

Effects of Personalized Learning on Kindergarten and First Grade Students' Early Literacy Skills

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Abstract: The Waterford Early Reading Program is a computer-assisted instruction program that ensures individualized learning for kindergarten through second grade students. The Waterford curriculum was assigned to kindergarten, first grade, and second grade students in a school district in South Carolina for the 2015-2016 school year. The Developmental Reading Assessment was administered to students at the end of the fall, winter, and spring terms to assess reading skills. Analysis revealed statistically significant end of year scores made by kindergarten students and statistically significant gains made by first grade students with high usage of the Waterford Early Reading Program, indicating that Waterford curriculum improves early literacy skills.

1 INTRODUCTION

The Every Student Succeeds Act (ESSA), a new education law signed in December 2015, built on the American ideal that all children across demographics deserve an equal opportunity to education by assisting at-risk students and students with special needs as well as increasing access to pre-kindergarten (U.S. Department of Education, 2016). This changes the No Child Left Behind Act focus from standardized testing to state-driven testing, aiming to set up all students for success by creating useful, impactful change to the school system (Darling-Hammond et al., 2016). This new system of accountability was created because the one-size-fits-all approach to improve education was unsuccessful and outdated. The new law was recently enacted, however, so innovations within education still need to improve, as the trend of average reading scores for fourth grade students has only risen 13 points (from 208 to 221) in the past forty years (National Assessment of Educational Progress [NAEP], 2015). Despite policy changes and increased funding over the decades, the United States has significantly, but not meaningfully, improved the reading scores of young students: American children have not had significant changes in literacy skills over the past forty years, meaning that as postsecondary education is increasingly required for entry-level jobs, workers are not prepared for these education or training requirements (Murnane et al., 2012). As the literacy of young

cohorts remains stagnant, our country demands increasing literacy skills to match the increase in higher-paying occupations. Clearly, our nation is in need of meaningful changes in education to improve the reading scores of elementary school students for later school success.

Recent innovations in technology and increases in federal funding for education have led to dramatic increases in the tools available for teachers and students (U.S. Department of Education, 2016). However, while technological advances have created promising instructional tools for education, new technology may not be closing the literacy gaps between students, especially between students from low- and high-income families (Biancarosa and Griffiths, 2012). While technology has been found to increase ease of observation and curriculum development for teachers, teachers from high poverty schools are using technology to send updates such as concerns to individual parents and students much less than teachers at low poverty schools (Gray et al., 2010; Hoffman et al., 2015). Moreover, teachers and school systems have been found to stress practical reading skills but not addressing analytic, in-depth reading skills that lead to understanding. Students from low-income families need to have higher literacy skills in order to keep up with the labor force of today and to close the gap between less and more advantaged children (Murnane et al., 2012). The question that needs to be addressed is: how can incorporating technology into the classroom

transform literacy education to close the academic achievement gap between lower- and higher-achieving students (Biancarosa and Griffiths, 2012)?

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 take control of their learning which increases students' flexibility, interactivity, and engagement (Jethro et al., 2012). According to research of CAI in the classroom setting, early childhood instruction using CAI can improve mathematical performance (Aunio and Niemivirta, 2010) and literacy performance (Saine et al., 2010; Stetter and Hughes, 2010) in comparison to a typical public classroom setting. CAI presents material with animation and immediate feedback, individualizing the learning process in a way only one-to-one teaching styles can. When implemented with fidelity, CAI technology has been found to improve students' abilities and to effectively teach subjects to all populations, especially elementary school students (National Mathematics Advisory Panel, 2008).

Individualized educational technology programs need to target students of all demographics, be easily incorporated into the classroom, and be functional for students and teachers. A recent literature review found that CAI programs incorporated into the classroom led to statistically significant moderate gains in phonological awareness in early readers for disadvantaged students (Zomer and Kay, 2016). Among schools with diverse students, the extent and effectiveness of technology-based literacy curriculum use distinguishes lower- and higher-performing elementary schools (Wilcox et al., 2015). These findings combine to show that CAI technology individualizes literacy curriculum for students across demographics, narrowing the gap between students in early literacy skills. Overall, CAI programs coupled with traditional classroom settings increase the interactivity and individualization of the learning environment for each student, but further research is needed to evaluate the effectiveness of CAI technology on academic achievement (Vernadakis et al., 2005).

The purpose of the present study was to evaluate the effectiveness of the Waterford Early Reading Program in improving early literacy skills of kindergarten and first grade students. We predicted that this CAI program will improve reading scores when incorporated into early elementary school programs.

2 METHODS

2.1 Participants

This study consisted of 2,148 students enrolled in a public school district in South Carolina during the 2015-2016 school year. The majority of students in the study are White, and approximately one-third of the students qualify for free lunch.

For kindergarten, the experimental group consisted of 1,004 students, and the control group consisted of 28 students. For first grade, the experimental group consisted of 1,064 students, and the control group consisted of 52 students. This analysis excluded second grade because of the low experimental group sample size: Throughout the 2015-2016 school year, only 2 second grade students used the Waterford Early Reading Program.

2.2 Materials

2.2.1 The Waterford Early Reading Program (ERP)

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

2.2.2 The Waterford Early Math and Science Program (EMS)

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

2.2.3 Developmental Reading Assessment (DRA)

The DRA is a standardized reading test used to determine a student's instructional level in reading. The DRA is administered individually to students by teachers and/or literacy coaches. The test identifies whether the student is below, meeting, or exceeding grade level reading expectations.

2.3 Procedure

Students were expected to use ERP for 30 minutes per day, five days per week, throughout the 2015-2016 school year. The experimental group consisted of students that used ERP for greater than or equal to 1000 minutes throughout the 2015-2016 school year, and the control group consisted of students that used ERP for less than or equal to 500 minutes throughout the 2015-2016 school year. Usage was tracked within the program and monitored weekly by Waterford personnel, and total minutes of usage of ERP for the school year per group was calculated. The DRA was administered at the end of the fall, winter, and spring terms.

Since kindergarten students were not administered the DRA at the beginning of the 2015-2016 year, only end of year scores were analyzed. Additionally, due to the low number of students in the control groups of kindergarten and first grade, analyses of ethnicity were not conducted.

3 FINDINGS

This analysis excluded second grade because of the low experimental group sample size: Throughout the 2015-2016 school year, only 2 second grade students used the Waterford Early Reading Program. Additionally, due to the low number of students in the control groups of kindergarten and first grade, analyses of ethnicity were not conducted.

3.1 Kindergarten

The experimental group for kindergarten ($n = 1,004$) included students that used Waterford curriculum for greater than or equal to 1,000 minutes throughout the 2015-2016 school year. The control group ($n = 28$) included students that used Waterford curriculum for less than or equal to 500 minutes throughout the 2015-2016 school year. Since kindergarten students were not administered the DRA at the beginning of the 2015-2016 year, only end of year scores were analyzed.

3.1.1 Group Differences using an Independent Samples *T*-Test

An independent samples *t*-test examining group differences in DRA end of year scores between the experimental group and the control group was conducted (see Figure 1). Analysis of end of year scores revealed a significant difference between

groups, $t(1, 1030) = -2.37, p < .05$, due to higher end of year scores made by experimental students ($M = 5.99$) than by control students ($M = 4.39$). Effect size ($d = 0.45$).

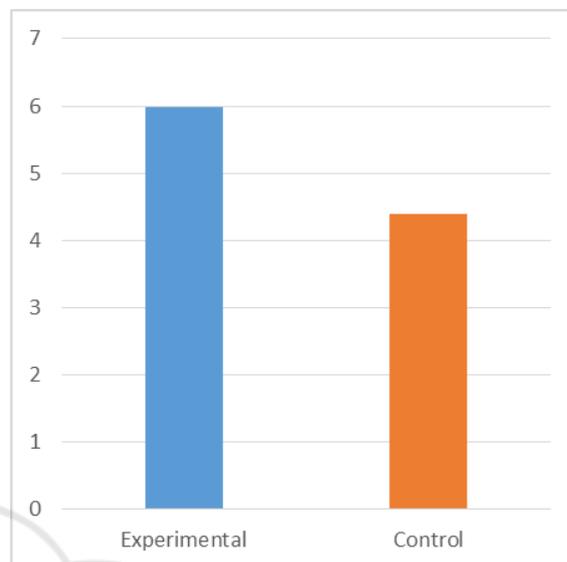


Figure 1: Kindergarten DRA end of year scores.

3.1.2 Group Differences using Two-Way ANOVAs

Further analysis was conducted to examine the effects of gender and subsidized lunch on end of year DRA scores. Two separate two-way ANOVAs were conducted to examine the effect of Waterford curriculum and demographics on DRA end of year scores (see Figure 2).

3.1.3 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on DRA end of year scores, $F(1, 1028) = 1.26, p = .261$. 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.

3.1.4 Socioeconomic Status

There was no significant interaction between the effects of subsidized lunch and Waterford curriculum on DRA end of year scores, $F(2, 1026) = 0.68, p = .505$. Simple effects analysis showed that for students with reduced lunch, end of year scores in

experimental group were higher than in the control group, approaching significance. Students in the experimental group with free lunch and paid lunch scored slightly higher than the control group, but the difference was not significant.

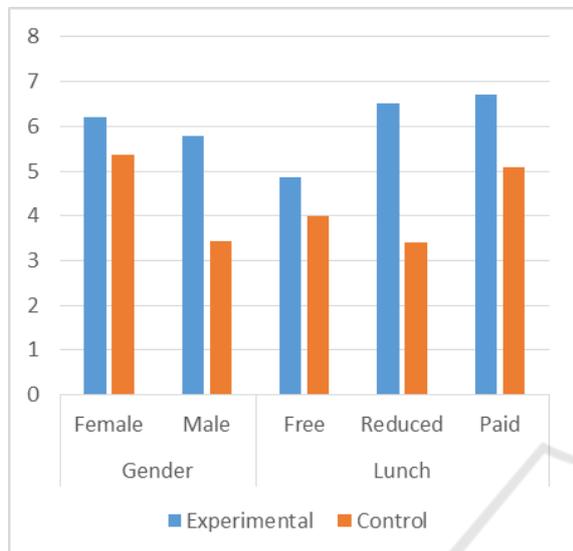


Figure 2: Kindergarten DRA end of year scores by demographics.

3.2 First Grade

The experimental group for first grade ($n = 1,064$) included students that used Waterford curriculum for greater than or equal to 1000 minutes throughout the 2015-2016 school year. The control group ($n = 52$) included students that used Waterford curriculum for less than or equal to 500 minutes throughout the 2015-2016 school year.

3.2.1 Group Differences using an Independent Samples *T*-Test

An independent samples *t*-test examining group differences in DRA gain scores between the experimental group and the control group was conducted (see Figure 3). Analysis of gain scores from DRA beginning of year scores to DRA end of year scores revealed a significant difference, $t(1, 1114) = -2.07, p < .05$, between the experimental students ($M = 12.07$) and the control students ($M = 10.90$). Effect size ($d = 0.29$).

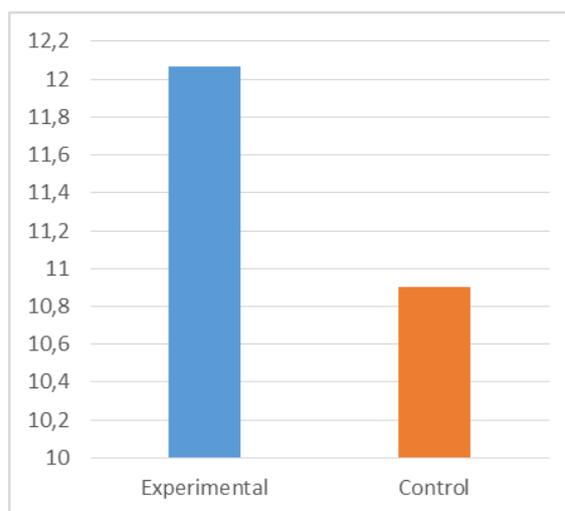


Figure 3: First grade DRA gain scores.

3.2.2 Group Differences using Two-Way ANOVAs

Further analysis was conducted to examine the effects of gender and subsidized lunch on DRA gain scores. Two separate two-way ANOVAs were conducted to examine the effect of Waterford curriculum and demographics on DRA gain scores (see Figure 4).

3.2.3 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on DRA gain scores, $F(1, 1112) = 0.91, p = .340$. Simple effects analysis showed that for males, students in the experimental group significantly outperformed students in the control group. Females' gain scores in the experimental group were slightly higher than in the control group, but the difference was not significant.

3.2.4 Socioeconomic Status

There was no significant interaction between the effects of subsidized lunch and Waterford curriculum on DRA gain scores, $F(2, 1110) = 0.52, p = .594$. Simple effects analysis showed that for free lunch, students in the experimental group significantly outperformed students in the control group. Students in the experimental group with reduced lunch and paid lunch had gain scores slightly higher than the control group, but the difference was not significant.

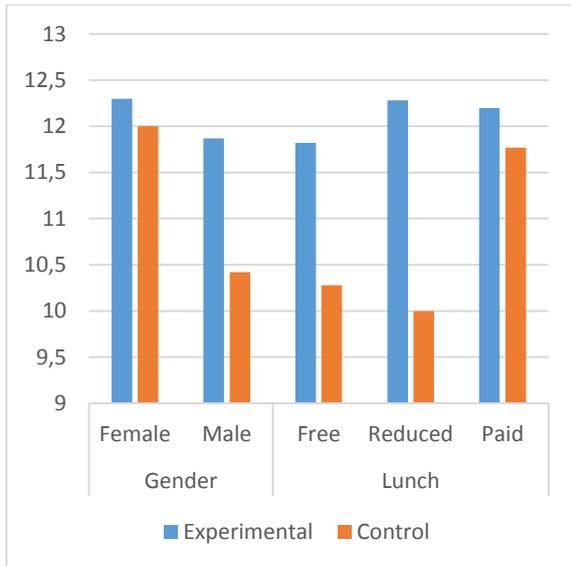


Figure 4: First grade DRA gain scores by demographics.

3.2.5 Group Differences using an ANCOVA

An ANCOVA examining group differences in DRA end of year scores while covarying for DRA beginning of year scores was conducted (see Figure 5). Analysis of DRA end of year scores, while covarying for DRA beginning of year scores, revealed a significant difference between groups, $F(1, 1113) = 9.14, p < .01$, due to higher end of year scores made by experimental students ($M = 18.54$) than by control students ($M = 16.87$). Effect size ($d = 0.18$).

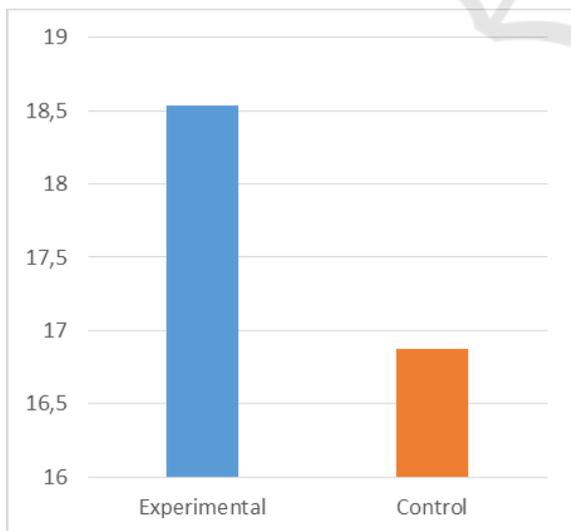


Figure 5: First grade DRA end of year scores.

3.2.6 Group Differences by Demographics using ANCOVAs

Further analysis was conducted to examine the effects of gender and subsidized lunch on DRA end of year scores, covarying for DRA beginning of year scores. Two separate two-way ANCOVAs were conducted to examine the effect of Waterford curriculum and demographics on DRA end of year scores, covarying for beginning of year DRA scores (see Figure 6).

3.2.7 Gender

There was no significant interaction between the effects of gender and Waterford curriculum on DRA end of year scores, covarying for DRA beginning of year scores, $F(1, 1111) = 1.15, p = .284$. 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.

3.2.8 Socioeconomic Status

There was no significant interaction between the effects of subsidized lunch and Waterford curriculum on DRA end of year scores, covarying for DRA beginning of year scores, $F(2, 1109) = 0.45, p = .639$. Simple effects analysis showed that for free lunch, students in the experimental group significantly

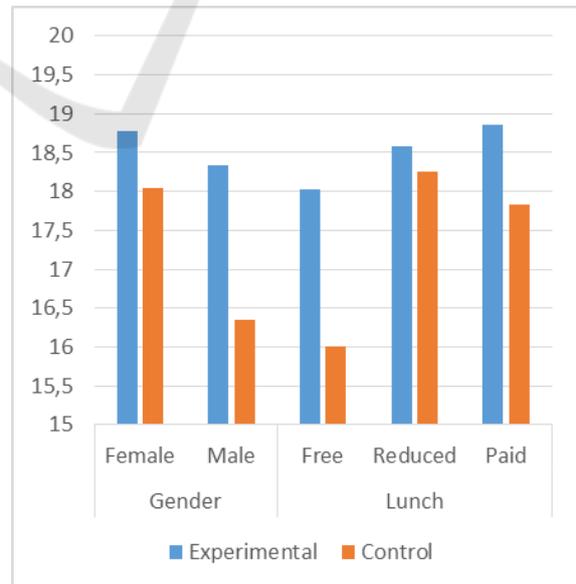


Figure 6: First grade DRA end of year scores by demographics.

outperformed students in the control group. Students in the experimental group with reduced lunch and paid lunch had end of year scores slightly higher than the control group, but the difference was not significant.

4 DISCUSSION

According to ESSA, schools need to be continually improving aspects of the education they provide for their students, specifically through improving curriculum for students of all demographics (Darling-Hammond et al., 2016). The achievement gap in literacy skills of students entering school needs to be accounted for, or students are bound on a track to dropping out of high school (Hernandez, 2011). One solution to the achievement gap is adding computer-assisted instruction technology into the classroom. CAI technology in the classroom was found in this study to allow children to learn at their own pace, as found in other studies (Flewitt et al. 2014 Vernadakis et al., 2005). In both kindergarten and first grade, students in the experimental groups significantly outperformed students in the control groups. Moreover, across demographics, students in the experimental groups scored consistently higher than the students in the control groups.

This study also supports previous findings that early literacy skills are improved when technology is integrated into an existing elementary school curriculum (Shamir et al., 2011). In the current study, the hypothesis was supported, that students with high usage of Waterford curriculum will have higher literacy test scores than their control counterparts. If the expected usage had been met by all students, the literacy test scores of the students could have been even greater. Additionally, this study involved only one elementary school district, so further research can incorporate a more diverse population to increase generalizability of the results. Overall, these findings indicate that computer-assisted instruction improves literacy test scores and literacy skills when combined with in-class curriculum.

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