LITERACY IMPROVEMENT IN EARLY LEARNERS USING TECHNOLOGY

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Abstract

Computer-assisted instruction (CAI) is the presentation of different forms of educational media material in an interactive, instructional way. The Waterford Early Reading Program (ERP) is a CAI program that offers a comprehensive, computer-adaptive reading curriculum for kindergarten through second grade students. The purpose of the study was to evaluate the effectiveness of ERP in improving early literacy skills of kindergarten through second grade students. First grade and second grade experimental students significantly outperformed control students on end of year Volusia Literacy Test (VLT). Further analysis on demographics revealed that ELL students in the experimental group outperformed students in the control group in kindergarten and second grade. Additionally, for all cases with a large enough sample size, experimental students of all ethnicities outperformed control students in kindergarten, first grade, and second grade, contributing to research relating to reducing the achievement gap in early learners. Overall, these findings suggest that CAI programs, specifically ERP, can improve early literacy skills of students from all backgrounds when incorporated into classrooms.

Keywords*:* computer-assisted instruction (CAI), literacy, early childhood

1 INTRODUCTION

Effective early childhood education develops a wealth of cognitive abilities and social skills that lessen the educational inequality gap [1]. Because of emerging technology in today's society, a "digital divide" is evident between young children with access to technology at home and young children with little or no opportunity to engage with technology at home or at school [2]. This gap is apparent not only in technical skills but in academic achievement as well. The gap in achievement in school seems to result from the perpetuation of family, neighborhood, and school differences between Caucasian and African American children. A study of 1,253 Latino students found that kindergarten readiness strongly predicted achievement in second through fifth grade, highlighting the importance of helping students succeed academically at an early age [3]. The National Center for Education statistics has found an achievement gap in reading between African American and Hispanic students and their Caucasian peers. In 2015, African American students in fourth grade scored 26 points lower on the NAEP Reading Scale than Caucasian students, and Hispanic students scored 24 points lower than Caucasian students [4]. Additionally, a longitudinal study involving 1,364 low-income families found a substantial racial gap among low-income children in math and literacy academic achievement [5]. Unfortunately, gaps in skills can only be adjusted slightly after second grade according to Heckman's research [1]. Cognitive and social factors lead to the extension of academic gaps, but school districts could devote stimulating curriculum to earlier grades to eliminate self-perpetuating achievement gaps [6]. Additionally, English language learners (ELL) are a growing population, yet reading difficulties are very prevalent in this population, and schools are not equipped to effectively improve their literacy skills [7]. For students to overcome the racial achievement gap and for ELL students to read proficiently, effective curriculum that addresses their early literacy needs is necessary.

1.1 Computer-assisted Instruction (CAI)

Computer-assisted instruction (CAI) is the presentation of different forms of educational media material in an interactive, instructional way. While teachers conduct large group instruction meant for many students to learn a subject, CAI allows individual students to learn digitally, which increases students' flexibility,

interactivity, and engagement [8]. According to research of CAI in the classroom setting, early childhood instruction using CAI can improve mathematical performance [9 & 10] and literacy performance [11 & 12] in comparison to a typical public classroom setting. CAI presents material with animation and immediate feedback, individualizing the learning process.

1.2 Purpose

When implemented with fidelity, CAI technology has been found to improve students' abilities and to effectively teach students of all populations, especially elementary school students [13 & 14]. For example, reading comprehension skills can be significantly improved by computer-based interventions in students with disabilities and children at risk of a learning disorder [11, 12, & 13]. ELL students in kindergarten, first grade, and second grade significantly outperformed their control counterparts in word recognition skills when a literacy CAI program was paired with regular classroom teaching [16]. Additionally, computer use reduces the gap between native English-speaking students and ELL students [17]. Despite findings that suggest that gaps in academic achievement between students from low- and high-income families persist through elementary school [18], for students of all demographics, CAI programs have been found to improve reading scores [19 & 20] and math scores [10 & 15]. Because the gap in academic achievement emerges so early and perpetuates if not addressed, the integration of technology into schools needs to aim to improve the literacy educational content for children of all demographics [20].

The purpose of the present study was to evaluate the efficacy of the Waterford Early Reading Program (ERP) in improving early literacy skills of kindergarten through second grade students. It is predicted that the CAI program will improve reading scores when incorporated into early elementary school programs.

2 METHODS

2.1 Participants

This study consisted of 6,131 kindergarten, first grade, and second grade students enrolled in a public school district in Florida during the 2015-2016 school year.

The experimental group for kindergarten consisted of 1,287 students, and the control group consisted of 43 students. For first grade, the experimental group consisted of 1,892 students, and the control group consisted of 34 students. For second grade, the experimental group consisted of 2,150 students, and the control group consisted of 109 students.

2.2 Materials

2.2.1 The Waterford Early Reading Program

The program offers a comprehensive, computer-adaptive reading curriculum for 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 reading curriculum.

2.2.2 Volusia Literacy Test (VLT)

The VLT is a county reading and writing test used to determine a student's instructional level in reading and writing according to Florida State Standards for kindergarten, first grade, and second grade.

2.3 Procedure

Kindergarten students were expected to use ERP for fifteen minutes per day, five days per week. First and second grade students were expected to use ERP for thirty minutes per day, five days per week.

2.3.1 The Waterford Early Reading Program Usage

For the Waterford Early Reading Program, the experimental group for kindergarten included students that used ERP for more than 1,000 minutes throughout the 2015-2016 school year, and the control group included students that used ERP for less than 500 minutes throughout the 2015-2016 school year. For first grade, the experimental group included students that used ERP for more than 1,000 minutes, and the control group included students that used ERP for less than 300 minutes. For second grade, the experimental group included students that used ERP for more than 1,200 minutes, and the control group included students that used ERP for less than 500 minutes.

2.3.2 Testing

The VLT was administered to students at the end of the 2015-2016 school year.

2.4 Group Differences Using an Independent Samples *t*-test: Kindergarten

An independent samples *t*-test examining group differences in VLT end of year scores between the experimental group and the control group was conducted (see Fig. 1). Analysis of end of year scores did not reveal a significant difference between groups, $t(1, 44) = -1.64$, $p = .109$, between experimental students ($M = 79.35$) and control students ($M = 72.56$), but the end of year scores in the experimental group were slightly higher than in the control group.

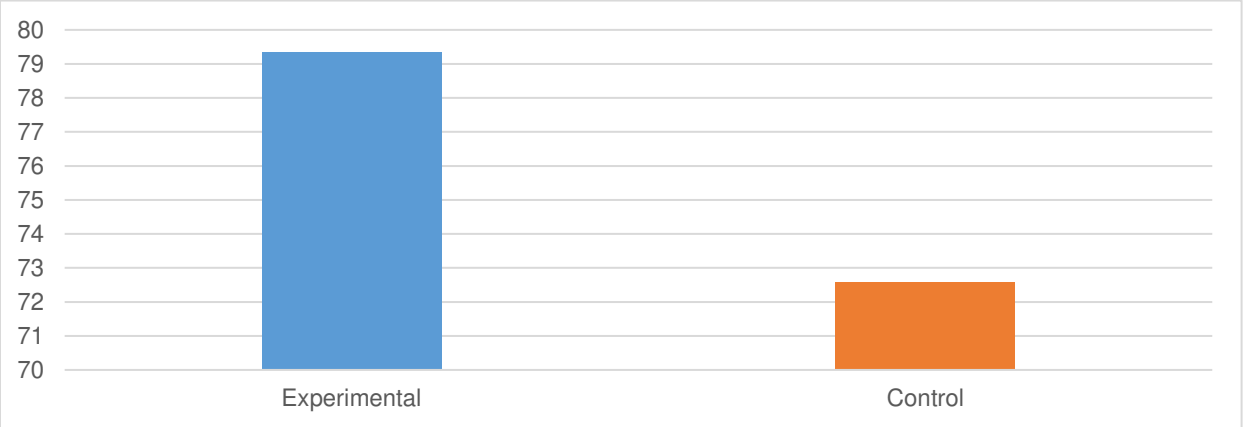

Fig. 1. Kindergarten VLT End of Year Scores

2.5 Group Differences by Demographics Using Two-Way Analysis of Variance: Kindergarten

Three separate two-way ANOVAs were conducted to examine the effect of Waterford curriculum and demographics on VLT end of year scores (see Fig. 2).

2.5.1 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on VLT end of year scores, $F(1, 1326) = 1.36$, $p = .244$. Simple effects analysis showed that for females, students in the experimental group significantly outperformed students in the control group. Males' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.5.2 Ethnicity

There was no significant interaction between the effects of ethnicity and Waterford curriculum on VLT end of year scores, $F(3, 1319) = 2.17$, $p = .090$. Simple effects analysis showed that for Hispanics, students in the experimental group significantly outperformed students in the control group. Caucasian students' end

of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.5.3 Limited English Proficiency (LEP) Status

There was no significant interaction between the effects of LEP status and Waterford curriculum on VLT end of year scores, $F(1, 1326) = 3.57$, $p = .059$. Simple effects analysis showed that for LEP students, students in the experimental group significantly outperformed students in the control group. Students with no LEP status' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

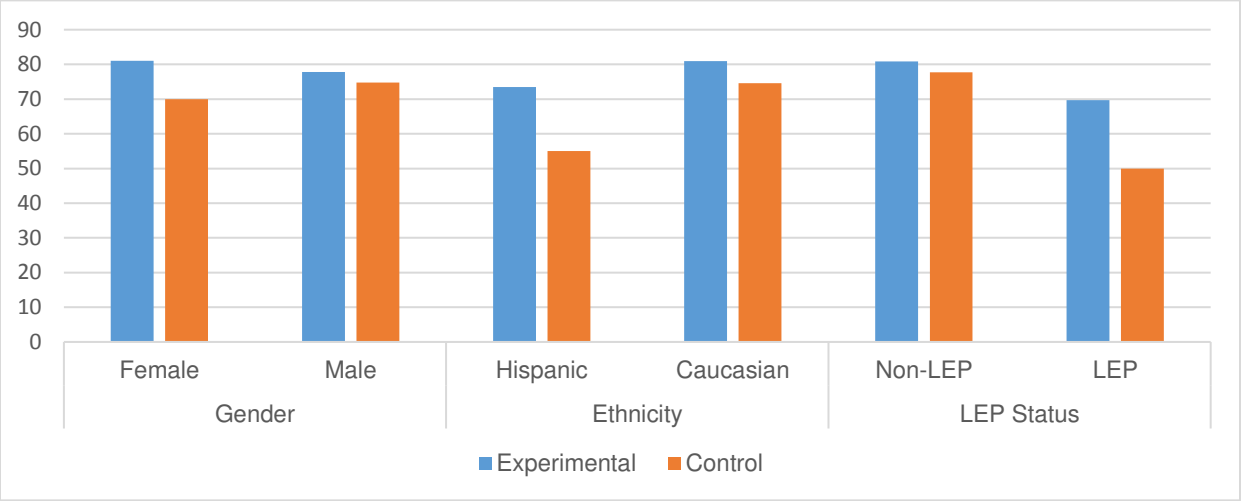

Fig. 2. Kindergarten VLT End of Year Scores by Demographics

2.6 Group Differences Using an Independent Samples *t*-test: First Grade

An independent samples *t*-test examining group differences in VLT end of year scores between the experimental group and the control group was conducted (see Fig. 3). Analysis of end of year scores revealed a significant difference between groups, $t(1, 1924) = -3.14$, $p < .01$, due to higher end of year scores achieved by the experimental students ($M = 71.32$) than the control students ($M = 60.50$). Effect size ($d = 0.54$).

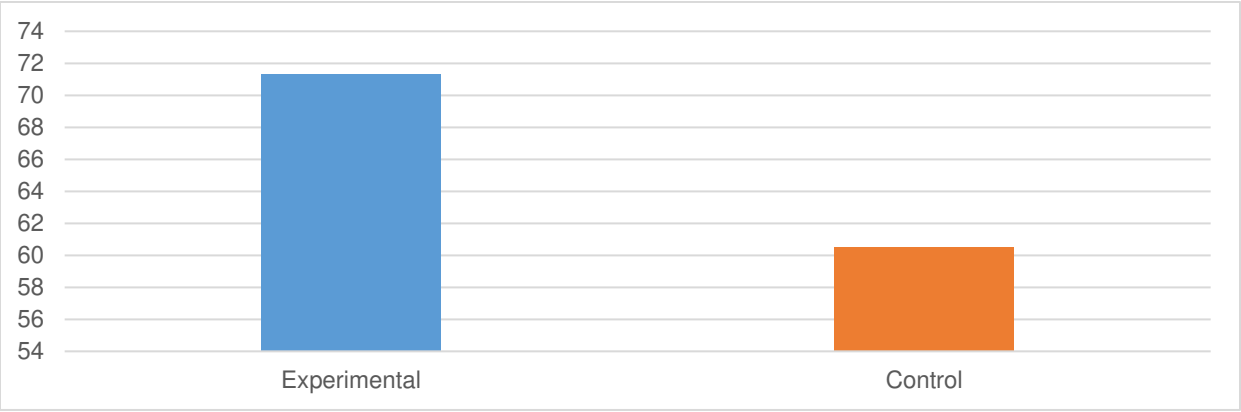

Fig. 3. First Grade VLT End of Year Scores

2.7 Group Differences by Demographics Using Two-Way Analysis of Variance: First Grade

Two separate two-way ANOVAs were conducted to examine the effect of Waterford curriculum and demographics on VLT end of year scores (see Fig. 4).

2.7.1 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on VLT end of year scores, $F(1, 1922) = 1.16$, $p = .282$. Simple effects analysis showed that for females, students in the experimental group significantly outperformed students in the control group. Males' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.7.2 Ethnicity

There was no significant interaction between the effects of ethnicity and Waterford curriculum on VLT end of year scores, $F(3, 1915) = 0.70$, $p = .551$. Simple effects analysis showed that for Hispanics, students in the experimental group significantly outperformed students in the control group. Black/African American and Caucasian students' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

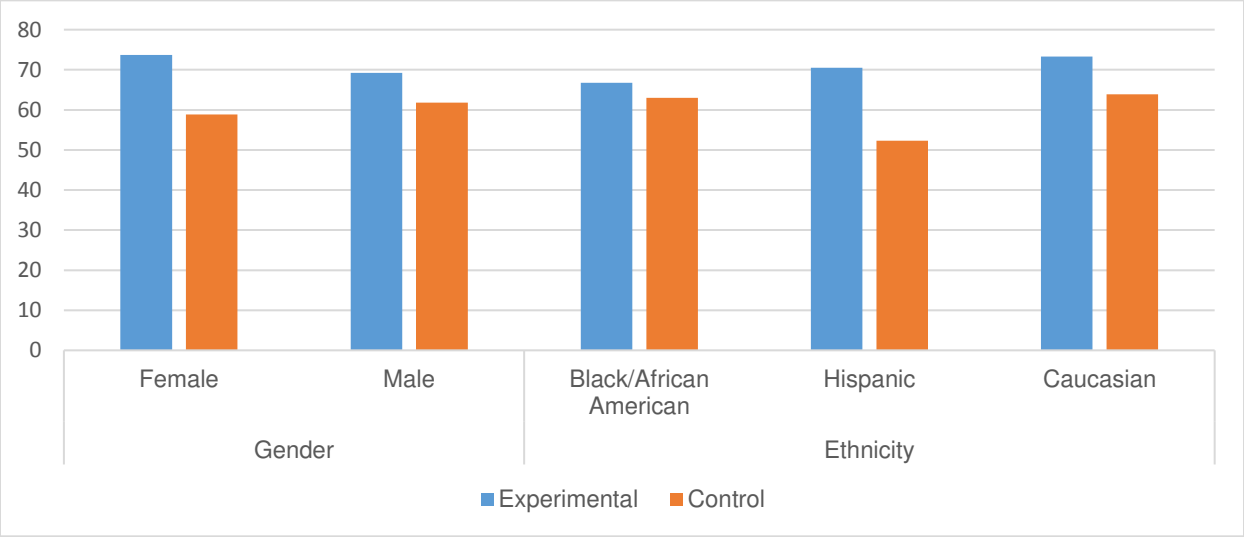

Fig. 4. First Grade VLT End of Year Scores by Demographics

2.8 Group Differences Using an Independent Samples *t*-test: Second Grade

An independent samples *t*-test examining group differences in VLT end of year scores between the experimental group and the control group was conducted (see Fig. 5). Analysis of end of year scores revealed a significant difference between groups, $t(1, 2257) = -2.57$, $p <. 05$, due to higher end of year scores achieved by the experimental students ($M = 71.24$) than the control students ($M = 66.19$). Effect size ($d = 0.25$).

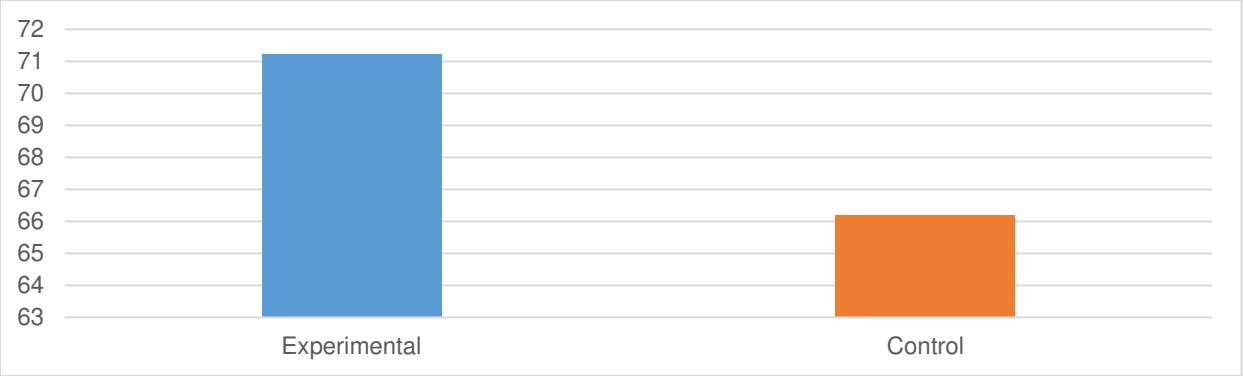

Fig. 5. Second Grade VLT End of Year Scores

2.9 Group Differences by Demographics Using Two-Way Analysis of Variance: Second Grade

Four separate two-way ANOVAs were conducted to examine the effect of Waterford curriculum and demographics on VLT end of year scores (see Fig. 6).

2.9.1 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on VLT end of year scores, $F(1, 2255) = 0.01$, $p = .941$. Simple effects analysis showed that for males, students in the experimental group significantly outperformed students in the control group. Females' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.9.2 Ethnicity

There was no significant interaction between the effects of ethnicity and Waterford curriculum on VLT end of year scores, $F(5, 2246) = 0.63$, $p = .680$. Simple effects analysis showed that Black/African American, Hispanic, and Caucasian students' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.9.3 LEP Status

There was no significant interaction between the effects of LEP status and Waterford curriculum on VLT end of year scores, $F(1, 2255) = 0.01$, $p = .913$. Simple effects analysis showed that for students with no LEP status, students in the experimental group significantly outperformed students in the control group. LEP students' end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

2.9.4 Special Education Indicator

There was no significant interaction between the effects of special education status and Waterford curriculum on VLT end of year scores, $F(1, 2255) = 0.60$, $p = .440$. Simple effects analysis showed that for students with no special education indicator, students in the experimental group significantly outperformed students in the control group. For students with a special education indicator, end of year scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

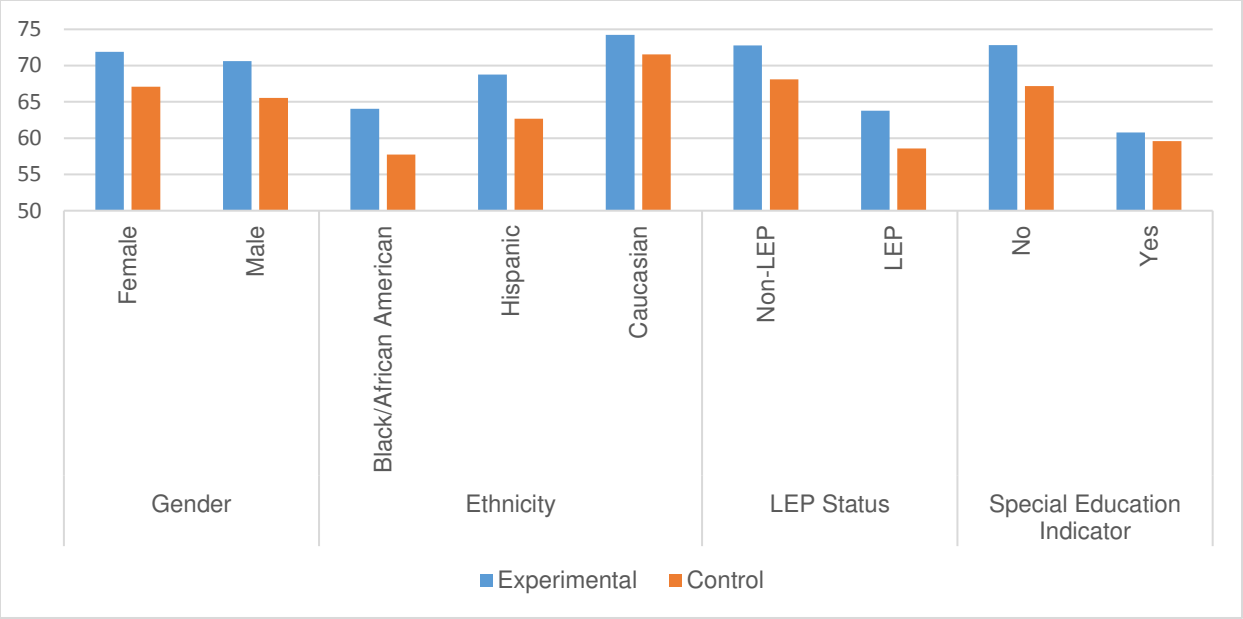

Fig. 6. Second Grade VLT End of year Scores by Demographics

3 DISCUSSION

Findings of this study are consistent with previous research that CAI improves literacy scores of students when combined with in-class instruction [11]. Experimental students in first and second grade significantly outperformed control students on the reading assessment. Consistent with previous research, CAI technology was found to improve literacy scores of ELL students [12, 16, 19, & 21]. ELL students in the experimental group outperformed students in the control group in kindergarten and second grade. In the current study, for all cases with a large enough sample size, experimental students of all ethnicities outperformed control students, contributing to research relating to reducing the achievement gap in early learners.

Where significant differences were not seen, greater student usage of the experimental students may have produced significant results. As supported by this study and previous studies, the achievement gap between early literacy skills in students can perhaps be narrowed with higher usage, despite initial disadvantage caused by poverty [14 & 18]. Suggested further research would be to include students from differing districts to account for the effects of district implementation of the CAI technology. Additionally, testing literacy skills with a national standardized test would result in more generalizable findings. Early literacy skills have proven to be difficult to equalize across students, but these findings make evident that technology can be a very useful tool in education. Overall, these findings suggest that CAI technology, specifically the Waterford Early Reading Program, can improve early literacy skills of students from all backgrounds when incorporated into the classroom.

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