



National Center
on Accessing the
General Curriculum

NCAC

The Promise of Accessible Textbooks: Increased Achievement for All Students

Policy Brief

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U.S. Office of Special
Education Programs

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Just Beyond Reach-Appropriate Materials for All Students

Today's classrooms house an increasingly diverse student population, including not only students with widely different social, economic, cultural and language backgrounds, but also students with a wide range of physical, cognitive, and sensory disabilities. The federal No Child Left Behind Act of 2001 and the Individuals with Disabilities Education Act (IDEA) of 1997 mandate increased expectations and accountability for this diverse range of students to access, participate, and progress in the general curriculum. In order to ensure that all of these students are able to achieve in the general curriculum, particularly in light of such disparate strengths and needs, teachers must individualize instruction.

One critical barrier to individualizing instruction is the curriculum itself. Rather than offering multiple gateways to learning and understanding, the "one size fits all" printed textbooks and other resources that make up the general curriculum often serve as barriers. While conventional materials are reasonably accessible to many students, they clearly present significant barriers for students with sensory or motor disabilities; they also present a challenge to students with low cognitive abilities, those with attentional and organizational problems, and more subtle, yet equally pervasive, barriers for the largest population of identified special education students – those with learning disabilities.

With fixed, uniform learning materials, teachers are left with the burden of individualizing instruction by providing supplementary adaptations or accommodations. Unfortunately, few teachers have either the time or expertise to adequately adapt the curriculum materials to meet the diverse needs of their students (Ellis & Sabornie, 1990; Moon, Callahan & Tomlinson, 1999). Moreover, while some teachers are able to adapt materials for accessibility, it is a different matter to adapt them for instruction. Doing so requires careful attention to ensure that the goals for instruction are preserved in spite of the adaptations and to ensure that adequate learning progress has been achieved (Rose & Meyer, 2002; Edyburn, 2004). Further, teachers' efforts sometimes are ineffective because students perceive the adaptations as "different," feel stigmatized by them, and are therefore reluctant to use them (Ellis, 1997).

The Scope of the Challenge

In the majority of the Nation's approximately 100,000 public and private K-12 schools, textbooks are the primary curriculum material. Eighty to ninety percent of grades 4 - 12 math and science classrooms use textbooks (Hudson, S.B. & McMahon, K.C., 2002), and that figure is similar for reading and language arts instruction (NCREL, 2000). The average yearly expenditure for textbooks and related materials in each of these 100,000 schools is approximately \$10,000 per school per year (Li, P., 2002).

In addition to being the principal learning resource for general education students, the use of textbooks by students with disabilities increases steadily as these students progress through the educational system. As reported from the National Longitudinal Transition Study-2 (NLTS2):

Students with learning disabilities, emotional disturbances, or speech, sensory, or other health impairments are among the most likely to use textbooks often (61% to 72% do so, compared with 41% of students with autism, $p < .001$ for most comparisons), at least in part because they also are the most likely to have experiences reported for academic subject classes (Levine, P. & Wagner, M., 2004)

If the achievement of students with disabilities is to be assessed by the same instruments that chart the progress of general education students, these instruments need to be accessible and flexible enough to accurately chart these students' skills. Concomitantly, the curriculum resources – textbooks – that these students are provided with to acquire these skills also need to be accessible and appropriate from the outset.

Accountability Raises the Bar

The preface to Section 1 of No Child Left Behind succinctly frames the purpose of the legislation: “To close the achievement gap with accountability, flexibility, and choice, so that no child is left behind.”¹ In the four years since its enactment, the majority of teachers, school administrators and school boards have focused on its accountability mandates while parents and advocates have attended to its provisions for choice, especially as regards school placement. Surprisingly, NCLB's third keystone component, flexibility, received significantly less attention in the months immediately following the bill's passage. In many cases, it wasn't until the annual reporting mechanisms of the legislation's Adequate Yearly Progress (AYP) requirements were implemented that the issue of flexibility increased in importance.

Adequate Yearly Progress is the annual benchmark against which schools are measured. All schools must provide achievement data in four separate areas: reading/language arts, mathematics, and either graduation rate (for high schools and districts) or attendance rate (for elementary and middle/junior high schools). Schools that do not meet annual progress goals (as established by individual states) in each of these three areas may be identified as “needing improvement”. Finally, AYP is also dependent upon a dis-aggregation of student achievement data by economic background, race, ethnicity, English proficiency and disability. The intent of separately assessing the progress of students in these sub-categories is to assure an eventual parity in achievement for students perceived as disadvantaged – the “achievement gap” students.²

The combination of annual progress monitoring with a deliberate emphasis on students with disabilities quickly caught the attention of school, district and state level education personnel. Between 2001 and 2004 most states had moved towards some form of large-scale assessment in order to gather the achievement data that the AYP process required; very few of these assessment initiatives adequately addressed the needs of students with disabilities, despite the fact that NCLB was specific in its intent that the majority of enrolled students were expected to participate.

¹ The No Child Left Behind Act of 2001, United States Department of Education, Washington, DC, 2001
<http://www.ed.gov/policy/elsec/leg/esea02/beginning.html#sec1>

² The No Child Left Behind Act of 2001, United States Department of Education, Washington, DC, 2001
<http://www.ed.gov/nclb/accountability/ayp/yearly.html>

Further, NCLB clearly required these large-scale assessments to be designed, from the outset, to accommodate these students:

§200.2 State responsibilities for assessments

(b) The assessment system required under this section must meet the following requirements:

...

(2) Be designed to be valid and accessible for use by the widest possible range of students, including students with disabilities and students with limited English proficiency.³

Many educators presumed that the majority of students with disabilities would qualify for “alternate” assessments, and this perception led to a qualification from the U.S. Department of Education in December of 2003. The Department clarified that NCLB limits participation in alternate assessment to 1% of the total student population⁴ (approximately 9% of identified special education students) and that the majority of special education students were expected to participate in the same assessments as their non-disabled peers.

In contrast to previous statutes (PL94-142; IDEA; Section 504; ADA) which mandated either unique services or equal access but left compliance to be shaped by the complaints or litigation of the very individuals these laws sought to protect, accountability under NCLB was designed to reflect the responsiveness and quality of the educational system itself. As a consequence, classrooms, schools, districts and states must pay as much attention to the achievement of students identified as “disadvantaged” (including those with disabilities) as they pay to any other student.

Not surprisingly, the accountability mandates of NCLB have increased consideration of large-scale assessments that are designed from the beginning to be accessible to appropriate for students with disabilities (Thompson & Thurlow, 2002; Dolan & Hall, 2001; Dolan & Hall, 2003; Abell, M., Bauder, D. & Simmons, T., 2004). These investigations have in turn prompted a re-analysis of classroom practices (Bowe, F., 1999; Orkwis, 2003), the achievement standards on which they are based (McDonnell, L., McLaughlin, M. & Morison, P., 1997; Gloeckler, L., 2001; Thurlow, M., 2002b), and with intense scrutiny, the textbooks that create the foundation for instructional materials in the majority of the nation’s schools (Orkwis R., 1999; Gordon, D., 2002; Perl, E. & Gordon, D., 2003; Dalton, B., 2003).

Existing Solutions

The Materials

Alternate format materials are commonly provided to students with disabilities in one of four categories: Braille, audio, large print, and etext. An overview of how materials in each of these four categories are created, made available to and used by students is presented below.

Braille. For over one hundred years the American Printing House for the Blind (APH) has created books in alternate accessible formats, including Braille, supported by an annual federal appropriation. In the early 1900s Congress began requiring that copies of embossed books be provided to the Library of Congress, and in the early 1930s, concurrent with the

³ Federal Register: December 2, 2002 (Volume 67, Number 231)

⁴ Federal Register: December 9, 2003 (Volume 68, Number 236)

establishment of a uniform system of Braille, Congress established the National Library Service for the Blind and Physically Handicapped (NLS) at the Library of Congress. One of the purposes of establishing NLS was to provide federal coordination of the process of Braille production and distribution⁵. In addition to these large national Braille production and distribution centers, additional regional and state Braille distribution systems have been evolved in an effort to keep Braille editions current and readily available. A number of private Braille production companies have also been established to augment government-supported efforts.

For the majority of the past century, the process of creating Braille has been one of retrofitting existing print works into embossed versions. Of necessity this has involved obtaining, storing and transcribing the print versions, re-creating the work in an embossed format, validating and proofing the embossed version, and mailing these versions to the Braille readers who have requested them. In addition to the complexity and time required to complete this process, the ratio of embossed Braille pages to pages of print is approximately 6:1; a 500-page print book would require nearly 3,000 pages of embossed Braille.

During the past three decades, refreshable Braille displays (RBDs) have evolved to create temporary print-to-Braille transformations. RBDs receive digital information – Braille-formatted ASCII text, for example -- and transform it into Braille characters which are then displayed on a flexible membrane via a series of movable pins. RBDs offer considerable improvements over embossed Braille in their portability and ability to create “Braille on the fly,” but their high cost limits their widespread use.

Regardless of limitations, RBDs highlight the incredible potential of digital media to revolutionize the Braille creation process. As more curriculum publishers adopt a digital workflow – creating digital source files at the beginning of the production process rather than at its end – the potential of creating Braille-ready digital versions without having to retrofit existing print works becomes technologically feasible. This possibility, with its attendant elimination of the inefficiencies and inaccuracies associated with the creation of Braille as an afterthought in the book production process, provides the foundation for the National Instructional Materials Accessibility Standard (NIMAS) detailed in section 6 below.

Audio. In the early 1930’s the American Foundation for the Blind (AFB) and its collaborating research partners pioneered the “Talking Book.” Originally created on acetate and vinyl records, this new audio format provided print disabled users with recorded human narration and some rudimentary navigation, and it quickly became popular. This new format steadily evolved into four-track cassettes, and, for the past thirty years, has been the primary format of both NLS and Recording for the Blind and Dyslexic.⁶

Concurrent with the development of digital source files as the preferred medium for the efficient creation of Braille, digital versions of audio books have also evolved. Research and development during the past fifteen years led to the approval of the “Digital Talking Book” standard by National Information Standards Organization (NISO) and the American National Standards Institute (ANSI) as ANSI/NISO Z39.86-2002. Synonymous with “DAISY 3”, a “Digital Audio-based Information System” format developed by the international DAISY Consortium, this ANSI/NISO standard provides the foundation elements of the recently endorsed National Instructional Materials Accessibility Standard (NIMAS). Regardless of which “flavor” of the

⁵ National Library Service, “That All May Read”, http://www.loc.gov/nls/about_history.html

⁶ National Library Service, “History”, http://www.loc.gov/nls/about_history.html

standard is applied, Digital Talking Books hold enormous potential. This format supports recorded human audio either as a stand-alone medium or synchronized to onscreen text, extensive navigation, support for additional media (images, charts and graphs, even video), and, by design, well-formatted Braille.

While these broad-based initiatives have been evolving at the national and international levels, special educators, assistive technology vendors and students have also capitalized on readily-available and cost effective digital solutions. The use of text in electronic formats (etext) by students with disabilities has increased exponentially in the past ten years, and students with visual, learning and attentional disabilities have experienced enormous benefits from the flexibility these formats have offered. Students with visual impairments may use screen readers such as JAWS or WindowEyes to have any onscreen text spoken aloud, while students who do not need to have the entire computer interface read aloud may use supported readers like WYNN, Kurzweil, Read & Write, ReadPlease and eReader to have text spoken aloud by synthetic speech. The majority of these assistive technologies will auditorize files created in Microsoft WORD, RTF, ASCII or HTML, yielding a high degree of flexibility. Many of these software applications are presently being expanded to accommodate the emerging Digital Talking Book (DAISY) formats as well.

Large Print. Many of the libraries and production houses that produce or distribute Braille and Talking Books also produce large print books. The National Library Service maintains a listing of large print production and distribution facilities in the United States. The use of large print materials, while fairly common among older adults with vision loss, is less common in schools. The American Printing House for the Blind does produce large print textbooks, and a number of commercial publishers routinely produce large print versions for sale, although the use of these materials in the nation's classrooms is limited.

etext. As summarized previously, the use of etext as a primary alternate format in today's classrooms has expanded exponentially in during the past ten years. With the exception of Braille, etext formats such as WORD, RTF, ASCII and HTML can provide each of the accommodations that are singly offered by audio-only and large print. etext can be highlighted (selected with a mouse or key combination) and read aloud by synthetic speech on almost any computer. While the tonal quality of computer-generated speech is not as good as recorded human voice, it is far more flexible, and continuing research in this area has resulted in increasingly high quality pronunciation. etext can be instantly increased in size, preferential color schemes can be applied, and letters, words, phrases, sentence, paragraphs and sections can be sequentially highlighted as the text is read aloud.

In the past ten years, the cost of desktop computer technology has steadily decreased while its capabilities have steadily increased. Digital scanning equipment and software, required to transform print into digital text, ten years ago cost thousands; today it costs hundreds. Once a rarity, this technology is not uncommon in schools, and it provides educators will the ability to themselves transform inaccessible print works into accessible digital formats. Faced with the mandates of federal special education and civil rights laws, special educators have turned to this solution.

While this approach to providing accessible versions of print curriculum materials is pragmatic and effective, it also diverts the available educational resources to product retrofitting and file format production – neither of which is an efficient use of instructional resources. These local solutions also result in materials of varying quality and usability, and often end up meeting the

needs of an individual student, with no potential of scalability. Clearly, the acknowledged efficiencies offered by digital tools and formats need to be combined with a national agenda in order to eliminate redundancies and allow educators to return to the task of instruction.

Copyright Law and Efforts to Increase Widespread Availability

As part of the 1966 revisions to the Copyright Act, Section 121 – known as the “Chafee Amendment” - was enacted to allow alternate format creation by “a nonprofit organization or governmental agency that has a primary mission to provide specialized services relating to training, education, or adaptive reading or information access needs of blind or other persons with disabilities”⁷, without seeking permission from the copyright holder. The purpose of the Chafee Amendment was to institutionalize a process by which these specialized organizations could provide alternate format materials and to clarify the ambiguities inherent in existing “Fair Use” requirements.⁸ The Chafee exemption was designed to expedite the creation and availability of accessible versions of selected print works (“non-dramatic literary works”) in “specialized” formats to “qualified” individuals.

While this exemption has significantly facilitated the capacity of educational institutions, both K-12 and postsecondary, to meet the needs of students with disabilities, its requirements have also emerged as ambiguous. As a consequence, many education personnel who provide services to students with disabilities have come to assume that any “special” educator or disability support specialist may obtain or create an accessible version in any format for any disabled student struggling with access to print. Discrepancies in the interpretation of Chafee constraints are not limited to educators, however, since even widely acknowledged “authorized entities” such as Recording for the Blind and Dyslexic and the National Library Service for the Blind apply differing interpretations.

Regardless of whether the Chafee exemption is interpreted narrowly or broadly, its enactment set a precedent in its affirmation of the right of “print disabled” individuals to be provided timely access to the same information as is available to their non-disabled peers, and, pursuant to Section 504 of the Rehabilitation Act, that access should be provided in a format most appropriate to their needs⁹. The fact that some students with Learning Disabilities may not qualify under existing Chafee guidelines, or that students with attentional, cognitive or hearing disabilities are, in fact, excluded collides with the “Access, Participation and Progress” requirements of IDEA and the “Equal Access” requirements of the Rehabilitation Act and the ADA. It is precisely this collision that has motivated educators and disability service providers to err on the side of civil rights legislation and federal special education law when determining which students receive accessible materials and when.

In the long run, the current Chafee exemption provides an inadequate foundation for the large scale provision of alternate format materials for students with print disabilities, simply because it was designed to meet the needs of a small subset of individuals on a case-by-case basis. In order to address the ever-increasing national demand for accessible instructional materials while simultaneously maintaining compliance with intellectual property law, new enterprise-level solutions need to be created.

⁷ Public Law 104-197; Chapter 1 of Title 17, *United States Code*, SEC.121. Library of Congress <http://www.loc.gov/nls/reference/factsheets/copyright.html>

⁸ 17 USC Sec. 107, Title 17, Chapter 1 – Subject Matter and Scope of Copyright, Sec. 107. Limitations on exclusive rights: Fair use (2002)

⁹ OCR Letter: Los Rios Community College District, Office for Civil Rights (OCR), U.S. Department of Education, September, 1993. Case No. 09932214. Retrieved from <http://www.dlrp.org/html/topical/FAPSI/OCR/losrios.html>

At the present time, thirty-one states have alternate format requirements specifically relating to the provision of files for the creation of Braille versions of print textbooks (AFB, 2003). In addition, a smaller but expanding number of states (Arizona, California, Georgia, Kentucky, New Mexico, and New York) either require publishers to provide accessible versions of textbooks, require publishers to provide digital versions, or give preference to publishers who provide accessible versions (Perl et al., 2003).

While the Braille laws are longstanding the expanded state legislation requiring accessible or digital versions of textbooks for a broader category of “print disabled” students has been enacted in the past seven years, primarily as the result of a Section 121 copyright exemption, the Chafee Amendment.

The Chafee Amendment enlisted “authorized entities” to provide permission to “blind or other persons with disabilities” with accessible versions of print materials in “specialized formats”. Originally intended as a means of providing print disabled individuals with accessible versions, Chafee has come to be used by special education personnel in schools, and content transformation organizations (Recording for the Blind and Dyslexic, BookShare, etc.) as the basis for the large-scale creation and distribution of accessible textbooks, without compensation to either publishers or rights holders. This widespread application of Chafee has generated considerable concern among publishers and copyright holders (Adler, 2002), some of whom believe that many current initiatives exceed the Chafee restrictions.

The current system of creating and distributing alternate format instructional materials to print-disabled students is a patchwork of national and local efforts. Conversion entities and repositories who perceive themselves to be “Chafee-compliant” offer a range of alternate formats. Recording for the Blind and Dyslexic produces audio versions, BookShare produces digital text versions in the Digital Talking Book format, American Printing House for the Blind produces both embossed and electronic Braille, and large print, American Foundation for the Blind produces Digital Talking Books, the National Library Service for the Blind produces Digital Talking Books and Braille. For-profit commercial entities such as Duxbury Braille Systems and ghBraille and others also contribute their expertise to the other providers or directly to states and districts. Finally, with the advent of cost-effective and efficient digital scanning technology, local districts and schools have significantly increased their capacities to digitize books directly into more accessible digital formats.

While this array of efforts reflects both the importance of alternate format materials and the deep commitment of alternate format providers, it is also rife with redundancy, inefficiency and inaccuracy. The current options for acquiring alternate formats also results in the creation of materials that vary widely in quality, and perpetuates a process of localized and highly “disability-specific” solutions where efforts to support one sub-group of students with disabilities often do little to support the needs of the other groups.

Working Towards a National Approach

On July 27, 2004, the United States Department of Education officially endorsed the National Instructional Materials Accessibility Standard (NIMAS). This voluntary file format reflects the consensus of disability advocacy groups, publishers, technology experts, and production and distribution experts. Version 1.0 of NIMAS details the baseline technological specifications for the creation of valid digital source files of preK-12 textbooks and related instructional materials. NIMAS Version 1.0 is sufficiently flexible to create multiple student-ready versions (Contracted Braille, Digital Talking Book, etc.) from the same publisher-provided source file package,

eliminating the need for repetitious and inefficient transformations (print-to-Braille; print-to-ebook, etc.). The current standard codifies the minimum requirements for a subset of students with disabilities, particularly those with blindness/low vision and other print disabilities.

NIMAS marks a major step toward ensuring that the ubiquitous textbook will be within reach of students with disabilities at the critical point of instruction in an accessible and usable form. NIMAS will therefore begin to serve the needs of states and local authorities as they endeavor to provide students with disabilities with the opportunity to learn, a prerequisite for participation in standards-based reform and accountability. (Elmore, R.F. & Fuhrman, S.H. 1995; Guiton, G. & Oakes, J., 1995). NIMAS 1.0 is an essential first step that provides the foundation for the subsequent creation of a variety of alternate format versions designed to meet the needs of students with a range of disabilities.

The Department of Education has recently awarded two cooperative agreements to CAST to continue the NIMAS initiative. The NIMAS Development Center will continue the refinement of the NIMAS standard and the NIMAS Technical Assistance Center will provide support to states, publishers and other stakeholders in implementing the standard nationwide.

The Benefits of Accessible Textbooks

What instructional realities underlie the exponential increase in national, state and local attention that is being paid to accessible instructional materials, and how will the increased availability and quality of these materials increase student achievement?

For students with visual impairments. Approximately 94,000 blind/low vision students are provided special education support under IDEA, and for the vast majority of these students, access to alternate format materials is essential (source: American Foundation for the Blind, <http://www.afb.org/Section.asp?SectionID=8>). For a subset of this population, Braille versions of textbooks are the preferred format, and on a daily basis in every state the timely provision of quality Braille textbooks is dependent upon the seamless cooperation of a dispersed network of publishers, textbook adoption entities, alternate format providers, Braille transcribers, teachers of the visually impaired and students. Even when this network of support and provision works efficiently, the time and money required to produce Braille is staggering.

“A book the size of the biology text I have with me today will take approximately nine months to transcribe.” Most transcribers work on several books at one time - and regularly provide volumes of Braille to stay ahead of the class syllabus. A book like this - 1,183 pages - would translate into 4,732 pages in Braille. The average cost to produce this Braille book would be \$16,562.

(Barbara McCarthy, Director, Library and Resource Center, Department for the Blind and Vision Impaired, Richmond, VA 23227. Testimony before the Health, Education, Labor, and Pensions Committee United States Senate hearing on S.2246. The Instructional Materials Accessibility Act: Making Materials Available to All Students, June 28, 2002.)

Thirty-one states with “Braille Laws” require textbook publishers to provide digital files compatible for Braille transcription. These required formats include ASCII, ICADD-22, SGML, .brf, WORD, and RTF. In addition, the majority of states require these files to be provided free of charge. As a consequence, publishers must generate multiple files in multiple formats for multiple jurisdictions, with no financial incentive to produce anything beyond the baseline requirements.

A unified national approach would eliminate many of the current file format incongruities while simultaneously meeting the requirements of individual states, It would increase the quality of Braille-compliant digital files and significantly accelerate the delivery of alternate format materials to students with visual impairments.

For students with physical disabilities. Approximately .8% of the population of students receiving services under IDEA and Section 504 of the Rehabilitation Act of 1973, or 188,000 K-12 students are identified with orthopedic or physical disabilities. While not all of these students experience challenges with print materials, a significant number of them do. The provision of alternate format materials to students with physical disabilities, while not as multi-layered nor as time-consuming as the provision of alternate formats to students with visual impairments, is nevertheless fraught with complexities.

First and foremost, the digital files that are provided to many states for conversion into Braille are generally unsuitable for students whose primary print disability is physical. Since the required digital files are designed primarily to be transformed into a specific “student ready” format (in most cases, Braille) they are not developed with direct display or direct use by students with limited dexterity in mind. It is possible to apply layout and navigation structure (unit, chapter, section, head, subhead, paragraph etc.) or emphasis (bold for glossary terms, for example) as well as validate page number correspondence, but this is a time-consuming process and it is often easier and less costly to scan the print version into a digital format. For the majority of students with physical disabilities, navigation through the text becomes a significant issue since students unable to physically manage a print book are generally unable to use a mouse.

Once supplied with usable structure, the digital file becomes inherently more navigable using voice control, eye gaze, head pointer, single-switch access or keyboard. Unfortunately, the majority of alternate format materials created for students with physical disabilities do not contain images or graphics, so these students are often forced to alternate between the on-screen display of text and the graphical elements in the textbook.

A more unified approach will allow for the creation of varied, well structured and complete student-ready versions, including easily navigable digital files with images, from the same source file, eliminating redundancies and simultaneously improving the accuracy of the alternate version and aligning it with the print work.

For students with learning disabilities. As of 2001, students with specific Learning Disabilities (such as dyslexia, ADHD, etc.) comprised slightly over 45% of all K-12 students with disabilities. (NCES <http://nces.ed.gov/programs/digest/d02/tables/dt052.asp>). While not all of these students struggle to extract meaning from print, and while not all of them may qualify for alternate format materials under the Section 121 copyright exemption, they all evidence unique and challenging learning needs of varying degrees of intensity. A large majority of Learning Disabled students do struggle with print materials, however, and, setting aside for the moment the issue of who does or who does not qualify for alternate format materials under existing copyright law, both special education legislation (IDEA) and civil rights laws (ADA, Section 504) have repeatedly reinforced the rights of students with disabilities to equal learning opportunities, including access to appropriate and accessible textbooks.

Much in the same way that students with visual impairments cannot read a standard 7th grade Social Studies textbook because they cannot see it, students with learning disabilities cannot keep pace in the same class – not because they find the Social Studies content too challenging – but because they cannot read sufficiently to keep pace with their non-disabled peers. In these circumstances, if these students have access to alternative representations of the printed work (audio versions, for example, via synthetic speech or recorded human voice); they will then not be denied access to educational achievement opportunities like Social Studies solely on the basis of their print disability.

The debilitating impact of print disabilities continually emerged through the data compiled from the National Longitudinal Transition Study-2 (NLTS2). Of Learning Disabled students on IEP or Section 504 plans, 41.2% had test read to them as an accommodation, a percentage higher than for students with visual impairments (35.5%)¹⁰. Similarly, the percentage who required “additional time required to complete assignments” (65%) the highest of any population of special education or Section 504 students with the exception of Traumatic Brain Injury¹¹. Clearly the reliance on print materials in the process of education has a profound and compromising impact on Learning Disabled students.

The availability of textbooks in accessible alternative formats suitable for representation via human or synthetic speech would significantly increase the independent use of these core curriculum resources by students with Learning Disabilities.

For students who are Deaf or hard of hearing. Students with hearing impairments are not routinely considered to be “print disabled.” However, young children with hearing impairments either have little or no exposure to the prosody, vocabulary, syntax and semantics of spoken language and it is this foundation upon which the literacy skills of reading and writing are based. Hearing impaired students who acquire sign language as their primary medium of communication internalize a linguistic structure that is marked different from standard English; as a consequence, few Deaf students develop beyond a fifth grade reading level, and this factor alone becomes a significant limitation as these students attempt to progress through school. In fact, some of the most recent research on the literacy level of 17- and 18-year-old Deaf students yielded a median reading grade level score of 4.0 on the Stanford 9¹².

During the past decade, research has emerged which documents a strong causal relationship between proficiency in sign language (specifically, ASL) and proficiency in standard English (Strong & Prinz, 1997; Prinz & Strong, 1998; Padden & Ramsey, 2000). Researchers who have found promise in this “bilingual” approach to improving Deaf literacy also note that providing signed equivalents to standard English (or English equivalents for sign) has generally relied upon the sequential display of information – first sign, then English, for example, primarily because the logistics of creating an accurate, efficient and practical approach to creating a simultaneous display – both sign and English available at the same time – have been daunting. There is wide spread agreement, however, that technologies such as the Signing Avatar and the use of

¹⁰ Levine, P. & Wagner, M. *Secondary School Students’ Experiences in Secondary Education Classrooms, National Longitudinal Transition Study-2 (NLTS2)*, SRI, Menlo Park, CA, 2004

<http://www.nlts2.org/search/tables/7/NPR1D3afm.html>

¹¹ Ibid

¹² Holt, Judith A., Traxler, Carol B., & Allen, Thomas E. 1997. Interpreting the Scores: A User’s Guide to the 9th Edition Stanford Achievement Test for Educators of Deaf and Hard-of-Hearing Students. *Gallaudet Research Institute Technical Report 97-1*. Washington, DC: Gallaudet University.) <http://gri.gallaudet.edu/Literacy/#reading>

concatenated video recordings of human interpreters can increasingly be combined with ever-increasing power of computers to create instantaneous onscreen translations from one language to another.

The increased availability of digitally-based standard textbooks provides the necessary foundation elements for the subsequent creation of learning resources that contain both signed and text versions of the same instructional content.

For students with mental retardation, traumatic brain injury and other cognitive impairments. This subset of students with IEP's or Section 504 plans, though ineligible for alternate format materials under the "Chafee" copyright exemption, often find their educational opportunities limited by the inflexibility of instructional materials. In contrast to the drill and practice approach to basic "sight word" development that permeated the reading instruction of students with cognitive disabilities for many years, recent findings (Gurry, S. & Larkin, A. (1999); National Reading Panel) indicate a shift in awareness towards a research-based approach. Koppenhaver, Erickson & Skotko, (2001) and their colleagues at the Center for Literacy and Disabilities Studies suggests that students with mental retardation benefit from the same research-based instructional approaches that work for other students who are learning to read (National Reading Panel, 2000). That is, reading instruction that:

- Focuses on reading for meaning
- Provides direct instruction in reading skills such as decoding
- Offers appealing print and electronic texts.

The type of reading instruction envisioned by the National Reading Panel contributors and by other researchers is readily facilitated by the availability of flexible, adjustable versions of core instructional materials.

Media that can be transformed from one modality to another (text-to-speech, for example) or used to customize the display of a page into discreet and manageable chunks can help to focus the attention of distractible students or help differentiate salient from less important information. Students with mental retardation often experience difficulty with motivation and attention¹³. These students clearly benefit from engaging and adjustable displays, or displays that support constrained presentations of information. Further, research has shown that students with mental retardation have difficulty understanding abstract concepts, especially when the abstractions cannot be effectively concretized or represented as an aid to understanding¹⁴.

Accessible, flexible alternate versions of core curriculum materials can increase engagement, attention and achievement by offering adjustable levels of complexity, novelty and mixed media.

Challenges to Be Overcome

Technological Challenges. The initiative to establish version 1.0 of the National Instructional Materials Accessibility Standard (NIMAS) is designed to provide the foundation for the subsequent creation of a variety of alternate format versions designed to meet the needs of students with visual, physical, hearing, learning and cognitive disabilities. The NIMAS file

¹³ Hickson, L., Blackman, L.S. & Reis, E.M. (1995). *Mental retardation: Foundations of educational programming*. Boston: Allyn & Bacon

¹⁴ Beirne-Smith, M., Ittenbach, R. & Patton, J.R. (1998). *Mental retardation (5th ed.)*. Upper Saddle River, NJ: Prentice Hall.

package will consist of an XML (eXtensible Markup Language) source file and associated PDF (Portable Document Format) files that contain the graphical elements included in print textbooks. One proposed workflow involves the distribution of the NIMAS file package to centralized repository for validation and subsequent distribution to third-party content conversion organizations (Recording for the Blind and Dyslexic, BookShare, American Printing House for the Blind, etc.) who will in turn create a variety of student-ready versions for distribution to schools and states. Alternatively, the NIMAS file package might be distributed directly to states that have established digitally-based alternate format distribution mechanisms (e.g., Texas Braille Production Center, the Kentucky Digital Text Network, etc.). Regardless of the distribution established, a number of technological challenges need to be addressed.

Legislative Challenges. As mentioned previously, six states have extended the scope of their existing Braille laws to encompass broader requirements for accessible textbooks. While these state-level mandates are progressive in their intent and designed to facilitate the state's capacity to meet its obligations under existing federal special education and civil rights laws, they are also duplicative, and, in some cases, divisive. Only three of the six states (Kentucky, Arizona and New Mexico) specifically reference an alignment with a "national file format" (NIMAS) once endorsed by the United States Department of Education; without this acknowledged alignment with a unified national format, some existing and emerging state legislation threatens to perpetuate redundancies and inefficiencies.

In order to prevent this effect, curriculum publishers, third-party content transformation organizations, and disability advocacy groups have proposed and supported first the Instructional Materials Accessibility Act of 2002 (IMAA) and, more recently, the inclusion of a mandated NIMAS compliance in the reauthorization of IDEA. Both of these federal legislative efforts are designed to achieve the same goal: a federal mandate for both states and publishers to adopt a unified approach to address this issue.

Commercial Challenges. The systematic provision of accessible alternate format versions of print materials began with the invention of Braille in the early 1800s¹⁵. The institutionalization of this effort in the United States occurred in the early 1930s with the establishment of the National Library Service for the Blind at the Library of Congress¹⁶. Government-supported organizations like Recording for the Blind and Dyslexic and American Printing House for the Blind were created to address an expanding and differentiated need. The steady emergence of additional non-profit and for-profit alternate format organizations during the past fifty years has attested to the sustained need for these materials.

Inherent across all of these initiatives has been an acknowledgement that the provision of alternate format versions of print materials is an expensive and time-consuming process. Historically, practice has dictated that individuals with "print disabilities" be provided with these versions at reduced or no charge, and, concomitantly, that print publishers not be expected to produce this content, but to facilitate its production at little or no cost to the consumer. Since the passage of the first Elementary and Secondary Education Act (ESEA) in 1965 and the

¹⁵ Roblin, J. (1952) *The Reading Fingers: The Life of Louis Braille*. Translated from the French by Ruth G. Mandalian. (Original in English, 1955) New York: American Foundation for the Blind. (Reprinted, 1993)

¹⁶ Perl, E. (2002). Federal and State Legislation Regarding Accessible Instructional Materials. National Center on Accessing the General Curriculum, CAST, Inc. Wakefield, MA. Retrieved from <http://www.cast.org/publications/index.html>

subsequent evolution of state departments of education as distribution points for “categorical” aid (Title I, Title IV, Title VI, etc.)¹⁷, these state-level requirements have steadily increased.

Concurrent with this increased systemic demand, the local (site-based) transformation of print textbooks into accessible digital versions -- WORD or HTML or RTF files, for example -- has also increased exponentially. As previously mentioned, special education personnel at the state, local and district level interpret the Chafee copyright exemption as providing them with a legal means of creating accessible versions of textbooks to students identified as print disabled. While this approach offers a pragmatic solution to meeting the needs of students in a timely manner, very few of these local efforts include any embedded security (digital rights management) to ensure their limited distribution and use. Further, there is nothing in the Chafee exemption that requires the purchase of a print version of the textbook for students who are eligible for alternate format versions, although in practice the print version is purchased as an artifact of a site’s purchasing policies.

Finally, as these localized accessible format creation efforts become more widespread, the determination of which students are actually eligible to receive these versions is often left to special education personnel who may or may not be fully aware of the constraints imposed by the Chafee exemption. Even when special educators are aware of the requirements, the division of students into “haves” and “have-nots” may appear arbitrary and capricious, and fundamentally inequitable. Faced with providing some students with accessible materials and not others, most educators will decide to support the equal access provisions of federal special education and disabilities law in favor of abiding by copyright constraints. This, in turn often begs the question of why these materials should not be made available to students who can certainly benefit from them, but who fall well outside the population sanctioned by Chafee (English Language Learners, for example).

This cluster of challenges – the cost to publishers of responding to a myriad of state requirements with no compensation; the widespread increase in unmonitored localized solutions that may negatively impact textbook sales, and increased pressure to extend the provision of these materials to an ever-widening circle of students – has created a significant challenge to the creation of a commercial solution.

A commercial solution offers one of the most compelling scenarios for the timely provision of high quality accessible textbooks to students with, or without, print disabilities. Many textbook publishers are now routinely acquiring the rights to reproduce materials digitally as well as in print. If states, districts, schools and classrooms were willing to purchase these materials in addition to or as an alternative to traditional print textbooks, it would eliminate the need to perpetuate ad hoc local solutions. Accessible commercial versions of textbooks could benefit from cooperative arrangements between existing third-party alternate formats organizations – experts in designing to meet the needs of their constituents – and commercial publishers, who themselves would be incented to invest in research and development to insure the high quality of these products. In order for commercial publishers to envision the viability of this type of “market” solution, they will need to perceive the willingness of states, districts and schools to purchase these materials.

¹⁷ Ravitch, D. (2000). The reauthorization of the federal Elementary and Secondary Education Act: An Introduction, *Brooking Papers on Educational Policy*. Brookings Institute, Washington, DC.

In order to address each of the three challenges listed above – technological, legislative and commercial – each stakeholder group will be required to shift and adapt its current practice.

Adjustments by Each Stakeholder Group Will Benefit All

Publishers. Textbook publishers will need to develop the capacity to create properly formatted XML files. Some of the major publishing houses have already or are in the process of migrating to a digital (XML) workflow, and for these companies the creation of the agreed-upon source files will be an extension of an existing process. For publishers who do not have XML file creation capabilities or for whom that process would be cost prohibitive (smaller, supplemental publishers, for example), the creation of these files will be more problematic and will likely require new and innovative partnerships. All publishers will need to be provided with technical assistance, guidelines and models in order for them to create valid and properly-structured XML files. Finally, publishers will need to be convinced that the technological investment will contain their current costs, facilitate their ability to respond to multiple state and local requirements, maintain quality, and align with intellectual property law.

Third-Party Conversion Organizations. Existing “Chafee Compliant” non-profit alternate format conversion organizations like Recording for the Blind and Dyslexic, BookShare, American Printing House for the Blind, and others will need to envision strategic partnerships that place their expertise at the beginning of a publisher’s product cycle rather than just at the end of it. If publishers produce only print-based materials then the primary work of third-party organizations is the transformation of those print works into accessible formats. Once publishers are able to routinely produce digital files, however, the need for third-party conversion will diminish incrementally, while the opportunity to incorporate accommodations and alternatives directly into curriculum materials – a universal design approach – will concomitantly increase. A collaborative approach pairing the disability and alternate format expertise of the third-party conversion organizations with the editorial and instructional expertise of curriculum publishers will likely result in more innovative and accessible products than either organization could independently create.

States, Districts and Schools. Educators who teach and support students with disabilities will need to assess the benefits of embracing a more proactive and systemic approach to acquiring alternate format materials for their students. While existing district or school-level solutions may address the immediate needs of individual students, in most instances these solutions are neither scalable nor cost-efficient, they often yield curriculum materials of inferior quality, and, in some circumstances, these initiatives may violate copyright law. Further, and perhaps of most importance, these local content transformation efforts divert the efforts of education personnel away from the process of instruction.

States that have enacted accessible textbook legislation (Braille and beyond) are most likely to have also established centralized accessible textbook distribution systems to support those mandates. The purpose of these centralized approaches is to insure copyright compliance, quality, and timeliness and to minimize redundancy and inefficiency. In many circumstances the management and oversight of these systems by states also frees district and school education personnel from the process of retrofitting materials and allows them to redirect their time to instruction.

To further institutionalize the expectation that students with print disabilities will be provided with accessible and appropriate alternate format versions some states have added an additional consideration to their Individual Education Plan (IEP) and Section 505 Plan documents. Asking

the site-based teams who best know the needs of individual students to document whether or not the student is eligible to receive accessible alternate format curriculum materials reinforces the expectation that these materials will be provided.

Finally, as the requests (or, in some cases, the requirements) for accessible materials from states, districts and schools increase, these entities need to express their willingness to purchase these products. Textbooks and associated instructional materials can be made accessible by design, and the availability of these versions as market alternatives will only occur if the market is perceived as viable.

Accessible Textbooks: Reaching Every Student, Then Teaching Every Student

While the primary purpose of establishing either a national alternate format distribution process or a market based solution is to ensure the timely provision of accessible materials to students with disabilities, it is important to maintain the focus that these materials will be used to support the education of these students. From that perspective, it is important to address how, and to what extent, alternate, accessible versions of textbooks enhance student achievement. This emphasis on increasing the achievement of all students, including those with disabilities and other learning needs, is a hallmark of NCLB, and needs to be an active consideration as accessible, alternate format materials become more widely available.

As previously mentioned, the existing NIMAS initiative is developing within the constraints imposed by existing copyright law, and the Section 121 exemption (Chafee Amendment) that address the needs of a specific subset of students with print disabilities. As referenced in the NIMAS version 1.0 report¹⁸:

Students who manifest a print disability as the result of a physical or sensory impairment (blind, low vision and some learning disabled students) currently qualify, while students who may struggle equally to decipher or extract meaning from print (ADHD, Deaf and hard-of-hearing, students with limited cognitive of abilities, etc.) do not. (p.36)

Regardless of which students are presently eligible to receive alternate format textbooks, the fact remains that the precedent-setting consensus building achieved by the National File Format Technical Panel has established both a foundation for the creation of accessible, alternate format versions and the broad-based momentum necessary to deliver these versions to students who require them. In addition to the states (Kentucky, Arizona, New Mexico) that have already referenced the adoption of NIMAS in their state-wide accessible textbook legislation, and major publishing houses (Thompson, Pearson, Houghton-Mifflin, McGraw-Hill) have pledged NIMAS adoption as well. Further, major postsecondary publishers and a number of organizations working to secure accessible versions of college textbooks have indicated that they will adopt the NIMAS standard, once formalized, in their procurement processes.

This momentum towards a standardized approach raises a significant question: since accessible versions of core curriculum print textbooks have previously not been available in sufficient quantities to measure their broad impact within the context of academic achievement, for both students with disabilities and those without, what impact do they have? It is known that students with a wide range of disabilities (including those who currently qualify as persons with print

¹⁸ National File Format Technical Panel, National Instructional Materials Accessibility Standard Report – Version 1.0, National Center on Accessing the General Curriculum, CAST, July, 2004, retrieved from <http://nimas.cast.org/about/report/index.html>

disabilities and those who do not) can benefit from technology-based instructional solutions, and some of this documentation was provided in the NIMAS Version 1.0 report¹⁹.

A recent extensive summary of research in this area has been prepared by the National Center on Accessing the General Curriculum (Strangman, Hall & Meyer 2003). Among many studies in this area are the following:

- Students with language-related disabilities showed positive effects for word recognition, comprehension, and fluency when using digital texts with synthetic, syllable, or letter name-level synthetic speech transformations. (Elbro, Rasmussen & Spelling, 1996)
- Students with attentional, organizational and learning disabilities have shown increased academic gain when exposed to technology-supported concept mapping strategies. (Anderson-Inman, Knox-Quinn & Horney, 1996; Herl, O'Neil, Chung & Schacter, 1999)
- Students who are Deaf or hard of hearing show consistent academic gains when provided with the sequential text highlighting and supportive captions available with digital instructional materials. (Mcinerney, Riley & Osher, 1999; Andrews & Jordan, 1997)
- Students with low cognitive abilities demonstrate increased functional skills when exposed to flexible technologies that maximize their strengths while helping to compensate for their weaknesses. (Wehmeyer, Smith, Palmer, Davies & Stock, 2003; Carroll, 1993)

(NIMAS Version 1.0, p. 36)

We know that visually impaired students cannot see words or images, and that alternate format versions, specifically digital, can more easily be converted to Braille or voice with text descriptions of images. Students who cannot hold a print book or turn its pages, benefit from the virtual “pages” of a digital book can be turned with a key press or a switch. Students who cannot decode the text, can benefit from any words read aloud by a computer. Going beyond baseline accessibility, students who lack background vocabulary can benefit from definitions (in English or another language) that can be readily provided. Moving beyond accessibility, digital texts can also be embedded with supports for syntax, semantics, and comprehension (Boone & Higgins, 1993; Dalton, Pisha, Eagleton, Coyne & Deysher, 2001; MacArthur & Haynes, 1995).

The advantage of digital source files is that these alternatives, and many others, can be created from them and made available on an individual student basis. These versions then become available for students who require them, and, ultimately, an option for students who may prefer them. They enable teachers to individualize materials in previously unimaginable ways (Hay, 1997; Lewin, 2000; MacArthur et al., 1995). Customized alternatives can substantially reduce the barriers found in traditional texts, and research evidence demonstrates the benefits of using such digital materials in the classroom (Barker & Torgesen, 1995; Bottge, 1999; Dalton et al., 2001; Erdner, Guy & Bush, 1998; MacArthur et al., 1995; Wise, Ring & Olson, 1999).

Conclusion

Technological advances during the past fifty years have resulted in alternate format materials, providing those with disabilities new access to a world of information and ideas that traditionally has been restricted to printed text. Consistent Braille formatting, high-quality audio versions,

¹⁹ Ibid

synthetic speech, and electronic text are just some examples. Because it offers significantly increased flexibility and enables rapid transformations from one media type to another, electronic text in particular is emerging as the foundation of a revolutionary approach to the provision of alternate format materials. As that approach is realized, students with disabilities will be provided with a wide range of accessible and individualized learning materials; materials that have been extracted from a single digital source file. The efficiency of this approach is immediately apparent, and while there are numerous legal, commercial and technological issues to be overcome, everyone stands to gain from achieving a solution.

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