Reading difficulties in the general education classroom:
A taxonomy of text modification strategies

By Dave L. Edyburn

Learning to read is a developmental milestone celebrated by hundreds of thousands of young children every school year. Not everyone, however, learns to read by third grade. Recognition of the personal and social costs associated with not being able to read was a key issue motivating passage of the federal educational accountability legislation known as NCLB, "No Child Left Behind Act of 2001," (P.L. l07-110).

Let's reiterate a few facts:

• 96% of students with disabilities attend regular schools. The majority spend most of their school day in general education classrooms (U.S. Department of Education, 2002).

• One of the leading reasons for referral to special education involves reading difficulties. Estimates suggest that 80% of students with learning disabilities receive services for a reading disability (Bryant, Young, & Dickson, 2001).

• The Nation's Report Card on the reading skills of fourth graders for the year 2000 reveals that 63% of the students read at the basic skills level. Only 32% of the fourth graders read at proficient or expected levels (Donahue, Finnegan, Lutkus, Allen, & Campbell, 2001).

Access to the general curriculum

Whereas learning to read is the predominant focus of reading instruction in grades 1-3, in grade 4 and beyond, the focus is on reading to learn. However, what happens when a child with a disability cannot read at grade level? When does a child have the opportunity to learn how to read when he's spending the majority of his time in the general education classroom where the focus is on reading to learn? If a child cannot read at grade level, how will he acquire the essential knowledge he is supposed to learn? Indeed, unresolved questions like these are at the crux of many discussions about inclusion, high-stakes assessment, and now the mandates associated with NCLB.

Increased attention has been devoted to approaches for making the general education curriculum accessible. King-Sears (2001) describes a three-step process model for schools to use for reviewing and improving curriculum accessibility. Wehmeyer, Lattin, and Agran (2001) examine issues associated with access to the curriculum for students with mental retardation. The development of the Student Access Map (SAM) by Dacey, Eichleay, and McCauley (2002) offers a means to systematically review the use of assistive technology for enhancing curriculum access. Despite these important advances, to-date, inadequate attention has been devoted to the problems associated with reading deficiencies in the general education classroom and ways in which technology can facilitate access to the curriculum and subsequently enhance learning.

Remediation vs. compensation

Part of the problem may be our inability to explicitly articulate the relationship between remediation and performance support technology (Edyburn, 2002b). Two theorists (Cook & Hussey, 1995, 2002; King 1999) have highlighted a critical, but overlooked question, associated with assistive technology consideration. That is, how do we decide if the best course of action is remediation (i.e., additional instructional time, different instructional approaches) versus compensation (i.e., recognizing that remediation has failed and that compensatory approaches are needed to produce the desired level of performance)?

Perhaps it is not coincidental that these writers are therapists by training and thus are experienced in making decisions about physical performance. For example, if I cannot complete certain tasks with-

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out my right arm, additional therapy may be an option if I am recovering from surgery, but not an option if I've had an amputation. Certainly, the benchmarks to guide decision-making about remediation and compensation are much clearer in situations involving mobility and sensory impairments. Unquestionably, compensatory approaches are often used because there are simply no other ways to complete the task.

Remediation: instructional technology

Teachers are extremely comfortable with the options associated with remediation: reteach the information, use alternative instructional strategies, break the tasks down into smaller parts to analyze what the child knows and what components are problematic, provide additional practice, engage in one-on-one tutoring, etc. Technology applications in this realm are often thought of as instructional technology.

For students needing additional instruction to learn to read, many options are available. Some products provide carefully sequenced instruction and extensive student management systems for guiding students through an appropriate sequence of instruction (i.e., Balanced Literacy, <www.intellitools.com>; Lexia Early Learning, <www.lexialearning.com>; Read 180, <www.scholastic.com>; Reading Strategies for Older Students, <www.donjohnston.com>; Simon Sounds It Out, <www.donjohnston.com>; WiggleWorks, <www.scholastic.com>. Other products provide supplementary and enrichment opportunities for readers or specific skill development (i.e., First Words, <www.laureatelearning.com>; Reading for Meaning, <www.tomsnyder.com>. Other tools seek to improve instruction through an improved individual performance assessment data (i.e., Soliloquy Reading Assistant, <www.reading-assistant.com>.

However, if remedial approaches always worked, we would never see high school students that couldn't read independently beyond the second grade level or middle school students who failed to master the basic math facts. Routine failure to attain appropriate levels of academic performance should trigger assistive technology consideration. That is, compensatory strategies that use technology to enhance performance.

Compensation: assistive technology

At some point in the educational process, we must recognize the need for compensatory approaches. For example, if a known characteristic of a student's disability involves difficulty processing and retrieving information, then why doesn't the IEP team's consideration of assistive technology result in the recommendation of the Web search engine, Ask Jeeves? Functionally, this would allow a child to look up the answers to anything s/he doesn't know. Of course, our first response is that would be cheating. However, change the context. If I was an employer, would I value your ability to find information in a timely manner, or would I prefer to penalize you for the fact that you didn't know? (For additional information on fairness, see Welch, 2000.)

Compensation approaches recognize that on-going persistent deficits in performance must be addressed through strategies that minimize or eliminate the impact of disability on performance. Despite the critical importance of reading, beyond simplistic text-to-speech applications, little attention has been devoted to advancing theory and practice relative to assistive technology for reading (Cook & Hussey, 2002).

Assistive technology for learning

Despite the current educational reform rhetoric about high academic standards, educational practice prefers to hold time constant rather than performance. That is, if all students are to achieve a given education standard, then time should vary to allow for differences in learning. However, we prefer to hold time constant (i.e., one day lessons, two week units) moving onto the next topic despite the extreme variance in performance by a class. As a result, when time is held constant it is impossible to make claims about all students achieving high standards. Rather, it suggests the urgent need to provide compensatory interventions since a student's history documents a pattern of failure given typical instructional strategies. After all, if time is to be held constant and traditional instruction has generally failed to produce acceptable levels of academic performance, then it appears that the only other option is to explore the options for

Table 1 - Strategies and Resources for Reading Material in Alternative Formats	
Strategy	**Resources**
audio books	American Printing House for the Blind, <www.aph.org/>
	Audible.com, <www.audible.com>
	Audio Books for Free, <www.audiobooksforfree.com/>
	Books Aloud, <www.booksaloud.org/>
	National Library Service for the Blind and Physically Handicapped <www.loc.gov/nls/>
	Recordings for the Blind and Dyslexic, <www.rfbd.org/>
e-texts via membership	BookShare.org, <www.bookshare.org>
e-texts in the public domain	Bibiomanic, <www.bibliomania.com>
	Electronic Text Center, <etext.lib.virginia.edu/>
	Infomations, <www.infomotions.com>
	Library of Congress, <www.loc.gov>
	The Plays of William Shakespeare, <www.theplays.org>
	Worditude, <www.worditude.com/ebook/index.html>
	Project Gutenberg, <promo.net/pg/>
periodicals	Some periodicals can be found on the Web in digital format.
ready-reference	Ask Jeeves, <www.askjeeves.com>
	Dictionary.com, <dictionary.reference.com/>
	RefDesk, <refdesk.com>
scan print materials using OCR software	OmniPage, <www.scansoft.com/omnipage/>
scan print materials using OCR software and text-to-speech	TextHelp, <www.texthelp.com/>
	WYNN, <www.freedomscientific.com/WYNN/>
teacher-made materials	Request the word processing file that was used to create the document.

technology-enhanced performance (assistive technology).

Unfortunately, few guidelines are available to inform decision-making about assistive technology for learning. If a child has repeatedly failed a test of essential knowledge (e.g., adding fractions, states and capitals, presidents of the United States, parts of a plant), how much failure data do we need before we have enough evidence that the child can't perform the task? When do we intervene? And, what do we do?

The pervasive problem of children not being able to read textbooks is well documented (Allington, 2002; Cibrowski, 1993). The key question in the NCLB-era is: What do we do about it? Whereas the assistive technology consideration process provides a mechanism for addressing the critical decisions associated with whether to pursue remediation or compensation strategies, the question should be explicitly addressed rather than assumed that the question is intrinsic to the process. Further, it may not be an either/or decision. Rather, it may be necessary to ask, what percentage of time and effort will be devoted to remediation and what percentage of time and effort will be devoted to compensatory approaches?

The purpose of this article is to advance a decision-making framework for assistive technology consideration concerning text modifications for students with reading difficulties in the general education classroom. A brief discussion concerning the source materials student readers may encounter will be followed by an overview of a taxonomy of text modification strategies and its application for assistive technology consideration.

Mixed media source materials

Rose and Meyer (2002) argue eloquently for the need to have curriculum, instruction, and assessment (C-I-A) materials in a digital format. When C-I-A materials are available in a digital format, a wealth of possibilities are available for manipulating the information into formats appropriate for individual learner's needs. Advocates of universal design suggest that digital C-I-A will have a profound impact by enhancing educational performance for all learners (Hitchcock, Meyer, Rose, D., & Jackson, 2002; Rose & Meyer, 2002).

When students are required to learn from text, any number of sources and formats may be involved: (a) Web pages, (b) textbooks, (c) teacher-created handouts, (d) periodicals, or (e) reference materials. Therefore, assistive technology and universal design interventions must recognize the array of information sources and formats commonly used in classrooms. Table 1 outlines a number of essential resources for teachers, therapists, and technology specialists in need of accessible reading materials.

Regardless of the source of the original text, to make "the curriculum accessible", it is necessary to obtain the information in a digital format. Once we have a digital version of a reading assignment, a number of text modification strategies are possible. To-date, much of the potential of assistive technology has yet to be captured due to the limited amount of classroom instructional material available in digital format.

Text modifications

In response to mandates to make the curriculum accessible, the majority of efforts by assistive technology specialists to make reading materials accessible involved scanning textbooks into the computer and teaching students to use text-to-speech software so they could listen to information that they could not read independently. Observers have noted the extensive time required of teachers to make these modifications (Dyck & Pemberton, 2002; Edyburn, 2002a). Critics bemoaned that listening to text was not the same as reading (notice the unresolved remediation vs. compensation issues in this argument), while universal design advocates argued that text-to-speech could prove beneficial to everyone. The lack of theoretical constructs and systemic decision-making guidelines have contributed to confusion concerning what types of modifications should be made and who could benefit from which modifications.

The theoretical void on this topic has been partially filled recently through the work of Dyck and Pemberton (2002). They advance a model for making decisions about text adaptions and outline the theoretical rationale for five types of text adaptations: (1) bypass reading, (2) decrease reading, (3) support reading, 4) organize reading graphic organizers, and (5) guide reading, and provide examples of how these interventions might be used by struggling readers and their teachers.

Despite my excitement about the work of Dyck and Pemberton (2002), assistive technology is not central to the proposed interventions. Nonetheless, inspired by the clarity of their approach, I created a taxonomy of text modifications strategies

Table 2 - A Taxonomy of Text Modification Strategies

If the reading problem is due to…	…the functional difficulty is…	…then, AT consideration should explore…
inability to see the text	low vision	screen magnification
the fact that English is a second language	limited English language skills	language translation
a lack of interest	motivation / interest	high interest reading material
poor decoding skills	inadequate word attack skills	multimedia reading materials
too many unknown words	vocabulary deficiencies	electronic word tools
a lack of fluency	reading is slow and tedious	audio books
		text-to-speech software
		text-to-speech conversion software
a mismatch between the text's readability level and the reader	poor comprehension	cognitive rescaling
difficulty understanding due to limited back ground knowledge	poor comprehension	locate comparable content at a lower developmental level
difficulty understanding concepts and relationships	poor comprehension	concept mapping
difficulty identifying important information	poor comprehension	electronic quizzes

(see Table 2). The purpose of this work is to facilitate assistive technology consideration by (a) raising awareness about the remediation/compensation decision, (b) providing a systemic process for examining assistive technology interventions and overcoming the "paradox of consideration," and (c) stimulating research on assistive technology outcomes in education. Teachers, therapists, and assistive technology specialists can utilize the decision chart by using diagnostic information about the student's needs in column one or by selecting the appropriate functional deficit in the second column. Either of these access points will provide users with starting points to locate information in column three to guide assistive technology consideration efforts.

The taxonomy represents an important contribution to assistive technology consideration by providing teachers, therapists, and technology specialists with tools for locating appropriate assistive technologies. The paradox of consideration (Edyburn, 2000) is that non-specialists are mandated to consider assistive technology possibilities, but often do not have access to the knowledge base of experts, and thereby are deprived of opportunities to actually consider the full array of possibilities. Once a reader has located an area of assistive technology consideration in Table 2, a resource listing like the one found in Table 3 can be made available to guide subsequent exploration and evaluation of the possibilities.

Implications for practice

The value of the current taxonomy and assistive technology consideration tools presented here needs to be tested for its efficacy and effectiveness through research and practical application. If this approach appears viable, taxonomies like the one presented in Table 2 could be developed for all major areas of the curriculum where students' academic performance is less than desired (i.e., organization, math, behavioral challenges, etc.).

New tools for decision-making would demonstrate important progress in overcoming the "paradox of consideration" and fulfilling the original purposes of the assistive technology consideration mandate. Ideally, Tables 2 and 3 should be transformed into Web pages to provide users with an interactive experience in selecting appropriate assistive technologies to explore with individual students. Additional links could also be provided to download ready-to-use performance assessment materials to provide data collection and analysis tools for data-based decision-making about the effectiveness of each intervention for any student.

Concluding thoughts

In this NCLB-era it is unlikely that interest in the issues associated with low reading performance will diminish anytime soon. Readers interested in accessing more information on research-based approaches to reading instruction are encouraged to consult works by the National Reading Panel (2000), Hunter (2000), Jetton and Alexander (2000), and Snow, Burns, and Griffin (1999).

If a fundamental characteristic of a disability is difficulty learning, then it behooves the profession to respond with a deeper understanding of assistive technology for

Table 3 - Assistive Technology Consideration: Reading	
Strategy	Resources
Screen Magnification	enlarge the font in the current program
	utilize the Accessibility features in the Control Panels
	ZoomText, <www.aisquared.com>
Language Translation	Bablefish, <world.altavista.com>
High Interest Reading Materials	How Stuff Works, <www.howstuffworks.com>
	Living Books, <www.riverdeep.net/products/living_books/index.jhtml>
	Start-to-Finish Books, <www.donjohnston.com>
Multimedia Reading Materials	Hollywood High, <www.tomsnyder.com>
	Living Books, <www.riverdeep.net/products/living_books/index.jhtml>
	My First Amazing Science Explorer, <www. edresources.com>
	Sammy's Science House, <www.edmark.com>
Electronic Word Tools	Franklin Spelling Ace, <www.franklin.com>estore/details.asp?ID=SA-206>
	Reading Pen, <www.wizcomtech.com>
	Dictionary.com>, <dictionary.reference.com>
	Thesaurus.com>, <thesaurus.reference.com>
	The Plumb Design Visual Thesaurus, <www.visualthesaurus.com>
	Usborne's Animated First Thousand Words, <www.tomsnyder.com>
Audio Books	American Printing House for the Blind, <www.aph.org>
	Audible.com>, <www.audible.com>
	Audio Books for Free, <www.audiobooksforfree.com>
	Books Aloud, <www.booksaloud.org>
	National Library Service for the Blind and Physically Handicapped, <www.loc.gov/nls/>
	Recordings for the Blind and Dyslexic, <www.rfbd.org>
Text-to-Speech Software Screen Readers	CAST eReader, <www.cast.org/udl/index.cfm?i=211
	JAWS for Windows, <www.freedomscientific.com>fs_products/software_jaws.asp>
	ScreenReader, <www.texthelp.com/screenreader.asp?section=product>
Talking Word Processors	ReadPlease, <www.readplease.com>
	WordQ, <www.wordq.com>
	Write OutLoud, <www.donjohnston.com>
	WYNN, <www.freedomscientific.com/WYNN/>
Text-to-Speech Conversion Software	Text Aloud, <www.textaloud.com>
Cognitive Rescaling	executive summaries: Microsoft Word, <www.microsoft.com>
	rebus-enhanced text: Picture It, <www.slatersoftware.com>
Electronic Quizzes	QuizStar, <quiz.4teachers.org>
	Quiz Center, <school.discovery.com>quizcenter/quizcenter.html>
Locate Comparable Content at	Google, <www.google.com>
	TrackStar, <trackstar.hprtec.org>
	Windows on the Universe, <www.windows.ucar.edu>
Concept Mapping	Inspiration, <www.inspiration.com>
	Kidspiration, <www.inspiration.com>
Pre-reading Guides	Study Guides and Strategies, <www.iss.stthomas.edu/studyguides/>
Structured Notes Summaries	Read On!, <www.sunburst.com>

learning in order to ensure that children and youth are receiving a free appropriate publication education (FAPE). As a result, I believe there is an urgent need to address the gap in the knowledge base regarding the relationship between remediation and compensation as it applies to students with disabilities; their failure to experience high levels of successful academic performance, as is their right under FAPE; and the role of assistive technology to enhance learning.

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