Literacy and Assistive Technology Instruction for Children with Visual Impairments and Multiple Disabilities

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**Introduction**

Fifty years of rapid technological innovation have left educators with some important questions to answer. Has technology changed the definition of literacy? Is it possible to teach technology and literacy at the same time, and if not, what is the priority? Where does education for children with specialized needs, especially those with multiple disabilities, fit into the literacy vs. technology debate? More specifically, can technology actually be used to promote effective print or braille literacy instruction for children with severe visual impairments and multiple disabilities? The groundwork to answer this last question, at least, already exists. Decades of research and federal legislation already support training in alternative literacy and assistive technology for students who require them. This discussion takes an active look at why combining the two systems is necessary, and how to successfully merge them to foster and encourage student success.

**Technology and the Twenty-First Century**

“Technology” is the twenty-first century’s educational buzzword. To the point that innovation no longer seems innovative, improvements and discoveries flood a market almost saturated with devices and gadgets. On one hand, it is impossible to view such a time and such miracles without awe. Dreams for the future and its endless possibilities run away with even the most conservative imagination, when inundated by wonders that students on every campus carry daily in their pockets. On the other hand, does anyone know where all of this is leading, and for what purpose?

Fifty years ago, students were fortunate to have black chalkboards and current print textbooks for use at school. Today, it is not uncommon to find their grandchildren using smart boards in their classrooms, with laptops and touch tablets both at home *and* at school. However, despite research that indicates that teachers believe technology offers unique educational benefits, many continue to employ it only for limited, isolated purposes (Kurt & Ciftci, 2012). Lack of educator training is repeatedly identified as a barrier to using technology while teaching, so that technology becomes more of a distraction in the classroom than a tool (Postman, 1994; Sutton, 2011). Despite all of the promise that technology holds to revolutionize education, how is its effective application being administered to actually fulfill that promise?

Nowhere in education are these questions more significant than for children with visual impairments, especially those with multiple disabilities. Caught in what could become an educational maelstrom may be the very students whom technology has the potential to empower. As teachers, administrators, and policy-makers sift through the wealth of novelty at their fingertips, the capacity of technology to deliver increased information access to those who need it the most may be lost.

Continuing to rush forward with no idea of how the past should guide the present, or the present transform the future, may be more harmful than beneficial. Perhaps it is time to re-assess where education is going, how it is going to get there, and what will happen when it does.

**The Past as a Guide to the Present**

Prior to the appearance of instructional technology, teaching in the United States changed little from generation to generation (Bucher, 1995; Robinson, 2006). Until the second half of the 20th century, instructional methods in the United States may not have been meaningfully distinguishable from those common to the Civil War era. The major difference toward the middle of the 20th century was more a matter of fluctuating populations and growing student numbers than educational substance (Talbot, 1971). With the 1954 Supreme Court decision *Brown* v. *Board of Education of Topeka*, legislation began trending toward a guarantee of ever-widening free access to public schools (Warren, 2007).

In retrospect, this decision appears as a monumental paradigm shift. This is evident not only for children on whom it had an immediate impact, but also those for whom it paved the way. It would not be implausible to make a direct connection between the groundbreaking work of *Brown* v. *Board of Education* and the 1975 Education for All Handicapped Children Act, or from there to the 1997 Individuals with Disabilities Education Act (IDEA) (Chapman, 2008). Since 1954, the appearance of technology, expansive legislative protections, and concomitant, radical educational improvements have arguably laid a foundation for individualized education such as the world has never before experienced.

**The Present Can (and Must) Transform the Future**

At the same time, the stunning power of technology, with its elusive potential to help lead students to success, has yet to find its place in most classrooms for children with specialized needs (Loertscher, 2011). Research documents the particularly vital connection that technology provides for students with visual impairments in guiding their educational progress across curricular spectra (Presley & D’Andrea, 2008). However, the introduction of many students and their teachers to the very technology that can transform lives has been, and continues to be, fragmented and disconnected (Alves et al., 2009; Kelly, 2009; Smith et al., 2009; Zhou et al., 2011). This is especially true for children with multiple disabilities.

This disparity results ultimately in an increasing lack of educational, personal, and professional access. Students reading braille fifty years ago would have discovered, as Helen Keller described so gracefully, a “new world opening in beauty and light” not much different from that of their peers (Keller, 2013). By contrast, students reading print or braille today without the concurrent benefit of technology will occupy a considerably darker and smaller world, with far less opportunity, than their peers will find.

The time is past when literacy instruction, unmerged with strategic technological co-instruction, was sufficient for students with visual impairments. At the same time, technological access without the solid literacy foundation that print and braille offer cannot deliver all of the benefits that students require for independent success. The only truly important question, then, is how to link the past with the present, providing students with visual impairments and multiple disabilities the capability to enjoy futures increasingly free from limitations.

**The Legacy of Braille**

Few would dispute the importance of print as the primary element in visual literacy instruction. There is a much more vigorous argument today over the importance of braille, so a few words here on that topic might be appropriate and timely. In 1821, Louis Braille, a precocious 12-year-old student at the Royal Institute for Blind Youth in Paris, began work on the revolutionary tactual reading system that eventually assumed his name (Worley, 2008). His uncommon ingenuity led to the development of one of the world’s most unusual and fascinating literary systems, a code that was perfectly suited for reading by the small pads of the fingertips and could be easily embossed. This created the potential for vastly increased reading speeds by blind individuals and enabled mass materials production (Mousty & Bertelson, 2007).

Louis Braille died in 1852, and did not live to see the sweeping impact that his work would have on the world. By 1854, however, anecdotes and letters from children and adults around the world were pouring in to affirm what Helen Keller eloquently summarized nearly one hundred years later: “We … are as indebted to Louis Braille as mankind is to Gutenberg” (Mellor, 2006; Special to *The New York Times*, 1952, p. 52).

Today, the word “braille” is almost as common a word in the United States as “Kleenex,” and few people remember where either name originated. Despite its celebrity, however, braille remains a mysterious and little-understood phenomenon, sometimes even within the visual impairment community. Researchers have documented a steady and perplexing decline in braille reading proficiency and student reading speeds over the last several decades (Keil, 2004; Trent & Truan, 1997). Aging populations of non-braille readers, growing numbers of students with multiple disabilities, public school integration, and emphasis on vision use by potential dual learners are often cited as the culprits contributing to this decline.

Enhanced access to technology for students of all abilities, or its lack, does play a significant role (Wittenstein & Pardee, 1996). This should come as no surprise; much as Americans like to believe they are successful multi-taskers, research indicates that there is no such thing (Buser & Peter, 2012). All protests to the contrary, it seems that trying to do too many things at once just results in everything receiving less attention. The amount of technology available for learning is substantial, to say the least; if too much unguided attention is diverted toward it, there will naturally be less effective focus on braille or even print instruction for children with complex needs.

Shifting attitudes toward tactual literacy may also play a role, as auditory technology appears to offer more universal access than braille (Engelhart, 2010). By implication, braille instruction risks isolation of blind children in general education settings, where non-specialists and peers cannot read their materials (Kelly & Smith, 2008; Stone, 1995). The inevitable debate raises a few provocative questions: If the goal of education is to promote mutual interaction, is braille still relevant? Would using auditory feedback software instead of braille make everything easier for everyone? What evidence exists to support the use of braille in an educational forum that seeks to include students rather than to exclude them?

Widespread consensusamongresearchers,vision professionals, and university administrators indicates that *braille literacy matters* for students with severe visual impairments (D’Andrea et al., 2009), including those with multiple disabilities. Learning primary reading skills, building fluency, and developing conventional awareness require tactual reading and writing (Swenson, 2008). Like print, braille aids students in developing phonological skills, including syllable segmentation and sound isolation (Hatton et al., 2010). Spelling, capitalization, paragraphing, and formatting are as highly dependent on tactual connections for braille readers as they are on visual connections for print readers (Farnsworth & Luckner, 2008).

Opinions may differ on how best to provide effective braille and print instruction to children with complex needs, or how to address educational challenges that accompany literacy instruction (Conroy & Collins, 2012; Wormsley & D’Andrea, 1997; Wright et al., 2009). However, researchers agree that a true literacy foundation is not optional for students who have the motor and cognitive skills necessary to accommodate it (Koenig & Holbrook, 2000; Toussaint & Tiger, 2006; Wormsley & D’Andrea, 1997).

According to federal law, literacy instruction must be considered by educational teams while planning services for students with visual impairments (Koenig & Holbrook, 2000). IDEA (2004) mandates qualified learning media assessments for students with visual impairments to determine whether specialized print or braille training will benefit them. It also provides for expert personnel to deliver individualized instruction, using adaptive reading and writing materials as appropriate (U.S. Department of Education, 2013).

**The Basis for Technological Literacy**

Assistive technology research related to visual impairment is less prolific than braille and print reading research, probably because technology itself is still being developed. Still, a sufficient amount exists to also establish the importance of assistive technology in the education of students with severe visual impairments. In a world increasingly dependent on electronic media for business and entertainment, technological literacy breaks down information access barriers (Farnsworth & Luckner, 2008; Presley & D’Andrea, 2008). It enhances reading and writing skills for students with visual impairments and additional disabilities, and increases their ability to communicate equally with others (Alves et al., 2009). Children who lack applied technology training in authentic educational settings consequently lack the ability to maintain grade-level pace (Kelly, 2011; Smith et al., 2009). Technology impacts not only students’ education, but also their employment, independence, and full recognition of potential (Zhou et al., 2011).

Federal law protects assistive technology with the same interest and intensity that it does literacy instruction. IDEA reauthorizations actively promote student access to innovative technological devices and services, including training for general and special educators. Technology is expected to maximize participation in general educational curricula, and IEP teams must collaborate to determine the most beneficial individualized assistive technology strategies for their students. Educators have an obligation to support curricular design and active research that help to integrate technology into the lives of students with disabilities (U.S. Department of Education, 2004).

**You Can’t Have One without the Other**

Evidently, neglect of either literacy or technology instruction for students who require them is both misguided and educationally harmful. Research demonstrates that braille readers have difficulty absorbing grade-appropriate academic expectations and learning group cooperative skills when they receive their lessons in isolation year after year, using wholly different materials than their classmates (Coppins & Barlow-Brown, 2006). This is true also for students with visual impairments who require access to print.

At the same time, use of auditory technology without braille or print does not provide a sufficient literacy foundation for students with severe visual impairments (Goudiras et al., 2009; Johnson, 1996). Not many enterprising individuals would recommend that the majority of students without disabilities stop reading print and depend entirely on auditory feedback; how would removing their entire literacy platform make any more sense for children with visual impairments, including those with multiple disabilities?

**Merging Two Vital Systems with Seamless Integration**

At this point, at least one of Aesop’s fables is instructive and relevant. Upon finding a little water at the bottom of a pitcher, with a beak too short to do her any good, a thirsty crow considers her options. A few small rocks nearby present both a temptation and a solution. The crow reacts patiently and ingeniously: Instead of smashing the pitcher to release a few dusty drops of water, she combines the pitcher’s marvelous structure with the rocks’ untapped potential. Dropping the rocks one at a time into the pitcher until the water rises to the top, the triumphant crow reaps the benefits.

As with all clever moral stories, this tale can be analogized to the present situation. So far, the general tendency for each side of the literacy-technology debate appears to be to abandon one system in favor of the other. How unnecessary, and inadvisable, that would be. Literacy and assistive technology are not mutually exclusive, with the success of one depending on the annihilation of the other. The structure of the first, when combined with the potential of the second, offers unlimited possibilities.

Technology has, in fact, made access to literacy even more important in the education of students with visual impairments and complex academic needs (Brittain, 2007). Mutually inclusive, technology and literacy together provide the avenue through which students’ success and competitive capability in the twenty-first century is strategically enhanced. If the exclusion of neither literacy nor technology will result in full educational benefit and academic access, it is time to merge the two and create systems that utilize both for the benefit of all.

**Research to Support Combined Technological and Literacy Instruction**

While research clearly supports both technological and tactual or visual literacy training, there are few studies that guide instruction using the two in tandem, and even fewer for children who have multiple disabilities. Fellenius (1999) found that daily use of a computer improves students’ braille text editing skills, and tends to motivate them to do the same work as, and cooperate with, their peers. Bickford and Falco (2012) demonstrated that instruction using refreshable braille technology might help to increase students’ motivation and improve their reading fluency. Farnsworth and Luckner (2008) concluded that electronic assistive technology, including notetakers, embossers, and related software, is useful in creating curricular materials and programs. These studies lay the groundwork for more intensive and conclusive investigation. In the current absence of additional research, however, perhaps it would be valuable to examine ways that teachers can begin now to encourage literacy development using both braille and technology.

**The Role that Teacher Preparation Plays**

Unfortunately, research has also shown how unprepared many teachers feel when confronted with the prospect of teaching their students with visual impairments how to use technology. A number of studies completed around the world by de Freitas, et al. (2009), Zhou et al. (2011), Kamei-Hannan et al. (2012), Smith et al. (2009), Wong & Cohen (2011), Kelly & Smith (2011), Munemo & Tom (2013), and Wolffe et al. (2003) all concluded that although teachers believe that use of technology is important for academic success and improved quality of life, many students with visual impairments do not have access to technology in their schools. They further concluded that this has a disabling effect on these students’ ability to progress adequately through their educational programs.

There are many complex factors that may play greater or lesser roles in the ability of students with multiple disabilities to access and use technology in their classrooms. These may include university training of specialists, impact of additional disabilities, behavior issues in the classroom, student readiness to use technology devices as tools, willingness of general or other special educators to allow students with visual impairments and multiple disabilities to use technology, support of parents, and classroom/district access to technology devices. However, many of these issues could be resolved by simplifying educator approaches to technology instruction and device acquisition.

**Effective Application of Existing Tools**

Any vendor table at a national or international conference with its dazzling array of new gizmos and gadgets, many of them costing multiple thousands of dollars, is a giddy sight. Technological innovation is truly a marvel. The sheer number and diversity of devices, however, are irrelevant to this discussion. Technology is only as grand as its effective presentation. It is a means to an end, not the end itself—one (often rather expensive) vehicle for driving toward the ultimate goal of independent student success.

No matter what advances the future holds for technology, teachers are still the creative, vital link between innovation and practical application. Many different tools may be used to foster the same purpose; teachers simply need to know what to do with what they have. The possibilities are limitless; consider, for example, just a few ideas for how the following devices can be manipulated to help students build literacy skills.

**Handheld book readers.** Handheld book readers are useful because they are portable, flexible, and intuitive. Preschool-aged children can be taught to start, stop, and change the volume on a book reader. Multiple motivating, age-appropriate texts that build literacy connections and familiarity with electronic voices can be read using a device that fits in a pocket. Students can learn to track lines of print or braille, either independently or with assistance, while listening to the text. Games using words, phrases, and characters from the stories are limited only by the teacher’s imagination. As students get older, they can use auditory feedback and variable speeds on the book reader to improve decoding fluency and increase their own reading speeds, one click at a time.

**Screenreaders and braille displays.** A computer equipped with an auditory feedback program and a braille display or enlarged print screen provides a dynamic literacy package. This system ensures mutual interaction between students, teachers, and peers, while students build and apply literacy and technological skills at the same time. Cause-and-effect understanding is engendered for a preschool-aged child each time he or she presses a letter key, hears its name, identifies its location, and sees its visual or tactual image. Using voice coupled with print or braille output, students can learn to read and write text. Students develop a heightened sense that spelling is important, that punctuation matters, and that correct capitalization is not optional, as their teachers interact with and help them to check their work. Desktop navigation and word processing training can begin as soon as a student starts to learn keyboarding skills. These, along with Internet, email, software, and other advanced computer skills instruction for older students can also be better facilitated using electronic print or refreshable braille. When combined with visual or tactual literacy, generalizable technological training naturally occurs in grade-appropriate stages and delivers full informational access at every level of a student’s academic preparation.

**Braille translation software.** Braille translation software allows a student to turn a computer into a braillewriter, albeit one that is portable, quiet, cost-effective, and inexpressively powerful. Its potential as a literacy tool, especially for mathematics and science, is enormous. The computer becomes what pencil and paper are to print readers as students read and type documents in Nemeth, with the capability to copy, paste, overwrite, and display problem-solving steps. Math produced electronically using braille can be translated on screen or in hardcopy print for teachers and peers, providing easy interactive access. Students can work with multiple windows at once, juggling calculators, class Internet sites, email, math projects, and text documents. Notes, as well as entire textbooks, can be filed in electronic folders and stored for perpetual use and reference. Bookmarks and text searches are easy to create and execute. Students can even read, interpret, apply, and create their own electronic spatial problems and braille dot graphics.

**Online book translation services.** As students learn to use the Internet, online book translation sites are a good place to start. Ordering electronic books and downloading them in print, braille, and auditory formats teach students important advocacy skills. They learn how to interact on a professional basis with others, develop awareness and preferences for available formats, and discover which software programs and hardware devices will support them. Students can print or emboss their materials, read them using specialized software, or convert them to auditory text formats.

**Conclusion**

From research to legislation—from innovation to application—technological progress, with its power to revolutionize education, is as formidable as it is breathtaking. Without systematic, flexible, literacy-based presentation that integrates devices smoothly into classrooms and student routines, technology can be a greater distraction than a benefit. Seamless integration of technological and tactual systems offers to fulfill the promise that students can be truly competitive with all of the advantages their world has to offer them. For students with visual impairments and multiple disabilities, both literacy and technology instruction are comparable to the key that unlocked Alice’s door to Wonderland (Carroll, 1993). Unlimited information and communication access at their fingertips await, ready to connect them to the world in ways that many children before them never could have dreamed. What wonderful opportunities this provides, and what great responsibility for educators! Ingenuity, patience, and solid commitment to literacy are the links that will guide students to enjoy independent success.

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