Reinforcing Second Grade Literacy Skills Using a Computer-Adaptive Reading Program

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Abstract: New technologies have had a large and transformative impact on education. This study explored the benefits of a comprehensive, computer-adaptive reading program for the literacy skills of young learners. Second grade students enrolled in a public school district used a computer-assisted instruction (CAI) program and were evaluated at the beginning and end of the school year on a standardized literacy assessment. Analysis indicated that end of year literacy scores made by students who used the CAI program were higher than those made by students who did not use the CAI program. Similarly, students who used the CAI program had higher end of year scores while controlling for beginning of year scores than students who did not use the CAI program. This study supports the use of CAI, when used with fidelity, in early literacy instruction.

Introduction

Emerging technologies have changed the world and irrevocably rearranged education systems (Collins & Halverson, 2018). With each passing school year, novel innovations have touched on every level of the educational environment: Technology has been employed to teach learners of all ages, from basic elements of literacy and numeracy to prekindergarten students (Rogowsky, Terwilliger, Young, & Kribbs, 2017) to anatomy to medical students (Vázquez et al., 2007). As a result of the expanded role technology now plays in daily life, an increased level of digital literacy is required for participation in the workplace (Goldin & Katz, 2007). To meet these heightened expectations, increased funding has been dedicated to enable all students to keep pace with the technology-centered world (Fox et al., 2017; May, Sirinides, Gray, & Goldsworthy, 2016). As the field of technology in education continues to expand, emphasis needs to be placed on research, and old norms need to be re-evaluated.

While originally perceived as a neutral medium for conveying educational material (Clark, 1983), the presence of technology in the classroom has more recently been viewed as fundamentally altering how students learn (Bernard, Borokhovski, Schmid, & Tamim, 2018). Computer-assisted instruction (CAI) describes a broad educational framework that leverages the structural advantages of technology in the classroom. When well designed and properly implemented, CAI curriculum can be customizable, responsive, and engaging (Jethro, Grace, & Thomas, 2012). A CAI program can identify content appropriate to each individual student and tailor that student's educational experience to their own specific level of competency. CAI can provide meaningful feedback in real time, offering students a tangible sense of progress and teachers valuable information needed to coordinate a lesson plan. CAI can utilize different forms of interactive and instructional media to foster engagement with a lesson. When used with fidelity, CAI has been shown to improve literacy (Shamir, Feehan, & Yoder, 2017b; Stetter & Hughes, 2010) and math (Shamir, Feehan, & Yoder, 2017a) skills in young learners.

Recent findings investigating the general efficacy of CAI have demonstrated benefits for students at the start of their academic careers. In a study involving preschool students, young students given personal devices and educational software outperformed students receiving traditional instruction on standardized literacy assessments (McManis & McManis, 2016). In a separate study that investigated the impact of a computer-assisted curriculum on

reading outcomes for first through third grade, students with access to the curriculum made greater gains on the Measures of Academic Progress assessment than students who did not use the program (Taylor, 2018). In another study involving second grade students, students receiving a computer-assisted reading intervention for ten months scored higher than their peers on measures for both literacy and memory (Messer & Nash, 2018). These findings extended the results of a prior study, which had shown improved reading performance by the end of third grade for students who received a technological intervention (Union, Union, & Green, 2015).

However, the literature has not been unanimous regarding CAI, and valid concerns have been raised (Coleman, MacLauchlan, Cihak, Martin, & Wolbers, 2015; Fiorella, Kuhlmann, & Vogel-Walcutt, 2018; Luo & Murray, 2018; Hughes & Read, 2018). Media intended to make a lesson accessible to the average student can make participation difficult for some (Coleman et al., 2015; Hughes & Read, 2018). In case studies involving deaf students, students preferred the use of a computer-assisted vocabulary task but ultimately did not benefit from it (Coleman et al., 2015). Further, the interactive and immersive nature of CAI has also presented new hurdles for educators to overcome. In a study of middle school students, Fiorella, Kuhlmann, and Vogel-Walcutt observed students getting lost in a narrative based curriculum (2018): Students spent upwards of 80% of their time using the program interacting with the scaffolding elements of the lesson, and no actual benefits were noted for students' academic abilities. These results contextualize a recent teacher survey in which respondents expressed doubt that young students were capable of acting as motivated and self-directed learners in the modern classroom (Luo & Murray, 2018).

Mechanisms that might address these concerns have been slow to act or missing. Replication studies in educational research have been comparatively rare (Chen, Tseng, & Hsiao, 2018; Handley, 2018; Makel & Plucker, 2014). An analysis of 100 credible education journals found replications composed less than one percent of articles, and replication was significantly less likely with differing researchers (Makel & Plucker, 2014). While studies into technologically-based interventions in education have recently been replicated (Chen et al., 2018; Handley, 2018), this does place emphasis on the need for further investigation. In light of valid criticism, research into the impact of technology on education is required to provide teachers and policy makers with the most accurate information possible.

This study investigated the benefits of a CAI curriculum for students in the second grade. It was hypothesized that students who used the computer-adaptive reading program would demonstrate higher scores on a standardized assessment of literacy skills.

Methods

Participants

This study consisted of second grade students (N = 1,562) enrolled in a public school district in Maryland during the 2017-2018 school year.

The experimental group (n = 778) consisted of students who used Waterford Early Learning for more than 2,000 minutes. The control group (n = 784) consisted of students who used Waterford Early Learning for less than 300 minutes.

Materials

Waterford Early Learning (WEL)

The software provides an individualized, computer-adaptive curriculum for pre-kindergarten through second grade students to learn pre-reading and reading skills. Various multimedia activities such as songs and games are incorporated into the software, and students are presented with material in an adaptive sequence to meet their individual skill level throughout the curriculum.

Northwest Evaluation Association (NWEA) Measures of Academic Progress (MAP)

The MAP is a valid assessment intended to measure individual growth and mastery for students in kindergarten through twelfth grade on a range of skills. The skills considered relevant to second grade students for

this study are RIT Score, RIT to Reading, Foundational Skills, Language and Writing, Literature and Informational, and Vocabulary Use and Functions. Results are scored on a standardized Rasch Unit (RIT) scale.

Procedure

Students were expected to use WEL for thirty minutes per day, five days per week. Usage was tracked within the program and monitored weekly, and total minutes of WEL usage was calculated. The MAP assessment was administered to all students at the beginning and end of the school year.

Findings

Second Grade

Group Differences Using Independent Samples t*-tests*

Independent samples *t*-tests were conducted to examine group differences on MAP end of year scores between experimental and control groups (Figs. 1-2).

RIT Score. Analysis of RIT end of year scores revealed a significant difference between groups, $t(1, 1539) = -2.00$, $p < .05$, due to higher end of year scores made by experimental students ($M = 178.32$) than by control students ($M = 176.81$).

Foundational Skills. Analysis of Foundational Skills end of year scores revealed a significant difference between groups, $t(1, 1539) = -2.30$, $p < .05$, due to higher end of year scores made by experimental students ($M = 176.39$) than by control students ($M = 174.55$).

Language and Writing. Analysis of Language and Writing end of year scores revealed a significant difference between groups, $t(1, 1539) = -2.35$, $p < .05$, due to higher end of year scores made by experimental students ($M = 179.25$) than by control students ($M = 177.33$).

Literature and Informational. Analysis of Literature and Informational end of year scores did not reveal a significant difference between groups, $t(1, 1539) = -1.05$, $p = .295$; however, experimental students ($M = 179.59$) outperformed control students ($M = 178.71$).

Vocabulary Use and Functions. Analysis of Vocabulary Use and Functions end of year scores did not reveal a significant difference between groups, $t(1, 1539) = -1.27$, $p = .203$; however, experimental students ($M = 177.99$) outperformed control students ($M = 176.90$).

RIT to Reading. Analysis of RIT to Reading end of year scores revealed a significant difference between groups, $t(1, 1021) = -2.17$, $p < .05$, due to higher end of year scores made by experimental students ($M = 352.86$) than by control students ($M = 330.86$).

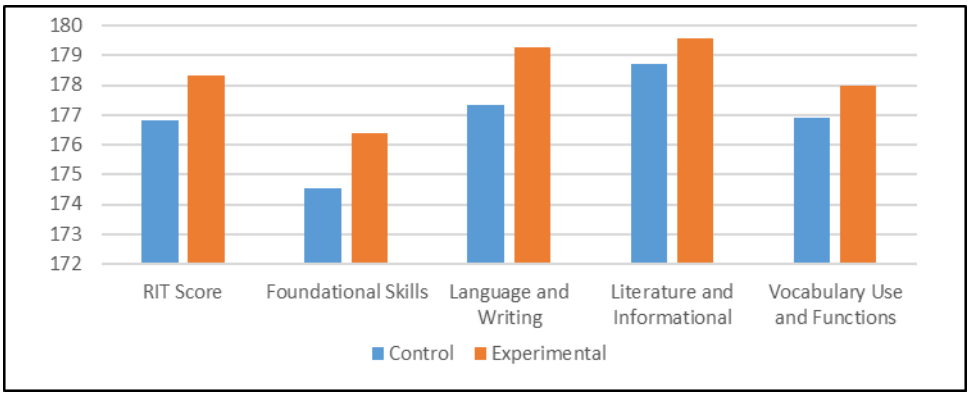

Figure 1: Second Grade MAP End of Year Scores by Strand

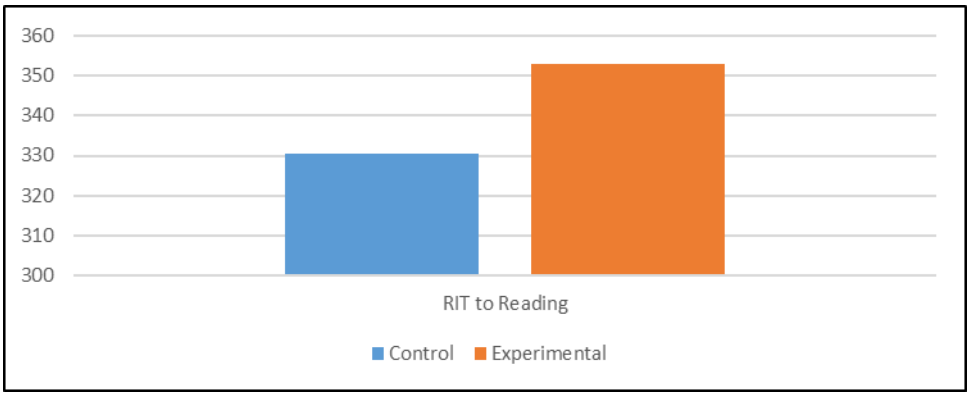

Figure 2: Second Grade MAP End of Year RIT to Reading Scores

Group Differences Using Analysis of Covariance (ANCOVA)

ANCOVAs to examine group differences in end of year MAP scores between the experimental and control groups while covarying for beginning of year scores were conducted (Figs. 3-4).

RIT Score. Analysis of RIT end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 1450) = 22.21$, $p < .01$, due to higher end of year scores made by experimental students ($M = 179.08$) than by control students ($M = 176.92$).

Foundational Skills. Analysis of Foundational Skills end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 1450) = 13.10$, $p < .01$, due to higher end of year scores made by experimental students ($M = 176.94$) than by control students ($M = 174.69$).

Language and Writing. Analysis of Language and Writing end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 1450) = 15.08$, $p < .01$, due to higher end of year scores made by experimental students ($M = 179.97$) than by control students ($M = 177.64$).

Literature and Informational. Analysis of Literature and Informational end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 1450) = 5.98$, $p < .05$, due to higher end of year scores made by experimental students ($M = 180.35$) than by control students ($M = 178.80$).

Vocabulary Use and Functions. Analysis of Vocabulary Use and Functions end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 1450) = 9.54$, $p < .01$, due to higher end of year scores made by experimental students ($M = 178.86$) than by control students ($M = 176.93$).

RIT to Reading. Analysis of RIT to Reading end of year scores, covarying for beginning of year scores, revealed a significant difference between groups, $F(1, 450) = 14.15$, $p < .01$, due to higher end of year scores made by experimental students ($M = 467.18$) than by control students ($M = 428.04$).

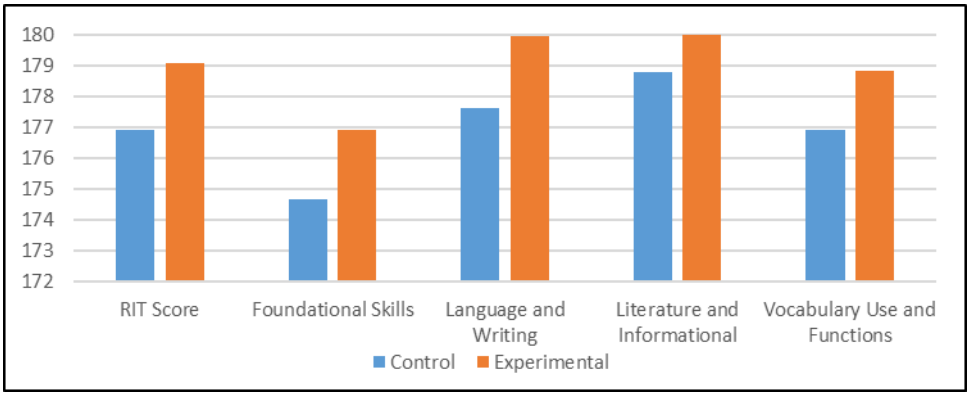

Figure 3: Second Grade MAP End of Year Scores Controlling for Beginning of Year Scores by Strand

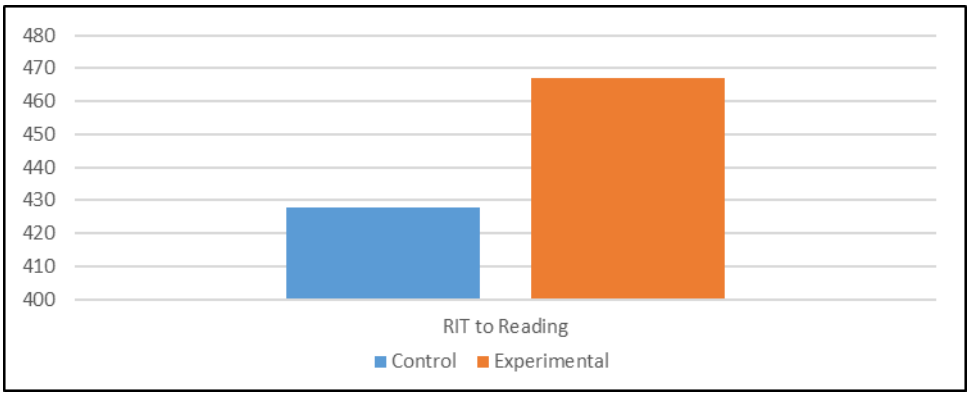

Figure 4: Second Grade MAP End of Year RIT to Reading Scores Controlling for Beginning of Year Scores

Conclusions

In this digital age, students need to not only use technology in the classroom but gain creative knowledge from these products to succeed in the technology-driven world (Goldin & Katz, 2007). When effective, educational technology can significantly improve students' assessment scores while simultaneously preparing them for our constantly changing, globally connected world. As technology becomes increasingly incorporated into schools of the twenty-first century due to increased funding, educational research needs to evaluate which instructional practices are significantly increasing students' test scores (Fox et al., 2017; May et al., 2016). In the current study, we examined whether the computer-adaptive reading program, used as a supplement to traditional literacy instruction in the classroom, improved the literacy test scores of second grade students, an extension of prior research into the efficacy of CAI.

In the current study, second grade students with high usage of the computer-adaptive reading program outperformed their control counterparts on the MAP literacy assessment. After using the computer-adaptive reading program for only thirty minutes per day, five days per week, students who used the program to fidelity outperformed their control counterparts across all literacy strands. Early literacy skills are extremely important to set students up for success, and when used consistently throughout the school year, computer-adaptive reading programs can improve literacy scores of elementary school students, as shown by the results of this study.

Further research should investigate the impact of the computer-adaptive reading program on scores of students with differing demographics. Additionally, this study includes second grade students from a single school district, so results from differing grades and differing districts would enhance the generalizability of the findings.

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