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Literacy Instruction Using Technology With Primary-Age Culturally and Linguistically Diverse Learners

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Abstract

With continuing advances in the digital world, a variety of technologies are becoming easily accessible in the classroom. Although teachers may be using some of these technologies in their daily lives, they may not know how to incorporate these devices to support classroom learning. This article provides a guide for teachers interested in using technology to deliver supplemental literacy instruction in their classroom, particularly for primary-age students from culturally and linguistically diverse backgrounds. Benefits of using technology along with classroom applications are discussed.

Keywords

technology in the classroom, literacy instruction, mobile device

Despite national efforts to improve academic outcomes for all students, the recent national report card (National Center for Education Statistics, 2011) shows that 51% of African American, 49% of Hispanic American, and 53% of Native American fourth grade students were reading below basic levels. The groups that are consistently identified at the greatest risk for reading are culturally and linguistically diverse (CLD) learners from different ethnic backgrounds (i.e., African American, Hispanic, Native American) and households of low socioeconomic status, typically concentrated in urban areas. Included in this heterogeneous group are students who enter school speaking languages other than English, commonly referred to as English language learners. The disproportionate and accurate identification of CLD learners in special education programs is a long-standing issue in the field (Artiles & Harry, 2006; Klinger, Artiles, & Barletta, 2006). Klinger et al. (2006), for example, cited data from the U.S. Department of Education indicating that approximately 56% of English language learners in special education are referred for reading-related difficulties. Culturally responsive literacy instruction for this population needs to include explicit, systematic, code-based instruction that takes into consideration the role of instructional and sociocultural context of the learners (Musti-Rao & Cartledge, 2007).

Explicit instruction requires identifying and teaching specific skills that will help students decode print. Phonemic awareness, alphabetic understanding, and automaticity with the code should serve as the framework for any beginning reading instruction (Coyne, Kame'enui, & Simmons, 2001). Intensive instruction involves providing students with multiple learning opportunities to practice the skill, resulting in increased repetition of previously learned skills. Educational researchers, for example, emphasize the importance of giving students many opportunities to respond to academic material, noting that enhanced opportunities to respond are likely to lead to more practice and learning (Haydon, Borders, Embury, & Clarke, 2009). Finally, systematic instruction requires the careful sequencing of instruction such that each skill builds on previously taught skills. Such instruction is beneficial to all learners, but especially CLD learners, who start their school experience behind their

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more affluent peers and fail to catch up without more intensive, systematic instruction. In most cases, this instruction would require Tier 2 interventions, which, given the resource and skill limitations found in many classrooms, could be facilitated and delivered more easily through technology.

Evidence of efficient and effective delivery of supplemental literacy interventions with computer software is mounting, and continuing advances in the digital world are making technology more accessible in the classroom. More than a few studies have documented the successful use of technology to teach many academic subjects, such as reading and math (e.g., Fuchs et al., 2006; Kim et al., 2006; Mechling, Gast, & Krupa, 2007). Much of this research is with children at both the preschool and primary grade levels, such as reading fluency instruction for first grade urban learners (Gibson, Cartledge, & Keyes, 2011; Gibson, Cartledge, Keyes, & Yawn, 2014), speech recognition in literacy programs for primary-age children (Adams, 2005), and technology-based reading assessments for very young children (Tepperman, Lee, Narayanan, & Alwan, 2011). Furthermore, some investigators contend that computer-assisted instruction (CAI) produces superior results compared with teacher-assisted instruction (Hitchcock & Noonan, 2000; Macaruso & Rodman, 2011).

Despite findings of greater gains, it should be noted that computers and technology do not teach but rather are vehicles through which instruction is delivered. Indeed, even in studies in which CAI's effects exceeded those of teacher-assisted instruction, teachers were instrumental in presenting the materials and making certain that they were pedagogically sound. Nevertheless, as discussed in the next section, instruction delivered through technology has certain attributes that provide an added learning advantage, particularly beneficial for at-risk children and those with disabilities. Although attention to the use of technology in the classroom has increased, there is still a gap between teachers' knowledge of the use of these new technologies and their actual application in classroom practice. Laffey (2004) studied preservice teachers' technology use and concluded that they needed to learn (a) how to plan for technology, (b) how to apply it in the classroom, and (c) how to work with other professionals to use it most effectively. Other studies have shown that teachers have favorable attitudes toward the use of technology in the classroom, but these teachers feel that their training and technological resources are inadequate (Joshi, Pan, Murakami, & Narayanan, 2010).

This article outlines the benefits of using technology in the classroom for CLD learners. Technology in this context includes desktop and laptop computers that run software programs and mobile, handheld devices (e.g., iPads, Android tablets) that run software applications available commercially for free download or purchase. The article also provides teachers with steps to consider when using technology as a supplemental instructional tool in the classroom for reading instruction. In particular, the importance of developing a protocol of steps for technology use and measurement of fidelity of implementation are emphasized.

Benefits of Using Technology

Technology offers several benefits for educators interested in leveraging the classroom technology available to them. Some of the benefits of using technology include (a) active student response (ASR), (b) the ability to individualize and differentiate instruction, (c) consistent delivery of instruction, (d) increased motivation, and (e) resources for classroom management.

ASR

Computer-assisted instruction is the ultimate response form for fostering ASR, whereby students make observable responses to presented stimuli. In CAI, students must not only respond to advance the materials but must respond correctly. The value of a computer in producing high response rates can be seen in a study in which kindergarten children experiencing literacy delays received intensive computer intervention and performed better on phonics skills than students with similar delays in the control condition (Van der Kooy-Hofland, Bus, & Roskos, 2012). Experimental students were required to engage in high rates of accurate responding within short time periods. According to the authors, the CAI was more intense than instruction offered by the classroom teacher.

Individualizing and Differentiating Instruction

Another advantage of using CAI is the ability to individualize instruction for each student. Hilton-Prillhart, Hopkins, Skinner, and McCane-Bowling (2011) used a computer-based sight word reading intervention with three students in which each sight word was displayed on a PowerPoint presentation slide on the computer. The students were prompted to try to read the word before they heard a recording of the word, listen to the word, and repeat the word before a new word was displayed. All three students met or exceeded the goal of 85% accuracy on word reading. In another study, Mechling et al. (2007) used SMART Board technology to teach target grocery sight words to a group of students with moderate disabilities and found it to be an effective medium to differentiate instruction and teach in a small-group setting.

Consistent Delivery of Instruction

Another potential benefit of technology-based teaching is that the instruction can be delivered in a consistent, pedagogically prescribed manner, fairly free of instructional

error (Black, Tepperman, & Narayanan, 2011). This is particularly important in settings in which teaching experience, qualification, and preparation are often at issue (Kozleski, Sobel, & Taylor, 2003; Skiba, Simmons, Ritter, Kohler, & Wu, 2003). A well-designed program will have built-in treatment integrity and delivery will be controlled and systematic, taking the guesswork out of instruction. In the absence of built-in treatment integrity, the teacher can easily develop a list of essential steps that need to be fulfilled in order to deem the intervention complete.

Increased Motivation

Computer academic programs have been found to be especially beneficial for children from low-income and minority backgrounds (Laffey, Espinosa, Moore, & Lodree, 2003), partly because of the motivating properties of technology for young children. Some commonly cited benefits to using technology as a tool in delivering instruction include increased motivation, attention, and time on task (Hitchcock & Noonan, 2000; Mechling, Gast, & Thompson, 2008). Information presented through an interactive medium with the use of sounds, video, and animation can be an effective means for engaging disengaged or reluctant learners. Couse and Chen (2010) cited evidence that the motivation of preschool and primary-age children increased when academic tasks were paired with computers. A particular advantage for CLD learners is that as noted, these children tend to enter formal schooling behind their nonminority or affluent peers, and early intervention can be greatly maximized with long-termed benefits (Tough, 2008).

Resources for Classroom Management

Classroom technology can alleviate some of the teacher resource problems encountered in our schools (Parette, Hourcade, & Heiple, 2000; Van der Kooy-Hofland, et al., 2012). Laffey et al. (2003) reported that computer programs elevated the social as well as academic behaviors of young, low-income, urban children. Teachers in settings in which sizable portions of their classes evidence academic delay typically do not have the time or personnel to address all the learning needs presented in their classrooms. In some urban classrooms, for example, more than 50% of the students are struggling readers, greatly taxing the abilities and resourcefulness of the typical classroom teacher. With CAI, however, once students learn how to operate the software, they will be able to engage in learning sessions without teacher prompting, thus providing for more attentive behaviors and learning independence. Another related advantage is data collection and evaluation. The system can continuously monitor and record students' progress on a consistent basis, allowing ongoing performance assessment and data-based decision making.

Using Technology in Reading Instruction

Culturally responsive instruction is good teaching (Musti-Rao & Cartledge, 2007), and the strategies that are shown to be effective with reading instruction for CLD learners hold true regardless of whether technology is included. As noted in the previous discussion, technology can provide that added advantage teachers of CLD learners with and without disabilities sorely need. The technology should be used as a supplemental tool in addition to evidence-based reading interventions. To provide supplemental literacy instruction using technology, teachers need to (a) identify the target skill, (b) identify an evidence-based strategy, (c) identify a suitable type of technology, (d) develop a protocol for use, (e) train students in the use of technology, (f) measure treatment integrity, (g) monitor progress, and (h) be flexible. Each of these steps is described in the following section using a case example of how a first grade teacher, Ms. B, carried out these steps in her classroom of 27 CLD learners (see Note).

Identify the Target Skill

Skill identification will require skill-specific assessments to gauge students' skill levels in reading, specifically in precursor skills such as phonemic awareness, alphabetic principle, and fluency in decoding. Conducting benchmark assessments at the beginning, middle, and end of the year will allow teachers to screen students who need more systematic instruction. Data from these assessments will help teachers identify whether to focus on the target skill (e.g., fluency with text) or select a precursor or subskill to the target skill (e.g., phonemic awareness, consonant blends, sight word fluency). Moreover, there is support for the use of curriculum-based assessments with CLD learners (Huang, Clarke, Milczarski, & Raby, 2011).

> *Example*: Data from Ms. B's winter benchmark assessments showed seven students performing at the "some risk" and "at risk" levels and needing additional instruction. All seven students were CLD learners struggling in reading, two of these students were classified with disabilities (i.e., speech and language impairment), and one student was referred for special education evaluation. These students were targeted to receive additional reading help under the district's response-to-intervention services. Because of low scores in oral reading fluency (ORF) and sight word reading, Ms. B decided to target sight words for three students and ORF in connected text for the remaining four students.

Identify an Evidence-Based Instructional Strategy

Introduce the skill or concept using an explicit, direct instruction model whereby the skill is first modeled,

followed by providing students with guided practice and independent practice. This will provide students with multiple opportunities to practice the skill, leading to meaningful understanding of how to use the skill in context. Regardless of the presence of technology, interventions need to be based on procedures documented to be effective for the targeted skill and population.

Example: The teacher selected 5 words for each student from the high-frequency sight word list (Fry & Kress, 2006) and first taught these words both in context and in isolation by encouraging the students to make sentences using the target words. She then used the incremental rehearsal procedure in which unknown words were introduced in small sets until students reached mastery (Nist & Joseph, 2008). In developing ORF, repeated readings have consistently been shown to be effective with young children (National Reading Panel, 2000), including young urban children (e.g., Gibson et al., 2014). The four students engaged in repeated reading sessions, repeatedly practicing a passage until they reached the desired level of ORF, such as 40 correct words per minute.

Identify a Suitable Type of Technology

The decision on what type of technology to use will depend on classroom resources, the availability of technology, and good-fit match to skill targeted for instruction. Most important, the selected device and software should be aligned with the evidence-based instructional model discussed previously. Some guiding questions to help teachers with decision making include the following: How many students are targeted for this instruction program? How many computers or devices are available for use? If technology is limited in number, will a small-group format be a viable option? Can the program be set up such that students rotate through various centers or stations and have individual access to the technology?

It is important that the type of technology selected and the content provided match the appropriate developmental level of the student (Northrop & Killeen, 2013). For instance, it would be inappropriate to use a software program developed for preschool children with students in the fourth grade who need practice with reading fluency and comprehension. Northrop and Killeen (2013) contended that easy navigation through the software program does not necessarily equate to easy understanding of the content. Content selected should be within the student's instructional level to allow for skill reinforcement and development.

Example: Ms. B had access to four iPads in her classroom. After browsing the App Store, Ms. B identified the Sight Words: Kids Learn app for the iPad, developed by Teacher Created Materials Publishing. This app was selected because of its simple user interface with easy-to-follow activities, providing students with a multimodal approach to learning. With access to two laptop computers, Ms. B looked for software that ideally (a) used an evidence-based repeated readings model, (b) conducted timed readings without her assistance, (c) recorded the student's voice, (d) recognized student errors, (e) provided corrective feedback, (f) progressed the students through increasingly difficult stories, (g) recorded student progress, and (h) provided stories that were age and culturally appropriate. No system had everything, but Ms. B. found one with many of these attributes. Read Naturally (http://readnaturally.com), for example, is one commercial software program with many of these features.

Develop a Protocol for Student Use

One of the benefits to adopting CAI is that it promotes independent student learning. When designed properly, CAI can take the form of self-mediated instruction, whereby a student follows a series of steps during the practice and review session. Teachers can consider arranging their classrooms in the form of different stations, with each station focusing on a specific skill or activity, and assigning one station as the "tech station," where students engage in a self-mediated, self-regulated practice session. To ensure smooth completion, teachers should develop a protocol of steps that clearly specify expectations and procedures. The protocol can include rules for the use of devices, followed by step-by-step instructions on skill practice and program completion.

Example: Although the rules were specific to the software used in Ms. B's classroom, examples of rules for the iPad session included the following: (a) be gentle with the iPad, (b) only go to the Sight Words app, and (c) use the headset at all times. Similarly, rules for the ORF session included the following: (a) use the headset at all times, (b) read with a loud and clear voice, and (c) follow Betty Buckeye's instructions. As shown in Figure 1, the steps for using the ORF software functioned as an advanced organizer that the students filled out as they proceeded through the different steps in the program. The ORF tutor program allowed students to listen to the text, read along with the tutor, and then read independently to the tutor on three different trials. The completed forms also served as a way to monitor students' progress and hold them accountable for proper implementation.

Train Students in the Use of Technology

It is better to err on the side of caution rather than to assume that students will know how to use the technology. Set aside one or two class sessions to train students in the use of the

Name:	Name of Story:
Date:	Computer Number:
1. Read to Me	☐
2. Read Along	☐
3. Listen to Me Score:	Listen to Me Score:
Listen to Me Score:	_____ CWPM _____ Errors
Listen to Me Score:	_____ CWPM _____ Errors
4. Timed Reading Score:	_____ CWPM _____ Errors
5. Maze Score:	_____ CWPM _____ Errors

Figure 1. ORF tutor program: steps for students to follow along and complete during each session.

device. Start the training session by providing a rationale for using the technology. Discuss the importance of technology in daily life and emphasize that technology will be used as a way to practice and review skills learned during literacy instruction. Explain and model how to turn on the device, navigate through the software or app, and turn off the device. General routines on where to access materials needed should also be reviewed at this time.

Example: Ms. B spent the first 2 days training the students to use the iPad and navigate through the app. Only one of three students had owned a personal iPad. None of the students were familiar with the selected app. The teacher provided hands-on assistance until students were able to use the device and app independently. A similar procedure was used in training students to use the laptops and software for ORF.

Observer: _____ Date: _____

Time: _____ Session: _____ (Words #: _____ to _____)

Instructions:
1. Time the length of the session as you collect data.
2. Indicate whether or not the student performs each of the steps below with a tally mark for each word, and looping around for repetitions.
3. Write comments, observations, or suggestions in space provided.
4. Use a symbol (e.g., * or ½) to indicate if student completed the step partially and make a note of what he/she missed.

	Student 1	Student 2	Student 3	Student 4	Student 5
Student looks at and tries to read the word					
Student taps on the word, listens to the word, and says the word					
Student writes the word and says the word					
Student records the word and listens to the recording					
Student says the word before moving on to the next word					
Student does not make significant errors in speaking or writing the word					

Exact duration of session: _____

Notes/Comments:

_____

_____

Figure 2. Treatment integrity checklist for the iPad Sight Words app session.

Measure Treatment Integrity

Critical to the success of any intervention program is the measurement of *treatment integrity* (Conroy, Stichter, Daunic, & Haydon, 2008; Gresham, 2004). Also known as *intervention adherence*, treatment integrity is the extent to which an intervention is implemented as designed. Positive outcomes cannot be attributed to the intervention without evidence of strong treatment integrity. By the same token, important decisions about whether to continue, increase, or decrease the intervention cannot be made in the absence of integrity data (Hawkins, Morrison, Musti-Rao, & Hawkins, 2008). Teachers will have to determine essential steps that need to be completed and collect data on students' adherence to these steps.

Example: Once the students were using the technology independently or semi-independently (on a laptop), the teacher collected data periodically on students' adherence to program protocol. As shown in Figures 2 and 3, the treatment integrity checklists include the essential steps students were required to follow in the respective programs. Treatment integrity was calculated by counting the number of steps students completed correctly divided by the total number of steps in the protocol multiplied by 100. If integrity fell below 90%, the teacher retrained the student in completing the steps.

Monitor Progress

Collect data periodically. Teachers can use the existing technology to collect these data or can use teacher-developed or commercially available curriculum-based measures. Some software programs allow teachers to create individual student profiles and capture the data at the end of the session.

Example: The Sight Words app did not have a provision to capture students' responses. Therefore, Ms. B conducted bimonthly probes on sight word fluency and ORF measures to track student progress. The ORF software

Student: _____

Date: _____

Did the student:	Yes	No	Comments
Adjust the computer screen for best view			
Put on headphones and adjust microphone so that it is in front of mouth			
Follow menu to test that microphone is working			
Find and click on student's name			
Use graph to identify goal and click on appropriate goal under his/her name			
Click **listen** and listen to the program directions (e.g., "Hi, I'm Betty Buckeye ..."); click **yes** or **listen again** after prompt given.			
Find assigned story in his/her folder and find and click on appropriate training story ("When I Grow Up")			
Click **read to me** after prompt is given; listen to the story 1 full time; use eye gaze to follow the blue highlighting feature			
Click **read along** after prompt is given; read along 1 full time with a loud, clear voice			
Click **listen to me**; immediately start reading after he/she hears **GO!**; read independently for 1 minute; click on unknown words; accurately click on the last word he/she read; follow computer prompt based on his/her performance			
Click **timed reading** when prompted; complete timed reading; accurately click on the last word he/she read; chart progress on graph			
Click **maze** when prompted; accurately click on answer choices; chart progress on graph			
Exit the tutor			

Figure 3. Treatment integrity checklist for ORF tutor session.

did permit the students to record their word counts, but Ms. B. or her assistant had to conduct weekly independent probes to verify these recordings.

Be Flexible

One of the positive traits of a good teacher is the ability to be flexible with lesson plans and improvise in response to unexpected changes in circumstances. Although there are benefits to using technology in the classroom, on any given day the selected apps or software can present significant limitations or application barriers. For example, it is not uncommon for laptop computers and iPads to "freeze" on a particular screen, locking a student from navigating any further. It is important that teachers be familiar with the basic mechanics of the device and software, and specifically, how to troubleshoot or restart the device. If the school does not have technology personnel available, teachers need to contact the software or app developers for assistance.

Example: One day the screen on one of the iPads froze, necessitating a software update and an Internet connection. Ms. B instead gave the student a set of flashcards with the words to be practiced with a peer as a backup activity. Similarly, a technology breakdown for ORF practice might simply lead Ms. B to direct the students to practice with hard copies until the computer is restored.

Conclusion

When applied skillfully and used consistently, technology can be a valuable tool in providing supplemental instruction for students with disabilities from culturally diverse and low–socioeconomic status backgrounds. For many CLD learners, schools may be the only venue for accessing technological devices that may otherwise be unavailable to them. It is also important to keep in mind that technology is a means for delivering instruction; it does not replace the teacher. Therefore, teachers must carefully choose the most appropriate instructional software and make sure that it is used in ways that build and strengthen skills. Teachers can vary the intensity of instruction by closely monitoring students' responses to instruction and adjusting the frequency and/or duration of instruction accordingly. When students attain mastery of the target skill, teachers can gradually introduce new skills that build on previously learned skills, thereby providing systematic instruction. Data on treatment integrity should be collected from time to time, and students must be trained in the essential steps with booster sessions as needed. Young children tend to be highly motivated by technology, and teachers should not pass up the opportunity to achieve high levels of accurate academic responding under these conditions.

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Note

1. The vignette presented in this article is a fictionalized account drawn from several authentic situations and put together as an aggregated scenario.

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