Readable English: Can Interactive Orthography and Phonetic Cueing Improve Reading Scores of Struggling Adolescent Readers?

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Abstract

High school students with significant reading deficits must read to learn course content. A pilot study of Readable English, a phonics intervention providing embedded interactive orthography to scaffold online grade level content, increased both reading accuracy and reading comprehension compared to control group. Findings suggest this new learning intervention technology may particularly benefit students struggling to read and pronounce English at the word level.

Keywords: online learning; struggling readers; interactive orthography; educational software; reading intervention software; dual route theory; reading models; adolescent readers

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Scores of Struggling Adolescent Readers?

The majority of high school students are not reading on grade level (NAEP, 2019), yet students must read in order to learn new course content. Students not reading at grade level in high school suffer the Matthew Effects as the gulf of reading ability and knowledge widens between proficient and non-proficient readers (Stanovich, 1986). Lack of exposure to rare vocabulary as well as insufficient practice necessary to achieve automaticity and fluency in accessing complex high school text further hinder reading comprehension. Vocabulary is largely learned through reading in context (Kirk & Gillon, 2009); hence, poor readers often lack the vocabulary needed to comprehend course material. Reading research suggests that scaffolded reading in context may particularly benefit older struggling readers (Lovett et al., 2000).

In older students, phonics interventions alone show minimal gains in reading fluency and comprehension (Arnbak & Elbro, 2000). A study by Torgeson, Wagner, and Rashotte (2001), found that despite intensive phonics instruction, 25 percent of students with diagnosed reading disabilities did not show significant reading growth, and benefits of remediation decrease as students age (Lovett & Steinbach, 1997). Providing struggling readers with orthographic and phonetic instruction improves word-level and reading comprehension skills over phonetic instruction alone (Abbott & Berninger,1999; Apel & Swank, 1999; Arnbak & Elbro, 1996; Kirk & Gillon, 2009).

Effective intervention elements targeted to improve struggling readers are suggested by three interrelated theories of cognition: Dual Route Theory (DRT), Triple Word Form Theory (TWFT), and Cognitive Load Theory (CLT). DRT hypothesizes that students recognize words

using simultaneous processes of graphophonemic rules analysis and orthographic-semantic analysis for word recognition (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Word recognition and lexical access occur simultaneously as the reader recognizes the word and understands what it means in the context of its current usage.

Similarly, TWFT posits that individual processes of orthographic, phonological, and morphological awareness co-develop in a mutually facilitative manner (Berninger, Abbott, Nagy, & Carlisle, 2010). Morphological awareness includes semantic analysis as part of its construct because morphemic analysis involves understanding how words are used in context, as well as accessing meaning through recognition of root words. CLT hypothesizes that providing information in meaningful chunks reduces the load on working memory and allows for greater integration of meaning (Sweller, 1988). The ability to recognize root words allows more efficient retrieval from the lexicon than phonetic reading alone; and rapid, efficient word recognition sharply divides good and poor comprehenders (Nagy, Anderson, Schommer, Scott, & Stallman, 1989). Therefore, CLT applied to reading may partly explain why the interaction of morphological awareness and word reading contributes to reading comprehension (Gilbert, Goodwin, Compton, & Kearns, 2013).

These theoretical underpinnings predict, and reading research has shown, that scaffolded reading using orthographic, phonetic, semantic, and morphemic supports and instruction improves student word-level and reading comprehension skills (Tighe & Schatschneider, 2016). The present study asked whether Readable English, an intervention program providing orthographic and phonetic instruction with embedded interactive orthography, syllabication, and phonetic cues to scaffold reading fluency, would improve adolescent student word-level and reading comprehension skills in unscaffolded text. Educational software and adaptive technology

are now commonplace, and students are acclimated to online learning environments. Benefits of computer-based interventions include standardized implementation fidelity; and attendance issues are minimized because students pick up where they left off in prior sessions. Using technology allows students to access exactly the content they need when they need it.

Method

Participants

Participants were students in grades 9-12 selected from two alternative high schools in the suburban Midwestern United States based on screening results. Students (N = 24) were demonstrated significant deficits in reading fluency and/or reading comprehension ($M_{deficit} = 4.17$ years below chronological age) (see Table 1). Participants were all native English speakers under age 20. Four students who scored above their chronological age in oral reading fluency were excluded from this study.

Table 1

Demographics of Study Sample

Factor	Control Group	Intervention Group
Gender		
n	10	14
Male	7	8
Female	3	6
Mean age (M_{age})	16.4	16.5
Burt Word Reading		
M_{age}	10.6	11.3
GORT-IV		
M_{age} Rate	11.2	12.6
M_{age} Accuracy	12.9	13.7
M_{age} Fluency	11.8	13.0
M_{age} Comprehension	12.3	12.4

Materials

Readable English reading intervention takes a unique approach to improving both word-level reading and reading comprehension skills. The program provides interactive orthography that supports graphophonemic access to word recognition by using "glyphs" over letters to indicate pronunciation without changing the spelling of words. Phonemic access is further supported by "graying-out" the silent letters of words while visually retaining all letters, thus keeping words recognizable. Because unknown words remain intact, orthographic-semantic analysis allows for direct lexical retrieval of the word. Words are displayed as distinct syllables, allowing readers to easily see the morphemes and intuit word meanings. Structured literacy skills are embedded within, and scripted instruction is explicit and systematic.

During Phase One, students learn standard English phonetic sounds, diphthongs, and digraphs. Once these are mastered, students learn the 21 glyphs and sounds that explicitly teach non-standard sound of letters in words. Students learn the glyph symbols through a series of 60-second videos that include memorable songs and body movements. The glyphs are situated around the letters they are cueing, thus resembling diacritical marks. Students interact with glyphs through games and online practice activities to acquire automaticity of usage, and each skill must be mastered before advancing to new skills. Once the 21 glyphs are learned, students apply the mark-up to their course text and begin reading. Students have an immediate path to word recognition through phonics review, decoding, and morphological awareness.

In Phase Two, students practice word attack, spelling, word reading, and reading in context using text in the Readable English mark-up. Students practice using this three-part scaffold while building reading volume and improving accuracy. Students also practice using the online text conversion tool to convert text from standard English to text with the Readable

English mark-up. The tool superimposes glyphs to text, facilitating pronunciation of words that do not follow typical spelling conventions. This tool also divides words in to syllables and grays out silent letters.

Phase Three involves scaffolded writing projects, reading comprehension strategies, and reading grade-level content and curriculum that students convert into Readable English. This phase integrates phonics, phonemic awareness, syllable pattern recognition, morphemic analysis, semantics, pragmatics, inference making, and vocabulary. The goal of the intervention is to strengthen those skills to improve word reading fluency and reading comprehension.

Procedure

Students in the control and intervention groups were enrolled in alternative high schools which required online coursework in Plato as part of credit recovery. During the 14 weeks of this study, students in the control group completed work in Plato and received phonics and sight word instruction as needed to read coursework text at student request.

Participants in the treatment group received 47.5 hours of Readable English intervention instruction and were required to use the text conversion program to embed their Plato coursework and other required reading with the Readable English mark-up. Intervention instruction was delivered both in-person and via Readable English online interactive lessons and text conversion software. All participants in the treatment group completed Phases 1 and 2 of word-level reading skills and were working in Phase 3 writing and comprehension when the study concluded.

All study participants were administered pre- and post-tests in measures of oral reading fluency and reading comprehension using the Gray Oral Reading Tests (GORT), Fourth Edition. Word reading skill was assessed using the Burt Word Reading Test (BWRT).

Statistical methods

This was a quantitative study with a quasi-experimental design because students were grouped by convenience rather than random assignment. Data were analyzed using comparisons of means, descriptive statistics, ANOVA, independent samples t-tests, and multiple linear regression.

Results

Independent samples t-tests indicated no statistically significant differences between the control and intervention groups in participant age, GORT-IV pre-test measures of reading rate, accuracy, fluency, comprehension or the BWRT. One-way ANOVA indicated that the intervention was effective on measures of word reading, reading rate, accuracy, and fluency. Word reading measured by the BWRT median increase was .75 years, which was statistically significant $F(1, 23) = 4.59$, $p = .038$, $\eta^2 = .17$ (see Table 2). The mean reading rate of the intervention group improved 1.64 years and was statistically significant, $F(1, 23) = 4.99$, $p = .034$, $\eta^2 = .18$. Mean reading accuracy increased 3.08 years and was statistically significant, $F(1,23) = 10.07$, $p = .004$, $\eta^2 = .30$. Mean reading fluency, a combination of reading rate and accuracy scores, increased 2.32 years and was statistically significant, $F(1,23) = 9.16$, $p = .006$, $\eta^2 = .28$.

Table 2

Mean Change in Reading Skills

Factor	*Control* M	*Intervention* M
Burt		
Word reading	0.34	0.75
GORT-IV		
Rate	0.82	1.64
Accuracy	0.60	3.08
Fluency	0.85	2.32
Comprehension	-0.44	0.77

ANOVA and regression analyses were performed to determine the effects of improved word-level reading skills on comprehension. The intervention group showed a mean reading comprehension score increase of .77 years, compared to a mean net loss of -0.44 years for the control group; however, the difference between groups was not statistically significant at $F(1,23) = .91$, $p = .350$, $\eta^2 = .04$ compared to the control group. A regression analysis was performed to evaluate the degree to which GORT-IV reading fluency and BWRT word reading post intervention scores predicted improvement on passage reading comprehension. Order entry for the analysis was GORT-IV fluency followed by BWRT, the combination of which predicted 25% of reading comprehension improvement, $F(2,22) = 3.81$, $p = .038$, $R^2 = .26$, Adjusted $R^2 = .19$. The difference between the control and intervention groups clearly demonstrates that the control group's reading comprehension failed to keep pace with same-age peers whereas the intervention group maintained the expected growth rate and made significant strides toward closing their reading comprehension gap.

As predicted, the control group failed to show .27 years growth (study length) in comprehension due to participants' reading difficulties. The intervention group exceeded

expectations, showing a mean gain of .77 years whereas the control group displayed a mean loss of -.44 years. A paired-samples t-test post hoc analysis of intervention group comprehension pre-test scores ($M =12.37$, $SD = 4.37$) and post-test scores ($M =13.13$, $SD = 8.86$) indicated that post-test scores approached statistical significance, $t(-2.08) = 2.14$, $p < .06$, $d = .76$.

Discussion

Whereas both groups' reading fluency benefited from reading instruction and reading in context, the treatment group using Readable English showed gains in reading fluency (2.4 years) and word reading (.75 years) despite the short duration of the trial. The intervention provides scaffolding using the Readable English mark-up whereas assessments do not. Reading assessment gains demonstrated a significant transfer effect when intervention scaffolding was not used and students tested reading standard English text.

Study findings indicated that Readable English improved adolescent word level and comprehension skills in unscaffolded, standard English text. Passage reading comprehension improvement of .77 years was remarkable considering the severity of students' reading difficulties. This builds on prior research indicating that older struggling readers may substantially benefit from explicit, sequential instruction that includes the component elements of structured literacy. Future studies should consider expanding scaffolded e-reader instructional time and post testing for far effects to determine if lasting change in reading fluency and/or comprehension is present. Increasing intervention time spent in Phase 3 writing and comprehension should further boost reading comprehension. The GORT-IV passage reading comprehension test showed ceiling effects due to the age of the participants and upper limit of the assessment (18.67 years). Additional, more sensitive comprehension assessments should be used to better reflect comprehension variances.

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