# Technology-Based Literacy Instruction for At-Risk Students

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## Introduction to the Problem

Closing achievement gaps for students from low-socioeconomic backgrounds has historically been an issue surrounding all arenas of education, but particularly for reading instruction. Across the United States, initiatives to further integrate technology-based instruction to achieve differentiation are constantly emerging. The issues surrounding which programs to use and how to best implement the technology to produce the highest academic gains still remain as districts launch technology initiatives and professional development training. Schools with high percentages of at-risk students that invest in technology-based literacy programs to achieve highly-effective differentiated instruction may help close the literacy achievement gap among low-income, high-minority students.

Although technology-based literacy programs are frequently being implemented through avenues such as one-to-one initiatives, research has shown that technology-based programs can produce the same positive or negative effects as teacher-led instruction (Ross, Morrison, & Lowther, 2010). This was especially evident when technology was used as an alternate form of pencil-and-paper versus a differentiated instructional tool. A program, just like a teacher, has been found to be ineffective in its methods if the assessments, results, and modes of instruction are not aligned to student needs (Ross, Morrison, & Lowther, 2010). If achievement effects of traditional versus computer-assisted instruction can produce similar positive or negative effects, then inquiries into the types of highly-effective technology and supporting classroom infrastructures are essential to strategic planning, particularly in regards to the literacy instruction of at-risk student populations. Computer-assisted instruction, just like a teacher, should be considered highly-effective only when positive results are obtained.

## Current State of Affairs

### Low Progress Trends in the United States

**Accountability.** The United States has been moving towards an era of accountability as increased attention on student achievement to measure teacher effectiveness has been incorporated into national and state funding efforts through policies such as the No Child Left Behind (NCLB) Act and the American Recovery and Reinvestment Act's Race to the Top initiatives (International Reading Association [IRA], 2010). Demonstrating the growth of every student learner was no longer optional as funding efforts required states to include accountability in the teacher evaluation process. The hope was that requiring growth data would result in increased attention on meeting the needs of every student learner through differentiated instruction. Essentially, the ideology was that every child could learn if teachers were effective in meeting students' individualized needs (IRA, 2010).

In 2002, data showed that over 8 million students between grades eight and 12 could not read on grade level (Biancarosa & Snow, 2004). Additionally, 70% of older readers required some form of remediation, not in phonological components, but rather comprehension of the content that they read. Biancarosa and Snow suggested that although NCLB focused attention on achievement and literacy, its focus was primarily on the lower grade levels. The focus on early literacy was not the issue; however; it became problematic that early literacy efforts were not providing essential comprehension instructional strategies.

**Continuing achievement gaps.** Based on results from the 2013 National Assessment of Educational Progress (NAEP), the National Center for Education Statistics (NCES) found that from 1970-2013, there has been a steady literacy achievement gap between white and minority fourth- grade students. From 2008-2013, there was

an average 48 point gap in vocabulary recognition between white and black students and an approximately 30 point gap between white and hispanic students. NCES also reported that the vocabulary achievement gap between white and black students was 32 points in 1980 and 23 points in 2012, only narrowing the minority vocabulary gap by 9 points in over 30 years.

The NAEP also attempted to compare and correlate student scores on the vocabulary assessments and the comprehension assessments. The NCES (2013) recognized the limitation that the grading scales were developed separately, so the organization decided to compare students at the lower, middle, and upper quartiles. In 2013, the students who scored well on the vocabulary assessment were the same students who performed above the 75th percentile in comprehension, while the lowest vocabulary scorers were also the same students who performed below the 25th percentile on comprehension. Kieffer (2008) also found significant gaps between immigrant English Language Learners (ELL), low-income minority students, and white students. The study compared the literacy ability of ELL students and found that the effects on limited English background in the home were significantly similar to the effects found for students from low-income minority homes. These studies suggested that vocabulary has a direct correlation to comprehension, so those students from ELL or low-income homes are more susceptible to falling behind in terms of reading achievement (Kieffer, 2008; NCES, 2013).

## Literacy Linked to Poverty

**Generational poverty.** Closing achievement gaps in literacy in schools with high percentages of students from low-socioeconomic backgrounds is of paramount importance given the contextual needs of the students and parents. Literacy ability has lifelong impacts that affect income and employability that studies have shown to be generational (Kieffer, 2008). It is imperative that reading achievement be at the forefront of any school's improvement plans, but particularly for low-income students who start their schooling at a disadvantage in terms of vocabulary and oral communication skills which research has linked to higher unemployment rates (Timmons, 2008).

**Nonliteracy leads to lower pay**. Kutner et al. (2007) analyzed the household results of the National Adult Literacy Survey (NALS) and found alarming evidence that eleven million people in the United States' adult population were considered completely nonliterate in English because they could not answer basic questions in the categories of prose literacy, document literacy, and quantitative literacy. Scores ranged from below basic, basic, intermediate, and proficient. The NALS sample size of participants scoring below basic in prose literacy was interpreted as representing 14% of the United States population in 2003, or 30 million adults, who would have scored in the lowest category of continuous text comprehension. Additionally, 35% of survey participants with below basic literacy capabilities in any category were employed in low-paying service-related jobs that led to poverty compared to just 7-10% of participants with proficient literacy skills.

**Lower pay leads to higher nonliteracy**. The National Center for Education Statistics (2013) found that fourth-grade children who qualify for free or reduced lunch experience significant literacy gaps when compared to their non-qualifying peers that have been ongoing since 2003. On average, there was a 30 point gap between the free lunch and non-qualifying groups, and a 17 point gap between the reduced lunch and non-qualifying groups. A study conducted by Hart and Risley showed that three-year-old children raised in professional households demonstrated a more extensive vocabulary than adults living in welfare homes (as cited in Payne, 2013). The study also found that children from low-income homes not only heard less vocabulary, but also received negative comments over positive comments in a 2:1 ratio compared to a middle class 1:5 ratio.

**Informal language structures.** Studies have found that households containing immigrant parents were more likely to experience poverty and often employed informal, conversational English language structures versus engaging in formal language usage (Kieffer, 2008; Kutner et al., 2007). Additionally, Payne (2013) found that African

American males were more likely to come from generational poverty, where parents had to work multiple jobs to maintain their households and children were at greater risk of outside influences on language and behavior. Essentially, students from low-socioeconomic backgrounds could experience a lack of parental support due to time or language barriers, arrive at school with limited vocabulary, or confuse varying home and school language structures.

## Theoretical Framework

### Philosophical Views

Dewey (as cited in Hill, 1997), who was associated with pragmatic and progressive philosophies, believed that education was experiential-based and that any curriculum, despite its aims or content, must address not only what is to be done but how it is to be done. Experiential educators facilitate learning experiences with standards that reflect autonomous discovery to meet individualized needs. Pragmatism is rooted in the belief of a holistic experience of life in order to help students grow academically and morally through cooperative learning both inside and outside the classroom through differentiated methods that increase student interest and motivation (Hill, 1997). Pragmatic curriculums rely on interdisciplinary structures that are not fixed by the ends, although flexible ends are specified, but are more concerned with the process of learning through doing (Hill, 1997). Progressivism takes pragmatism a step further by emphasizing that thinking and doing are equal in scholarly pursuits, and that perpetual learning throughout life is the ultimate goal of education (Fairfield, 2009). Learning by doing, or instruction that is experientially differentiated, can be facilitated through technology programs that customize instruction, remediation, and extension activities. Differentiation can be planned for and facilitated through technology to foster experiential learning if the program is responsive to a student's personalized learning needs either in content, process, product, or learning environment (Tomlinson, 2000).

### Differentiated Instruction

Technology has been used to differentiate instruction in attempts to close achievement gaps in reading. Differentiation is described by Tomlinson (2000) as creating variance in classroom practice to meet every student's needs. Tomlinson (2000) described three areas of student variability which were student readiness, interest, and learning profile. With these student characteristics in mind, educators can differentiate content, process, products, and learning environments to meet the students' needs. Given that content has been shown to have the greatest effects on comprehension, Tomlinson (2000) suggested adjusting reading levels, utilizing audio, adjusting vocabulary instruction, using both auditory and visual representations of books, participating in partner reading and discussion, and engaging in small group meetings. The use of audio and visual representations of texts provide students with multimodal instruction that they can use to help develop fluency, expression, and inflection.

**Content.** Tomlinson conducted early studies utilizing the theoretical framework of multiple intelligences created by Gardner (as cited in Eidson & Tomlinson, 2003). Gardner developed eight intelligences that shaped Tomlinson's early studies regarding student learning profile, which are interpersonal, intrapersonal, linguistic, bodily-kinesthetic, logical, music-rhythmic, naturalistic, and spatial intelligence. The naturalistic intelligence is normally seen in nature, which is not easily accessed through the use of computers. The other seven intelligences, however, provide a framework for understanding learning profiles and interest based upon their multiple intelligences. Providing differentiation in terms of student profile would require a program to incorporate diverse activities to cater to student needs, some of which are met through the use of technology-based instruction.

**Assessment-driven instruction.** Tomlinson (2000) emphasized the importance of attending to student differences and combining assessment and instruction to guide personalized learning efforts in the classroom. In a supporting study, the highest-performing schools' literacy programs were

heavily-laden with responsive technology that used data results to guide instruction and monitor student progress for up-to-date information (Wilcox, 2013). The technology was found to foster reading engagement by scaffolding book and activity selections to provide differentiated literacy practice that could be completed independently to facilitate one-to-one tutoring interventions with minimal teacher support. The key to data-driven instruction to differentiate learning is to employ both formative and summative assessments, beginning with placement pretests to start students at their current instructional level (Butler & McMunn, 2006). Assessment should be the basis for differentiated instructional techniques, but can often be considered too time-consuming for educators to conduct, grade, and make sense of the data. Technology-based instruction can assist teachers with quick, effective assessments.

**Learning environment.** Weller, Carpenter, and Holmes (1998) found that the traditional classroom structures presented scheduling problems for differentiated interventions, loss of overall instructional time when providing accommodations, and inadvertent labeling of students during instruction. In their study that examined the performance of fifth-grade students on an Iowa state standardized reading test, the students who used daily computer-assisted reading technology outperformed the students who received the traditional classroom interventions, demonstrating that computer-assisted instruction can provide a supplemental environment that is conducive for student learning. Technology can serve as a classroom structure that helps teachers easily and quickly provide differentiated instruction, individualized pacing, and text processing support (Kamil, 2003). Numerous studies have demonstrated that individualized reading technology such as e-storybooks had positive effects on the achievement of low-income and ELL learners by providing opportunities for the students to independently explore texts. The independent exploration led to an increase in vocabulary development, decoding skills, and comprehension abilities as evidenced by classroom-based assessments (Zucker, Moody, & McKenna, 2009). A review of the research surrounding computer-assisted instruction found that placing students in technology-based literacy programs that used support features such as ebooks, hypermedia, and modules resulted in greater effects with all populations, but particularly students with disabilities (Stetter & Hughes, 2010). The supporting features of technology, when sequenced in instructionally responsive ways, were found to provide students with supplemental information to better comprehend the text in a safe, private, and nonjudgmental environment.

## Response to Intervention

**Overview.** Yell, Shriner, and Katsiyannis (2006) defined Response to Intervention (RtI) models as "designed to identify students who are having academic problems when the problems first become apparent, and then matching evidence-based instruction to their educational needs" (p. 13). The RtI system was developed specifically for literacy differentiation in response to the disproportionate number of ELL and minority students being identified as having special needs (International Reading Association [IRA], 2010). With the reauthorization of the Individuals with Disabilities Education Act (IDEA) in 2004 came a new language that prompted educators to develop instruction from a proactive standpoint rather than first attempting to identify failure. Essentially, there are students who benefit from larger amounts of small group or one-to-one instruction that do not have learning disabilities but need more personalized instruction. RtI requires teachers to plan differentiated instruction using research-based methods, document progress, and determine what methods work for each student. RtI's methods of differentiation require standards-relevant assessments to drive instructional efforts to determine which methods work best for each individual student. If a number of methods have been employed over an appropriate period of time to achieve implementation, without adequate student progress according to benchmark accountability measures, then further testing into special needs can occur based on sound data (IRA, 2010).

**RtI to facilitate differentiation.** Response to Intervention systems have been implemented since NCLB to facilitate differentiated instruction by providing a tiered system that provides individualized levels of support (Watts-Taffe et al., 2012). Most RtI systems have utilized three tiers based upon student assessment results. For reading, tier 1 is the differentiated instructional efforts given to the whole group, or the core program utilized by the school. Tier 2 instruction consists of identifying academic deficits to supply students with instruction that meets their specific needs in addition to the core curriculum, usually by providing additional small group learning. Tier 3 instruction has also been utilized for small group settings, but in most cases is implemented as a one-to-one tutoring intervention. Tier 1 classroom-based instruction should meet the needs of approximately 80% of the students, while tier 2 extended differentiation should meet the needs of 20% or less of the student population, and tier 3 instruction should support the needs of around 1-5% of the student population (Smith, Fien, Basaraba, & Travers, 2009). In high poverty areas, however, a school may have a disproportionate number of students requiring tier 2 and 3 supports. Schools with high numbers of immigrant populations that employ English as a second language in the home also could experience more students who need tier 2 and 3 leveled support. Schools and teachers need a way to effectively assess and monitor student progress, as well as provide the tiered, differentiated support systems to close literacy achievement gaps. Technology-based literacy programs could be potentially be used as a resource for those purposes.

## Opponents to Computer-Assisted Instruction

Opponents of computer-assisted instruction claim that the initial costs associated with the technology for the infrastructure, human resources, and time outweigh the academic benefits of such programs, especially when the programs are used as mediums for recording work versus responsive instructional tools (Parker-Gibson, 1999). Other concerns included ways to evaluate the teaching provided by the program, which can be time-consuming and difficult if the program does not readily include reporting measures. Teachers are not always able to evaluate the program as a student, or easily incorporate the program into whole-group instruction. Opponents also claim that technology is constantly changing, making updates costly, time-consuming, or impossible if the technology becomes quickly outdated. The usability, or shelf life of a product before it is too outdated to update, is difficult to predict in some cases (Parker-Gibson, 1999).

Most children have an innate need to be social beings (Lentz, Seo, & Gruner, 2014). This includes working with other students, developing relationships with peers, learning to interact socially, and making connections to other living things. Opponents to computer-assisted instruction claim that the risks of technology addiction, lowered physical activity, and social emotional impacts should be considered, as well as other basic components of development that might simply be left out if teachers and parents rely too heavily on technology (Lentz, Seo, & Gruner, 2014). Research has shown that over 70% of children ages birth to two years old are using technology daily (Vandewater et al., 2007), so using technology in combination with other developmental structures is essential to the learning processes of the whole child (Rosen & Jaruszewicz, 2009).

While there are concerns that technology will quickly become outdated, choosing a computer-assisted technology program that dedicates consultants and technology contacts could help to alleviate concerns about product relevance. By providing these types of company contacts, schools and teachers could feel more comfortable knowing that issues concerning implementation will be quickly addressed. Infrastructure can be a costly endeavor, as schools are facing new challenges to keep up with innovative technology. Internet connectivity is becoming more commonplace as districts integrate technology standards to prepare a global workforce, so these issues, however costly, must be addressed in order to teach students 21st century skills. Training the staff, students, and parents about ways to couple technology with other instructional techniques would ensure that students are developing all essential social and emotional

components. Technology could, in fact, be very social when students are allowed to work within the programs together or set-up classroom playrooms that incorporate chats, games, and feedback.

## The Imagine Learning Program

### Differentiation

**Content and process.** There are several ways that the Imagine Learning program could potentially facilitate Tomlinson's (2000) differentiated instructional model. The Imagine Learning program provides multimodal learning modules that incorporate oral language, writing, and comprehension. All students are provided with ample opportunities to use ebooks chosen for each individual student after placement testing has occurred. Tomlinson suggested auditory and visual reading instruction, and Imagine Learning engages students in partnered reading with the software through prompting, call and response, and choral reading exercises. The ebooks are followed by scaffolded comprehension questions that are modified based on student responses therefore assessing the students in order to adjust the process of learning. The computer-assisted software then provides supplemental remediation or extension activities based on student progress (Imagine Learning, 2015). To build content knowledge, Tomlinson (2000) recommended scaffolded vocabulary instruction, which Imagine Learning provides by incorporating both leveled book-based vocabulary, and content-focused vocabulary.

**Assessments-driven instruction.** Imagine Learning (2015) cited references from the RtI Action Network, a division of the National Center for Learning Disabilities (NCLD), that the program claims were used to develop what is described as a differentiated program that provides students with assessments-based systematic, explicit instruction. Although Imagine Learning (2015) cited the NCLD as a guiding resource for program development, it did not provide any independent research that demonstrated alignment with the NCLD guidelines. Imagine Learning determines a student's accomplishments, overall program placement, and areas of need according to mini-assessments issued throughout the student's program of study (Imagine Learning, 2015). The program provides students with immediate feedback from the assessments and subsequently claims to differentiate the instructional modules. The program claims to cater to English Language Learners (ELL) through first-language opportunities, as well as levels instruction for special needs students and students with reading difficulties (Imagine Learning, 2015). First-language support can be teacher-activated, and includes monolingual instruction that is assessments-based and scaffolded for gradual release, bilingual support, common phrase instruction, picture-text-oral dictionaries, and first-language newsletters for parents. The Imagine Learning program currently provides first-language support in 15 different languages (Imagine Learning, 2015).

### Response to Intervention

The National Center for Learning Disabilities (as cited in Imagine Learning, 2015) identified four main components of most RtI programs which are as follows: high-quality and scientifically-based classroom instruction, ongoing student assessment, tiered instruction, and family involvement. In terms of scientifically-based instruction, Imagine Learning (2015) claims to accomplish differentiation by administering placement tests for instructional starting points, regulating sequencing through ongoing assessment, providing scaffolded first-language support for ELL students, and providing immediate feedback. The program collects student scores, which immediately shapes the student's curriculum for one-to-one support, reteaching or accelerating by offering a large database of activities and videos. In addition to the differentiation piece associated with research-based instruction, Imagine Learning provides tiered instruction aligned with RtI. Imagine Learning (2015) could potentially reduce tier 1 students' odds of needing additional tiers of intervention by providing all students with tier 3, one-to-one instruction that provides continual assessment results to drive instruction.

Differentiation for English Language Learners was previously identified as a concern

given the extensive vocabulary background associated with higher reading comprehension skills (NCES, 2013). Imagine Learning facilitates tier 3 instruction for this student population in several ways. First, the program provides instruction in the five core reading areas that encompass phonological awareness, phonics, reading fluency, vocabulary, and comprehension by using direct and explicit instruction in a one-to-one setting with the computer. The direct instruction occurs through individually sequenced activities that include video modules, songs, chants, rhymes, animated games and lessons, and complex storytelling. In addition to multimodal, responsive instruction, Imagine Learning provides a first-language feature for ELL students that is scaffolded for gradual release. According to student testing and responses, the program offers language support systems that can offer directions, translate words and phrases, provide visual definition support, and customize activities that include common phrases and academic language (Imagine Learning, n.d.).

Vocabulary has been shown to have a positive effect on reading comprehension skills for all learner types. Imagine Learning (n.d.) uses several RtI strategies for vocabulary comprehension. The program includes over 600 activities for academic language and content language that is used by spelling, speaking, or writing the words. The words themselves are taught, coupled with phonological awareness and decoding strategies. Vocabulary instruction also includes figurative language to support inferential thinking. When explaining how the program developed a well-rounded vocabulary database, the Imagine Learning program claimed to have drawn upon the work of researchers such as Marzano, Coxhead, and Cunningham (as cited in Imagine Learning, n.d.), as well as phrases found within multiple state standardized tests.

## Conclusion

A meta-analyses of 4, 875 studies regarding the use of computer-assisted technology showed trends that the best use of technology occurred when the program provided student-driven instruction and delivered extensive feedback (Hattie, 2009). Blok, Oostdam, Otter, and Overmaat (as cited in Hattie, 2009) found that students enjoyed computer-based learning because the feedback was less threatening. Timmerman and Kruepke (as cited in Hattie, 2009) found that computer-assisted explanations had a high effect of 0.66 on overall student achievement, while remediation had an effect size of 0.73. Given that Imagine Learning employs Tomlinson's (2000) methods for assessment-driven differentiation, provides Hattie's (2009) suggested remediation and explanatory feedback, includes multimodal instruction to meet the needs of multiple intelligences (Eidson & Tomlinson, 2003), and is developed using RtI research-based methods (Imagine Learning, 2015), it is valuable to explore the effectiveness of Imagine Learning to close literacy achievement gaps for high-risk students to ensure that every student is receiving highly-effective instruction. The theoretical frameworks appear to support the program's effectiveness, but no direct research regarding the program's suggested student achievement rates has been conducted or compared to other measures of student literacy ability. This study seeks to determine if the Imagine Learning program is effective when implemented as suggested by the company, and if the subsequent results match the participating district's accompanying assessments to determine reading achievement.

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