THE EFFECTS OF THE USE OF AN ICT-BASED READING INTERVENTION ON STUDENTS' ACHIEVEMENT IN GRADE TWO

by

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by Deborah Schneider, titled The Effects of the Use of an ICT-Based Reading Intervention on Students' Achievement in Grade Two and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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STATEMENT BY THE AUTHOR

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ABSTRACT

A quasi-experimental research design was used to evaluate the efficacy of MindPlay Virtual Reading Coach (MVRC), an ICT-based reading intervention, in addition to regular daily language instruction provided by a classroom teacher. After attrition, participants included 170 students enrolled in eight second-grade classrooms (four classrooms in each school) in two public elementary schools in the southwestern United States. Examiners obtained reading achievement data for each participating student. Pre- and post-test measures included tests of the Woodcock-Johnson Tests of Achievement (WJ IV ACH), as well as the Test of Silent Word Reading Fluency (TOSWRF-2). A multivariate analysis of covariance (MANCOVA) was used to determine whether there were significant mean differences in (a) non-word reading, (b) real word reading, (c) non-word spelling, (d) real word spelling, and/or (e) reading fluency post-test achievement scores favoring students assigned to use the MVRC online reading intervention, once the effects of differences in pre-test achievement scores and relevant demographic variables had been accounted for. Analyses revealed a significant main effect ($\lambda = .668$, F [5, 161] = 16.014, $p < .001$, multivariate $\eta^2 = .332$) of the intervention on achievement scores of participants assigned to the treatment condition, a result which was confirmed across three of the study's dependent variables: real word spelling (F[1, 165] = 16.341, $p < .001$, multivariate $\eta^2 = .090$), non-word spelling (F[1, 165] = 29.212, $p < .001$, multivariate $\eta^2 = .150$), and reading fluency (F[1, 165] = 58.348, $p < .001$, multivariate $\eta^2 = .261$).

KEY WORDS: achievement, computer, Internet, intervention, language arts, quasi-experimental, reading, software

CHAPTER ONE: INTRODUCTION

Literacy and its component skills, the ability to read with fluency and comprehension and write fluently and coherently, are essential to educational attainment across domains: they "[bridge] the gap between learning to read and reading to learn" (Duke, Bennett-Armistead, & Roberts, 2003, p. 226) and provide the key that opens the door to a world of textually-based knowledge. The American system of education, however, has not yet achieved its potential in ensuring that as many Americans as possible enjoy the benefits of literacy. The findings of the National Assessment of Adult Literacy revealed that 43% of adults in the United States scored at basic or below basic levels in prose literacy, or the ability to understand, summarize, make simple inferences, determine cause and effect, and recognize an author's purpose when presented with texts of moderate density (Kutner, Greenberg, Jin, Boyle, Hsu, & Dunleavy, 2007). Results of the National Assessment of Educational Progress (Grigg, Daane, Jin, & Campbell, 2003) painted an even bleaker picture of American youth. As of 2002, over two-thirds of fourth-grade students scored at basic or below-basic levels of grade-level literacy (Grigg et al., 2003). Research suggests that once children have reached this point in their education, when the focus of instruction has shifted from learning to read to reading to learn (Duke et al., 2003), they are at increased risk for academic failure (Felton & Pepper, 1995; Juel, 1988), often struggling to acquire the content knowledge necessary for academic success.

Reading failure poses a serious threat to a child's future educational, professional, and social success. This conclusion is well supported in the literature. Kennely and Monrad (2007) identified a statistically significant correlation between low reading

scores and school dropout, and researchers have consistently found that youngsters with reading-related difficulties are disproportionally represented in the juvenile detention system (Rutherford, Bullis, Anderson, & Griller-Clark, 2002; Shelley-Tremblay, O'Brien, & Langhinrichsen-Rohling, 2007), placing them at increased risk for future criminal behavior and social dysfunction.

The vast majority of children at risk for illiteracy can be taught to read with fluency and comprehension, provided they receive developmentally appropriate instruction in the sound-symbol correspondences of spoken and written language (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001; Snow, Griffin, & Burns, 2005). In particular, sequential instruction in code-based skills, including explicit, systematic phonics has been shown to positively affect the reading and writing abilities of students with reading-related challenges (Ehri et al., 2001; Hatcher, Hulme, & Snowling, 2004; Torgerson, Brooks, & Hall, 2006).

Systematic reading instruction using information and communication technologies (ICT) has been enthusiastically trumpeted as a means by which to promote reading achievement (Savage et al., 2013), and such instruction often requires little or no direct intervention on the part of the classroom teacher (Bishop & Edwards Santoro, 2006). ICT-based instructional programs have been widely adopted in classroom contexts, "generally with an underlying expectation that student learning can improve … through supportive skill instruction with practice" (Cassady & Smith, 2005, p. 362). This sentiment was mirrored in the National Reading Panel's (NPR) report of 2000, which characterized ICT-based reading instruction as a potentially promising development, allowing students greater opportunity to "interact instructionally with text" than typically

offered by conventional instruction alone (Ch. 6, p. 8).

Some key potential advantages of beginning reading instruction using information and computer technologies are (a) explicit, systematic instruction in the sound-symbol correspondences of spoken and written language (Camilli et al., 2003; Ehri et al., 2001; Torgerson et al., 2006), (b) multimodal instruction to promote recall and retention (Low & Sweller, 2005; Moreno & Mayer, 2007), (c) formative feedback to guide learning and activate prior knowledge (Narciss, 2013), (d) interactivity to promote attention and engagement (Sims, 2000, 2003), and (e) opportunities for mastery learning to enhance achievement (Guskey, 2007, 2012). The question of whether or not ICT-based reading interventions have actually leveraged the potential advantages of the medium, however, remains unresolved, with the authors of large-scale evaluations of software concluding that ICT-based beginning reading programs generally have provided inconsistent and unsystematic instruction (Edwards Santoro & Bishop, 2010; Grant et al., 2012). Furthermore, ICT-based reading instruction remains poorly theorized (Savage et al., 2013) and inadequately researched (Blok, Oostdam, Otter & Overmaat, 2002; Kulik, 2003; Slavin, Lake, Chambers, Cheung, & Davis, 2009; Torgerson & Zhu, 2003), particularly with regard to studies involving participants aged eight years and younger (Lankshear & Knobel, 2003). In the present study a quantitative, quasi-experimental research design is employed to evaluate the efficacy of the MindPlay Virtual Reading Coach (MVRC), a sequential, code-focused online reading intervention, when used to supplement regular reading instruction provided by a classroom teacher.

Statement of the Problem

With some notable exceptions (e.g., Macaruso, Hook, & McCabe, 2006; McMurray, 2013; Savage et al., 2013; Savage, Abrami, Hipps, & Deault, 2009; Savage, Erten, Abrami, Hipps, Comaskey, & van Lierop, 2010), relatively little high quality experimental or quasi-experimental research has been published examining the effects of ICT-based reading interventions on beginning reading achievement (Blok et al., 2002; Kulik, 2003; Slavin et al., 2009; Torgerson & Zhu, 2003). Prominent voices in the field have suggested that teachers and education authorities remain wary of adopting any ICT-based reading program until it has a consistent base of high quality evidentiary support (Slavin et al., 2009; Torgerson, 2007; Torgerson & Zhu, 2003).[1] Through the present study, the author wishes to fill a gap in the existing ICT-based beginning reading intervention literature, while addressing issues of research design and intervention quality that have been inadequately explored in previous intervention research.

Nature of the Study

In the present study, the author relates the results of quantitative research designed to evaluate the efficacy of MindPlay Virtual Reading Coach (MVRC), a sequential, code-focused online reading intervention, when used to supplement regular reading instruction provided by a classroom teacher. The study employed a quasi-experimental design with multivariate data analyses and statistical controls for differences in pre-test achievement scores and relevant demographic variables.

[1] Among the recommendations of Torgerson (2007) and Torgerson and Zhu (2003) was the conduct of randomized controlled trials (RCTs). Owing to the small sample size in the present study, it was not

Conceptual Framework

The conceptual framework for the present study is based on five research-supported premises. First, failure to develop strong reading skills in early elementary school has pervasive impacts on student achievement in every aspect of education, and those impacts tend to intensify as children progress through school (Felton & Pepper, 1995; Juel, 1988). Second, the vast majority of children can be taught to read with fluency and comprehension when provided high quality, research supported interventions designed to meet individual needs (Ehri et al., 2001; Hatcher, Hulme, & Snowling, 2004; Torgerson et al., 2006). Third, systematic instruction in code-based skills has been shown to positively affect the reading ability of both typically developing students and those with reading-related challenges (Ehri et al., 2001; Snow et al., 2005). Fourth, sequential ICT-based reading interventions of sufficient duration and intensity can and do improve beginning reading achievement (Macaruso et al., 2006; Savage et al., 2009; Savage et al., 2010; Savage et al., 2013), even among students with reading-related challenges (McMurray, 2013). Fifth, ICT-based reading interventions whose content and delivery are consistent with theoretically informed models of reading development and instructional design are likely to be of greatest benefit to students (Savage et al., 2013).

Objectives of the Present Study

The primary objective of the author of the present study was to contribute to the research base in ICT-based beginning reading interventions by reporting the results of quasi-experimental research designed to evaluate the efficacy of MindPlay Virtual Reading Coach (MVRC) (MindPlay Educational Software for Reading, 2015), an ICT-based reading intervention, when used to supplement regular language instruction

provided by a classroom teacher. MindPlay Virtual Reading Coach offers highly individualized and developmentally sequenced instruction in phonics, fluency, comprehension, vocabulary, and grammar consistent with the recommendations of the NRP (2000). The MVRC software provides multisensory learning, engaging students visually and auditorily, in order to strengthen associations between learned content (Kast, Meyer, Vögeli, Gross, & Jäncke, 2007) and reduce memory demands on individual cognitive systems (Low & Sweller, 2005). Immediate formative feedback is provided to students while they interact with program content, rather than simple corrective feedback, as formative feedback has been shown to increase retention and decrease demands on cognitive processing (Moreno, 2004). Furthermore, MVRC requires mastery (typically to 90%) of initial concepts and skills before new concepts and skills are introduced, ensuring that students do not have gaps in foundational knowledge and promoting sustained retention of learned content (Guskey, 2010).

The secondary objective of the author was to ensure the conformity of the present study with the highest standards for design, analyses, and reporting in educational research. Therefore, the author elected to align the present study with the indicators for high quality experimental and quasi-experimental research identified by Gersten et al. (2005) and published by the Council for Exceptional Children. The present study, as designed, meets all of the relevant[2] essential quality indicators and five of the desirable quality indicators, thus satisfying the criteria for high quality research.

[2] One essential quality indicator was not relevant to the present study, as it applied only to studies involving populations presenting with disabilities or learning difficulties.

Importance of the Present Study

A critical issue of national significance is ensuring that all students have optimal opportunities to develop the reading skills necessary to succeed in school and in life. The present study employs high quality design and data analytic techniques, and an intervention grounded in evidence-based theory and best practices for the promotion of literacy development among beginning readers. It will yield important findings regarding the efficacy of MVRC's highly interactive, individualized, and developmentally-sequenced mastery model of instruction, and it will contribute to the knowledge base regarding ICT-based beginning reading interventions and the systematic instruction of phonics, fluency, comprehension, vocabulary, and grammar. Furthermore, it will provide educators and administrators with information critical to the selection of effective ICT-based reading interventions for use in the classroom.

Research Question

In the present study, the following research question was addressed: Are there significant mean differences in (a) non-word reading, (b) real word reading, (c) non-word spelling, (d) real word spelling, and/or (e) reading fluency post-test achievement scores of students assigned to use the MVRC online reading intervention in addition to regular classroom reading instruction and those of students from a business-as-usual comparison condition, once the effects of differences in pre-test achievement scores and relevant demographic variables have been accounted for?

Statement of Hypotheses

The author of the present study has identified the following alternative hypothesis (H_A) related to the overall effects of the intervention: Statistically significant main effects

of the intervention favoring the treatment group will be detected in overall reading and spelling achievement. The author has identified the following alternative hypotheses (H_A) related to the effects of the intervention on individual dependent variables:

- Statistically significant effects of the intervention favoring the treatment group will be detected in non-word reading.
- Statistically significant effects of the intervention favoring the treatment group will be detected in real word reading.
- Statistically significant effects of the intervention favoring the treatment group will be detected in non-word spelling.
- Statistically significant effects of the intervention favoring the treatment group will be detected in real word spelling.
- Statistically significant effects of the intervention favoring the treatment group will be detected in reading fluency.

Participants

Participants included 209 students enrolled in eight, second grade classrooms in two public elementary schools in the southwestern United States. Of those, 107 were assigned to the treatment condition, and 102 were assigned to a business-as-usual comparison condition. Owing to attrition and illness, 39 participants had incomplete data sets following post-testing. Ultimately, the treatment condition comprised 89 complete cases, and the comparison condition comprised 81, representing 170 complete cases, or 81.34% of original cases. While overall data loss was below 20%, data loss did not impact each condition equally, as the treatment group retained 83.12% of original cases, while the comparison group retained 79.41% of original cases, producing a differential