

A Literature Review: Effect of Computer-Assisted Instruction on Phonological Awareness,
Word recognition, and Reading Comprehension in Students with Reading Difficulties

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Abstract

The studies in this review address the problem of increasing the reading proficiency of students with reading difficulties (RD) including phonological awareness, word recognition, and reading comprehension. Studies in the review are peer reviewed from scholarly journals. The participants in the studies ranging from kindergarten through twelfth grade experienced reading difficulties.

This review addresses the question: Does computer-assisted instruction (CAI) increase phonological awareness, word recognition, and reading comprehension in students with RD? The research is limited due to the short duration of implementation of CAI. The research implies CAI positively affects phonological awareness and word recognition while having little or no affect on reading comprehension.

Keywords: computer-assisted instruction, reading difficulties, phonological awareness, word recognition, reading comprehension

Effect of Computer-Assisted Instruction on Phonological Awareness, Word Recognition, and Reading Comprehension in Students with Reading Difficulties

The No Child Left Behind Act (NCLB) requires the use of technology to increase student achievement and requires the use of educational programs and practices that are proven successful through “scientifically based research” (United States Department of Education, 2004). In addition, schools must meet Adequate Yearly Progress (AYP) as mandated by NCLB requiring proficiency of all learners in reading and math including students with disabilities by 2014 (United States Department of Education, 2006.). Educators desire achievement of all students, but the mandates of NCLB make it necessary for all students to make academic gains each year. Our schools and school systems strive toward the goal of making AYP. Unfortunately, many students struggle in making the required gains, especially students with RD. The studies in this review discuss the problem of increasing reading proficiency using CAI for students with RD including students with learning disabilities. In reviewing research literature, several skills for successful readers became evident. Successful reading skills include phonological awareness, word recognition, and reading comprehension. This review addresses the question: Does CAI increase phonological awareness, word recognition, and reading comprehension in students with RD?

Methods

A search of electronic databases was conducted through GALILEO at the University of West Georgia Ingram Library including EBSCOhost, ProQuest Educational Journals, and ProQuest Psychology Journals seeking peer reviewed journals. Keywords in the searches included CAI, disabilities, comprehension, word recognition, and reading. A physical search was conducted through the Journal Locator of the Ingram Library seeking articles quoted as

references in the articles obtained through the initial database search. This review includes information from 15 articles regarding the studies of students receiving CAI for RD. The majority of the articles include quantitative methods and data analysis of bimodal (i.e. auditory and visual) CAI. A few of the studies included auditory only CAI or visual only CAI. A small number of the studies contain mixed methods including qualitative research results relating to student or teacher perspectives of CAI.

Phonological Awareness

Phonological awareness (PA) is one of the skills found in successful readers. In 2000, a study states:

A child who does not easily hear the order of sounds in syllables has difficulty grasping the “alphabetic principle” of how print translates to speech sounds, often called “phonological decoding” (Liberman, Shankweiler, & Liberman, 1989). Difficulties with phonological decoding lead children to misread words. (Wise, Ring, & Olson, 2000, p. 198)

With advancements in technology, educators strive to improve the PA skills of students with RD by implementing CAI. Using a series of multivariate analysis of variance (MANOVAs), one study found when using bimodal CAI for phonological decoding, students in second through fifth grades with RD made significant gains (Wise et al., 2000). Even 2 years after training, student gains continued to be significant (Wise et al., 2000). This data indicates educators can feel comfortable implementing CAI as a means of improving PA skills.

Other studies show CAI beneficial to the PA skills of fourth grade students with RD. Student improvement in PA was found through a series of analyses of variances (ANOVAs) through bimodal CAI in an eight-month study (Roth and Beck, 1987). The study suggests,

children in the third grade and above with RD need continued phonological decoding practice (Roth & Beck, 1987). CAI can provide extra practice for struggling readers while offering an appealing form of learning.

Students with reading difficulties made significant gains in PA through bimodal CAI as shown in a study conducted in 2004 (Higgins and Raskind, 2004). Even though previously reviewed studies did not compare computer versus traditional human instruction, this 17-week study determines a difference in the type of instruction. The students with the greatest gains received PA automaticity activities with CAI. Automaticity activities strive to increase the rapid, automatic naming of words (Higgins and Raskind, 2004). Another group made gains in PA with speech recognition-based CAI, but they were not as significant as the group receiving automaticity activities. The data illustrates the perspective of students in administering a student interest questionnaire using a 5-point Likert scale. The questionnaire results showed students enjoyed participating in the speech recognition CAI more than the group participating in automaticity activities. The gains in the CAI groups indicate educators can rely on CAI for improving PA in students with RD.

Another mixed method study attempts to show the effects of CAI on PA of students with RD as well as the attitude of students when using CAI. The study compared bimodal CAI versus traditional human instruction for a five-week period (Karemaker, Pitchford, & O'Malley, 2010). Even though the gains were not significantly different for both types of instruction, the CAI group had slightly higher gains. Specific PA activities were not included in the method of either group, but the CAI highlights the text when spoken while the teacher points to the text during traditional instruction possibly leading to higher gains. The student attitude questionnaire indicated students enjoyed using the CAI, which may have led to the significant gains. The study

suggests, “poor readers find multimedia software more enjoyable than traditional reading books, prolonged use of e-books may be an effective aid in the classroom for supporting developing literacy skills in children that are struggling with learning to read” (Karemaker et al., 2010, p. 206). Due to gains in both the CAI and traditional instruction groups, educators can determine from this study CAI does improve PA in students with RD, but CAI is a supplement to traditional instruction.

Many times educators implement special reading programs to improve PA in students with RD. A special reading program in Israel implemented with CAI was compared to the special program with traditional instruction and the regular special education program for children ages five and six (Mioduser, Tur-Kaspa, & Leitner, 2000). Even though students in the three programs began the program with no significant differences in PA, the CAI group was significantly higher in six of the eleven PA subtests. Three of the other PA subtests produced similar gains in CAI and the special reading program group. Only two of the eleven subtests revealed insufficient gains for CAI. The study suggests, “the computer module’s features contribute to the learning process” (Mioduser et al., 2000, p. 61).

Word recognition

Word recognition is another skill mastered by successful readers. If students are unable to recognize words, then the act of reading can become very laborious. Many times PA does not assist the student in reading a word correctly. One nine-week study states, “Given the large number of phonetically irregular words (e.i., sounds that do not map onto the spelling of words) in the English language, there are some advantages in whole-word approaches...” (Lewandowski, Begeny, & Rogers, 2006, p. 396). The sample of students participating in this study was a convenience sample with all third grade students participating within a school

including fourteen special education students. Bimodal CAI appears to be effective in improving the word recognition of students across all ability levels. Random assignment formed the comparison groups providing a higher assurance of equal intelligence between groups. An analysis of variance conducted on the data in the study indicated that CAI and tutor groups made significant improvement in word recognition of a target word list as opposed to a control group receiving no tutoring (Lewandowski et al., 2006). This study does not find one instructional method more beneficial between bimodal CAI and human instruction gains. The data does provide evidence CAI can be a useful tool in conjunction with human instruction for improving word recognition across ability levels.

An additional study indicates CAI is an effective and efficient method for teaching students with difficulties in word recognition (Coleman-Martin, Heller, Cihak, & Irvine, 2005). The three participants in the study increased word recognition using the Nonverbal Reading Approach (NRA) in three comparison groups including a teacher only, a teacher with CAI, and CAI only. The data of this study indicates CAI is equally beneficial to student word recognition as human instruction. CAI can provide students the opportunity to work independently with repeated practice and without negative feedback from classmates when students respond incorrectly (Coleman-Martin et al., 2005).

First grade students with RD appear to improve in word recognition using an internet based bimodal CAI when compared to paper and pencil activities (Englert, Yong, Collings, & Romig, 2005). Both comparison groups in the study made improvement in word recognition. T-tests revealed no significant difference on weekly word list recognition between groups. Total word list results did find significant differences indicating CAI made greater gains in word recognition than paper and pencil activities. With larger class sizes and less time available for

individual assistance, teachers need support improving word recognition in students with RD. The results of this study approached statistical significance in showing CAI allows students to work independently without requiring teacher assistance as compared to the paper and pencil group (Englert et al., 2005).

In today's schools, students with disabilities are included in general education classrooms. The general education classrooms are unable to offer large quantities of individual assistance. Students with disabilities often need direction instruction with repeated practice (Lee & Vail, 2005). Computers can save teachers instructional and preparation time while providing individual assistance to students with RD (Lee & Vail, 2005). The results of a study in 2005 show teachers supported bimodal CAI for improving word recognition in students with disabilities (Lee & Vail, 2005). In reviewing the data, a sample group comprised of four students with disabilities made improvement in word recognition when using CAI. Educators can ascertain from the study that improvement in word recognition is made when using CAI. Unfortunately, educators are unable to be certain as to the significance of improvement with CAI due to the lack of data showing the statistical significance.

Even though the previous study lacked data showing statistical significance in CAI improving word recognition in students with RD, other studies exhibit data with statistical significance. Students in first, second, and third grade with RD increased word recognition when using CAI during an eight-week period (Torgesen, Waters, Cohen, & Torgesen, 1988). An analysis of data using the Newman-Keuls procedure showed no significant difference between three CAI conditions including auditory only, visual only, and bimodal (Torgesen et al., 1988). The results indicate additional assistance in word recognition appears to be the change agent in improving word recognition even when CAI is presented differently.

Additional research shows students with RD can increase word recognition with CAI. A follow up investigation to the preceding study performed an analysis of the results using the Newman-Keuls procedure showing no significant differences in word recognition between two types of CAI. The nine-week study did show a significant difference in learning between the groups receiving CAI and the group of students who did not specifically practice word recognition (Cohen, Torgesen, & Torgesen, 1988). The CAI group made significant gains in word recognition over the group with no practice (Cohen et al., 1988). The results encourage teachers to attend to individual student needs or tasks while other students can use CAI to increase word recognition for students with RD.

Reading Comprehension

Reading Comprehension is the ultimate goal for reading instruction in providing students with the skills necessary to be functional in society. In 1992, a seven-week study investigated the use of a CAI feedback system with a 14 student sample group with RD ranging from 13 years old to 18 years old (Farmer, Klein, & Bryson, 1992). The study found no statistically significant difference in reading comprehension when using a CAI feedback system. The participants in the study had to activate the feedback system in order to gain assistance in reading. The study suggests the students had not developed a habit in using the system in order to obtain a higher level of reading comprehension (Farmer et al., 1992).

In addition to the previous study, another study examined the effects of bimodal CAI in eighteen students with RD in the eighth and ninth grades (Montali & Lewandowski, 1996). After planned comparisons were conducted using Dunn's method, the data implies students with RD are able to comprehend significantly more when receiving bimodal reading instruction than receiving only auditory CAI or only visual CAI (Montali & Lewandowski, 1996). The bimodal

CAI automatically presented reading passages to students without the need for students to activate the technology. Results indicate students need CAI presented automatically without prompting in order to make gains in reading comprehension.

A Dutch study conducted for two months in 2005 provided evidence against CAI improving reading comprehension in students with RD (Irausquin, Drent, & Verhoeven, 2005). The comprehension scores did increase, but “A 2 x 2 (Group x Time) MANOVA on the scores on the Reading Comprehension Test showed no significant effects” (Irausquin et al., 2005, p. 260). Educators would expect significant gains when spending time and money on CAI. The study suggests the reading comprehension scores were relatively high during pretesting therefore leaving less opportunity for growth (Irausquin et al., 2005, p. 260).

An additional study attempted to find the effect of CAI on reading comprehension in students with RD as opposed to traditional human instruction. Twelve students with RD in second through fifth grades received bimodal CAI for eight weeks (Sorrell, Bell, & McCallum, 2007). The results do not indicate significant gains between CAI and traditional instruction. CAI should make a significant difference in student learning or the instructional method is not beneficial to students or teachers.

Conclusion

Educators are searching for ways to improve student learning especially reading. Performance standards necessitate reading as an integral part of all subject areas. With recent advancements in technology, CAI would seem to be a logical choice in supporting students. Technology can individualize student learning, provide repetition, and address areas of weakness. When spending time and money on CAI, educators need to know CAI will increase student knowledge and performance.

The research included in this review supports the idea that CAI can increase PA and word recognition. One study indicated gains in reading comprehension, but the majority of research does not support CAI improving reading comprehension. Bimodal CAI appears to create the most gains. Greater gains would seem logical when students are using more than one of their five senses as experienced in bimodal CAI. In addition, the majority of research indicates equal benefits in increasing student learning when comparing CAI to traditional human instruction. The results indicate specific instruction no matter the type appears to be the change agent in improving student learning even when the CAI is different.

Future Research

Several needs for future research arise during the review of literature. Reading comprehension is the ultimate goal in reading instruction. What type of CAI creates gains in reading comprehension for students with RD? Quantitative research in CAI for reading comprehension needs further research. Studying specific methods of CAI to increase reading comprehension is essential. Students with RD are a homogeneous group that does not require a large sample size. The most recent research presented in this review in CAI for reading comprehension is three years old. Technology is changing daily and more effective CAI may be available and more effective than previous studies. The Headsprout Reading Basics program has emerged as a CAI program targeting five key reading skills with students in kindergarten through fifth grade including reading comprehension (Layng, Twyman, & Stikeleather, 2004). The program implements assessment throughout to measure progress. As an additional measure, Star Reading is a norm-referenced instrument of measurement for reading comprehension. Star Reading can measure the reading comprehension gains of CAI.

An additional area of future research is knowledge retention. Can students maintain PA gains over a one or two year time? The largest part of research included in this review used CAI over a period of months while student learning must be maintained over years. Quantitative research is needed in producing evidence of maintained or continued improvement with CAI. The Headsprout Reading Basics program also targets PA through CAI (Layng et al., 2004). Even though the program implements assessment throughout to measure progress, the Star Early Literacy Test can be used as an additional measure of PA.

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