared to the control group that did not have access to the software. The researchers noted "it is clear that the program used in this study had a dramatic effect on kindergartners' performance on the examinations" (p. 143). This study suggests that computer programs can be successfully used to give students reinforcement and practice on concepts about print that are vital to literacy learning.

*Language development.* Language development is essential to the literacy learning of young students. Language skills often develop prior to other early literacy skills. Shilling (1997) conducted a study that observed literacy events of students using a computer center. Literacy events were defined as listening, speaking, writing, or reading. A teacher and another observer recorded anecdotal notes of literacy events that occurred during student use of the computer center. Data was also collected through writing samples and with the results of the Metalinguistic Book Handling Task, which was administered to students two times during the study. During the 5-month period of the study, 90 computer-related literacy events were recorded. The focus of data collection was on writing development. The researcher was encouraged by their results and stated that computers “can contribute to learning about the functions and features of print. The results of this study support the use of computers as another tool through which children can construct knowledge about written language and make discoveries about letter-sound relationships” (Shilling, 1997, p. 258). Shilling (1997) indicated that children who participated in this study both explored written language and used it in meaningful contexts within their learning.

Pastor and Kerns (1997) found that the use of technology in their classroom increased the development of language skills among their students. They reported that their kindergarten students used digital cameras to record events on the classroom computers, added the pictures to hypermedia software, and added text to describe the pictures. Students recorded information in this manner and created their own presentations. The authors reported that students were actively engaged in the use of this software and eager to share their work with others. They found that this project increased the verbalization of ideas and

promoted creative writing as students synthesized their thoughts into commentary and captions.

### *Conclusions and Recommendations*

The importance of the critical academic task of reading in the early elementary curriculum cannot be underestimated or overlooked. Early literacy skills are vital to the future success that students will have as readers and are becoming a national priority for educators of kindergarten students. Letter naming, phonological awareness, concepts about print, and language development are important components of a child's early literacy skills and indicators of future reading success. Successful readers will be more productive learners as they progress through the educational system. This lends emphasis to the importance of the instruction and reinforcement of early literacy skills. Because children should begin to gain knowledge of these skills during their year in kindergarten, teachers and curriculum planners should actively seek innovative ways to supplement and reinforce early literacy instruction.

Many early childhood educators are convinced that computers can be used in ways that are developmentally beneficial to young students. Technology has proven successful in early childhood classrooms as an effective learning tool, to promote active student involvement, and as a tool for student motivation. The research included in this review presented evidence that technology can very effectively be used in the early childhood classroom. Researchers consistently found that students that used computers and software to reinforce learning were even more motivated and involved in their learning than was predicted at the onset of their studies. They found that student computer skills improved and motivation often increased as students gained experience with the technology. The

experience gained by using technology at a young age will benefit students as they continue their technology use throughout their educational careers. The successful ways in which technology has been incorporated and studied in early childhood settings provides evidence that computers and software could effectively be used in kindergarten classrooms.

Positive outcomes of studies have led researchers to embrace the use of software for the purpose of early literacy instruction. Successful attempts to incorporate computers and software into early childhood settings referenced in this review document that teachers can utilize the computer and software resources available to enhance classroom instruction of early literacy skills. Studies conducted on letter naming, phonological awareness, concepts about print, and language skills all provided evidence that computer software can improve student skills. Research presented in this review, though limited by the scope of early childhood studies available on this topic, shows that positive results were achieved through the use of computer software in each area of early literacy instruction discussed. Some of the studies presented involved at-risk children who were struggling to match the academic skills of their typically developing peers. The positive results seen in these studies indicate that early literacy software could be the additional reinforcement needed in order to improve the skills of struggling students.

Researchers were enthusiastic in their responses to the completed studies, but indicated that additional research, including some of longer duration than that currently available, were necessary to reproduce results and further examine the topic. Further studies into the specific benefits that early literacy software may have on reading scores are also needed to truly evaluate the use of computer software to teach early literacy skills. On-going research regarding the future reading success of students who participated in the use of early

literacy software in kindergarten would be beneficial in order to analyze the implications of this type of software on student success as they progress through several grades. Continued study on this topic would assist instructors and curriculum planners in their quest to incorporate the most effective technologies into their classrooms.

Computers and software programs can be effective tools when utilized to enhance instruction of early literacy skills in early childhood classrooms. This literature review presented an overview of the early literacy skills taught at the kindergarten level, the ways technology has been successfully used in early childhood settings, and positive findings on how software can improve the early literacy skills of kindergarten students. The information presented indicated that early literacy software used to supplement teacher instruction has great potential to have a significant positive effect on student literacy skills. Computers and early literacy software should be incorporated into kindergarten classrooms to enhance the instruction of vital early literacy skills.

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