USING CAI FOR IMPROVING ACADEMIC SKILLS OF STUDENTS WITH SPECIAL NEEDS

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Abstract

Students in special education classes have been found to make the greatest growth in reading skills during the early primary grades, making this a critical period for early literacy intervention. Research has also stressed the importance of early intervention for students with mathematics difficulties. Using computer-assisted instruction (CAI) technology has shown promise; however, most of the literature concerning students with disabilities involves case studies. The current study explored the impact of CAI instruction on literacy and math skills for students with active special education status. CAI technology was used by elementary school students with active special education status in two school districts. Performance at the end of the school year for students with active special education status who used CAI was compared to students who either had low usage of, or who did not use, CAI. In all cases, students with active special education status learning with CAI curriculum showed consistent improvement, demonstrating higher end of year scores and gain scores on measures of math and reading skills. Across all strands, students with active special education status who used CAI outperformed both control students with active special education status, as well as control students who do not have active special education status. These results add to the findings of prior research which indicated that CAI curriculum could have a particular benefit to sensitive populations.

Keywords: *early childhood, literacy, math, technology, special education*.

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1. Introduction

The increasing population of school-aged students with active special education status needs curricula that addresses these students' specific needs. Through changing policies over the past two decades, students with active special education status have transitioned from being expected to participate in standardized assessments to being expected to perform at grade-level standards (Browder, Wakeman, Flowers, Rickelman, & Pugalee, 2007; Greenwood, Bradfield, Kaminski, Linas, Carta, & Nylander, 2011); however, most students with active special education status have immense reading difficulties (Gersten & Dimino, 2006; Koppenhaver, Hendrix, & Williams, 2007) as well as poor communication skills, and less general knowledge than their peers (Janus, Hughes, & Duku, 2010). Students in special education classes have been found to make the greatest growth in reading skills during the early primary grades, so students with active special education status need early literacy intervention (Christ, Silberglitt, Yeo, & Cormier, 2010).

Computer-assisted instruction (CAI), presenting learning materials using interactive technology, has been found to have a unique impact for students with active special education status (Pennington, 2010). CAI activities require mere minutes of instructional time, allowing students to learn without needing to be engaged with the material for long periods of time (Pennington, Ault, Schuster, & Sanders, 2010) because of the salience of the technology (Pennington, 2010). Research has shown that individualized interventions have developed language and literacy competence in students with active special education status (Koppenhaver, Hendrix, & Williams, 2007): CAI has also been found to improve literacy skills of students with active special education status in upper elementary and middle school grades (Berninger, Nagy, Tanimoto, Thompson, & Abbott, 2015), so further research is needed to address the differences in the skills of students with active special education status entering elementary school, as demonstrated by the scores on standardized assessments (Browder, Wakeman, Flowers, Rickelman, & Pugalee, 2007).

Research involving the use of CAI for students with active special education status has been promising. Teaching functional sight words has been found to be more effective when taught by teachers than by CAI strategies (Coleman, Hurley, & Cihak, 2012), but teaching word identification was found to

be effective through teacher-directed only, teacher-directed and CAI, and CAI only (Coleman-Martin, Heller, Cihak, & Irvine, 2005). Concerning math and science skills, students using CAI technology significantly improved number comparison, but not other areas of math skills (Räsänen, Salminen, Wilson, Aunio, & Dehaene, 2009), and CAI technology has proven to be an effective way to teach science skills (Smith, Spooner, & Wood). However, most of the literature concerning students with disabilities involve small sample sizes or case studies (Fletcher-Watson, 2014; McClanahan, Williams, Kennedy, & Tate, 2012): More experimental studies with greater sample sizes are needed to give light to the academic needs of this population.

2. Methods

2.1. Participants

2.1.1. District 1

The first district consisted of 257 kindergarten students enrolled in a public school district in Indiana during the 2015-2016 school year. The majority of students in the district are Caucasian, and approximately half of the students qualify for free lunch.

2.1.2. District 2

The second district consisted of 1,551 first grade students enrolled in a public school district in Texas during the 2015-2016 school year. Approximately 40% of the students in the district are Hispanic, 30% are Caucasian, and 15% are African American.

2.2. Materials

Computer-adaptive Program. The program offers a comprehensive, computer-adaptive reading, science, and math curriculum for pre-kindergarten through second grade students. The software presents a wide range of multimedia-based activities in an adaptive sequence tailored to each student's initial placement and his or her individual rate of growth throughout the complete curriculum.

Mobile Classroom: The Dynamic Indicators of Basic Early Literacy Skills (mCLASS: DIBELS Next). The mCLASS: DIBELS Next assessment evaluates the early literacy skills of students. The assessment was designed to determine which students need additional assistance in developing early literacy skills.

Mobile Classroom: Math (mCLASS: Math). The assessment mCLASS: Math was designed to assess early mathematics skills and identify at risk students in need of remedial early mathematics assistance. The assessment measures fundamental skills required by the Common Core State Standards in mathematics for kindergarten through third grade.

The Texas Primary Reading Inventory (TPRI). The TPRI is an early reading assessment designed to identify the reading development of students in kindergarten through third grade and is administered to students individually. The test identifies students that are at risk for reading difficulties and sets learning objectives for students.

2.3. Procedure

Kindergarten students in the experimental group were expected to use CAI for fifteen minutes per day, five days per week, throughout the 2015-2016 school year, and first grade students in the experimental group were expected to use CAI for thirty minutes per day, five days per week, throughout the 2015-2016 school year. Students in the control groups received traditional literacy instruction for the same amount of time that the experimental group received CAI instruction. Thus, overall exposure to literacy and math instruction was the same for both groups.

In the first district, the mCLASS: DIBELS Next assessment and the mCLASS: Math assessment were administered three times throughout the school year, at the beginning, middle, and end of the year. In the second district, the TPRI was administered at the beginning and end of the year.

3. Findings

3.1. District 1

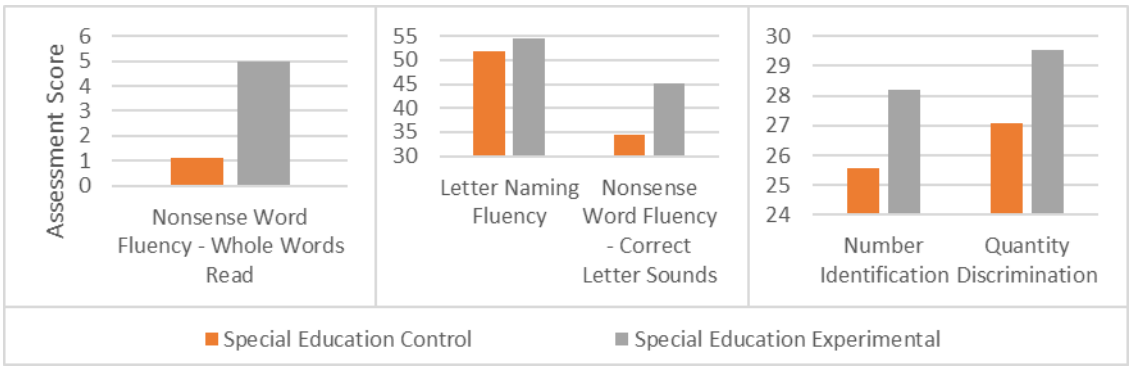
The experimental group for the mCLASS: DIBELS Next (n = 28) consisted of students with active special education status who used CAI for more than 1,000 minutes throughout the spring semester of the 2015-2016 school year. The control group (n = 8) that consisted of students with active special education status used CAI for less than 400 minutes during the spring semester of the 2015-2016 school year, and the control group (n = 12) that consisted of students with no active special education status used CAI for less than 400 minutes during the spring semester of the 2015-2016 school year.

The experimental group for the mCLASS: Math (n = 33) consisted of students who used CAI for more than 1,000 minutes throughout the 2015-2016 school year. The control group (n = 21) that consisted of students with active special education status used CAI for less than 400 minutes during the 2015-2016 school year, and the control group (n = 36) that consisted of students with no active special education status used CAI for less than 400 minutes during the 2015-2016 school year.

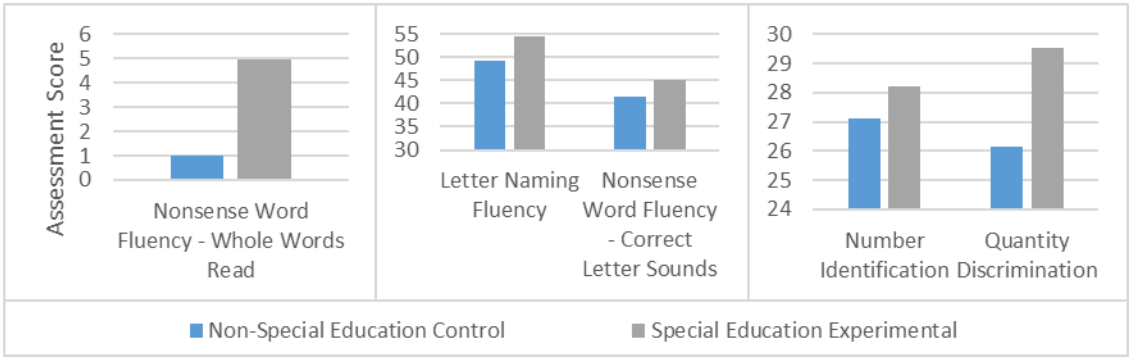
3.1.1. Group Differences Using Analysis of Covariance (ANCOVA)

ANCOVAs examining group differences in mCLASS: DIBELS Next end of year scores while covarying for middle of year scores were conducted, and ANCOVAs examining group differences in mCLASS: Math end of year scores while covarying for beginning of year scores were conducted (see Figures 1-6).

Figures 1-3. mCLASS: DIBELS Next and Math Scores by Strand by Special Education Control



Figures 4-6. mCLASS: DIBELS Next and Math Scores by Strand by Non-Special Education Control



3.2. District 2

The analysis includes students that participated in the TPRI test at the beginning and at the end of the year. The experimental group (n = 7) consisted of students with active special education status who used CAI throughout the 2015-2016 school year. The control group (n = 30) that consisted of students with active special education status did not use CAI during the 2015-2016 school year, and the control group (n = 257) that consisted of students with no active special education status did not use CAI during the 2015-2016 school year.

3.2.1. Group Differences by Special Education Status Using One-Way ANOVAs.

One-way ANOVAs were conducted to examine the effects of CAI and special education status on gains for each strand (see Figures 7-8).

Figure 7. TPRI Gain Scores by Strand by Special Education Control

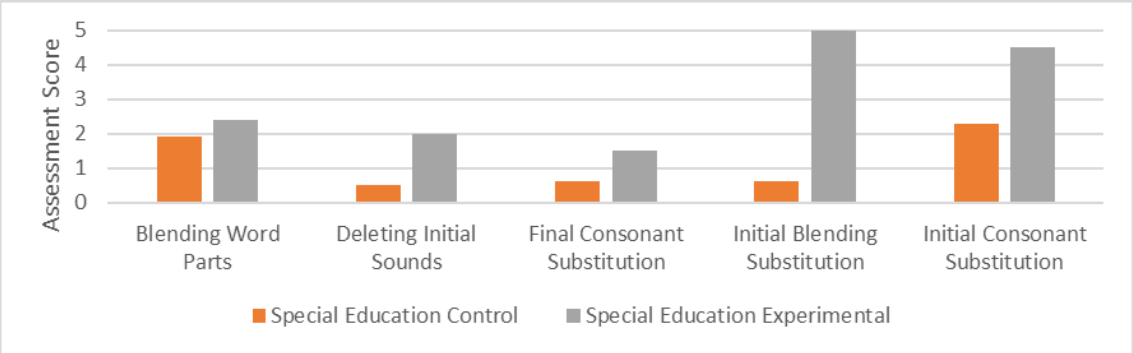
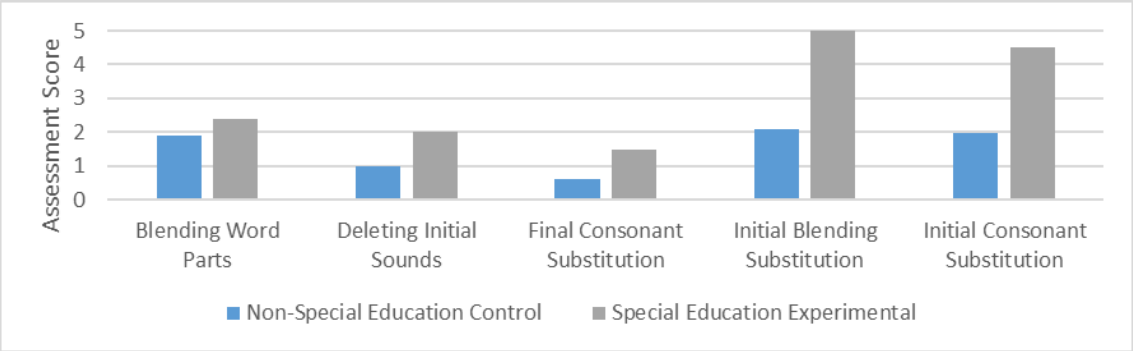


Figure 8. TPRI Gain Scores by Strand by Non-Special Education Control



4. Discussion

The current study demonstrated that use of CAI significantly increased overall performance on math and reading metrics: In all cases, students receiving CAI curriculum had better learning outcomes than students receiving traditional, teacher-centered lessons. Benefits of CAI were also shown to scale with use, with students using CAI for more than 1,000 minutes tending to have significantly better results than students using CAI for less than 400 minutes. These findings are consistent with, and extend the findings of, previous research which pointed to better learning outcomes coinciding with CAI curriculum (Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2010; Stetter & Hughes, 2010).

Students with active special education status learning with CAI curriculum showed consistent improvement. In all cases, the experimental group not only outperformed the control group with students with active special education status, but also the control group with students without active special education status. These findings demonstrate that CAI could increase the percentage of students with disabilities meeting proficiency on the Nation's Report Card: Most recently, 12% of fourth grade students with disabilities scored as proficient as compared to 40% of fourth grade students not with disabilities in 2015 (NCES, 2015). These results extend the findings of prior research which indicated that CAI curriculum could have a particular benefit to sensitive populations (Mohammed & Kanpolat, 2010; Ploog, Scharf, Nelson, & Brooks 2013).

The current study did not gather longitudinal data. Given this limitation, the current study provides no information on the long term impact of CAI curriculum, the longevity of any benefits of its usage, and the relative impact of multiple years of CAI education. Further research into CAI, both in general and specifically for students with active special education status, could benefit from addressing these subjects through employing a longitudinal design.

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