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Second-Grade Urban Learners: Preliminary Findings for a Computer-Assisted, Culturally Relevant, Repeated Reading Intervention

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Abstract

This study investigated the effects of a multicomponent, supplemental intervention on the reading fluency of second-grade African-American urban students who showed reading and special education risk. The packaged intervention combined repeated readings and culturally relevant stories, delivered through a novel computer software program to enhance oral reading fluency and comprehension. A concurrent multiple probe experimental design across seven participants was used to assess intervention effects. Results showed a positive effect on both practiced and novel passages during intervention and on the 2-week and 1-month maintenance probes. Further, reading growth rates for the participants exceeded the growth rates for comparison peers on AIMSweb assessments. This study supports previous research on the beneficial effects of repeated reading strategies and computer delivered instruction. The link between fluency and comprehension was further supported in these findings. The possible relative effects of the use of culturally relevant material as well as study limitations are discussed.

Keywords: oral reading fluency, repeated reading, computer-assisted instruction, culturally relevant, urban learners

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According to the Nation's Report Card, poor academic achievement disproportionately exists in urban settings (National Assessment for Educational Progress [NAEP], 2009). In 2013, for example, fourth-grade reading scores from most reporting urban districts were lower than their counterparts in non-urban districts and a disproportionate number of these struggling urban readers were minority students from poor communities (Cooper & Jordan, 2003; National Center for Educational Statistics [NCES], 2013). Low achievement in the earlier years is problematic because as children progress through school the curriculum becomes increasingly difficult; thus children who begin their school careers behind are likely to fall even further behind (Carlson & Francis, 2002; Stanovich, 1986), likely leading to school and later life failure (e.g., Chhabra & McCardle, 2004; McLoyd & Purtell, 2008; Shippen, Morton, Flynt, Houchins, & Smitherman, 2012). Furthermore, with the adoption of the Common Core State Standards (National Governors Association Center for Best Practices, 2010), academic requirements have been raised, increasing the challenge for students who are at risk for reading failure (Haager & Vaughn, 2013). Along with the adoption of the Common Core, at least 22 states and the District of Columbia have adopted policies aimed at improving reading achievement scores by third grade (Rose & Schimke, 2012).

Unfortunately, third grade may be too late to attempt meaningful gains. The extant literature emphasizes early identification of students who are at risk. "If a student hits third grade reading poorly, the chances of remediating him or her are not good. The vast majority of such youngsters will never climb beyond the bottom third of all readers" (Moats, 2007, p. 24). However, Moats and Foorman (2008) state that effective literacy instruction delivered to poor children during early elementary school (i.e., grades K-2) can allow those children to achieve reading success. In other words, high academic standards for children (e.g., Common Core, third-grade reading policies) should be offered in conjunction with a diligent focus on instructional best practices designed to improve literacy performances for underachieving students during early elementary school (Alexander, Entwisle, & Horsey, 1997; McIntosh, Flannery, Sugai, Braun, & Cochrane, 2008; Simner & Barnes, 1991) including direct and explicit instruction (Carnine, Silbert, Kame'enui, & Tarver, 2010).

The National Reading Panel (NRP; 2000) proposed five critical components of reading instruction: phonemic awareness, phonics, reading fluency, vocabulary, and reading comprehension. Much of the early intervention research has focused on phonemic awareness and phonics (e.g., Simmons et al., 2003). Despite evidence of beneficial returns (e.g., Yeh, 2003), focusing on only these two foundational skills

may be insufficient for many students, especially poor responders, to acquire the requisite reading fluency (e.g., Simmons et al., 2008; Yurick, Cartledge, Kourea, & Keyes, 2012). Fluency, a key aspect of reading competence, is often overlooked during early literacy instruction (Kame'enui & Simmons, 2001).

Oral Reading Fluency

Oral reading fluency (ORF) is the ability to read quickly, accurately, and with expression (NRP, 2000). It is difficult for a reader to comprehend if he/she is focusing his/her attention on decoding individual words (LaBerge & Samuels, 1974); for this reason, readers need to acquire decoding automaticity. Decoding automaticity, or the ability to decode effortlessly, is usually determined using timed oral reading assessments (e.g., 1-min timings). ORF is measured by calculating correct words per minute (CWPM). Low fluency performance is often correlated with difficulty in comprehension (Fuchs, Fuchs, Hosp, & Jenkins, 2001). Curriculum based measures that monitor the fluency skills of students in first and second grade may be insufficient for developing ORF. Researchers have found that fluency does not always spontaneously develop (Simmons et al., 2008; Yurick et al., 2012). In fact, the NRP (2000) recommended that fluency be explicitly taught. Oftentimes the critical component skill of reading fluency is an indicator of comprehension (Gibson, Cartledge, Keyes, & Yawn, 2014; Therrien, 2004) and, fluency is thought to be the bridge linking decoding skills to comprehension (Fuchs et al., 2001). The importance of fluency should not be underestimated. Lack of fluency skills can either be an indication of deficient decoding skills and/or an indication of deficient comprehension. Using students' fluency rates as a guide, teachers can adjust their instructional practices to meet students' needs in the areas of phonics (i.e., decoding) and/or comprehension. Assuming that a student has sufficient decoding skills, direct intervention on ORF skills can positively affect comprehension ability. Therefore, because comprehension is the ultimate reason for reading, good fluency interventions should also measure comprehension.

Repeated Reading Intervention

One evidence-based strategy to teach ORF skills is repeated reading intervention (RRI). RRI typically involves a reader practicing a passage for three to four 1-min timings until he/she meets a predetermined criterion (e.g., 90 CWPM). This strategy is based on LaBerge and Samuels's (1974) theory of automaticity. Since the late 1970s, many

empirical studies have been conducted on the effects that RRI has on fluency and comprehension (see Strickland, Boon, & Spencer, 2013; Therrien, 2004). RRI has strong effects on CWPM and comprehension (usually measured as retells) on practiced passages (i.e., non-transfer). However, the effects of various RRI strategies on the CWPM and comprehension on novel passages (i.e., generalization) are mixed (Strickland et al., 2013; Therrien, 2004). For poor and/or minority students, the reading material itself may serve as a barrier to fluency and comprehension. That is, the reading materials may not be reflective of these students' experiences, thus reducing their ability to use background knowledge to comprehend content.

Culturally Relevant (CR) Reading Material

Urban areas are heavily populated with students from economically disadvantaged homes, who are likely to be racial/ethnic minorities, and who may be English learners. These culturally and linguistically diverse students are a rapidly growing segment of the school population in American cities. For example, White students make up 52% of the total public school enrollment (NCES, 2014), yet only 20% of White students attend school in urban settings (Harris, Chandler, & Duvall, 2014). The poor reading/academic performance of students in urban schools is a major concern. Of the numerous intervention approaches proposed and needed, one persistent theme has been the application of culturally relevant (CR) interventions (e.g., Bishop, 2007; Boykin & Bailey, 2000; Gay, 2004; Ladson-Billings, 1995). CR materials have been defined variously, but for the purposes of this study, refers to literary materials that convey positive, meaningful messages representing the students' interests as well as their current and historical backgrounds. Advocates of CR literature believe it to be empowering, and that students may benefit through increased motivation, primed background knowledge, affirmations, and improved performance (Bishop, 2007; Cronin, 2001; Ebe, 2010; Ladson-Billings, 1995). CR material may provide a balanced approach to literacy instruction (Spiegel, 1992), blending explicit instruction with whole language approaches. CR material may be a critical element when programming for generalization (Stokes & Baer, 1977) to novel non-CR passages because CR material has the potential to teach to the interest of the child (thereby increasing reading behavior), program common stimuli (between oral and written language), provide multiple exemplars (for high overlap words), and provide a mediating stimulus (between familiar and novel material).

Computer Assisted Instruction (CAI)

Many of the instructional strategies recommended by the NRP (2000) for remediation of reading skills include supplemental instructional opportunities (e.g., small group, one on one) in addition to classroom instruction. However, in urban schools, where the student to teacher ratio is approximately 29:1 (NCES, 2007) and the percentage of students at risk is disproportionately high, such opportunities may be difficult to provide. An alternative to teacher directed supplemental instruction is CAI. Even before computers were common in the workplaces, homes, and schools (i.e., pre-1980), researchers have been designing computer software as supplemental reading instruction (e.g., Fletcher & Atkinson, 1972). Today, with an array of devices available in addition to computers (e.g., laptops, tablets, smartphones), supplemental CAI is often an integral part of the twenty-first-century education experience. CAI allows children the flexibility to acquire and practice skills in a variety of environments without requiring the teachers' constant one-on-one attention. Specifically as it relates to ORF, the classroom ratio, schedule, and groupings may make it difficult for the urban teacher to incorporate RRI as part of multi-tiered system of support (Mercier Smith, Fien, Basaraba, & Travers, 2009). The use of CAI can allow teachers to incorporate RRI consistently into their curricula as a Tier 2 or Tier 3 intervention and allow teachers to implement RRI with fidelity.

To be effective, CAI instruction should adhere to the principles of empirically validated pedagogy. For example, the strategy used in one such program, Read Naturally® (https://www.readnaturally.com), includes modeling, repeated reading, and progress monitoring. Several studies have measured the efficacy of the Master edition of the program and found positive results with second and third graders (Hasbrouck, Ihnot, & Rogers, 1999) as well as with first, second, and third graders considered to be at risk (Denton, Fletcher, Anthony, & Francis, 2006). Positive results were also found using the software edition of the program with young culturally diverse students who were at risk (Gibson et al., 2014; Keyes, Cartledge, Gibson, & Robinson-Ervin, 2016).

More specifically, Gibson et al. (2014) used Read Naturally® with eight first-grade African-American students in two different urban schools in the Midwest with high percentages of children who were economically disadvantaged (70% and 94%, respectively). The CAI software as an independent variable, included several stages: learning key words for the story, a 1-min cold read, listening to the passage being read, reading along with the computer as the computer modeled

the story, practicing reaching criterion during a 1-min timing until criterion was met, a comprehension test consisting of multiple choice and short answer questions, and a pass timing. Researchers implemented two phases of intervention; one where a goal criterion of 40 CWPM was set and a second where the goal was raised systematically based on student performance.

Gains in fluency as measured by the generalization passages increased after the goal was raised to a higher criterion. Gibson et al. (2014) found that five out of the eight participants reached benchmark criteria on generalization passages by the end of the study. Comprehension measures indicated that all 8 participants performed better on comprehension retell tests. This study, in addition to measuring the effects of CAI instruction also highlighted the efficacy of RRI with younger students and expanded the knowledge base on the importance of establishing performance criteria. One limitation, however, according to Gibson et al. (2014) was that it based the criterion on total words read and did not provide error correction when students missed a word, thus, allowing the practice of errors.

In a replication of the above study, Keyes et al. (2016) measured the effects of the computer delivered intervention on the fluency of second-grade students showing risk for reading failure. Although the findings were positive, participants' effects were not as large as with the first graders in the previous study, suggesting that RRI, and perhaps other reading interventions, are more powerful with younger learners. To achieve more robust returns with older learners the researchers of this investigation questioned the beneficial effects of a CR component on student fluency and comprehension. The purpose of the current study was to determine the effects of a RRI using CR material delivered through CAI on the reading fluency and comprehension of urban African-American second-grade students.

Method

Participants and Setting

Seven participants (i.e., students who actively received intervention in this study) and three comparison peers (i.e., students in extended baseline) were recruited from two inner-city elementary schools (Berkley and Grant Elementary) in a large Midwestern metropolitan area. School and student names are pseudonyms, and both schools housed two second-grade classrooms where a majority of the students (90% at Berkley and 86% at Grant) were Black. As determined

by the free and reduced-price lunch data, both schools had a high percentage of students who were economically disadvantaged (over 89% at Berkley and 80% at Grant). In addition, all four teachers used the Story Town (Beck, Farr, & Strickland, 2008) K-6 language arts curriculum as a basis for reading instruction. Story Town incorporates all five critical components of reading, has leveled readers, and has built in progress monitoring as a way to collect data. This curriculum was generally used district wide.

Classroom teachers administered the *Dynamic Indicators of Basic Early Literacy Skills Next Edition* (DIBELS; Good et al., 2012) to all students and provided the second-grade fall benchmark scores used to identify participants and comparison peers. Selected students were (a) given parental permission, (b) either *below* or *at or above* on nonsense word fluency (NWF) subtest (i.e., 35 CSPM) or higher, and (c) *well below benchmark* (0–36 CWPM) or *below benchmark* (37–51 CWPM) range on the DIBELS ORF (DORF) subtest (Good et al., 2012).

The study took place in a separate room in each school to minimize distractions. Each session included one to two participants and one to three researchers. There were three to five sessions a week with each session lasting 20 to 30 minutes. Participants were in intervention from 7 to 13 weeks, dependent on each participant's performance. A summary of participant information including name, age, gender, school, and DIBELS scores is given in Table 1.

Definition and Measurement of Dependent Variables

There were four primary and one secondary dependent variables in this study. The first dependent variable was correct words per minute (CWPM) during experimenter created and validated CR oral reading passages read on the computer in 18-point Times New Roman font. A word was counted correct when a participant accurately pronounced it within 3 s of the previous word being read. A word was counted as incorrect if the participant omitted or mispronounced the word or failed to read it within 3 s. Additions (i.e., adding or repeating a word) and self-corrections were not counted as errors. Corrective feedback was not provided for the mispronounced words during the timed reading. If a student did not read an unknown word after 3 s, the word was given.

The second dependent variable was correct responses to forced choice questions in corresponding CR mazes (i.e., comprehension) during a 3-min timing. Mazes were computerized and the computer scored a maze comprehension question as being correct if the response given by the participant matched the answer key. Conversely, if a response did not match the answer key, the response was scored as incorrect. Corrective feedback was not provided after the maze assessment.

Table 1

Participant Information

Name	Age [a]	Gender	School	DIBELS Next Scores BOY			
				Nonsense Word Fluency[c]		Oral Reading Fluency[d]	
				Score	Status	Score	Status
Adonica	7-7	F	Berkley	35	Below	11	Well Below
Taneisha	7-3	F	Berkley	48	Below	29	Well Below
DaJuan	7-1	M	Berkley	60	At or Above	23	Well Below
Markell	7-5	M	Berkley	69	At or Above	31	Well Below
Davion	7-11	M	Berkley	48	Below	38	Well Below
Kamara[+]	7-6	F	Grant	36	Below	44	Below
Xara	7-4	F	Grant	43	Below	35	Well Below
Imani[*]	7-7	F	Berkley	35	Below	49	Below
Sydney[*]	7-5	F	Berkley	65	At or Above	48	Below
Orlando[*]	7-7	M	Grant	40	Below	36	Well Below

Note:

[a] Age: refers to the age of each participant in years and months at the time DIBLES Next Beginning of the Year (BOY) sub-tests were administered (9/30/2013)
[b] School: refers to the school that each participant attended at the time of this study
[c] Correct Letter Sound (CLS) was used for Nonsense Word Fluency score
[d] Words Correct (WC) was used for Oral Reading Fluency score
[*] Comparison peer
[+] All participants were African-American except for Kamara, who was identified as Mixed Race
[++] DIBELS Next benchmark criterion for Second graders is 52 CWPM at Beginning of the Year and 87 CWPM at End of the Year.

The third dependent variable was CWPM on a novel AIMSweb (https://aimsweb.com) generalization probe. AIMSweb is a curriculum based management (CBM) system that provides for screening and progress monitoring of basic academic (i.e., reading, language arts, math) skills. Twenty of the second-grade passages from this system were used in this study. In addition, five first-grade stories that rated at the 2.5 to 2.7 grade level according to the Spache Readability Index (n.d.) were also used. Although the AIMSweb passages contain content that could be of interest to students in this grade level, the researchers viewed the passages as less CR (i.e., NCR) because the narratives are not specific to urban settings, nor did they include topics more familiar to African-Americans. Nine of the second-grade passages were selected because in a previous study (Cartledge, Keesey, Bennett, Gallant, & Ramnath, 2015) they were deemed to be the least CR. The other 11 second-grade passages were randomly selected from the remaining pool of 24 second-grade AIMSweb passages. Initially the same 18 second-grade stories were used throughout the study, although the presentation order of the stories was quasi-randomized for each participant. That is, half way through the study, the researchers learned that the difficulty level of the second-grade AIMSweb stories was uneven, with many stories being much harder than the CR passages. The researchers then used the Spache Readability Index (n.d.) calculator to assess and compare passage difficulty. The AIMSweb second-grade stories averaged a 2.9 grade level (range: 2.2–4.0). Stories that were at the 3.0 grade level and above were then removed from the study and replaced with AIMSweb stories equated at the 2.5 to 2.8 grade level.

The same rules for scoring CR passages were used for the AIMSweb passages. The participant was given a generalization probe (i.e. an AIMSweb passage) after two to three CR timed readings on practiced CR passages. If a participant took more than one session to meet his/her fluency goal for two consecutive CR practice passages, the generalization probe was given after five CR timed readings. The AIMSweb stories were presented on a 216 mm $\times$ 279 mm paper using 18-point Times New Roman font.

The fourth dependent variable was the correct responses to forced choice questions in corresponding AIMSweb mazes (printed on paper). The same rules as those for scoring CR mazes were used. The researcher plotted the data from these four dependent variables with the participant after the session using a paper graph generated by Microsoft Excel and printed in color. Maintenance data of both types of fluency and comprehension measures (i.e., treatment and generalization probes) were taken two weeks and one month after intervention.

A secondary dependent variable was a comparison of the overall reading growth of participants measured by CWPM and correct maze responses on AIMSweb and CR passages to that of comparison peers. Percentage growth was calculated for AIMSweb and CR scores by finding the difference between the pre-and post-test medians and dividing by the post-test median (pre-test [-] post-test/post-test) and then multiplying by 100 to yield percentage growth. For both AIMSweb and CR passages, the pre-test score was the median during the baseline phase. For AIMSweb percentage growth, the post-test score was the median of the last three points in the intervention phase. For CR percentage growth, the post-test score was the single final cold read score because the final three interventions points were practiced.

Independent Variable

The independent variable was the packaged intervention, which consisted of researcher-designed CR passages embedded in researcher-designed repeated reading software. As part of a larger project, the CAI application was designed to deliver a RRI to first and second graders. A unique and important feature of the software was that it allowed the researchers to add customized CR stories to the story bank. The program allowed participants to listen to a human voice model, read with that model, and had the capability to "listen" to participants as they read independently by using voice-recognition software, and to calculate total words read (TWR) on 1-min timings based on voice recognition during participant independent readings. Participants then verified the last word that they actually read by clicking on the word. The computer generated a TWR score and displayed it for the participant. In addition, the CAI provided assistance with unknown words (i.e., reading the word) when a participant clicked on the unknown word during specific practice phases during intervention. Two Toshiba laptop computers were used to deliver the intervention. A Logitech headset with a microphone was used so that participants could listen to the stories with limited distractions, to engage the voice-recognition software, and to audio-record students' oral reading.

CR passages and mazes. In previous work on the project, the research team created 30 CR passages written to reflect the interests and background of the target population (i.e., young urban learners who are at risk for reading failure; for examples of these passages/mazes see Cartledge, Keesey, Bennett, Council, & Ramnath, 2015). The passages were intended to be positive, affirming, and contain content with which the students could identify. Additionally, the software provided encouraging introductory statements, advising the students

that the researchers would help them reach their goals and that this practice would help their brains work harder to become better readers. The equated and validated passages (e.g., the procedures used in Cummings, Park, & Bauer Schaper, 2012) varied in length from 240 to 270 words with a grade range on the Spache Readability Index (n.d.) from 2.4 to 2.7. Twenty-five of these passages were retained for intervention, and an additional passage was used for the training phase only.

A maze was created to correspond to each of the 26 CR passages and was constructed to resemble those used in AIMSweb. For the purposes of this study, words were taken from existing leveled passages, the distractors were all the same parts of speech as the target words, and at least one of the distractors made sense in the sentence, but not according to the passage. Modifying the distractors in this way provided researchers with a better indication that the students understood the passage beyond the sentence level (e.g., Parker, Hasbrouck, & Tindal, 1992).

Experimental Design and Conditions

To control for learning that may have occurred outside the experimental setting, a concurrent multiple probe experimental design across participants during intervention was used for this study. The median CWPM score on the AIMSweb Oral Reading Fluency test was used to decide tier (i.e., legs of the multiple baseline design) and comparison peer placement for the intervention. Comparison peers were chosen because they had the highest median CWPM score out of the pool of students at his/her respective schools. The seven participants were placed in four tiers with two participants in the first two tiers, one participant in the third tier and two participants in the fourth tier. Four tiers were chosen so that sufficient experimental control could be established both within and across baselines (Johnston & Pennypacker, 2009). Because this was an applied study, the seven participants were yoked across these tiers to minimize risk as each waited to receive reading intervention. The first three tiers included participants from Berkley school, and the fourth tier included students from Grant Avenue School. Participants and comparison peers (N=10) began baseline condition at the same time. The two participants who had the lowest ORF scores and stabilized baseline data were the first to experience the intervention (i.e., first tier participants). When the first participants consistently met their goals on CWPM on practiced CR passages (i.e., treatment probes), then the next two participants entered intervention, and so on. All participants (N=7) entered the intervention condition 2 to 4 weeks after the initial baseline session. Each comparison peer was intermittently given generalization probes to establish extended steady

state responding until the participants were given the 2-week maintenance probes. At that time, all three comparison peers received intervention simultaneously (after the study was completed).

Baseline. Baseline consisted of 1-min cold reads of three CR passages read on the computer and at least three 1-min cold reads of AIMSweb generalization passages delivered on paper. The students were asked to read the passage as the researcher followed along on a duplicate passage to record students' errors, CWPM, and number of items scored correct and incorrect on the maze comprehension passage.

Training. During the session immediately preceding intervention, participants were trained on how to use the CAI using a checklist of sequenced behaviors. A CR example story that was not part of the 25 training stories was used. Participants were able to demonstrate all of the skills in the correct sequence after one trial, thus indicating their readiness to begin the study.

Intervention. Intervention consisted of the follow sequence:

- Setting the ORF goal and growth mindset (i.e., encouraging positive practice to promote academic performance),
- Read to me (i.e., the computer reads to the participant),
- Read along (i.e., the participant reads with the computer),
- Listen to me (i.e., the participant practices up to three 1 min timings with computer assistance for unknown words),
- Timed reading (i.e., an independent 1-min fluency timing on the same passage), and
- Maze comprehension passage (i.e., 3-min forced choice on a related maze passage).

Setting the goal. Before the CAI session began, the researcher showed each participant his/her baseline data (printed on 216 mm × 279 mm) and one of three goals (i.e., 60 CWPM, 90 CWPM, or 120 CWPM). Participants put the headphones on and logged on to the computer by finding their initials. The researcher then reviewed either baseline data (for the training and first session) or the previous day's data on the paper graph and had the participant click on the appropriate goal (60 CWPM, 90 CWPM, or 120 CWPM) as determined by the following criteria: According to DIBELS Next criteria, second graders were expected to read 52 CWPM at the beginning of the year and 87 CWPM by the end of the year. The 60 CWPM and 90 CWPM goals were slightly higher than the benchmark goals set by DIBELS Next to encourage transfer of ORF skills to generalization passages (i.e., AIMSweb). If the participant's baseline was below 60 CWPM, the participant was given a goal of 60 CWPM; if the participant's baseline was above 60 CWPM, he/she was given a goal of 90 CWPM. Three partici-

pants consistently read above 90 CWPM on CR passages and were given a goal of 120 CWPM. When a participant met his/her goal (i.e., 60, 90, or 120 CWPM) on a practiced timed reading the goal was reset to the next level (i.e., 90 or 120 CWPM).

Next the researcher prompted the participant to listen to the introduction. The computer read the same directions to each participant at the beginning of each session. Then, the researcher prompted the participant to find the assigned story for that day in the dropdown menu. The 25 CR passages were divided into five sets of five stories. Each story set was randomly assigned to students using random.org, and each story in the set was read in the same order. There was one expository text in each set, except the final set, which had only fictional passages.

Read to me. Once the participant selected the correct story, the researcher prompted the participant to click on the "Read to Me" button. The computer read the directions for this button. After the participant clicked "OK," the computer played the prerecorded human voice recording for that particular story at the participant's fluency goal speed (i.e., 60, 90, or 120 CWPM). The blue-highlighting feature kept pace with the voice recording and the participant followed along by watching each word being highlighted in blue as the story was read.

Read along. After the story was complete, the researcher prompted the participant to select the "Read Along" button. This step was identical to the "Read to Me" condition, except that during this step of the intervention, the computer prompted the participant to read aloud with the voice recording.

Listen to me. After the participant finished reading with the computer, the researcher prompted the participant to select the "Listen to Me" button. During this step of intervention, the participant had a chance to practice three 1-min timings, trying to reach his/her set criterion with 95% accuracy. If a participant did not know a word, he/she was prompted to click on the word and the computer provided the word. At the end of 1 min, the computer told the participant to click on the last word that was read. The computer then displayed the TWR to the participant. Experimenters provided corrective feedback at the end of each minute.

The experimenter followed an error correction procedure contingent on participant performance. The experimenter delivered correction for unknown words (i.e., if the participant clicked on an unknown word) and for sentences that the participant read incorrectly (i.e., for unclear speech, omissions, or substitutions). The experimenter highlighted each word with the mouse and said, "This word is _____. What word?" After the participant correctly said the word, the experimenter

then highlighted the sentence that word (or words) appeared in and said, "Read the whole sentence."

Once a participant reached his/her goal and read the passage with 95% accuracy, as determined by the experimenter, he/she was prompted to select the "Timed Reading" button. If a participant did not qualify for the timed reading after three "Listen to Me" trials, the session ended and the participant started the "Listen to Me" step on the same story the next session. If a participant did not reach his/her goal after two sessions, the goal was systematically lowered for the third session. In this case, in order to reduce frustration and help the student feel successful, the goal was re-set to a criterion that was more attainable for the participant. To systematically lower a participant's goal, researchers reduced the goal by 5 CWPM. For example, if a participant's goal was 90 CWPM, his/her goal was reduced to 85 CWPM. Once the participant reached the new goal, the goal was raised to the previous level (e.g., 90 CWPM) during the next session.

Timed Reading. The timed reading score served as the treatment probe. During this step, the computer gave the participant 1 min to read the passage practiced during "Listen to Me" and the computer did not provide corrective feedback (i.e., participants were not able to click on unknown words). The researcher recorded errors made during the reading using a paper/pencil data sheet to calculate the errors and CWPM to verify the computer's TWR calculation on both the listen to me and timed reading steps. The participant was required to reach the specified goal on this timing to move on to the comprehension maze passage. If the participant did not meet the goal during this 1-min timing, he/she was given a second chance to read the passage (where the second data point was kept for the graphs). All participants met their goal on their timed reading either the first or second time. In total (including the read along, listen to me, and timed reading steps of the intervention) the participants had the opportunity to read the same story five to seven times per session. The maximum number of times that one participant stayed on one story was three sessions.

Maze. After the participant met his/her goal during the timed reading, the researcher then prompted the participant to select the "Maze" button. The computer gave directions and timed the student for 3 min. There were approximately 30 to 35 response opportunities for each maze passage. Participants had three fill-in-the-bubble choices on the computer. The data taken by the computer served as a permanent product and the computer calculated the correct score. Mazes were only taken one time and the researcher and participant plotted the raw scores (both correct responses and errors) on a separate maze

graph. See Appendix A for a screen shot of the intervention components and to read an example of a CR nonfiction story.

Generalization Probes

After a participant met benchmark goals on multiple consecutive CR stories, a participant read a novel AIMSweb generalization passage after briefly warming up by reading the most recently finished CR passage for 1 min. The premise for having the students warm up was to get them settled into the environment with the researchers after transitioning from class and also to build upon the principles of growth mindset (Steele, 2010) as well as behavioral momentum (Nevin & Grace, 2000). After warming up with a passage that they were successful on the session before, students were given a message that they had been practicing and had the potential to reach their goal on a new passage. CWPM on AIMSweb passages were computed as generalization probes. After the participant completed the 1-min timing on the AIMSweb passage, regardless of the CWPM read, he/she was given a corresponding AIMSweb comprehension maze passage in paper/pencil form. After each participant was given two generalization probes, then his/her goal for the next CR passage was automatically raised to 90 CWPM. This was done to give participants as much practice opportunity as possible to read at benchmark level pace. Each of the comparison peers was given generalization probes intermittently to monitor their progress.

Maintenance

After the last CR treatment probe was completed, the participant had three additional sessions. During the first session immediately following intervention, the participant was given one generalization probe. Finally, 2-week and 1-month maintenance probes were given on both CR and AIMSweb passages. Conditions were similar to baseline, in that all 1-min timings were novel cold reads. The exception was the 1-month CR probe, which was the first CR treatment probe (a previously practiced passage).

Behavior Management

Participants' behavior was reinforced in several ways. First, after each session during pre-testing baseline, participants were given the opportunity to select a temporary tattoo as a small reward. Second, the computer displaying the results of TWR was used as performance feedback. Last, the participant immediately saw his/her own chart when treatment and generalization probes were plotted. Students consistently expressed the desire to meet or exceed their designated goal.

Interobserver Agreement (IOA)

A second observer was present for each student for at least 42% of each phase of the experiment. Exact word-by-word agreement on TWR and errors were compared. Aggregated IOA calculations for the seven participants for each phase of the intervention had at least 97.8% mean agreement (ranges for each phase: 91.3–100%).

Treatment Integrity

Treatment integrity was collected on the primary experimenter, the participants', and the computers' performance. In all instances, phase-specific checklists for baseline, intervention, treatment probes, generalization, and maintenance were used to calculate a percentage of steps completed correctly. First, a second experimenter observed the primary experimenter at least 53% of the time during each phase with an integrity range across phases between 93–100%. Second, the participants operated the computer software to receive intervention, the primary experimenters used a checklist to assess treatment integrity across 97% of the sessions. The aggregated means revealed that participants followed procedures with 82% accuracy (individual participants' mean scores ranged from 69% to 91%). Last, the primary experimenter used a checklist to assess treatment integrity of the computer 97% of the time. The computer had 99% treatment integrity.

Results

Figures 1 and 2 show that all participants increased their ORF on CR treatment probes. For example, Taneisha had baseline scores of the CR cold-reads between 10 and 20 CWPM. Immediately after intervention started, her score on practiced passages was slightly above 70 CWPM. By the end of intervention, she was reading above 120 CWPM on practiced passages. The percentage growth on CR CWPM for each participant, ranked in order of most improved can be seen in Table 2 (range: 38%–306%).

Generalization to novel passages can also be seen in Figures 1 and 2. Six out of seven participants (Davion the exception) showed fluency gains on novel AIMSweb generalization passages. The visual analysis of just AIMSweb probes suggest only modest intervention effects: there was a slow trend up, not a consistent change in level from baseline to intervention across participants, and a drop in level for some participants in the maintenance condition. However, percentage growth for all intervention participants on AIMSweb ranged from

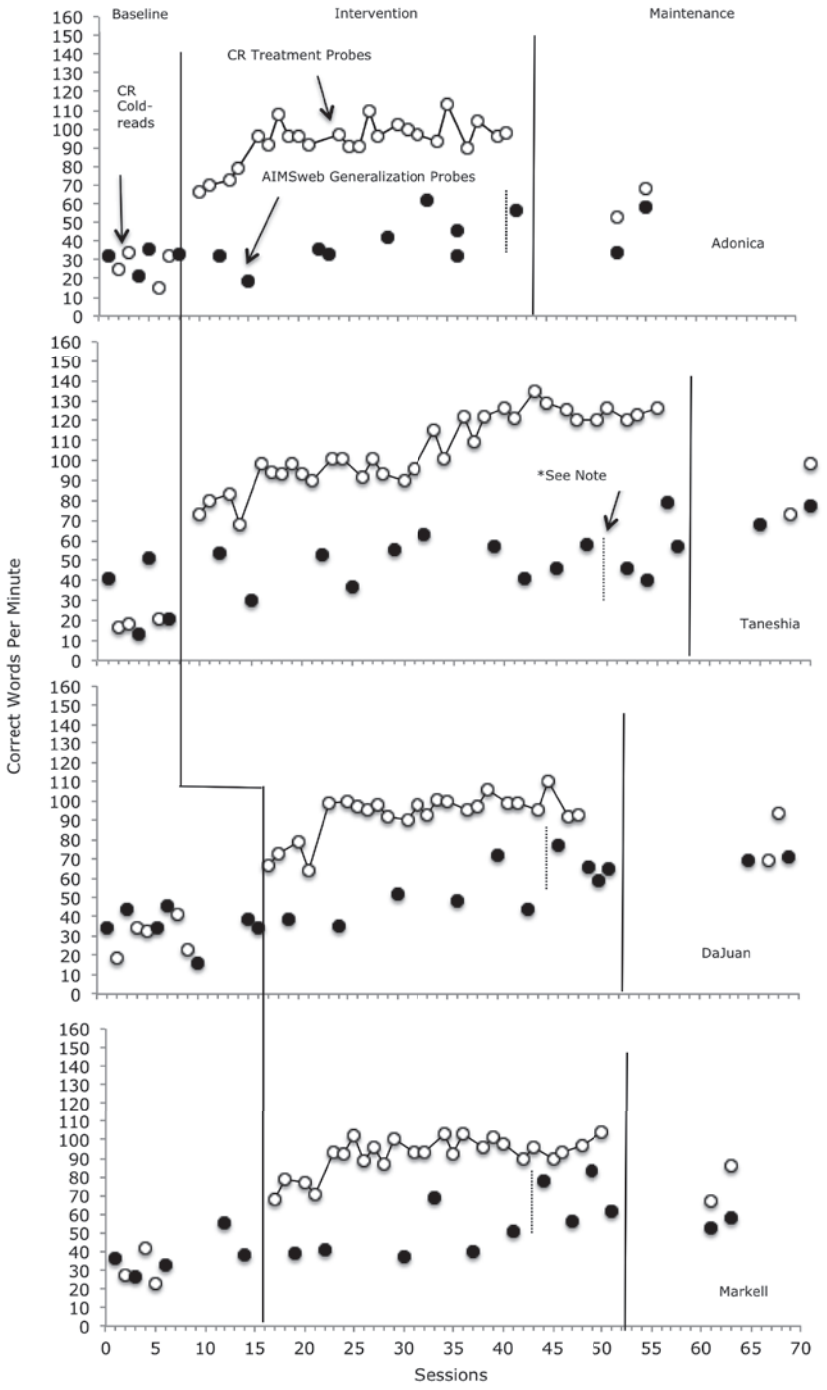


Figure 1. Tier 1 and Tier 2 Correct Words Per Minute per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

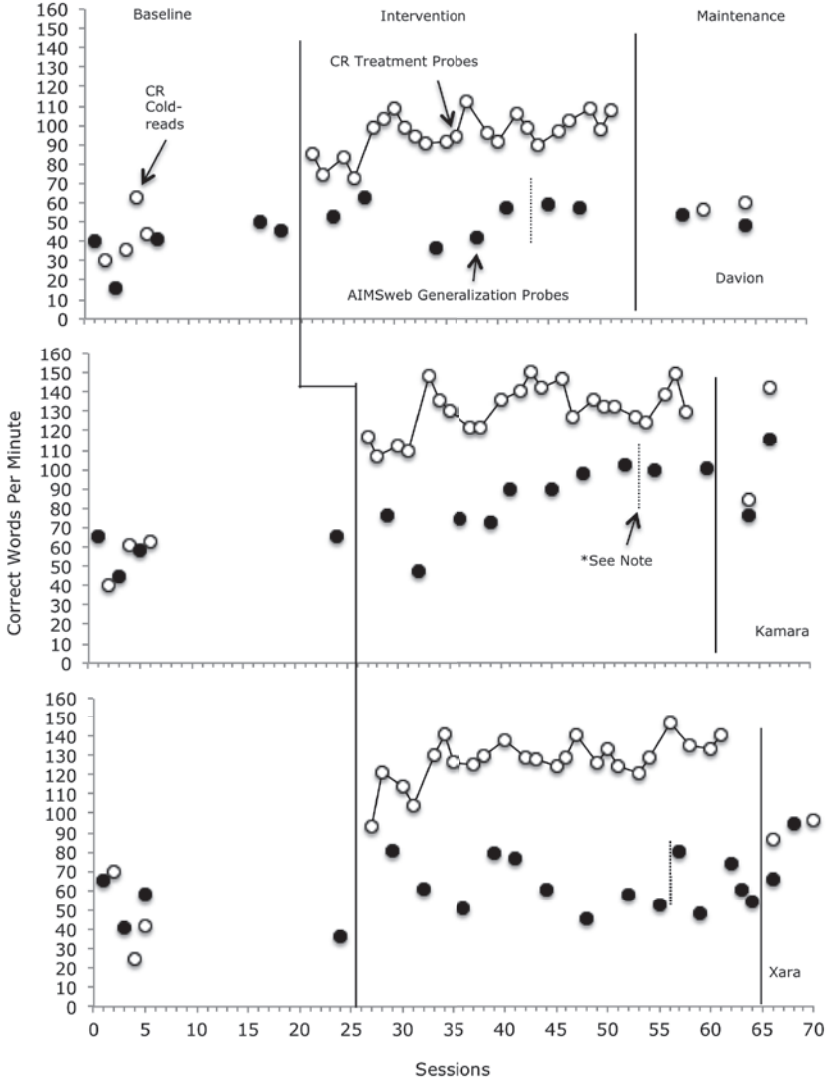


Figure 2. Tier 3 and Tier 4 Correct Words Per Minute per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

32% to 199% (Table 2). Even more, all comparison peers had steady state responding while in extended baseline (range of growth as seen in Table 2 was –28%–20%). Table 3 summarizes both the comparison peers' CWPM and responses to mazes for the AIMSweb probes.

Figures 1 and 2 show that on the 2-week maintenance AIMSweb passages, four participants (Taneisha, DaJuan, Davion, and Xara) performed as well as they did immediately following intervention. The remaining participants (Adonica, Markell, and Kamara) performed at similar levels to baseline. The 1-month AIMSweb passage was displayed on the computer and not on a paper copy, as were the other AIMSweb passages. Four participants (Taneisha DaJuan, Markell, and Davion) performed similar to the 2-week probe; three (Adonica, Kamara, and Xara) performed about the same as when they were in intervention but better than the 2-week probe. In fact, for the 1-month maintenance point, Xara read 95 CWPM. This was the only time she demonstrated transfer above the 90 CWPM benchmark.

For comprehension of CR passages, Figures 3 and 4 show that all participants increased their maze comprehension scores. For example, DaJuan had baseline maze scores that trended downward from 15 correct responses in 3 min to five correct responses. Immediately after intervention started, his maze scores steadily increased until he was making over 20 correct responses right before intervention ended. The

Table 2

Percentage growth for Culturally Relevant (CR) and AIMSweb correct words per minute (CWPM) and mazes for each participant, ranked in order of most improved.

CR CWPM	CR maze	AIMSweb CWPM	AIMSweb maze
Taneisha (306%)	Markell (100%)	Taneisha (199%)	Markell (225%)
Markell (148%)	Davion (87%)	DaJuan (103%)	Kamara (119%)
DaJuan (109%)	Xara (77%)	Adonica (72%)	Adonica (100%)
Xara (107%)	Kamara (73%)	Kamara (64%)	DaJuan (75%)
Adonica (86%)	Adonica (64%)	Markell (61%)	Xara (75%)
Davion (40%)	Taneisha (57%)	Xara (33%)	Davion (71%)
Kamara (38%)	DaJuan (27%)	Davion (32%)	Taneisha (56%)
Imani* N/A	Orlando* N/A	Imani* (20%)	Orlando* (67%)
Sydney* N/A	Sydney* N/A	Sydney* (8%)	Sydney* (33%)
Orlando* N/A	Imani* N/A	Orlando* (-28%)	Imani* (13%)

Note: *= Comparison Peer; N/A= Not applicable because comparison peers were not given CR stories; Comparison peers "post-test" reflect the last three points in extended baseline.

percentage growth on CR mazes for each participant, ranked in order of most improved can be seen in Table 2 (range: 27%–100%).

Figures 3 and 4 show that all participants increased their maze comprehension scores on novel AIMSweb passages. For example, Adonica's baseline AIMSweb maze scores were five or fewer correct responses in 3-min assessments. Immediately after intervention started, her maze scores steadily increased until she was making just under 15 correct responses right before intervention ended. The percentage growth on AIMSweb mazes for each participant, ranked in order of most improved can be seen in Table 2. The increases for all participants ranged from 56% to 225%.

Figures 3 and 4 show that on the 2-week AIMSweb maze passage for comprehension, five participants (Taneisha, Markell, Davion, Kamara, and Xara) performed as well as they did immediately following intervention, and two participants (Adonica and DaJuan) did not perform as well as in intervention. For the 1-month AIMSweb maze passage, three participants (Taneisha DaJuan, and Xara) performed better than the 2-week probe, with DaJuan reaching a performance level similar to the end of intervention; two (Adonica and Davion) performed about the same (i.e., not as well as in intervention); and two (Markell and Kamara) had fewer correct responses than the 2-week AIMSweb probe (i.e., similar to intervention).

The extended baseline of AIMSweb passages for comparison peers also remained unchanged over time (see Table 3 for summary). As seen in Table 2, two of the comparison peers had the lowest percentage growth for AIMSweb mazes (Sydney had 33% growth and Imani had 13% growth), while Orlando (67%) outperformed only Taneisha (56%).

The 1-month previously practiced CR probes in Figures 1 and 2 show that all participants except Davion retained or surpassed their original fluency score on the first practiced passaged during intervention. The 1-month previously practiced CR assessment data point in Figures 3 and 4 show that all participants exceeded their comprehension score on the previously practiced passage at the 1-month maintenance check.

Social Validity

After participants completed their last intervention session, they were individually asked social validity questions. All participants said that they liked reading on the computer, they liked charting their data, and that they would like to continue to read on the computer if there were more stories. Five of the participants felt that they became better at reading new stories on paper (i.e., AIMSweb). All the participants felt that their classmates would like this program.

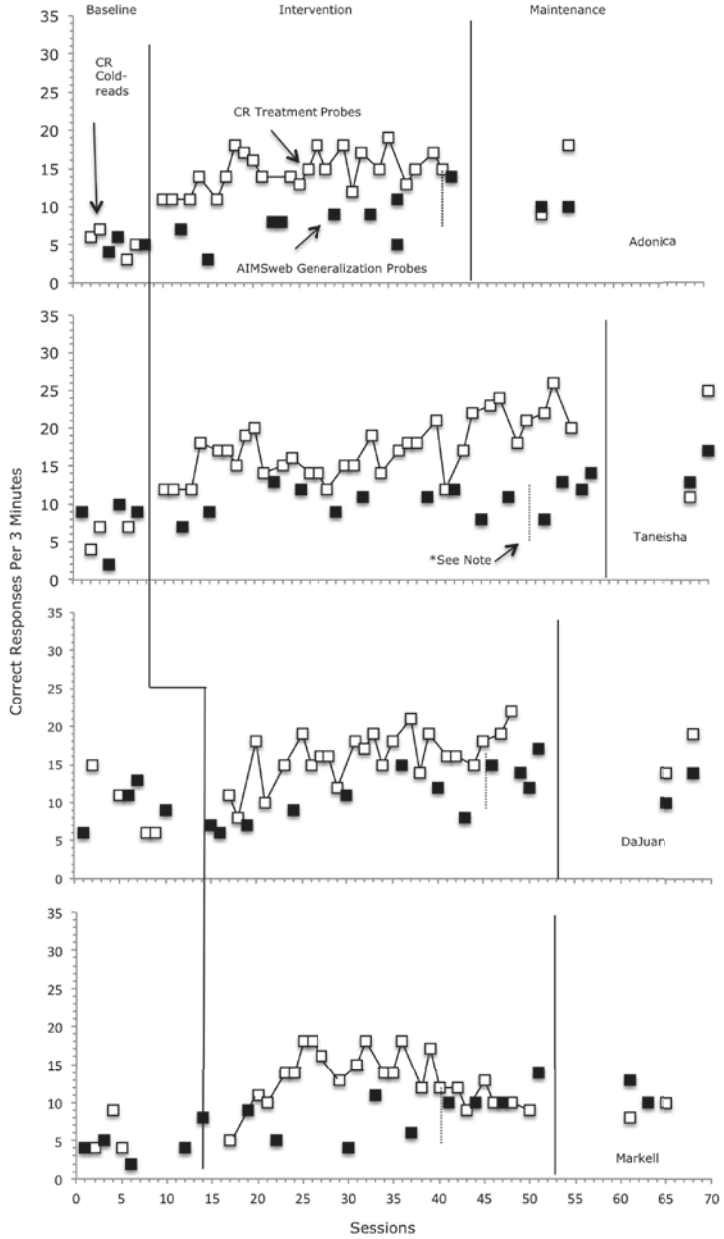


Figure 3. Tier 1 and Tier 2 Correct Responses to Maze Comprehension per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

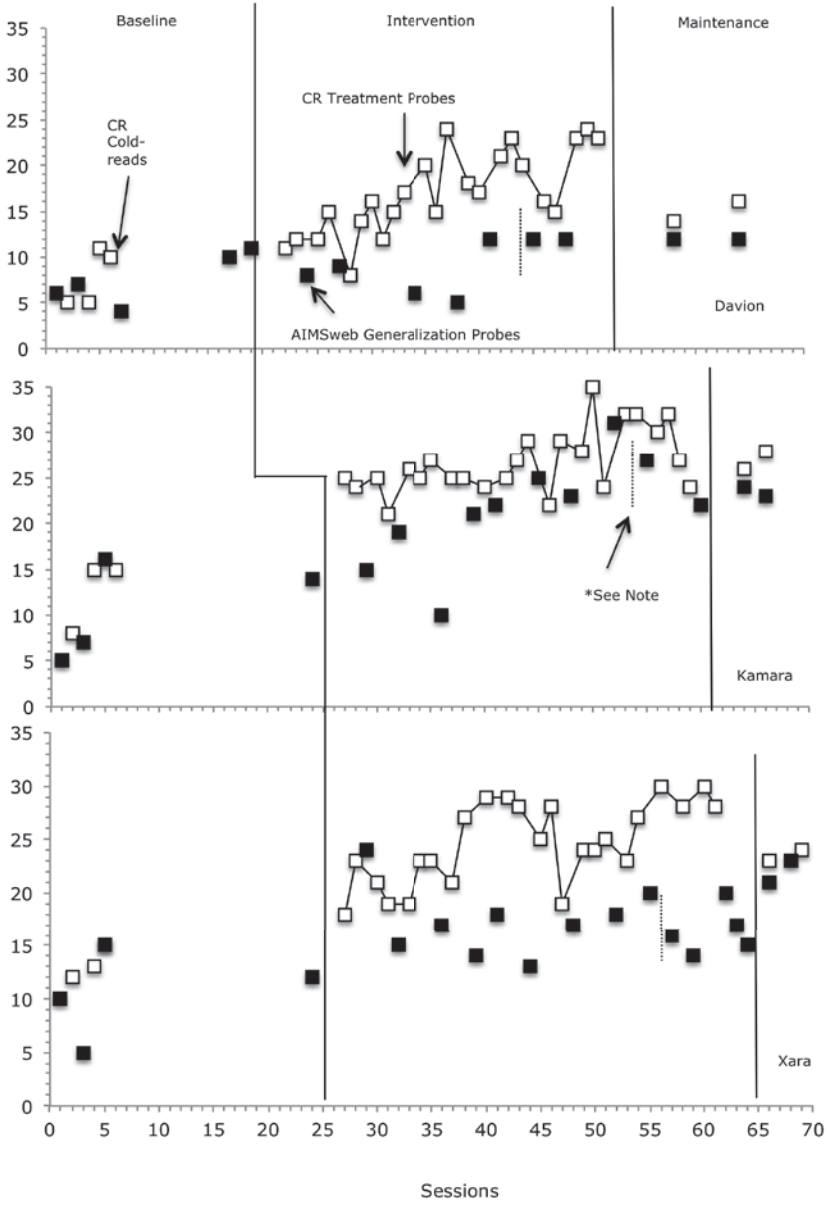


Figure 4. Tier 3 and Tier 4 Correct Responses to Maze Comprehension per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

Table 3

Summary of comparison peers scores on AIMSweb probes during extended baseline.

Comparison Peer	Mean CWPM	CWPM Range	Mean Correct Response on 3 min maze	Maze Range
Imani	69.4	(53–88)	16.5	(13–20)
Sydney	62.0	(44–72)	13.5	(9–16)
Orlando	56.7	(36–77)	11.4	(7–15)

Teachers were also given two different social validity questionnaires. The first was given as they watched a presentation and observed a video of their participants using the software. All four teachers felt that the participants were able to use the intervention independently with minimal adult assistance. Three teachers said they would use the software a few times a week; one said she would use it every day. All four teachers said their participants enjoyed the reading intervention.

The teachers were given a brief second survey after the participants had completed the intervention and before the maintenance phase. The teacher for the Tier 1 participants thought they improved their fluency by "a lot" and their comprehension improved "somewhat." The teacher for Tiers 2 and 3 participants thought they became "somewhat better" with fluency and comprehension. Kamara's teacher, felt that she became a much more fluent reader after intervention and that her comprehension became "somewhat better." Xara's teacher felt that she became a little better at reading fluently and a little better at comprehending passages. All teachers stated that reading intervention programs for struggling readers are important. Specifically, one teacher stated, "We need reading intervention programs for struggling readers in the K-2 primary grades. This intervention would be very beneficial."

Discussion

This study examined the effects of a multicomponent, supplemental intervention (i.e., RRI and CR passages) delivered through a computer software program. The researchers studied the effects of this intervention on the fluency and comprehension of practiced CR and AIMSweb generalization passages for seven African-American second graders who were at risk for reading failure. This study provides some support of earlier researchers' findings, showing a positive effect of RRI on fluency for both practiced passages (i.e., non-transfer) as well as novel passages (i.e., transfer; e.g., Kostewicz & Kubina, 2010, 2011; Kubina, Amato, Schwilk, & Therrien, 2008; Musti-Rao, Hawkins, & Barkley, 2009; Yurick, Robinson, Cartledge, Lo, & Evans, 2006). This intervention was effective for all participants on practiced passages; six participants on novel passages; and five participants on maintenance measures. Therefore, the current study also extends the work of Keyes et al. (2016) by suggesting that second grade students, need both CR material and early and consistent practice of fluency skills to approximate the fiftieth percentile. The study also supports the link between fluency and comprehension (Fuchs et al., 2001).

CR Passages

Once the intervention was implemented the fluency growth on practiced passages for all seven participants was evident by the immediate change in slope on participant graphs. The introduction of the intervention at staggered times across individuals was based on the immediate slope change on practiced CR passages. Figures 1 and 2 show that all participants quickly responded to the intervention and reached their fluency criterion while practicing CR passages. This indicates that explicitly targeting ORF skills aided in the ability of the low performing participants to read at higher rates on practiced passages. Moreover, participants continued to reach criterion when it was raised to higher levels (i.e., from 60 to 90 or from 90 to 120 CWPM). This supports the work on optimal performance criteria. Kubina et al. (2008), for example, set performance criterion for third graders at 200 CWPM, well above the expected rate for children that age. Similarly, Gibson et al. (2014) observed greater generalization resulting from increased fluency goals. In this study the greatest gains on ORF generalization passages occurred with Taneisha, whose goal was eventually raised to 120 CWPM during the intervention. Also supporting this premise are the data of Kamara and Xara, who had goals of 120 for most of the intervention and reached or exceeded the 90 CWPM mark for cold reads by the last probe.

Figures 3 and 4 show that all participants showed marked improvement on CR mazes compared to baseline, supporting the position that increased fluency contributes to comprehension. Reading at a higher fluency rate may have enabled the participants to attend more closely to and understand the content of the passages. In addition, being more familiar with the content in the practiced CR passages may have facilitated their comprehension.

The 2-week cold read on the novel CR passage (Figures 1 and 2) shows that all participants read at a level similar to what he/she was reading on the AIMSweb generalization probe during intervention. Five of the participants had a higher score on the cold read CR passage than on the AIMSweb passage at the 2-week maintenance probe, but that data point for the novel CR passage is no higher than their highest AIMSweb story during intervention or maintenance. Although these maintenance data suggest there may be a slight edge, these data do not document a distinct advantage for the CR passages as found in previous research (Cartledge, Keesey, Bennett, Gallant, & Ramnath, 2015). Nevertheless, it may be that the familiar content and greater background knowledge increased reading interest and greater willingness to practice reading. One participant who provides insight relative to CR passages is Davion. Although Davion did not show growth on the AIMSweb measure, he did show 87% growth on the CR passages. Davion was typically inattentive, easily distracted, listening to the stories without watching the blue highlighting, and often did not click on the word(s) as directed. Nevertheless, he did show an interest in the stories that correspond to his fluency growth. According to his classroom teacher, Davion demonstrated his highest level of attention during the CAI lessons.

More research is needed on the specific effects that CR material has on fluency. Samuels (1979, p. 4), in his definition of RRI, mentions the importance of conducting the timings using "meaningful" text. If nothing else, CR passages are useful to the extent that by definition they are meaningful and, perhaps, of greater interest. The role that CR material plays in programming for generalization with tactics such as teaching to the interest of the child (Stokes & Baer, 1977) needs to be further examined. This could be accomplished by adding a cold read 1-min timing before each practice session begins.

The 1-month previously practiced CR assessment data point in Figures 1 and 2 shows that all participants except Davion retained or surpassed their original fluency score on the first practiced passage during intervention. The ability to retain fluency over a 7- to 13-week period speaks strongly to the effectiveness of RRI. The fact that participants previously read the one, 1-month maintenance passage before

may have contributed to these positive results; regardless, this shows that they had strong retention over a 3-month period. Students are often asked to reread information initially read 1 or more months before in preparation for a test. This ability to accurately reread and understand information is an important skill for success in academic content areas.

AIMSweb Passages

By the end of intervention six out of seven of the participants (i.e., all except Davion) showed fluency gains on novel AIMSweb generalization passages. Although this growth was only enough to place two participants (Kamara and Xara) at benchmark for AIMSewb maze passages (see Figures 5 and 6), the gains made in a relative short amount of time are meaningful. An interesting and encouraging observation is that for five of the seven participants the data for the generalization passages paralleled the ascending path of the practice passages, indicating transfer. The generalization data are consistent with but not quite as robust as seen in Gibson et al. (2014).

Further, the transfer of ORF skills to generalization passages lagged behind the ORF skills observed with CR treatment probes. Specifically, six participants (except Kamara) did not show growth in ORF of AIMSweb passages until they had successfully reached their

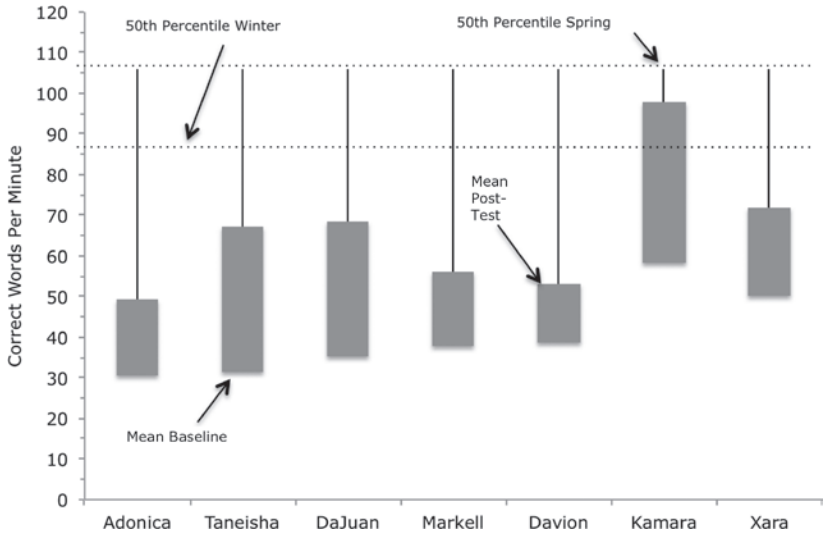


Figure 5. Box and whisker plot of participants' growth on AIMSweb CWPM compared to winter and spring benchmark, where post-test score is the last three data points after intervention.

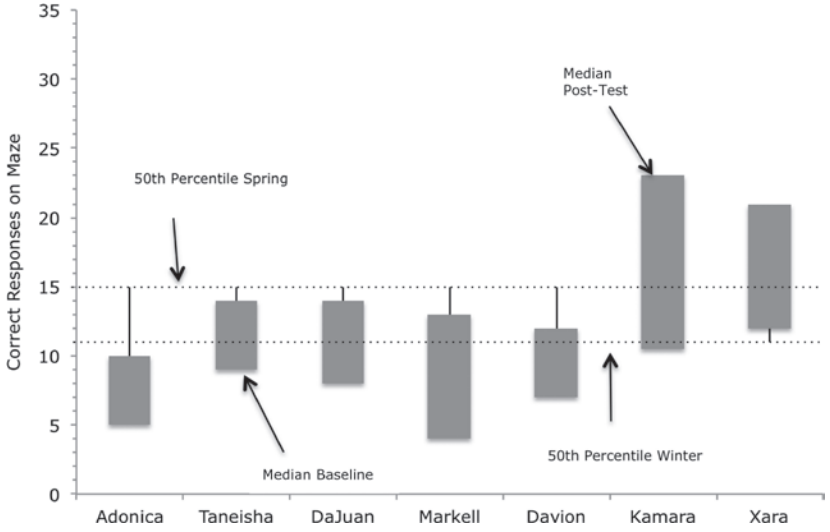


Figure 6. Box and whisker plot of participants' growth on AIMSweb mazes compared to winter and spring benchmark, where post-test score is the last three data points after intervention.

goal on 19 of the 25 CR stories. However, this may have been confounded by the change in passage difficulty described in the procedures. Moreover, the ORF rates seen in practiced passages (i.e., 90–120 CWPM) were not as high in the AIMSweb passages (except Kamara). Unlike the first-grade participants in Gibson et al. (2014), six of these second-grade participants did not seem to generalize their skills as quickly or as dramatically. Keyes et al. (2016) saw similar less positive results with second graders in a replication of the Gibson et al. (2014) study. This suggests that although beneficial, earlier interventions (i.e., before second grade) are likely to be more effective. There may be a greater overlap of words on first-grade intervention materials and first-grade AIMSweb passages due to a smaller pool of words for first graders compared to second graders. Further, older participants may have more opportunities to practice errors, struggle with more difficult text, and have a growing sense of failure. For these reasons, a longer period of time spent in intervention may be warranted.

This observation is consistent with the literature that children at risk fall increasingly further behind as they matriculate through school (Moats & Foorman, 2008). Therefore, older students may need more practice opportunities (i.e., more CR stories). Other students may need more intensive (i.e., systematically raising the goal criterion to 200 CWPM) and/or more comprehensive interventions (i.e., remediating

decoding skills). In other words, for students who have a longer history of struggling to read, they may need longer, more intensive interventions than the first graders. CAI may be a cost and time efficient way to provide second graders with essential additional fluency practice, but the amount of intervention needs to be clearly delineated.

In this study, all participants (except Davion) showed greater growth in maze comprehension (range 56%–225%) than on ORF AIMSweb passages (32%–199%; Table 2). This includes the mixed results of the maintenance data, where five participants maintained or exceeded their fluency levels, and six participants maintained or exceeded their intervention performance on AIMSweb mazes 2 weeks and 1 month later. However, AIMSweb maintenance data taken together indicate that although growth was seen for all participants in ORF and comprehension (except Davion) during intervention, for students at risk to maintain and show continued growth toward benchmark, intensive ongoing practice is essential.

Although none of the participants reached benchmark on DIBELS Next (the initial screening measure used) and only one reached benchmark on generalization AIMSweb passages (Winter benchmark is 88 CWPM, Spring benchmark is 106 CWPM, Figures 5 and 6), of the five who read just below or above 60 CWPM, three approached benchmark (i.e., 15 correct answers in 3 min) and two participants exceeded benchmark (Figures 5 and 6). Burns et al. (2010) suggested that for a second grader to achieve maximum comprehension, he/she should be reading at 63 CWPM. As the second graders in this study (see Figures 7 and 8 for a collective view across time) approached or read above 60 CWPM, their comprehension noticeably increased, supporting previous studies with young readers (Edmonds, Vaughn, & Wexler, 2009), and providing further evidence for fluency intervention at the acquisition stage of reading (Wolf & Katzir-Cohen, 2001).

Given the questions raised of the validity of mazes as a comprehension measure (January & Ardoin, 2012), an additional comprehension assessment such as oral retells might strengthen these comprehension findings. Nevertheless, the existing data add to the position that fluency is a bridge to comprehension (e.g., Burns et al., 2010; Cates, Thomason, & Havey, 2007; Fuchs et al., 2001; Klauda & Guthrie, 2008; Riedel, 2007; Therrien & Hughes, 2008). The ability to comprehend text effectively will be critical for these students as they enter third grade because not only will the text become harder, but also students will be expected to move from learning to read to reading to learn (Fang, 2008). Much of this reading to learn requires silently reading large amounts of expository text (Graves, Juel, Graves, & Dewitz, 2007). Students who read slowly are at a disadvantage and

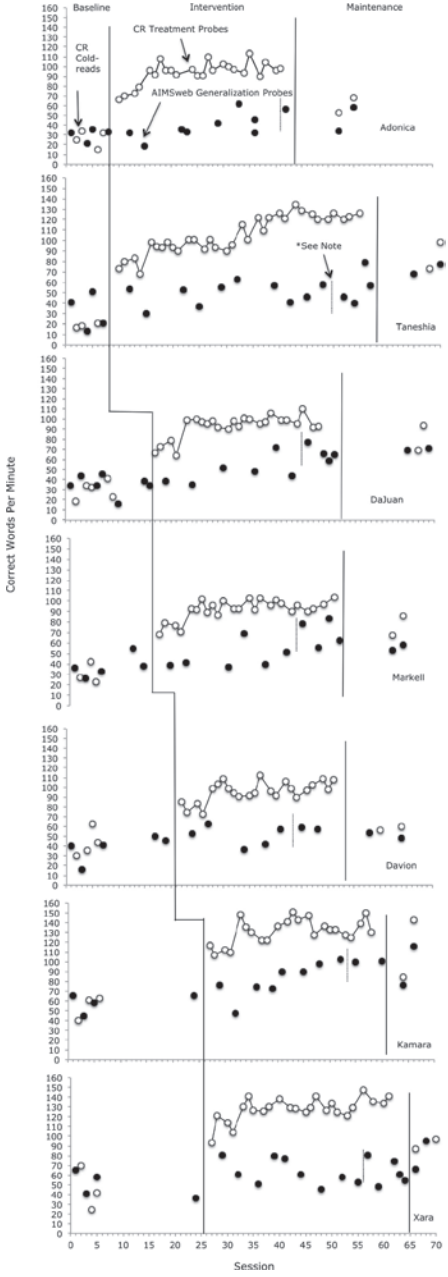


Figure 7. All seven participants' Correct Words Per Minute per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

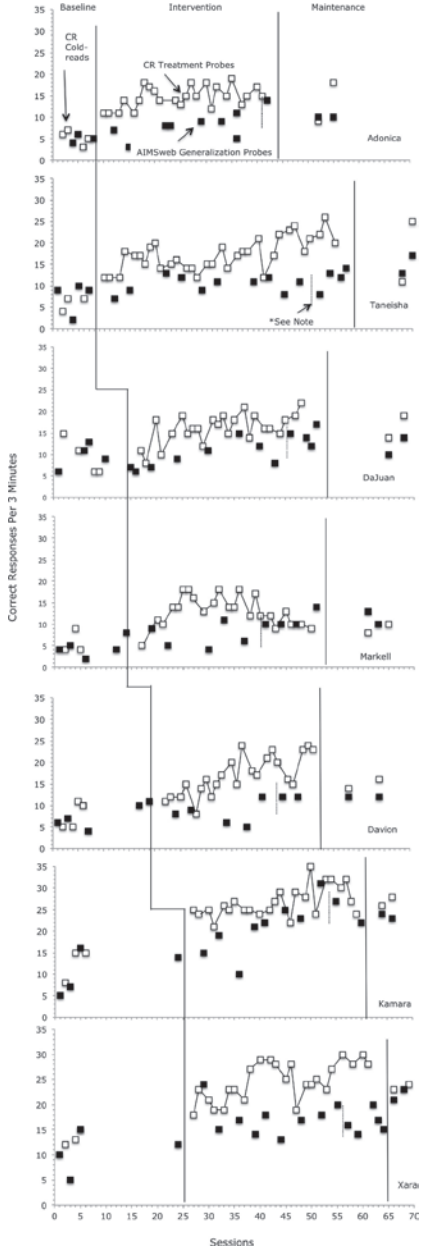


Figure 8. All seven participants' Correct Responses to Maze Comprehension per session.
Note. Small dashed phase change line indicates change in AIMSweb passage selection.

may struggle to complete assignments (Hall, 2007). Additionally, these struggling readers may be at increased risk for performing poorly on state-mandated tests required for grade promotion (McGill-Franzen, Zmach, Solic, & Love Zeig, 2006).

Comparison Peers

The intervention promoted reading growth at rates that exceeded the growth for comparison peers (who had stronger initial reading achievement). Table 2 shows that percentage growth for all the participants exceeded the percentage growth for the comparison peers. These data for participants and comparison peers support the research that fluency needs to be explicitly taught (NRP, 2000); ORF does not automatically emerge from teaching other skill areas such as phonemic awareness and the alphabetic principle (Bursuck & Damer, 2011; Harn, Stoolmiller, & Chard, 2008; Kourea, 2007; Reading & Van Deuren, 2007). The regression observed in some students such as Orlando (-28%) may due to harder text presented later in the school year and the absence of fluency intervention.

Limitations and Suggestions for Future Research

AIMSweb. Students were asked to read novel AIMSweb passages as a measure of generalization. Those stories were sometimes much easier or much harder than the practice CR passages. The variation in level of difficulty of the AIMSweb passages may contribute to the variable AIMSweb data. For example, for the second-grade passages, the average grade level is 2.9 (range: 2.2–4.0). As noted previously, the researchers reordered the AIMSweb passages according to the Spache Readability Index (n.d.). Although our scrutiny of student performance on these passages revealed no predictable pattern indicating stories with higher readability scores were read with lower oral fluency, these results should be interpreted with caution and future studies should equate treatment and generalization passages.

Culturally relevant material. Although the preliminary findings of the CR data points were generally positive, they were preliminary. Comparing the cold-reads of CR material in baseline to practiced reads during intervention threatens the validity of the dependent variable and makes conclusions more difficult. Questions still remain about the exact effect of CR material on fluency and comprehension and therefore, achievement. Future studies should compare repeated reading intervention using CR material and NCR material in attempt to answer these questions by adding a cold-read component to the intervention procedure. If students are given a cold read of a CR passage before they practice, the cold-read CR data could be directly

compared to the cold-read AIMSweb to parse out the potential role CR passages play in fluency and comprehension. An additional limitation is that a baseline point for the CR material was not taken immediately prior to beginning intervention with Markell, Davion, Kamara, and Xara because of the limited number of CR stories available for intervention. This makes it impossible to tell if there was an event outside of the experiment that affected the reading fluency between the last CR baseline point and the first intervention CR probe. Future studies should include more CR stories and/or wait to probe CR stories until just before intervention begins for each tier.

Paper vs. computer. An additional limitation was that students were asked to read AIMSweb stories on paper, even though they had trained to fluency criterion on the computer. Reading in a different mode is also a variable to consider when interpreting the results of this study. Previous research (Cartledge, Keesey, Bennett, Gallant, & Ramnath, 2015) indicated that students read the CR passages on paper with greater fluency that they initially displayed in this study on the computer. This observation prompted several questions. Was it because the students read the CR stories on the computer? Do students have lower fluency on the computer than on paper? Were the advantages of using CR stories negated until students could read fluently on the computer? How long does it take to train students to read as fluently on the computer as they do on paper? What does this mean for student performance on standardized tests that are being delivered on the computer in the fall of 2014?

Clinical settings. University graduate students conducted this school-based intervention instead of school personnel. The supplementary nature of this intervention suggests that ancillary personnel such as intervention/reading specialists or paraprofessionals will most likely deliver this instruction. Although the existing study approximates those conditions, this intervention needs to be studied with existing school personnel and amount of adult supervision needed under these typical settings need to be closely studied.

Prosody. The full definition of fluency includes reading with speed, accuracy, and with expression (NRP, 2000). The current study only measured speed (i.e., CWPM) and accuracy (i.e., errors) as dependent variables. Using CAI and voice recordings, future studies could use technology to measure the effects that RRI had on the expression (i.e., prosody) of students on both rehearsed and novel passages.

Implications for Practice

In general, as supported by over 30 years of research, the positive results from this study indicate that teachers should be explicitly

training students' fluency skills using a repeated reading intervention (Strickland et al., 2013; Therrien, 2004) Additionally, using CR reading material may ease the process of practicing fluency skills because of background knowledge—including vocabulary knowledge. This study also supports the notion that teachers should carefully select passages for RRI that reflect students' cultural background in order to motivate and interest the students (e.g., Ebe, 2010, 2011). CAI is one way to provide students with a level of independent practice and motivate them without taking time and resources away from other students or classroom wide activities (Gibson et al., 2014). This packaged intervention can be used as a Tier 2 or Tier 3 intervention in a multi-tiered system of support.

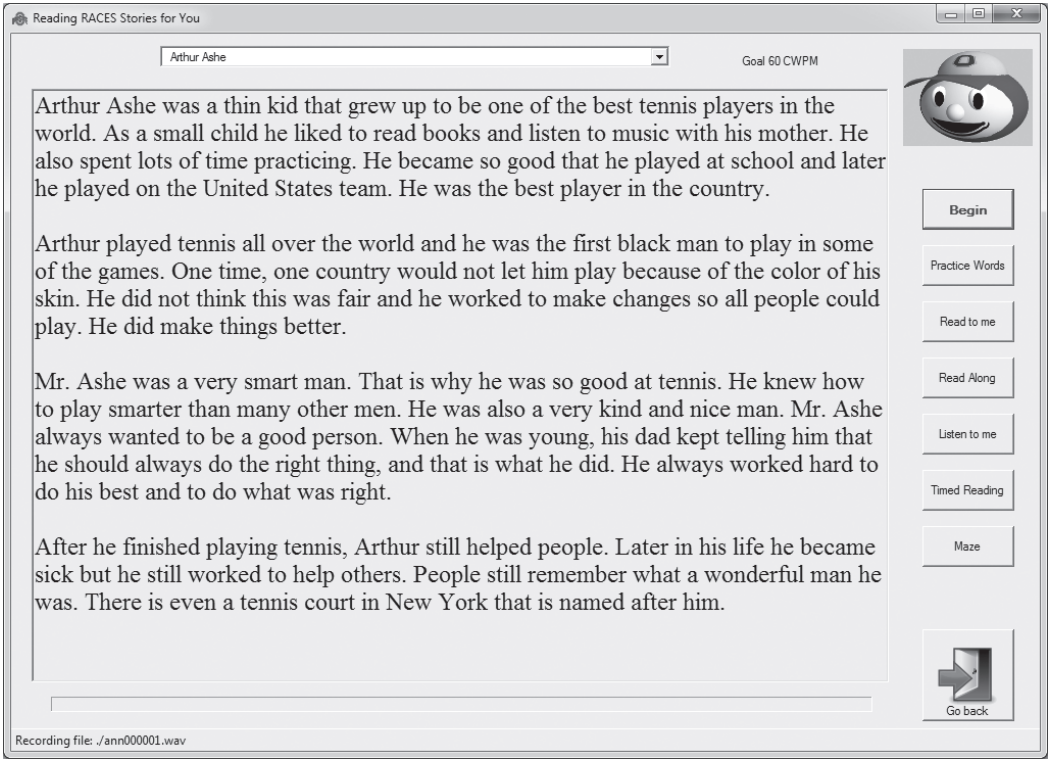
Consistent with prior research, the intervention was clearly more effective with practice passages than it was on the transfer (AIMSweb) passages. This could be because of the familiar content and language used in the CR passages or because of the variable level of difficulty of the AIMSweb passages. Passage selection is an important factor for practitioners to consider when choosing passages for repeated readings. In addition, the mode of paper vs. computer could potentially impact the reading fluency of students. Practitioners should be aware that the mode of instruction should be the same mode for testing (Kyllonen, 1991). As standardized testing moves to the computer, teachers should also be aware that explicit fluency training may need to be done on the computer in order to achieve the most reliable (and favorable) results for the students. Even when some level of adult monitoring is required to ensure that students are implementing the interventions as designed, RRI using CAI is one way in which teachers can do just that.

In light of the fact that participants improved on AIMSweb passages only after meeting criterion on CR passages, practitioners should consider optimal performance criteria to be at a higher rate than is expected at benchmark to encourage the transfer of fluency skills from practiced to novel passages.

This software shows promise to be used in environments outside of school for literacy instruction such as within summer programs, public libraries, and within the home. It also may be adapted to benefit older readers throughout the grades into adulthood.

Conclusions

Students need to read fluently and comprehend greater amounts of increasingly difficult text as they progress through school. In this study, the intervention of RRI with CR passages delivered through computer software was effective in improving the reading fluency



Appendix. Screen Shot of the Intervention.

and comprehension performance for six of the seven urban participants. These participants showed greater gains than comparison students, who initially showed more reading ability than their less skilled peers. Stated responses and observations suggest that this intervention was both motivating and reinforcing for participants. This study provides continued support for the benefit of RRI. Although not intended to determine relative effects, the advantages of culturally relevant passages and computer delivered instruction are indicated in the attractions the students expressed for both of these components. Furthermore, the potential and importance for computer-assisted instruction with modest adult supervision cannot be overstated. More research is needed for component analysis but even more important is the need to determine empirical efficacy with maximum pupil independence.

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