WINTER EDITION 2014

PERSPECTIVES
ON LANGUAGE AND LITERACY

A Quarterly Publication of The International Dyslexia Association

Volume 40, No. 1

TECHNOLOGY AND DYSLEXIA
PART 2

The International DYSLEXIA Association®

Promoting literacy through research, education, and advocacy.™

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ON LANGUAGE AND LITERACY

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IDA PURPOSE STATEMENT

The purpose of IDA is to pursue and provide the most comprehensive range of information and services that address the full scope of dyslexia and related difficulties in learning to read and write…

In a way that creates hope, possibility, and partnership…

So that every individual has the opportunity to lead a productive and fulfilling life, and society benefits from the resource that is liberated.

The International Dyslexia Association (IDA) is a 501(c)(3) non-profit, scientific and educational organization dedicated exclusively to the study and treatment of the specific language disability known as dyslexia. We have been serving individuals with dyslexia, their families, and professionals in the field for over 55 years. IDA was first established to continue the pioneering work of Samuel T. Orton, M.D., in the study and treatment of dyslexia.

IDA's membership is comprised of people with dyslexia and their families, educators, diagnosticians, physicians, and other professionals in the field. The headquarters office in Baltimore, Maryland is a clearinghouse of valuable information and provides information and referral services to thousands of people every year. IDA's Annual Conference attracts thousands of outstanding researchers, clinicians, parents, teachers, psychologists, educational therapists, and people with dyslexia.

TECHNOLOGY AND DYSLEXIA—PART 2

ON THE COVER: "The Lone Tree" (a tribute to Vincent Van Gogh) was contributed by Scott Robertson, a sixth grader at Rawson Saunders School.

IDA supports efforts to provide individuals with dyslexia with appropriate instruction and to identify these individuals at an early age.

The International DYSLEXIA Association®

Promoting literacy through research, education, and advocacy.™

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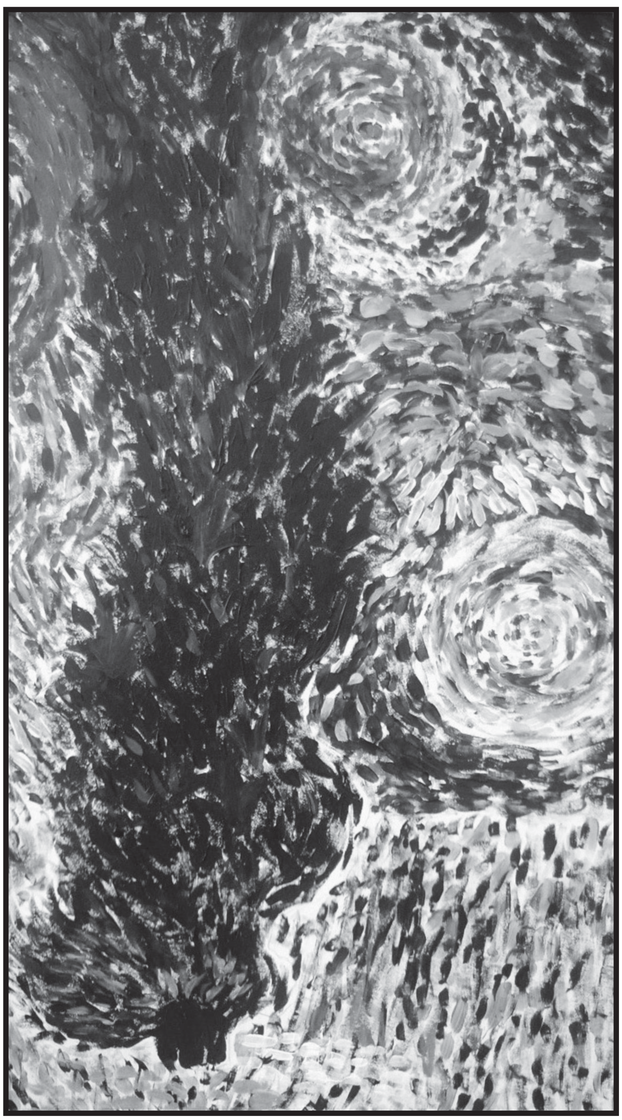
From the President's Desk

Ten in Ten

In this issue of *Perspectives on Language and Literacy*, the theme editors and authors explore not only how to overcome the challenges posed by the new media and technology for students with dyslexia, but also how to harness its power to maximize its benefits. As noted in the article "Universal Design Considerations for Technology-Based, Large-Scale, Next-Generation Assessments," by Christensen, Shyyan, and Johnstone, "the student with dyslexia faces an obstacle that is not equally shared by other students: decoding the text." This is at the core of the problem for those who struggle with reading and the reason why IDA exists.



ON THE COVER: "The Lone Tree" (a tribute to Vincent Van Gogh) was contributed by Scott Robertson, a sixth grader at Rawson Saunders School.

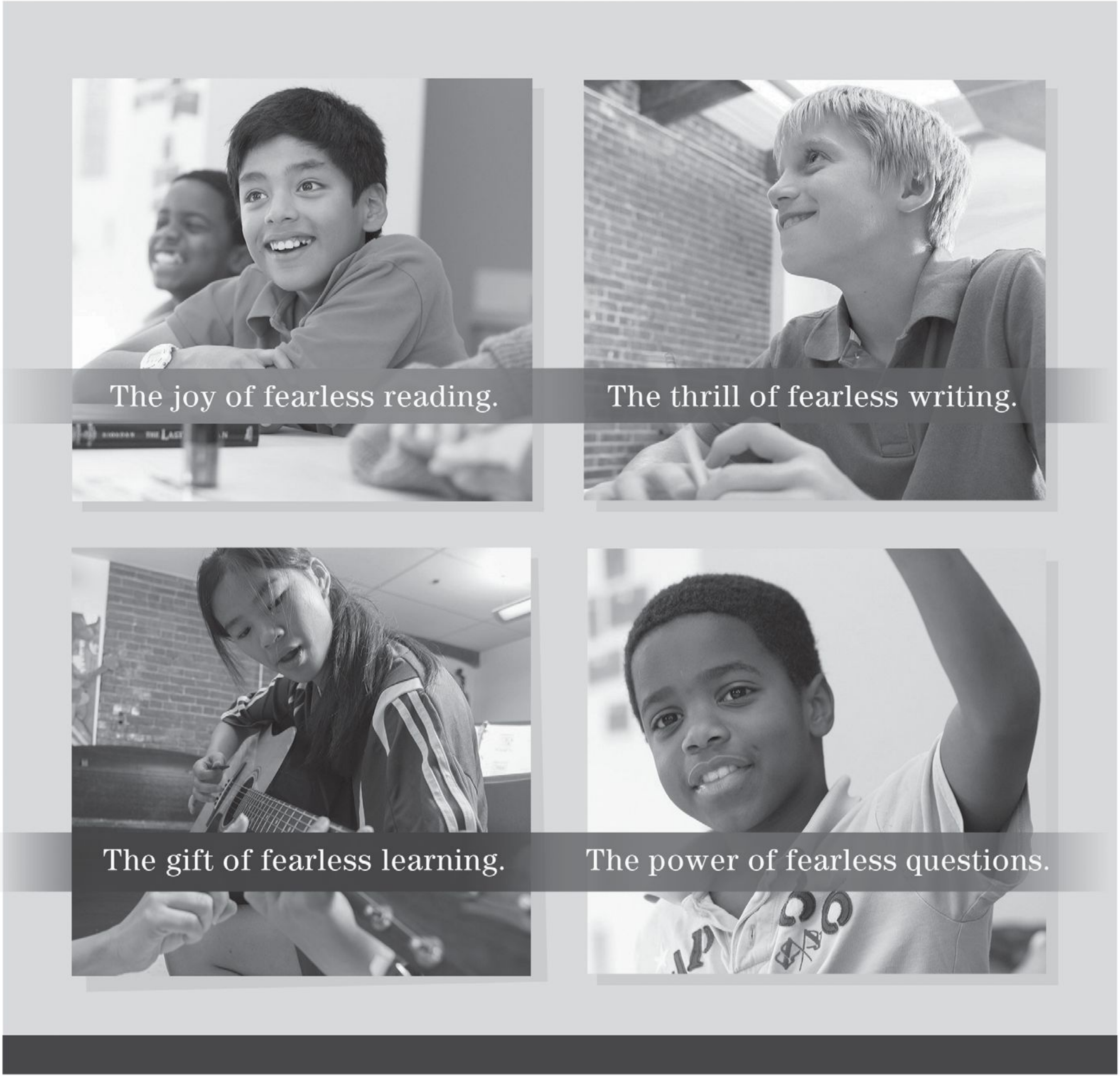
For 64 years, IDA has helped those who struggle to decipher the printed word by concentrating on interventions based on scientific research. While technology offers great opportunities to even the playing field for students who have learning challenges, the impact of poor reading skills still plagues one third of the students in our nation. The long-term effects of this devastating truth cannot be ignored.

As I have mentioned often in my previous letters, the IDA National Board is focused on changing the way we teach reading, not only in our country, but also around the world. We have currently embarked on a very ambitious journey—to change reading instruction. Using the *Knowledge and Practice Standards for Teachers of Reading* as our foundation, we have already accredited nine university programs that provide evidence-based training for their teachers. This year we are reviewing another ten universities and several others have requested our input to ensure that their teachers are trained using proven strategies to teach reading. We have also reviewed two teacher training programs/curriculums that are consistent with our standards and are in the process of reviewing several others. Finally, we are now focusing our efforts on developing a certification examination for teachers of reading. The IDA Board is committed to ensuring that those who teach our children to read should have the knowledge foundation to provide instruction that is based on sound research practices.

Our international partners are also working diligently in their own countries to develop evidence-based practices to teach students with dyslexia. With the collaboration of many IDA members, research-based reading programs have already been developed in Spanish and Arabic.

So, as we learn about technology and what the future may bring to ease the burden of those who can't read, let us not forget to dream. My dream is to reduce the illiteracy rate in our country by ten percent in ten years. We ask that you support IDA in its efforts to carry out this dream.

Eric Tridas, M.D.
President


The joy of fearless reading.
The thrill of fearless writing.
The gift of fearless learning.
The power of fearless questions.

Theme Editors' Introduction

Technology and Dyslexia—Part 2

by David H. Rose, Sam Catherine Johnston, and Amy E. Vanden Boogart

This issue of *Perspectives on Language and Literacy* is the second in a two-part series on technology in education, specifically about where dyslexia and technology intersect. The focus of the first issue (Fall 2013: Volume 39, No. 4) was the integration of assistive technology into traditional learning environments. In this issue, technology moves to the center of the learning environment with articles about how to make technology-mediated learning environments healthy for learners with dyslexia.

The issue begins with "Applying Principles of Text Complexity to Online Learning Environments" by authors Greer, Rice, and Deshler, a discussion of text complexity and why it should factor into evaluating the effectiveness of online courses for all learners. The authors offer strategies that stakeholders can use to assess the linguistic characteristics—structure, readability, and coherence—that make an online course more or less difficult to comprehend. They also explain how to use the Coh Metrix indices, a tool that provides information about five elements of cohesion that can be quantified as "high" or "low" and can help the reader determine if the text contains linguistic elements that provide cohesion. An analysis of cohesive properties of English/language Arts (ELA) text in online courses by three large vendors of online learning revealed a need to make several changes to ensure that learners with reading difficulties could comprehend text.

In their article "Maximizing Student Success in Online Virtual Schools" authors Coy and Hirschmann pose some specific challenges associated with students with dyslexia attending virtual schools and offer solutions for helping these students to succeed in the virtual schooling environment. The authors begin by explaining the benefits of a virtual school environment for children with dyslexia. For instance, online schools can minimize the challenges that students must often overcome to be successful in traditional face-to-face schools. The authors emphasize, however, that virtual schools also come with challenges, particularly related to the increased role that parents (who are often not trained as teachers) must play in the education of their children in a virtual environment.

Coy and Hirschmann identify several ways to address these challenges of educating children with disabilities online, offering ideas for how virtual schools can construct support teams for each child consisting of the child's at-home Learning Coach (often a parent or grandparent) as well as the general and special education teachers. By maximizing partnerships between all members of the student's support system and providing appropriate professional development for both teachers and parents the authors conclude that virtual schools can be an effective option for educating students with dyslexia and other learning disabilities.

Authors Christensen, Shyyan, and Johnstone focus on the field of assessment in their article "Universal Design Considerations for Technology-Based, Large-Scale, Next-Generation Assessments." The principles of Universal Design for Assessment, or UDA, suggest that assessments should be designed to be as accessible as possible from the outset to reduce the need for testing accommodations for students with dyslexia or other disabilities. The authors argue that it is particularly important to adhere to the principles of UDA in this time of transition to the new technology-centered national assessments designed by the Smarter Balanced Assessment Consortium (Smarter Balanced) and Partnership for Assessment of Readiness for College and Careers (PARCC). A focus on UDA helps to ensure that assessments measure only construct relevant knowledge and skills. The authors remind us that as with using the principles of UDL to design instruction, adhering to UDA when designing assessments benefits all students—not just those with print disabilities.

"Ensuring that Students with Text-Related Disabilities Have Access to Digital Learning Materials: A Policy Discussion" by Karger and Lazar addresses the challenges that arise as schools increase their use of digital content for instruction. The authors discuss the policy and legal context relating to equal and timely access for all learners to digital learning materials and highlight specific issues related to students with dyslexia. The authors illustrate how addressing the needs of students with print disabilities fits into international technical standards for accessibility. They also offer practical suggestions in three areas to help educators ensure that all students can use digital learning materials:

1. The authors provide recommendations for making content flexible enough that it can be adapted to meet the needs of individual learners, for example, the ability to resize text and adjust color contrast.

2. The authors provide recommendations about the use of assistive technologies, such as screen readers and speech recognition software, to ensure that these technologies are effective for all students that need them.

3. The authors provide guidance for educators, families, and others purchasing digital material, on how to buy materials that are accessible in terms of content and the technology delivery system.

In the afterword, "Canaries in the Mine: Reading and Its Disabilities in a Post-Gutenberg World," Rose, Johnston, and Vanden Boogart, the editors of these special issues, use the articles as a foundation for imagining the future landscape where technology and dyslexia intersect. Rather than focus on

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individual learners and how they must adapt to new environments, the afterword focuses on the future of print, technology, reading, and education, and the disabilities present in each of these areas. The editors conclude with a look at how Universal Design for Learning can help ensure that the benefits of new technology and media rich environments are accessible to all learners.

We hope that both this and the preceding special issue of *Perspectives on Language and Literacy* on technology have helped education professionals and other readers overcome the challenges posed by the new media and technology so that they may understand how to maximize the benefits of this ever-changing landscape.

***David H. Rose, Ed.D.**, is a developmental neuropsychologist and educator whose primary focus is on the development of new technologies for learning. In 1984, Dr. Rose co-founded CAST, a not-for-profit research and development organization whose mission is to improve education, for all learners, through innovative uses of modern multimedia technology and contemporary research in the cognitive neurosciences. That work has grown into the field called Universal Design for Learning which now influences educational policy and practice throughout the United States and beyond. Dr. Rose also teaches at Harvard's Graduate School of Education where he has been on the faculty for almost 30 years. Dr. Rose is the co-author of several scholarly books, numerous award-winning educational technologies, and dozens of chapters and research journal articles. He has been the principal investigator on large grants from the National Science Foundation, the U.S. Department of Education, and many national foundations. In the policy arena, he was one of the authors of the recent National Educational Technology Plan, has testified before the U.S. Senate, and helped to lead the development of the National Instructional Materials Accessibility Standard. Dr. Rose has won many awards, including recently being honored at the White House as a "Champion of Change." Dr. Rose holds a B.A. in psychology from Harvard College, a master's in teaching from Reed College, and a doctorate from the Harvard Graduate School of Education.*

***Sam Catherine Johnston, Ed.D.**, is a research scientist at CAST with expertise in peer-based learning models, distance and blended education and program evaluation. Her primary research focus has been on the use of technology-mediated peer-based learning to transfer knowledge and foster behavior change among interdisciplinary groups of professionals and para-professionals working in various fields including mental health care, education, criminal justice, and human services. At CAST Dr. Johnston directs a Bill and Melinda Gates Funded project to improve the capacity of community colleges to develop high quality Open Educational Resources (OERs) that utilize the principles of Universal Design for Learning to ensure all learners can benefit from OERs. Dr. Johnston also works as a researcher on a national center that examines the experiences of K–12 students with disabilities in online and blended learning courses and programs. Before joining CAST, Dr. Johnston was a Senior Associate and Distance Educator at the Center for Social Innovation (c4si), leading the company's online learning strategy.*

***Amy E. Vanden Boogart, M.Ed.**, is the Curriculum Specialist for Community Academy Public Charter Schools, where she manages the alignment of the curriculum of four elementary schools to the Common Core State Standards. Her primary responsibilities are the rollout of the curriculum and the ongoing training of teachers, coaches, and principals on effective curriculum implementation and literacy instruction. Amy has also worked as a reading and language arts curriculum designer and assessment writer, and she is a former elementary teacher. In addition, she is an adjunct professor teaching a course on children's reading development for the Special Education and Disability Studies department at George Washington University. Amy is a doctoral candidate in Curriculum & Instruction at George Washington University, where her research interests include upper elementary teacher knowledge for and beliefs about teaching reading, professional development for reading teachers, and how iPads and other emerging technologies can benefit reading instruction.*

Applying Principles of Text Complexity to Online Learning Environments

by Diana Greer, Mary Rice, and Don Deshler

Online learning and virtual schooling products are experiencing both a proliferation in kind and a surge in public interest (Barbour, Archambault, & DiPietro, 2013). However, there is also concern that online learning lags in interactivity (Barbour & Plough, 2009), requires a significant time investment from learners (Blau & Hameiri, 2012), and that attrition in online courses is highly prevalent (Lee & Choi, 2013). While Rauh (2011) argued that education is often conceived of as a public good that is equally available to everyone, learners who are genuinely "at risk" do not opt in to online courses and when they do, they are more likely to drop out.

Although persistence is still widely discussed as an important factor in online course completion (Lee & Choi, 2013; Xu & Jaggars, 2013), the reading load and the types of text students are required to learn from are gaining attention as important factors for satisfaction with courses and completion of work (Boling, Hough, Krinsky, Saleem, & Stevens, 2012; Marshall, Greenberg, & Machun, 2012). Given this information, it is important to make online learning more widely available, but also to give support to learners within the courses and distribute information about how to select courses to both the learners and their advocates.

For adults who are searching for higher and further learning, determining which online courses to take from which vendors or educational institutions may require some careful evaluation. In the case of parents who choose online learning options for their children, they are also choosing to have a greater influence over what, when, and how their children learn; therefore, it is important they have tools for making decisions about online learning environments so that children can have beneficial learning experiences. When online learning options are part of school district services, decision-making personnel may also want as much information as possible to inform their judgment about which online learning products are better suited to students who traditionally do not finish school.

The purpose of this article is to overview information about text complexity as a component of the evaluation of online courses. The article shares information about what makes a text complex, but it also shares findings from research conducted on online courses. The information about text complexity, coupled with the research findings, is used to offer several strategies that learners, parents, and other decision makers can use to efficiently evaluate whether text in a particular course has the linguistic characteristics that make a text less complex, and therefore facilitate comprehension.

Thinking about Text Complexity

Text complexity is the study of linguistic features that make a text easier or more difficult to comprehend. The study of text complexity began in the 19th century as a means to analyze, predict, and control the difficulty of the written communication (Pearson & Hiebert, 2012). Measures of text complexity are often categorized as being either qualitative (calculated with numbers and formulas) or quantitative (described with words). Indeed, this classification is how the National Governors Association Center for Best Practices & Council of Chief State School Officers (2010) organized text complexity in the Common Core State Standards (CCSS). These standards have been adopted in most states for implementation in K–12 settings, but their goal of college and career readiness gives them a wide scope of influence in curriculum across the continuum of educational settings for learners of all ages. The CCSS are concerned with text complexity on three interrelated fronts: text structure, readability, and coherence as achieved through cohesion. Each of these is discussed in the sections that follow.

Text structure. Attempts to describe or account for text complexity developed several foci, one of which was text structure. The concept of text structure has mostly been explored from a qualitative perspective. Drawing on cognitive research (Gardner, 1987), the exploitation of text structure continues to be an important element of reading comprehension instruction for both children (Shanahan, Callison, Carriere, Duke, Pearson, Schatschneider, & Torgesen, 2010) and adolescents (Beers, 2003). Text structure considers how a text is organized internally and whether that organization is legitimate for the purpose of the text (e.g., historical texts as chronologies). Text structures are also important for the readability of text because they are part of what determines the kinds of words and the types and lengths of phrases that are appropriately used to provide the structure.

Readability. Another focus of text complexity is readability. The concept of readability has mostly been explored from a quantitative perspective. Dale and Chall (1948) defined *readability* as the ease with which text can be read and understood. Sherman (1893) is regarded as having developed the first readability formulas in the 1880s. Sherman used this interest in sentence length to establish word counting methods as a way to look at the ease of reading text. His later work established several widely accepted tenets about text complexity that are still important today: 1) shorter text is easier than longer; 2) speech is easier than written communication; and 3) the more closely written communication resembles speech, the easier it is to understand. Rubakin conducted similar work in Russia in 1889, analyzing texts written by common citizens. He found that the main blocks to comprehension are long sentences and uncommon words (Choldin, 1979).

By the 1920s, word lists and readability formulas were being used in Russian and German schools. Thorndike (1921) became interested in this practice and advocated for the use of word lists in American schools. Lively and Pressley (1923) published the first readability formula in the United States, and by the 1980s many more followed—all based on some

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kind of mathematical model that was tested on the age range (children to adult) or profession (e.g., air force, health care workers) that it was targeting. One of the simplest, longest enduring readability formulas is based on the work of Flesch and his associates (1948). This formula is based on the total numbers of syllables, sentences, and words. In recent years the Lexile formula, with its more complicated statistical models (Stenner, Horabin, Smith, & Smith, 1988) has gained popularity in school settings. All readability formulae, regardless of how they are derived mathematically, provide insight into the length of words and sentences in a text. These insights have some value in determining the probability of comprehension by certain readers. However, the readability of a text has a limited relationship to the total coherence of a text. In considering coherence, the length of the words and sentences is less important than how they work together to create space for readers to draw out meaning.

Coherence. Coherence as an aspect of text complexity is an emerging field of study. Coherent text has a unified, succinct main idea or purpose with relevant and logical supporting details. The notion of coherence has been studied both qualitatively and quantitatively. In qualitative studies, coherence is often addressed as an issue of readers' background knowledge and knowledge about their goals as readers of a particular text to make sense of it (McNamara, Kintsch, Songer, & Kintsch, 1996). These insights came from cognitive studies in the 1970s that focused on reading as an act of thinking and organization. In particular, researchers became interested in the fact that texts written to attend to readability formulas were not always easier for readers. For example, Davison and Kantor (1982) conducted research into readability with children. They concluded that most successful changes in texts rewritten for younger readers in their study ran directly counter to readability formulas. Further, they presented evidence that most unsuccessful changes were those motivated by the strictures of the readability formulas. Other scholars in this period such as Blau (1982) and Pearson (1974–75) confirmed the negative effects of readability formula-driven adaptations on text comprehension.

Overall dissatisfaction with readability formulas emerged as scholars in the field reasoned that text expressing difficult ideas was complex by necessity and that attempts to simplify complex ideas actually resulted in more complex, more difficult to read text. Pearson and Heibert (2013) used qualitative approaches to text complexity to assert that texts from different disciplines have different kinds of demands that are nuanced. Readers, they argued, need to be supported in noticing and leveraging these nuances as they read. These slight differences in ways that authors in various disciplines present and discuss ideas contribute to the overall coherence of a text.

Coherence, according to some researchers, can be mathematically calculated. It is accomplished through patterns of linguistic factors that are referred to as *cohesion*. A quantitative tool designed to measure cohesion is Coh Metrix indices (McNamara, Louwerse, Cai, & Graesser, 2005). These indices were designed to move away from categorizing texts as "easy" and "hard" and instead providing information about five elements of cohesion (described below) that are either "low" or "high." A text is coherent to a reader if it contains linguistic elements that provide cohesion. A text with high cohesion scores is preferable to a text with low cohesion scores, but the indices themselves are seen as separate elements rather than a composite for ranking texts. In their study correlating popular readability formulas with CCSS texts, Nelson, Perfetti, Liben, and Liben (2012) did not use Coh Metrix as a measure of text difficulty for the texts. Instead, they used Coh Metrix indices to discuss why texts were found to be difficult by other measures, such as the Lexile framework.

The Coh Metrix indices are built on five classifications: Narrativity, Syntactic Simplicity, Word Concreteness, Referential Cohesion, and Deep Cohesion. *Narrativity* is the story-like characteristics of the text, that is, the degree to which the text captures sequences of actions involving animate beings (Graesser, McNamara, & Kulikowich, 2011). Consider the following sentence: *The scientist conducted an experiment using soil samples and then he presented his findings*. This sentence has a higher Narrativity than the sentence: *An experiment using soil samples was conducted and presented*. The first sentence is easier to understand, even though it is longer, because it has a clear animate actor, it more closely resembles oral language, and it is written in active voice. *Syntactic Simplicity* is the degree to which a text uses common structures for sentences. One simple structure is subject-verb-object. It is present in the sentence *Bill kicked Tom*. *Bill* is the subject; *kicked* is the verb; *Tom* is the object or receiver of the action. A more complicated syntactical construction of the same idea would be *Tom received a kick from Bill*. In this sentence, *Tom* is the subject of the sentence and *Bill* is the object of a preposition. The word *kick* is a direct object. This is a more difficult sentence to describe grammatically, and it is also longer. Syntactic Simplicity is achieved when the sentences in a text contain few words and use simple, familiar syntactic structures, which have been found to be less challenging to process (McNamara, Louwerse, Cai, & Graesser, 2005).

Word Concreteness is the degree to which words can be visualized in reality, which is referred to as *imagablility*. If a word in a sentence has fewer possible meanings, it is more concrete. A sentence such as *The teacher smiled at her students* is more concrete than *The teacher appreciated her students*. The word *smiled* is far more concrete in the first sentence because it has far fewer possible meanings. The second sentence is one word shorter, but the word *appreciate* is not as imageable: readers cannot form a picture in their heads about what is going on as easily as they can in the first sentence because *appreciate* could mean clap, smile, thank, or even verbally express appreciation. Word concreteness also takes into account the number of ways that a word can be imaged, or visualized. Some words only bring a few images to mind, while others bring many. To achieve coherence, it is better to use words that are imageable, but that have fewer possible images.

Referential cohesion is the degree to which ideas in a passage of text are related and referred to across text. The sentences that follow refer to one another and recycle key words such as *meatballs* and *liked:*

Hannah liked meatballs.
She liked meatballs since she was a baby.
She liked to eat meatballs with ketchup.

There is also only one pronoun, *she,* which only refers to *Hannah* and not anyone or anything else across the text.

Deep cohesion is the ability of a text to use connectives that are temporal (time), logical (organized using reason), and causal (results and/or effects). These words include *after, next, meanwhile* (temporal); *thus, therefore, nevertheless* (logical); and *because, since, owing to* (causal). The sentence *The student missed class and therefore failed the exam* has a logical connective in it (therefore). The sentence *The student missed class and failed* is much less explicit about the causation implied between the act of missing class and the result of failing the exam.

Text in online courses is regarded as being different from traditional texts in brick and mortar classrooms because content can be linked and hyperlinked to images, virtual presentations, and other forms of graphical displays and media. In looking at the coursework in several online environments, however, it was discovered that even with these technological affordances, there were still considerable sections of text that were in a traditional format entirely, or with only minor online capabilities, such as roll-over definitions for words. With the understanding that online coursework still involves reading traditional text that is merely on a screen, Coh Metrix was used to learn more about the characteristics of texts in online courses.

Analyzing Courses in Online Learning Environments

In an effort to better understand the cohesive properties of the text in online courses, a linguistic analysis of text from English/language arts (ELA) courses in three widely used online learning environments was conducted. ELA courses were selected because they exhibited a large variety of variation in text structure as compared to courses in other subjects. This analysis had two initial purposes. The first purpose was to provide vendors with an overview of the readability and the cohesion properties of their ELA course products. The review was intended to assist the vendors in considering the needs of all learners in its courses and to potentially make changes to meet the needs of the diversity of students who enroll in their courses. The second purpose was to help researchers gather information about the text in online learning environments so that suggestions can be made in the field of online learning for improving the educational experiences of students with disabilities and other students who struggle academically. The suggestions being offered in this article are for administrators, teachers, parents, and advocates for students who are enrolled in online courses.

The Coh Metrix tool was used to examine the cohesion in the text of courses from different online learning companies. To accomplish this, we copied and pasted text into a window on a computer screen and then the tool analyzed the text using various formulae. The research that we conducted was to determine if there was a statistical difference in the cohesion of the text in the same types of courses from different companies. This required us to paste a lot of text into the tool and then compare the differences in the scores.

Our research revealed several interesting findings. First, the text in the courses in the three learning environments was very different. Second, just because a course was marketed to younger learners, that did not mean the text was easier to read. For example, one of the environments had text that was marketed to students who were in elementary school, but the text in those lessons was not necessarily more conducive to comprehension than the text from other courses in other environments that were designed for high school students. Third, each of the courses needed different kinds of improvements in the way the texts were composed in order to provide optimal advantage to students who needed reading support. For example, some courses needed more imageable words. Some courses needed more words that connected ideas; other courses needed to repeat key words more often. Fourth, the texts in the courses that were most cohesive were often loaded with words such as *after*, *therefore*, *in order that*, and so forth. These connectives are not as important for advanced readers, but they are vital for students who, for whatever reason, have difficulty comprehending text.

Applying Strategies to Text in Online Courses

The information acquired by studying the online ELA courses suggests that using a tool like Coh Metrix would provide information that would help distinguish between online course offerings. Learning about the aspects of cohesion in individual courses also suggests that there might be simple strategies that people without access to statistical tools could use to determine whether text in an online course is likely to be reader-friendly or not. Proposing these simple strategies is the subject of the rest of this article.

Narrativity

The two suggested strategies for determining the Narrativity of a text are locating evidence of emplotment and pronoun case in addressing the audience.

Emplotment. A narrative is regarded as such because it has a plot. A *plot* is a sequence of events that are related to one another by the suggestion of causality (Fisher, 1984). A sequence of events without the suggestion of causality is a *chronicle*. *I came to work today* is a statement. *I came to work today, earned money, and then went home and fed my family* is a chronicle. *I came to work today so that I could earn the money I would need to feed my family* is a narrative. When evaluating an online course for Narrativity, an evaluator of an online course should be able to look at the text and see if it has a plot. If it does, then it is likely to be more conducive to comprehension then a chronicle or series of statements that are not causally related.

Pronoun case. Pronouns take the place of proper nouns in sentences, but they also give clues as to the relationship of the author to the audience. Text that is written to an audience as if they were there often addresses the audience as "you" and

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themselves (the author) as "I." Text that was meant to be written and read later is often in third person, using pronouns for example, *he* or *she*; *him* or *her*; *it* or *its*. Since oral language is regarded as easier to understand than written, the *you* or *I* pronouns when addressing the audience are usually easier to comprehend than the third person construction (Sherman, 1893). When evaluating an online course for Narrativity, an evaluator should be able to look at the text and see if the audience is addressed directly. If it is, then it is likely to be more conducive to comprehension.

Syntactic Simplicity

The two strategies for evaluating syntactic simplicity are looking at the location of the nouns and noting the length of the sentences.

Noun location. Text is generally easier to access when nouns are at the front and verbs follow immediately after. Nouns perform the role of subjects in sentences and so it is easier to process a sentence's meaning when a reader knows the topic first. See the difference in the following two sentences:

Pets require work to maintain.
A pet requires much work and effort to maintain.

The second sentence puts *A* in front of the subject or main noun and *much* in between the main noun and the main verb. It is not the length that is making the sentence more difficult; it is the obfuscation of the main noun and the main verb. When evaluating an online course for Syntactic Simplicity, an evaluator should be able to scan the sentences in a paragraph or two and see if the main nouns are visible and if they are close to the main verbs. If they are, that is a good sign that the text can be comprehended.

Sentence length. Shorter sentences are generally more comprehensible than longer ones because shorter sentences more closely imitate oral language (Sherman, 1893). Online text should have a variety in the number of words per sentence. A sentence with more words requires more effort to read it. When evaluating an online course for Syntactic Simplicity, a reader should be able to scan the sentences in a paragraph or two. Readers should determine if sentences tend to be very long, very short, or a mix where long and short are employed strategically. In this paragraph, the words per sentence are 17, 13, 12, 22, 22, 16, and 15. This pattern represents variation in sentence length, but even the longest sentences are relatively short.

Word Concreteness

Two strategies that can be used to determine word concreteness are visual text matching and informal imaging of the text.

Visual text matching. Text is deemed more comprehensible when readers can visualize the words or ideas. One easy way to tell if words are imageable is if the course vendors have been able to provide illustrations or graphics that match their text. An evaluator should be able to look at the pictures provided and the text next to it and check for that matching. If the image does not match the text it might be because the content in the text is not very imageable.

Informal imaging text. If there are no illustrations or the illustration/text matching is poor, then readers can try imaging the text themselves. Evaluators could pick out several main nouns and key phrases from the text and try to draw or diagram them. For example, *two leaders sat down to make a peace accord* is a much more imageable phrase than *peace was seen as a possible solution by both leaders*. If sentences and words cannot be illustrated in a straightforward manner, then the text is also less likely to be sufficiently imageable.

Referential Cohesion

Two strategies for evaluating referential cohesion involve looking for repetition of words in a paragraph and the repetition of words between paragraphs.

Repetition of words in paragraphs. Repeating words helps readers understand text because it signals importance, and because it provides more opportunity to process a word. When words are repeated in a paragraph, a reader should be able to identify them. On a computer screen, an evaluator might be able to scan for these words and highlight them or print a screen and circle them. The more often key words are repeated, the more comprehensible the text. This repetition can include words from the same word family, such as *repeat, repetition, repeated,* and *repeatedly*.

Repetition of words between paragraphs. Words and short phrases, particularly important ones, should be repeated between paragraphs as well. This practice reinforces the signal to a reader about the importance of certain words and phrases and provides additional opportunities for examining a concept or topic. A text that moves from idea to idea requires more processing effort than a text that repeats ideas as it moves from point to point. Evaluators should scan for and highlight repeated words from the same families or phrases in a group of paragraphs to determine if a text has referential cohesion.

Deep Cohesion

There are three types of words that connect ideas in cohesive text. In linguistic research, these are called *connectives*. Table 1 lists the three types and gives examples.

Connectives should appear in text and be used properly. Evaluators trying to determine if the text in an online course is appropriate could look for these words or words like them in a sample text. If many are found, the likelihood that the text will be easy to comprehend is greater.

Applying the Strategies

In this section of the article we take a hypothetical example that is typical of the style of texts we found in the online ELA courses and apply the strategies. Figure 1 contains a typical sample from an online ELA course. Reading through the sample and then applying the tests helps to determine whether this course as a whole is worth the investment. Table 2 summarizes the results of using the strategies.

Continued on page 14

TABLE 1. Types and Examples of Connectives

Type of Connective	Examples
Causal	accordingly, because, so, therefore, thus, as a consequence, consequently, stemming from, as a result, hence, since, therefore, in order to
Logical	for this reason, for example, to illustrate, for instance, to be specific, such as, moreover, furthermore, just as important, similarly, in the same way, and, but, in contrast, conversely, however, still, nevertheless, nonetheless, yet, and yet, on the other hand, on the contrary, or, in spite of this, actually, in fact, like, also, both
Temporal	next, afterward, finally, later, last, lastly, at last, now, subsequently, then, when, soon, thereafter, after a short time, the next week (month, day, etc.), a minute later, in the meantime, meanwhile, on the following day, at length, ultimately, presently

FIGURE 1. Sample of ELA Online Course Text

Ambrose Bierce was a short story writer who actually served in the Union Army during the Civil War. He was born in 1842. He died in 1914. He signed up to be in the army and he fought in several battles. Two of these battles were the Battle of Shiloh and the Battle of Chickamunga. In 1864, Bierce was wounded while fighting. In terms of his writing, Bierce is a both a satirist and a realist. This means that he likes to use the intricacies of everyday life to point out the flaws in human behavior. In order to achieve this realism, he employs various literacy devices. Some of these devices are tone, flashback, foreshadowing, and imagery.

Bierce was not known as a particularly friendly guy. His lack of social skills earned him the nickname "Bitter Bierce." He may also have been known as Bitter Bierce because he wrote articles and sold them to newspapers that exposed corruption and injustice. He accused a lot of people of wrongdoing. Bierce died in 1914, but the details of his death are sketchy. Some have speculated that he died in Mexico's Civil War, but no one really knows for sure. Like his real life, Bierce's stories are full of twists and turns that make for interesting reading.

TABLE 2. Summary of Online Text Evaluation Strategies

Cohesion Index	Strategy	Findings
Narrativity	Emplotment	Some ideas are drawn into a plot, such as the fact the Bierce's war experience was the subject of his stories; however other elements, such as the connection between his war experience and his style of writing in the first paragraph were not drawn together. Overall, there is some attempt at narration, but not a clear plot.
	Pronoun case	The pronouns refer to Bierce has *he*. These are the only pronouns used, which means that the text does not address the reader directly.
Syntactic Simplicity	Noun location	The topic is Ambrose Bierce. Most sentences start with his name or a pronoun referring to him. This suggests that the Bierce is the most important element of the passage.
	Sentence length	Average sentence length is 14 words. The shortest sentence is 5 words; the longest sentences are 20 words long. These lengths are appropriate.
Word Concreteness	Visual text matching	There are no visual images in this text sample.
	Informal text imaging	One could develop an image of a bridge of the battles of Shiloh and Chickamauga. However, many of literary ideas are difficult to image, such as satirist, realist, devices, and tone.
Referential Cohesion	Repetition of words in paragraphs	*Bierce* is a frequently occurring word, so are *railroad* and *predictions*. Looking at each paragraph separately, there are few repeating words. Notice also how these are not easily pictured.
	Repetition of words between paragraphs	*Bierce* is the most often repeated word in the whole passage. It is repeated eight times. The second most often repeated word is died, which is mentioned three times. There are a smattering of words repeated twice. This lack of repetition except for Bierce's indicates that there are too many topics in the paragraphs.
Deep Cohesion	Causal connectives	in order to, because
	Logical connectives	also, and, but, like, both
	Temporal connectives	in

Overall, this passage is about average in terms of its cohesion. It has some narrativity, but it isn't overly so. There are some long sentences and some short, but most are somewhere in between. Many of the texts words are highly imageable. There are few meanings of words like *died*, *newspaper,* and *battle*. The text is greatly lacking words that overlap and repeat to build ideas, especially for the harder concepts such as satire and realism. This is evident in the discussion about Bierce's nickname in the second paragraph that moves from a discussion about his journalistic practices to his death. The inference here might be that since his death is a mystery and he was not well-liked, maybe he was murdered, but it is hard to tell what the author was intending by putting information about his temperament and his death in the same paragraph. There is an average number of connectives holding that paragraph and the entire piece together. Looking at the actual Coh Metrix percentile breakdown in Table 3 confirms the findings obtained by using the strategies.

TABLE 3. Coh Metrix Percentiles for Sample Text

Index	Percentile Score
Narrativity	46.02
Syntactic Simplicity	61.79
Word Concreteness	80.51
Referential Cohesion	34.09
Deep Cohesion	50.00

The percentile scores available from Coh Metrix are based on percentiles. When percentiles are used for reporting, the highest score is 99. The sample text about Ambrose Bierce has scores that are slightly below average scores in Narrativity, above average scores in Syntactic Simplicity, substantially about average scores in Word Concreteness, low scores in Referential, and average scores Deep Cohesion. An evaluator could use the Coh Metrix tool to compare text from learning environments if he or she understands how to interpret the scores and what the Coh Metrix indices mean, which is why the strategies in this article are important. In addition, some text is not easily lifted and copied into the Coh Metrix tool. Therefore, the ability to look at samples of text and quickly evaluate general trends is important for gathering information to make accurate decisions about which content in which courses lends itself to comprehension for an individual learner.

Conclusion

The decision to take online courses or to offer them as part of a more comprehensive educational program is not one to be made lightly if courses are to be completed and result in optimal educational experiences for the learners involved. As part of a thorough investigative process of determining which courses to offer from which vendors, or as course developers engage in curriculum development, the linguistic characteristics are worth our attention. (See Table 4 for additional online word/text analysis tools.) In addition to the text from online sources, learners are often assigned additional reading offline that should be taken into account. Once the text complexity in these five key areas is known, other considerations that are more unique to online formats, such as hyperlinking, visual development, and interactive capabilities can also be evaluated and expanded in courses. As courses become more comprehensible, more learners are given a chance to participate in education through new technologies.

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TABLE 4. Online Word/Text Analysis Tools

Name	Capabilities	Website
Coh Metrix	Calculates and provides data on cohesion: Narrativity, Syntactic Simplicity, Word Concreteness, Referential Cohesion, and Deep Cohesion.	http://cohmetrix.memphis.edu/cohmetrixpr/index.html
Lexile Analyzer	Calculates readability in Lexile units for imported texts. *Note: text must be prepared in specific ways for analysis.*	http://www.lexile.com/tools/lexile-analyzer/using-the-professional-analyzer
Text Evaluator	Determines sources of comprehension difficulty based on text structure and gives grade level classifications.	https://texteval-pilot.ets.org/TextEvaluator/
Word Counter	Calculates and provides information about the number of characters, words, sentences, paragraphs, and repeated words for general readability.	http://wordcounter.net
Write Words	Calculates often appearing phrases in 2-, 3-, 4-, or 5-word strings for general readability.	http://www.writewords.org.uk/phrase_count.asp

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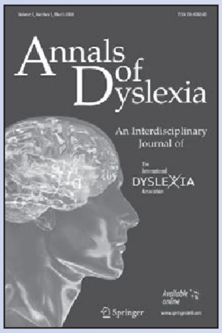

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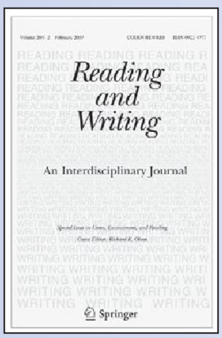

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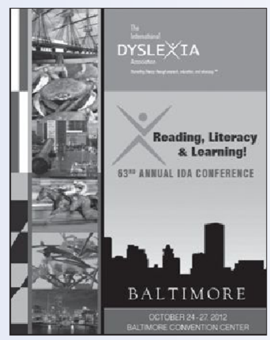

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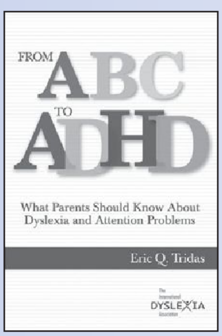

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Maximizing Student Success in Online Virtual Schools

by Kimberly Coy and Kristin R. Hirschmann

Virtual schools are attracting more students with learning disabilities in grades K–8 as online course offerings become more prevalent across the United States (Thompson, Ferdig, & Black, 2012). For example, in 2011, 55% of public school districts reported students who accessed online learning totaling nearly 2 million students enrolled in at least one course in grades K–12 (Queen & Lewis, 2011). Watson, Murin, Vashaw, Gemin, and Rapp (2011) found that online schools in 30 U.S. states experienced a 25% increase in online enrollment between 2009 and 2011.

Online learning is defined as "teacher-led education that takes place over the Internet, with the teacher and student separated geographically" (Watson et al., 2011, p. 12). The Internet and other computer technologies can deliver online content using audio, live interactive video, and prerecorded video formats. There are two primary modes of online course delivery, synchronous and asynchronous. *Synchronous instruction* allows students and teachers to interact in real time. *Asynchronous instruction* occurs across a predetermined time span. For example, in asynchronous learning students are presented with an online lesson, which they must complete and post responses to over a week-long period. Asynchronous courses are the most prevalent method for delivering online instruction (Setzer & Lewis, 2005). In addition to fully virtual schools where interactions among teachers and students occur primarily online, there are also hybrid models that combine online and face-to-face interactions among teachers and students. The case study that is provided in this article is about a fully virtual school.

Students with dyslexia continue to struggle in traditional school environments despite continued efforts by the education community to improve their performance. In traditional brick and mortar environments, academic and behavioral progress is monitored and reported to parents in several ways including parent/teacher conferences, Individual Education Program (IEP) meetings, and quarterly progress reports. However, parents are often excluded from daily activities related to instruction, modifications, or assessment. In contrast, a majority of students attending virtual schools have continuous contact with their parents. Students who attend virtual schools often rely on their parents as integral partners in the education process, looking to them to administer lessons and provide immediate corrective feedback on their performance toward the lesson objectives. The decision to send a child with dyslexia to a virtual school, especially a younger child in kindergarten through eighth grade, is a unique and often daunting family choice.

Online schooling offers promise as a means to enhance students' learning while minimizing instructional barriers that inhibit academic performance. For example, in the online classroom students can receive one-to-one attention in an environment where classroom distractions are eliminated and content delivery is optimized with engaging tasks. However, online courses offer challenges related to developing virtual relationships, working with parents who are not trained as teachers, and communication that is often delayed. This article is designed to help teachers and parents address these barriers by enhancing online professional development, providing a framework for facilitating collaborative relationships, and maximizing the likelihood of students' success in online learning environments.

Teaching and learning in online environments differs from traditional face-to-face settings on many levels. Infrastructure and hardware limitations associated with virtual environments can act as barriers, influencing tone of voice and volume quality, clarity of visual stimuli, and connectivity speed. Pauses in communication or lapses between voice and visual displays can lead to frustration for both teachers and students, as can untimely instructor responses and ambiguous directions regarding teacher and student responsibilities during assignments (Capdeferro & Romero, 2012; Hodges & Cowan, 2012; Tempelaar, Niculescu, Reinties, Gijselaers, & Giesbers, 2012).

Students with dyslexia continue to struggle in traditional school environments . . .

In addition, Vasquez, Forbush, Mason, Lockwood, and Gleed (2011), in case studies of fourth grade virtual classroom settings, noted that numerous challenges exist when teachers attempt to manage student behavior at a distance. Some of these challenges include difficulties with the technology, such as the quality of sound for the voice tone a teacher might use to communicate specific behavior expectations. Within this case study instructors who had less experience with direct instruction as an instructional methodology in face-to-face classrooms struggled more in the virtual environment than more experienced teachers. Based on the experience of the instructors who had more often used the methodology of direct instruction, the authors concluded that the transition from brick and mortar to virtual might be smoother for teachers with more face-to-face teaching experience.

The virtual setting requires that teachers create partnerships with families that are collaborative, transparent, and mutually supportive. Within both special and general education the relationship begins early as teachers and families begin the process of developing an individual learning plan (ILP), discussing the needs of the student as well as the needs of the family, and acquainting the family with the online tools and processes. The Learning Coach (often a parent), student, as well as the general and special education teachers become the educational team. The establishment of the team is based on the mutual goal of creating a successful environment for the student to learn and achieve and the belief that all the members of the team have a shared responsibility for student success.

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The following is a case study example of a virtual school that faces some of the outlined challenges to provide comprehensive services to students with dyslexia. This school has worked to overcome these challenges using a professional development model.

A Virtual School Case Study

The State Virtual School (SVS) is a public school in its seventh year of operation. It is completely online with teachers and students spread throughout the state. Currently 10% of SVS students have individual education programs (IEPs), up from less than 5% when the school first opened. To meet the needs of this increasing population, the school developed an annual professional development model for new teachers as well as ongoing staff development directed toward the needs of the new students and families.

Special education services in the virtual school environment are similar to the brick and mortar school as both models follow all state and federal laws and mandates. These include development and implementation of IEPs for students with documented disabilities, evaluations for students suspected of needing special education services, and the delivery of specially designed instruction as directed by the students' IEPs. However, the service delivery methods in a virtual environment are less traditional as they rely on technology resources and staff innovation. As one teacher explained during a weekly staff meeting: "I know how I would solve this problem in the brick and mortar setting, but how can I tackle checking reading fluency when I am not physically siting beside the student?"

Teacher communication pathways with parents and students are of vital importance. Online teacher communication pathways with students and parents are illustrated in Figure 1.

The parent, student, and teacher are intimately involved in a daily schedule. Consider Isa, a fifth grade student with dyslexia who has been schooled at home for several years. Her mother, Becky, works with Isa in the role of Learning Coach (LC). The LC role is critical and recognized by the school as a major key to student success.

The school has developed several layers of training. The beginning of the school year involved individual coaching by special education personnel to ensure that the LC understands the expectations of time, technology, and partnership involved in schooling at home with a public school. As the school year continues, more advanced interactions between the LC and the school occur with the LC involved in interpretation of student data, setting and carrying out IEP goals, and implementing accommodations. By the end of the first school year cycle most LCs feel a huge sense of accomplishment and can interact with the teacher much like a para-educator would for a child.

Isa accesses the public school curriculum in several different ways. First, she utilizes the online daily schedule her mother sets up for her. Becky makes decisions around the schedule collaboratively with Isa's teacher. Isa also attends synchronous lessons with special education teachers to meet her individual needs and address IEP goals and objectives. Isa has scheduled appointments with her teachers, conferences with additional school staff, and appointments and routines within the home. Because Isa and Becky school in the family home's kitchen, part of which has been transformed into a one-student schoolroom, meals and meal preparation are incorporated into the school schedule.

A daily schedule for Isa includes a math and language arts lesson using both the online interface as well as workbooks. Each lesson ends with an assessment that Isa needs to pass with an 80% or higher score. Her mother reviews the lessons the evening before and has the materials ready in a folder for Isa to access. Also included that day is a scheduled call between Isa and her teacher. During this call Isa will do a fluency assessment in the interactive online platform as well as demonstrate mastery of a mathematical concept she has been working on. After the call Isa will listen to a novel on her iPod and then go to her gymnastics class. Becky attends a book study for LCs late in the afternoon. This month's book study is centered on organization and motivation. Table 1 gives an example of a weekly schedule for Isa.

For first grader Sam the day looks different. Sam experiences both attention disorders and dyslexia. His parents and teachers are continuing to learn how to support him. Sam is also

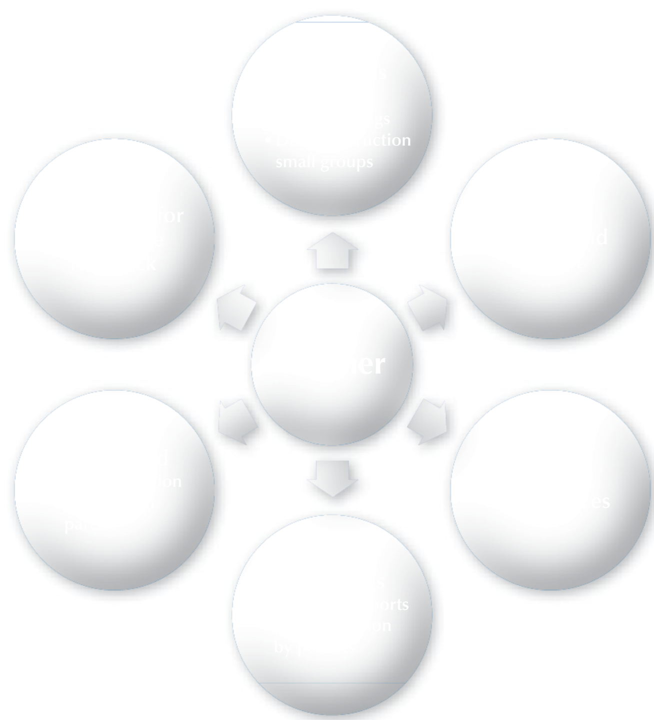

Figure 1. An illustration of six specific communication responsibilities virtual teachers address. Each family experiences their child's teacher in a variety of ways including emails, phone calls for immediate feedback, and scheduled, lengthy monthly conferences. In addition, students and LCs attend synchronous classes with their own teacher and the other students in their virtual classroom for weekly class meetings for students and parent book studies or content area (math, science, or language arts) workshops. Students are also able to go to content area synchronous lessons with teachers who are experts in specific areas. For example, research paper writing is offered as a series for different grade levels throughout the school year. A science fair is offered to the virtual students and preparation for the fair is also a synchronous series students can choose to attend.

TABLE 1. Example of Weekly Schedule

While each week may be a little different, below is an example of a weekly schedule for Isa developed by her LC and teacher. There are seven synchronous lessons or meetings scheduled and one face-to-face outing. The language arts class is administered by the LC in consultation with the teacher and the curriculum.

	Monday	Tuesday	Wednesday	Thursday	Friday
8am	Breakfast, read and emails from teacher Study Island	Breakfast, line up school work for the day Study Island	Breakfast, line up school work for the day	Breakfast, line up school work for the day	Sleep in reward morning
9am	Direct Instruction Reading, synchronous	Language arts class	Direct Instruction Writing, synchronous	Language arts class	Language arts class
10am	Language arts continues	Language arts continues	Language arts continues	History	History
11am	Class meeting, synchronous	Art	Museum trip with other students, face-to-face	Art	Art
Noon	**Lunch**	**Lunch**	**Lunch**	**Lunch**	**Lunch**
1pm	Science	Science	Monthly progress call with teacher, synchronous	Science with GenEd teacher, synchronous	Social Hour with counselors, synchronous
2pm	Math lesson	Direct Instruction Math Lesson, synchronous	Math lesson	Math lesson	Math lesson
3pm	Prepare dinner, incorporate math lesson	Listen to book for reading book study	Get ready for soccer practice	Prepare dinner, incorporate math lesson	Playdate with friend

developing self-advocacy skills to be a more engaged in his education. For example, during reading lessons Sam suggested that he snuggle on a couch with his mom with his small dog in his lap because it makes him feel more successful. Table 2 illustrates a typical school day for Sam.

Our third example is a school day for Kim, a middle school student who has dyslexia as well as extreme fatigue and frequent headaches caused by a medical condition. She lives with her grandmother who is her LC. During Kim's school day she frequently works independently, with her LC checking in and offering support. For example, Kim asks her grandmother to be with her during math lessons because she does not feel as comfortable or competent with this subject. Unfortunately, Kim's grandmother also finds math challenging, which makes that part of the day unpleasant for both of them. Providing support to LCs in subject areas is a relatively new problem the school has identified. One program currently being piloted by the school is a parent workshop focused on specific subject areas, such as math, to help LCs become more comfortable coaching students.

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TABLE 2. Example of Typical School Day

Typical school day for Sam. These usually occur in one hour increments, however with Sam's variations in focus the tasks can be accomplished more quickly or take twice as long.
Breakfast and reading lesson
Walk the dogs, do physical work around the house while Mom asks follow-up questions about reading lesson
Math lesson with manipulatives and synchronous small group math class
Lunch while listening to books
Sam dictates writing lesson and then illustrates lesson
Sam plays with siblings when they arrive home from brick and blackboard school
Dad arrives home. He and Sam work on a hands-on science lesson

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The Educational Team

As members of the educational team, parents' roles change many times during the day from parent to educational support person. This change in roles can be confusing to both the parent and the student. For example, understanding whether a child is exhibiting negative behavior because of an academic issue, such as not understanding a given task, or is doing so because of a household issue, such as a need for more independence, is challenging. One strategy that teachers recommend to parents is to have the student wear a hat/sweater/shirt that is specifically for school, so everyone knows what the expectations are for that time of the day.

In addition to supporting instruction, parents provide a view into their child's learning by providing data about their behaviors, challenges, learning preferences, and successes. Parents are provided data collection tools, such as teacher made charts, instruction on what and how to observe, and support in observation strategies that assure accurate collection of information. The data collected is used to inform instruction based on individual student needs as well as overall school subject emphasis. Individually teachers and LCs can discuss how often a student needs support strategies to stay focused on an academic task, such as completing a math lesson. Within the larger school system two teachers function as Data Coaches. The Data Coach observes and explains to the staff how students are preforming on tasks that may be related to State assessments. This focus has determined how much time Mathematics teachers give to understanding algebraic concepts verses measurement. Table 3 is an example of individual student data collection.

As in traditional schools, an IEP is required in the virtual environment for students with identified special education needs. A significant difference in the virtual world is that parents intimately know the present levels of performance of the student because they work with their child on a daily basis. Parents become contributing members of the IEP team in the development of the goals and recognition of the progress toward these goals. Meetings are held virtually in the interactive classroom where the forms are reviewed and revised as necessary, signatures are gathered, and lengthy discussions for additional strategies to support student achievement are the norm.

Professional Development for Teachers

All of the teachers at SVS are highly qualified, State certified teachers with a minimum of three years and an average of fifteen years of classroom teaching experience. Despite this extensive experience, the teachers face challenges related to delivering instruction using emerging technologies. Professional development for virtual teachers has evolved as online schools have increased in size and number. Lowes (2007) noted that teachers must be able to use new technologies effectively, manage costs, and mentor less experienced teachers within communities of practice (Lave and Wenger, 1991). Teacher professional development research is beginning to support the notion that student achievement in online environments is influenced more by teacher and student interactions than the online media (Murphy, Rodriguez-Manzanares, & Barbour, 2011).

One of the keys to success for teachers and families is offering robust professional development opportunities that are responsive to immediate challenges and teacher driven. In this SVS, the special education staff meets on a weekly basis online, to discuss successes, challenges, and to engage in problem solving as a team. At times, the problem solving focuses on systems, other times on specific issues that are student or instruction focused. The culture of the entire staff of the SVS is one of collaboration. It is common practice for staff to share their instructional resources, offer lesson plans and strategies, and teach each other newly found tricks of the trade. Each weekly meeting has some component of housekeeping (scheduling teaching groups, reporting requirements, IEP updates, etc.) and skills training (IEP writing, data collection, curriculum, etc.), but the primary focus is on creating and defining best practices within the SVS.

Quarterly meetings are full day, face-to-face opportunities that allow for in-depth examinations of the relationship between teaching and student success. Subjects such as State testing, improving working memory, enhancing vocabulary to increase student success, supporting families in Positive Behavioral Interventions and Supports, and student-led IEP meetings are just a few of the areas that have been approached by the team at face-to-face meetings. The staff and the special education director maintain a focus on continuous improvement in meeting the needs of all stakeholders.

TABLE 3. Data Collection on Work Completion

Learning Coaches: Please track 5 lessons of work completion. Please email by February 24.

Date	Course/Lesson Title	Completed? (Y/N)	Assessment Mastered (Y/N)	Total Time (minutes)	Verbal Prompts Given (tally marks)
2/20	Math	y	y	30	II
2/21	Math	n	n	45	IIIIIIIII
2/22	Math	y	n	35	IIII
2/22	Science	n	y	60	IIIIIIIIII
2/23	Art	y	n/a	60	I

Teachers Working with Parent Coaches

Becky, Isa's mother and learning coach, has specific challenges that the staff focuses on during staff development to support her and have an impact on Isa's educational experience. The first way teachers have identified to work with Becky is by providing targeted suggestions on setting up Isa's learning schedule based on the goals and objectives in her IEP. Teachers then help Becky understand how the IEP is developed and how this can drive instruction for Isa. Another powerful task is to have Becky observe the synchronous lessons when the teachers are working with Isa. Modeling teaching and support strategies is a powerful experience for Becky. During weekly conferences the teacher can build upon the modeled lessons by asking Becky if she tried any of the strategies and how they worked or did not work for Isa.

Working closely together is essential for both Sam's mother and LC, Carol, and Sam's teachers to help Sam learn to read. The teacher has expertise in content and strategies that he or she introduces to both Carol and Sam. Carol then puts these strategies into practice with Sam and provides explicit and direct feedback to the teacher. Together, they create a feedback loop that benefits Sam with continuous improvement in his instruction.

This educational cycle is apparent in the powerful interaction that occurred between Kim's learning coach, Colleen, and Kim's math teacher when Colleen was able to explain her hesitation in supporting Kim in math. When the teacher demonstrated how to understand and contextualize the objectives for each math lesson, Colleen could reference these objectives when checking to see if Kim understood, or find the breakdown in her understanding. Helping Colleen to understand this process from the teacher's perspective, rather than another learner's perspective has made a great difference in Kim's daily math time.

Conclusion

Although students with dyslexia who attend school in the virtual environment encounter different barriers and opportunities for academic growth than in brick and mortar environments, the role parents play in facilitating schooling activities is dramatically increased. Professional development in a virtual school differs from brick and mortar schools in part because the parents are involved in the student's educational experience in a new, intimate way. The skills of the parents as educational partners are a major focus as the parent provides tools and strategies to support the students' education on a continual and daily basis.

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Universal Design Considerations for Technology-Based, Large-Scale, Next-Generation Assessments

by Laurene L. Christensen, Vitaliy Shyyan, and Christopher Johnstone

As many of the articles in this special issue reveal, universal design principles, empowered by modern technology, can improve access to instruction for students with learning disabilities. But if the assessments that purport to *measure* student learning are not also universally designed, those assessments can impose barriers or obstacles for students with learning disabilities, obstacles that interfere with their ability to demonstrate what they have learned.

Fortunately, there is a field within the broader universal design movement—called universal design for *assessment* (UDA)—that applies the principles of universal design specifically to assessments, helping to ensure that they are accurate and equitable for all students. In this article, we describe the principles of UDA and demonstrate examples of how test items can be designed so that they are more fair and accurate for students with disabilities of all kinds, especially those with learning disabilities.

Universal Design in a Context of Education Reform

In the context of many recent changes in federal education legislation, greater emphasis has been placed on accountability in large-scale assessments. In past decades, some students, including those with learning disabilities, were exempt from large-scale assessments. However, with the implementation of the No Child Left Behind Act of 2001 (No Child Left Behind [NCLB], 2003) and more recent educational reforms, these students now must be equitably included in assessments so that they can demonstrate what they know and can do alongside their general education peers. Given the high-stakes nature of large-scale assessments grounded in Common Core State Standards (CCSS) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) (see *www.corestandards.org*), assessments that often have significant consequences for students, teachers, and schools, educators must ensure that tests are an accurate measure of the knowledge and skills of all students.

For students with learning disabilities, and many other special populations, ensuring that tests are fair and accurate requires some special attention to their design or implementation. As an example, consider a student with dyslexia who is taking a test item intended to measure his or her knowledge of science or history. In the standardized paper-and-pencil format, the student with dyslexia faces an obstacle that is not equally shared by other students: decoding the text. While it is true that all students are required to decode the text, for most students that requirement is a trivial matter and, for them, the demands of decoding add little or no difficulty to the item. For the student with dyslexia, however, decoding the text may well be the most difficult requirement of the item—more challenging than the science or history knowledge. In that case, the requirement for fluent decoding obscures the accurate measurement of science or history knowledge. The problem for assessment is that—for the student with dyslexia—the item is not really accurately measuring science or history knowledge because the demands for decoding interfere.

In the discussion that follows, we often use two terms which testing industry experts (and their critics) use to explain the problem just described. In any test item, there is at least one "construct" being measured—such as science knowledge about the solar system. To measure that construct accurately, the ideal scenario is that the test item would measure only that construct, and nothing else. Inevitably, however, test items require other kinds of knowledge and skills just to complete the item—knowledge about words, reading, syntax, language, cause and effect, etc. For the most part, these latter aspects of the item are "construct-irrelevant," they are not what the item is designed to measure. As long as they do not impose significant barriers or difficulty, construct-irrelevant parts of the item have little effect on the item's accuracy. But if they do impose significant barriers for some students (e.g., the item is written in an unfamiliar language or requires extraordinary concentration) then the item no longer measures the construct itself accurately, but rather is contaminated by the construct-irrelevant demands of the item itself.

For students with learning disabilities . . . ensuring that tests are fair and accurate requires some special attention to their design or implementation.

There are many construct-irrelevant impediments to accurate measurement for students with learning disabilities (and many other disabilities) in traditional standardized assessments. Students who struggle with early reading tend to read less and thus develop smaller vocabularies than other students in later grades, a construct-irrelevant obstacle for comprehension in many testing items. Others may struggle with calculation or writing. Some students with learning disabilities may have developed motivational or attentional difficulties from their schooling (e.g., they may have learned to be highly anxious during literacy tasks or tests, or have developed "learned helplessness" behaviors from repeated failure during testing); others may have difficulties with the executive function demands of testing (e.g., the most difficult aspect of the testing may be the requirement for sustained effort and attention on a single task, or the requirement for working memory). When these impediments are not relevant to what the item is supposedly testing, they are sources of distortion that differentially affect some

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students more than others, thus resulting in assessments that are neither inclusive nor accurate.

As the education world is "racing to the top" and embracing the principles of the Universal Design for Learning (UDL) framework in classroom instruction (see the Fall 2013 issue of *Perspectives on Language and Literacy*), the necessity of having accurate and reliable assessments—for all students—is of critical importance. The key imperative behind universal design of assessment (UDA) is that assessments should be designed from the beginning to reflect the diverse needs of the learner population who will take the assessment. These broad principles align philosophically with UDL principles, which are designed to increase access to academic content. When assessments are built to be as inclusive and accessible as possible, the need for external testing accommodations—a retrofit of sorts—can be reduced (although not completely eliminated). Most importantly, by practicing the principles of UDA, tests are rendered more accurate and fair, especially for students with a wide variety of disabilities and cultural differences.

In the world of paper-and-pencil tests, Johnstone, Thurlow, Moore, and Altman (2006) provided a context for UDA by posing the following questions of test item features:

1. Does the test item measure what it is intended to measure? Items should reflect the content standards and not inadvertently measure some other skill (e.g., a history item that, by requiring fluent reading, is inadvertently measuring reading ability).

2. Does the test item respect the diversity of the student population? Test items should be free from bias and not advantage or disadvantage one group of students (e.g., a math item that depends upon understanding ice skating and its vocabulary would privilege students living in the north over those in the south).

3. Does the test item have clear visuals when they are necessary? Visuals should only be used when necessary; they should include clearly defined features, sufficient contrast between colors, and labels.

4. Does the test item have clear and readable text? The language of test items should be simple and concise. Vocabulary should be simple and idioms should be avoided, except when these are tested.

5. Does the test item allow changes in format without altering the meaning or difficulty of the item? Well-designed test items can be translated into braille and other languages, including American Sign Language (ASL). Test items should be accessible by assistive technology.

Johnstone and colleagues (2006) recommended that by addressing these five components of UDA, item developers could write test questions that would reduce inappropriate barriers and obstacles and would produce assessments that are more accurate and fair for a wide range of students. These principles of universal design of assessment have been enacted by state departments of education as they have developed new assessments. A recent NCEO survey found that 75% of states now consider Universal Design during test development and construction (Rieke, Lazarus, Thurlow, & Dominguez, 2012).

However, important changes are modifying the landscape of assessment. With the Race to the Top Assessment initiative (through which states have been eligible for grants based on their adoption of assessments that prepare students to succeed in higher education and in their future careers), two large consortia of states—the Smarter Balanced Assessment Consortium (Smarter Balanced) (see *http://www.smarterbalanced.org/smarter-balanced-assessments/*) and Partnership for Assessment of Readiness for College and Careers (PARCC) (see *http://www.parcconline.org/*)—are developing national assessments that use technology-based platforms rather than paper-and-pencil to design and deliver assessments. PARCC, for example, is creating common math and English language arts tests for grades 3–11 that will be computer based and tied to college and career readiness competencies. Field tests on these assessments are currently underway in several States and the tests will be available for use in the 2014–2015 school year (PARCC, 2014). This development represents an important opportunity for applying UDA because many of the accessibility components of UDA can be built into the delivery platform of the assessment. How then, does UDA continue to fit in? What role does it play as we race to the top?

The Relevance of UDA in Technology-Based Assessments

Without proper design, tests on computers can be just as inaccessible and inaccurate as tests on paper. But modern technology can be an important enabler of UDA because many accessibility features and accommodations can be much more easily implemented with technology than print. UDA ensures that proper accessibility features and accommodations are built in from the beginning so that the tests accurately measure what they are intended to measure—for *all* students. In that regard, the analogy with universal design in architecture is apt: it is much easier (and better) to design universally accessible buildings from the beginning rather than trying to retrofit or accommodate to them later, after they have been built without proper universal design.

Technology, Assessment, and UDA

As many states have begun working in consortia to develop new assessments based on CCSS, there has been enthusiasm for what technology platforms can do in terms of increasing accessibility for all students. Accessible Portable Item Profile (APIP) standards mean that test items can be designed so that accessibility features, such as reading aloud, a pop-up calculator, or glossary, can be embedded in the test items. As the National Center on Educational Outcomes (2011) has noted, such features represent tremendous progress and create new possibilities for accessibility and accuracy of assessments.

But proper design of assessments requires more than a number of embedded accessibility features or accommodations. What is critical is that these features are designed and deployed correctly, that they improve the overall assessment design and optimize its value for educators, parents, and students. The objective is not to make tests easier, or even to make them more accessible, but to make them more accurate and informative. To return to the earlier example, a read-aloud feature can now be easily embedded in any modern testing platform. But its proper use depends both on the student and on the test item. If the item is designed to measure knowledge of some aspect of science—the construct being measured—then failure to allow a read-aloud option would ensure that the item is inaccurate for students with dyslexia (because it would largely be measuring their difficulties in reading, not their knowledge of science). On the other hand, if the item is designed to measure decoding ability, then it would be inaccurate to provide read-aloud support. Much of the "heat" in the design of modern UDA assessments is in understanding when (and for whom) the new kinds of accessibility features are critical to accurate measurement and when (and for whom) the same features would undermine that item's usefulness.

The key to UDA is a careful focus on what the item is intended to measure (the construct) and what kinds of other things it might be inadvertently measuring (e.g., potentially non-construct relevant things such as visual ability, decoding ability, or special vocabulary that injects cultural or linguistic bias). Only by careful design (UDA), from the beginning, can we be sure we are measuring the right thing, and especially for the right students who may be "atypical" in some way (such as students with dyslexia).

To ensure that new tests are designed from the beginning with accessibility in mind and to minimize the need for retrofitting, Thompson, Johnstone, and Thurlow (2002) developed seven elements of universally designed assessments based on research from various fields. These elements were primarily developed in the context of paper-and-pencil tests but they have even more important implications for the computer-based assessments currently administered or developed by states and consortia. These seven elements are described below:

1. ***Inclusive Assessment Populations.*** Universally designed assessments should be maximally accessible to ALL students, including students with disabilities, English language learners (ELLs), ELLs with disabilities, and others. When employing UDA principles, it is important to remember that if one category of students benefits from an accessibility feature, it is likely that other categories of students or individual students will benefit from the same feature as well. For instance, providing images can help with accessing test content for students with print disabilities but it can also be beneficial for such students as ELLs and visual learners.

2. ***Precisely Defined Constructs.*** This UDA element focuses on a uniform definition of what the test item is designed to measure. This approach does not mean altering the construct or lowering assessment standards. Rather, clearly identified constructs ensure that all students have the same understanding of what the test item is asking them to do.

3. ***Maximally Accessible, Non-Biased Items.*** Since large-scale assessments are designed with all students in mind, they should be comprehensible and free of bias. Ethnocentric examples representing one cultural group may not be understandable to those who are not familiar with this particular cultural group. Employing as much universal language as possible is the goal of this element.

4. ***Simple, Clear, and Intuitive Instructions and Procedures.*** Comprehensive test instructions and procedures are one of the first steps to accessing and responding to assessment content. The richness of the English language often invites the use of synonymous words and expressions. For example, there are at least twelve ways of expressing mathematical addition in English. When selecting terms for instructions and procedures, it is important to avoid infrequently used expressions and contextual idioms and maintain maximum simplicity and clarity of instructions to prevent test takers from getting confused.

5. ***Amenable to Accommodations.*** Universal design does not replace accommodations. Universally designed general assessments may reduce the need for accommodations and alternate assessments; still, universal design cannot completely eliminate the need for them. Special considerations should also be given to the compatibility of computer-based assessments with assistive technology. Recent technological advances are making it possible for students with various learning needs to use assistive devices that enable those students to access instructional and assessment materials. Ensuring that next generation assessments allow students to use the same devices with which they access content in instruction should be kept in mind when developing universally designed assessments.

6. ***Maximum Readability and Comprehensibility.*** Current technological applications make it possible to measure the level of readability and text complexity. It is important to develop test items at appropriate grade levels and to avoid language structures that may pose construct-irrelevant difficulties for some students and thus interfere with accurate assessment. (See article by Deshler and Greer, this issue).

7. ***Maximum Legibility.*** Assessments that use technology-based platforms allow multiple ways of manipulating the presentation of the test, including contrast adjustment, highlighting, magnification, etc. It is critical that these features are not only built into the test but that students get opportunities to practice using these features in instruction or during practice tests so that they are comfortable with their application during the high-stakes test administration.

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In addition to these seven universal design elements, Johnstone, Thurlow, Moore, and Altman (2006) identified additional considerations for universally designed, computer-based tests. Specifically, these considerations include the following:

1. **Layout and Design.** Computer-based assessments that are universally designed include sufficient contrast between background and text, have adjustable font size and color schemes, present stimulus and response options on the same view screen when possible, convey important information independent of color, use a consistent page layout, and follow Section 508 guidelines, which provide directions for ensuring accessibility of digital and media products (see the Karger and Lazar article in this issue for more details on Section 508 guidelines).

2. **Navigation.** Assessments should be easy to navigate. Navigation should be clear and intuitive; it should be possible when using a mouse, keyboard, or touch screen. Students should have adequate training on the navigation system prior to taking the assessment. Finally, computer-based assessments should be amenable to breaks.

3. **Screen Reader Considerations.** Assessments on a technology platform should be amenable to screen readers. The items should be intelligible when read by a screen reader. Links should make sense when read out of a visual context (for example, "go to the next question" rather than "click here"). Non-text elements, such as pictures, should have a text equivalent or description. Tables should be used to convey only data and should be compatible with screen readers.

4. **Test-Specific Options.** Access to other functions on the computer, such as email or the Internet, is restricted. Pop-up translations or glossaries are available when appropriate. When constructed response items have a word limit, the platform should provide feedback on how many words the student has written. Students should be able to record responses and read them back, as an alternative to a human scribe. Students are allowed to create persistent marks, such as marking items for review or eliminating multiple answer choices, to the extent that these are allowed on paper-based tests.

Computer Capabilities. Assessments on computers should have adjustable volume, speech recognition, compatibility with screen reader software, and be amenable to assistive technology. Masking items or text (allowing students to temporarily "hide" some of the information on the page in order to focus their attention) should be built into the delivery platform.

Many of these considerations have been addressed through the new APIP standards. New assessment items are being written to include features such as adjustable contrast, embedded glossaries, and amenability to breaks. However, a quick look at released items from assessment consortia indicates that new test items have addressed some, but not all, principles of UDA.

The relationship between testing accommodations and the curriculum. One concern that some educators raise is whether the availability of accommodations—such as read aloud—during testing decreases the sense of obligation to master early reading skills at all. The opposite concern is also raised—that by not providing those accommodations during testing, teachers will be obligated to remove them from the regular curriculum as well (so that students will be prepared to take tests without any accommodations). Both concerns are equally important. Nothing about UDA suggests that teachers should decrease their attention to early reading skills. Those early reading skills must be taught and assessed rigorously. What UDA does recommend is close attention to construct relevance—measuring reading skills carefully and rigorously (without accommodations) when they are the relevant constructs, but not measuring them inadvertently when they are construct-irrelevant (e.g., when the construct being measured is math computational skills).

Specific Test Items through the Universal Design Lens

The following four sample test items are from large-scale assessment consortia. These items represent innovations in assessment design—the items include drag-and-drop features, multiple test questions embedded in one general item, and embedded answer options (e.g., clicking on words in the reading passage). We present each item below along with suggestions for how the items could be improved by attending to UDA elements. Although we have focused our suggestions on students with learning disabilities, it should be noted that many other students would also benefit from these changes.

In our analysis of the following test items from a UDA perspective, we take a general approach. That is, both PARCC and Smarter Balanced have established accommodation policies, which include differing views on the read-aloud accommodation. For PARCC, having test items presented through text-to-speech, sometimes referred to as "read-aloud," is allowed for students with disabilities. For Smarter Balanced assessments, this accommodation is allowed for students with disabilities in grades 6–8 and 11 (as well as blind students who do not have adequate braille skills in grades 3–8 and 11). The difference in policies reflects strong differences in the field regarding the definition of reading, especially assessment of reading. Professional and philosophical disagreements persist, with thought leaders either believing that reading is a process of visually interacting with print or that reading is a process of comprehension that is not modality dependent (see Cline, Johnstone, & King, 2006, Johnstone & Thurlow, 2012). To date, these differences have not been resolved.

EXAMPLE 1. Grade 9 English Language Arts

The test item below is part of a cluster related to the reading passage "Fields of Fingerprints: Testing DNA for Crops." About this item, it is noted, "The skills of reading carefully, examining key ideas, and applying an understanding of a text are essential for college and career readiness. This Technology-Enhanced Constructed Response item asks students to analyze the various advantages of understanding plant DNA as put forth by the text and then provide textual evidence showing how those ideas are developed. The item can be found online at *http://www.parcconline.org/sites/parcc/files/Grade9SampleItemSet.pdf.*

Question: The article shows that understanding plant DNA offers many advantages to plant growers and scientists. To complete the chart below, first select the two statements from the left column that are advantages of understanding plant DNA. Then, drag and drop one quotation from the list of possible supporting evidence into the "Supporting Evidence" column to provide textual support for each advantage you selected. You will not use all of the statements from the box titled "Possible Supporting Evidence."

Advantages of Understanding Plant DNA	Sources of Evidence	Possible Supporting Evidence
A. The study of plant DNA has led to better understanding of human DNA.		1. "Easy to use DNA test kits for certain crops should be on the market within the next few years."
B. The study of plant DNA has led to advancements in computer programs that help with the analysis of genes.		2. "Specialized computer-based analysis programs identify the fingerprint, or specific genes, carried in the seed of individual crop varieties."
C. The study of plant DNA has enabled scientists to isolate the genes responsible for more useful plants.		3. "The technique of DNA fingerprinting has been developed using the science of genetics."
D. Scientists can now determine if a crop has desired characteristics much earlier in the growth cycle.		4. "An organism's DNA contains the blueprint of its characteristics—in the case of plants, that would include features like yield, drought resistance, and starch content."
E. Plant DNA now enables scientists to recreate species of plants that have become extinct.		5. "At one time, the researcher would have to grow the crop to see if the trait is present. But now, the DNA of the seed batch can be tested to determine if the seeds contain the sought-after gene."
F. Plant DNA has generated public interest in science and has resulted in new products being sold.		6. "Because DNA fingerprints are taken from the same DNA that carries the entire genetic blueprint for the plant, pieces of DNA that are close together tend to be passed on together from one generation to the next."

This item could be revised to be more accessible for all students, including those with learning disabilities, by addressing the following Elements of UDA:

Precisely Defined Constructs. A feature of CCSS is the application of skills in English language arts to other content areas. This item is an example of the application of reading comprehension skills to science content. But the item also requires multiple other constructs: from prior understanding of plant DNA, to specialized vocabulary, to skill in using drag-and-drop. These latter requirements are not, of course, strictly relevant to the construct being measured and thus interfere with accurate measure of reading comprehension per se, especially for students with dyslexia.

Maximally Accessible, Non-Biased Items. When it comes to maximal accessibility for all students, this item may pose challenges for students who have not had opportunities to learn about DNA in their science classes, including students with dyslexia who have not had appropriately accessible textbooks (e.g., textbooks that provide decoding or vocabulary support) and thus have not had an equitable opportunity to learn. Furthermore, for students with learning disabilities, the relevant challenge of the actual topic may be overshadowed by the expectations related to decoding and reading comprehension.

Simple, Clear, and Intuitive Instructions and Procedures. Some students may be familiar with the drag-and-drop instructions. However, for students with print disabilities, it may be beneficial to give students an example of how to approach answering the questions. Some students may not realize that each item in the first text box needs a source of evidence.

Amenable to Accommodations. For students with print disabilities, having the text read aloud may be critical to understanding the content and would reduce the inaccuracy of the item or test.

Navigation. This item layout would require students to scroll, and potentially to drag and drop while scrolling. This could prove challenging for some students with print disabilities, along with students who have physical or motor challenges.

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EXAMPLE 2. English Language Arts Item

The following question is from an assessment consortium's released items. For this item, students read a passage entitled "Grandma Ruth." The passage can be found online at http://sampleitems.smarterbalanced.org/itempreview/sbac/ELA.htm, and it requires the student to scroll down on the screen to read the full passage. After reading the passage, the student is given the following instructions:

Read the sentences from the passage. Then answer the question.

> My grandma pulled the ball out, unwrapped it, and held it out for us to see. The ball was scarred almost beyond recognition. It had dog bite marks, dirt scuffs, and fraying seams. Right in the middle was a big signature in black ink that I had somehow overlooked. It was smudged now and faded, but it still clearly said 'Babe Ruth.' I began to shake inside.

Click on two phrases from the paragraph that help you understand the meaning of scarred.

It should be noted that in the technology-enhanced item, the student can hover over any word in the above paragraph, and it will be shaded in grey.

This test item is technologically-innovative in that rather than answering a multiple choice question with potential answer choices or being a constructed response item, the student is asked to click on the phrases in the text that provide the correct answer. Nonetheless, the item could be improved with additional attention to the universal design features described below.

Inclusive Assessment Populations. This item type—a departure from traditional multiple choice or short answer questions—may be unfamiliar to some students, including students with learning disabilities. Therefore, practice items are necessary to equalize opportunity for all students to effectively engage in demonstrating their knowledge unimpeded by any difficulties in handling the special format of the item. Students with learning disabilities are often especially vulnerable to such unexpected difficulties because of their history of stigmatizing difficulty with testing generally. It is also important to ensure that the item works with screen readers and be aware that the item may pose challenges for students who have learned to use special adaptive techniques (such as masking).

Maximally Accessible, Non-Biased Items. The construct-irrelevant item content may be unfamiliar to some students, including some ELLs. The item could be made more accessible by including visuals to enhance the understanding of the reading passage when that is not the construct being assessed. Additional information, such as a textbox that provides information on the significance of a Babe Ruth autograph, may minimize bias and also provide more support for students with learning disabilities.

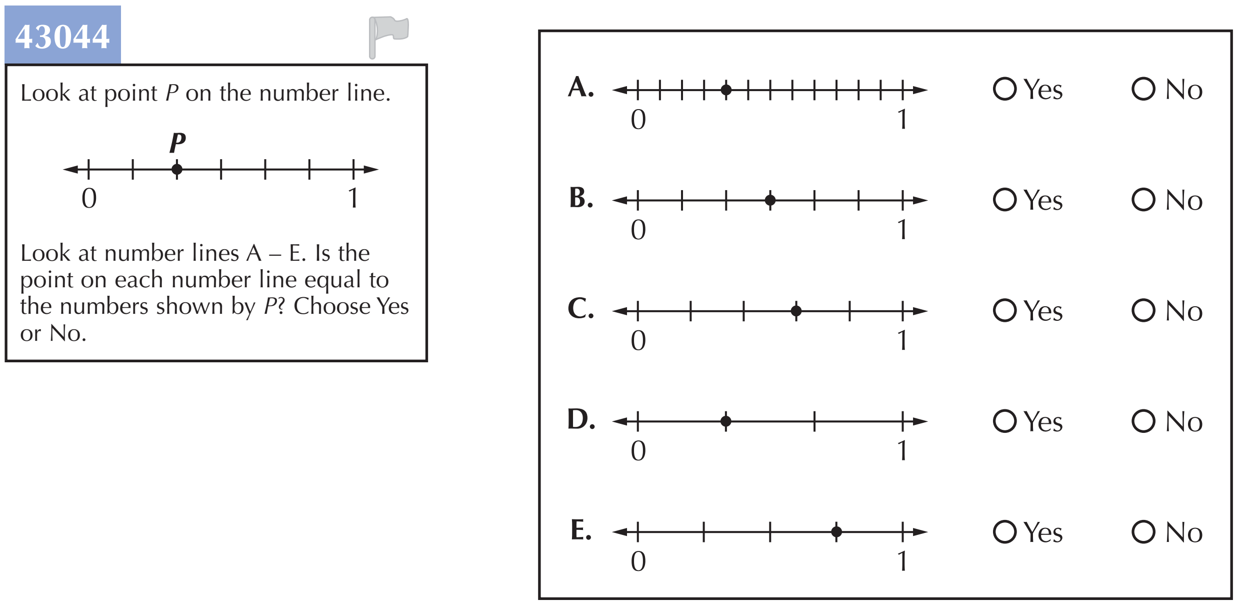
Simple, Clear, and Intuitive Instructions and Procedures. Some students may have difficulty understanding the directions for this question since the item does not indicate an answer area on the page. For students with learning disabilities, this lack of intuitive instructions may prove challenging. Students may need some clarification of the item or a visual depiction of what to do.

Maximum Legibility. For students with learning disabilities, it is important that this item can function as expected when students are using accommodations. For students who use color contrast on the computer screen, it is important that the shaded words remain legible and that the shading is visible with the color contrast.

Navigation. This item should be amenable to various delivery platforms. The term "click" above implies the use of a mouse; however, a stylus or finger to touch the answer should be another available option.

Test-Specific Options. Many students, including those with learning disabilities, would benefit from having some words available in a pop-up glossary (to maximize accessibility, the glossary would have an audio option, as well). Care must be taken to ensure that the words defined thusly are not "construct relevant"—i.e., that knowledge of their meaning is not what the item is intended to measure. Even for construct-irrelevant words, definitions should be written so as not to provide clues to the answer but to help reduce barriers to understanding the item.

EXAMPLE 3. Math Item



This item could be improved in alignment with the following elements of UDA:

Inclusive Assessment Populations. This item may be challenging for students with visual impairments and print disabilities, particularly if they need to use a magnifier. Allowing students to adjust the size of the visual display makes the item equitable. Another option could be to have a braille version of this item, as all items should be amenable to braille.

Amenable to Accommodations. To maximize accessibility for some students, including those with learning disabilities, this item may have to be accessed using two computer screens situated side-by-side, a setup that is not traditionally offered in conventional assessment settings. This setup is an emergent accommodation in the digital testing age.

Simple, Clear, and Intuitive Instructions and Procedures. The item instructions appear to be complex because they are asking five different questions in one. The five-question matrix also has an additional yes-no level. These features may be difficult for students who have learning disabilities because it may not be obvious that all five questions should be answered. Providing a sample to illustrate the directions would be one helpful improvement.

Navigation. This item may be difficult to navigate if a student decides to use masking techniques while accessing the content of the item. Masking techniques may be very helpful for students with learning disabilities because they allow the students to focus on one part of the test item at a time.

Test-Specific Options. This math item could be enhanced with pop-up translations or definitions that would not only benefit students with learning disabilities, but also ELLs.

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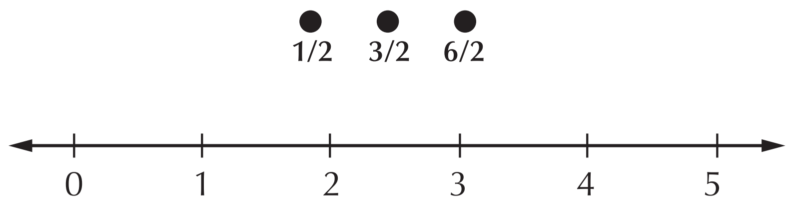
EXAMPLE 4. Grade 3 Math Item

SAMPLE ITEM

Drag each fraction to the correct location on the number line.



This item could be improved for students with learning disabilities in alignment with the following elements of UDA:

Precisely Defined Constructs. The item appears to incorporate multiple constructs because the first part is expressed in fractions but the number line only has ticks for whole numbers. It would be helpful for item designers to specifically identify the construct (and standard) to be assessed in the item.

Simple, Clear, and Intuitive Procedures. The drag-and-drop feature of the item may be challenging for some students with learning disabilities as well as other students with motor disabilities or ELLs. In addition, having only ticks for whole numbers requires the student to infer additional ticks on the number line. Having a sample illustration of the directions would prove helpful. In addition, the presentation of the fractions may be biased to those groups of students who are accustomed to seeing fractions that use a horizontal dividing line rather than a forward slash. This could be particularly important for students with learning disabilities, as a lack of familiarity with this format may add unintentional complexity to this item.

Maximum Legibility. The differences in font size and style have the potential to interfere with the legibility of the item, rendering it unnecessarily challenging for students with learning disabilities.

Navigation. When accessed with a magnifier, this item might require students to scroll and potentially drag and drop while scrolling. This could prove challenging for some students.

Test-Specific Options. This math item could be enhanced with pop-up translations or glossaries available to ELL students and other students who need additional language supports.

What the Future Holds for UDA

As educational assessment continues to advance within technology-enabled delivery platforms, the opportunity for innovative testing items is endless. Educators should be cognizant of a balanced approach to designing assessments to ensure that excessive technological applications do not make those items more complex than UDA requires. Some additional UDA considerations related to technology include but are not limited to the following:

1. Animations in test items should have textual descriptions and be used when they add meaning to the item, not simply because they are novel.

2. Test items should be compatible with multiple delivery systems (including laptops, tablets, phones, and other devices).

3. Built-in features should be tested to ensure they are not in conflict with each other or with other technologies (e.g., magnification affecting the function of the mouse, magnification limiting the use of a text reader, etc.).

4. The potential of UDA items for boosting students' engagement and motivation should be a focal point of current research and practice to address possible limitations of large-scale assessments.

In many ways, current assessments are more universally designed than ever. Built-in accessibility features will likely minimize the need for additional accommodations (such as having a human reader provide read-alouds, which can be stigmatizing and often awkward in practice). Further, students who are proficient with the use of computers will be able to customize settings in ways that were never possible in paper-and-pencil-based tests.

The most important reason for implementing UDA practices in the future is to ensure the close alignment of instruction and assessment that is essential in effective inclusive education for students with learning disabilities. Although UDL (see other articles in this issue and the 2013 fall issue of *Perspectives on Language and Literacy*) is not discussed explicitly in this article, our assumption is that UDL principles will be employed in the classroom to maximize the opportunity to learn for all students.

As that becomes more common (due to various federal initiatives and mandates), it will be all the more important that assessments are equally well-designed. Together, UDL and UDA provide a comprehensive approach to learning and its assessment for students with a wide range of differences and disabilities.

However, despite this tremendous progress, there is still a need to maintain steadfast focus on the end users of assessments—students, including students with learning disabilities. Although improved delivery of items through accessibility features has leveled the playing field for some students with print disabilities, new requirements may introduce the need for skills that are not known (or taught) as yet. These are likely to benefit students in many ways, but they are also likely to introduce new kinds of construct-irrelevant error, new opportunities for introducing bias into items, and new complexities that increase the difficulty of the item in unintended ways. As we have moved from the first generation of UDA to today's "UDA21" or Universal Design for Assessment in the 21st Century, there is a need to maintain focus on item-level design that is accessible for all types of learners. The content must remain aligned to standards and be written in ways that are accessible to students. While maintaining the classical focus of UDA, new learning will occur related to navigation, scripting of audio items, limitations on accessibility functions, and supplemental accommodations. While UDA is not a new concept, organizations such as the National Center on Educational Outcomes, the Center for Applied Special Technology (CAST), and increasingly test development companies are stretching definitions of UDA to fit new platforms while maintaining a focus on item-level accessibility. Ultimately, that effort will ensure that assessments are equitable and accurate for ALL students.

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Ensuring that Students with Text-Related Disabilities Have Access to Digital Learning Materials: A Policy Discussion

by Joanne Karger and Jonathan Lazar

In recent years, schools in both the K–12 and higher education context have been moving toward increased use of digital learning materials. Digital learning materials are materials such as textbooks, notes, slides, and graphs that are available in electronic format. These materials hold great promise for promoting enhanced levels of participation and flexibility in the general curriculum for students who have historically been marginalized as a result of traditional, print-based instructional materials such as textbooks. The movement toward digitization, however, also brings challenges for students, such as those with dyslexia, who may have difficulty accessing text in its digital format. The purpose of this article is to provide an overview of the various legal and policy issues associated with the shift toward digital learning materials and to discuss the implications for all students, in particular those with text-related disabilities such as dyslexia. As more schools begin to embrace the use of digital learning materials, it is important for practitioners to understand the underlying legal and policy issues in order to ensure that their students with dyslexia are able to participate in and benefit from these new learning opportunities.

Challenges Posed by Digital Text for Students with Dyslexia

It is estimated that more than 80% of individuals who have been identified as having a learning disability have dyslexia (Shaywitz & Shaywitz, 2008). Students with dyslexia experience challenges associated with the accuracy and fluency of word recognition, decoding, and spelling that often result from phonological weaknesses. Additional challenges may pertain to reading comprehension, hindering vocabulary development and formation of background knowledge (IDA, 2002). These difficulties ultimately serve to impede the manner in which students with dyslexia are able to interact with printed text.

At the same time, technology is changing the traditional model of what is considered to be *reading* (Gregg & Banerjee, 2009). For instance, hyperlinks are not part of printed text, and the nature of the differences between reading text online and reading in its printed form are still not totally understood (Gregg & Banerjee, 2009). For students with dyslexia, the use of technology such as electronic book readers (e-readers) may pose challenges, including an inability to navigate easily through headings and subheadings, when the headings are not properly tagged in electronic book (e-book) format. At the same time, digital technologies for reading can potentially provide enhanced features such as manipulation of font size as well as the potential for increased engagement (Ash, 2010). Furthermore, any potential stigma that someone with dyslexia might face when using a technology that draws attention because it is different is removed when the individual uses the same technology (such as a standard e-reader) as the general public, simply using accessibility features within that standard technology.

Legal and Policy Landscape

The obligation of schools to ensure that digital learning materials are accessible to students with text-related disabilities such as dyslexia is grounded in various laws, regulations, and policy guidance. At the federal level, these obligations stem from the Individuals with Disabilities Education Act (IDEA) and the disability civil rights laws—Section 504 of the Rehabilitation Act of 1973 (Section 504) and the Americans with Disabilities Act (ADA). Technical guidance on accessibility can also be found in the Web Content Accessibility Guidelines (WCAG 2.0) (an international standard) and Section 508 of the Rehabilitation Act (Section 508), although Section 508 technical guidelines are currently being updated. A number of states have also developed laws and/or regulations pertaining to accessibility, generally echoing the federal requirements. Moreover, there have been several recent policy developments that are likely to have implications for the provision of digital learning materials.

Individuals with Disabilities Education Act

At the K–12 level, students with disabilities served under IDEA have the right to receive a free appropriate public education (FAPE). This right includes the right to have access to, be involved in, and make progress in the general education curriculum—that is, the same curriculum as that provided to students without disabilities (34 C.F.R. § 300.320(a)(1)(i)). The instructional materials that students use in the classroom are a fundamental component of the general education curriculum. Therefore, for those students for whom text—in its print or digital format—serves as a barrier to learning, the right to receive appropriate, accessible instructional materials in a timely manner is a critical element of the right to FAPE (OSEP, 2006).

As part of the 2004 reauthorization of IDEA, Congress added new provisions pertaining to the quality and delivery of accessible instructional materials (AIM) to students who are blind or have other print disabilities, including students with dyslexia (Karger, 2010). AIM refers to textbooks and related core instructional materials (20 U.S.C. § 1474(e)(3)(C)) that have been converted into accessible or specialized formats (braille, audio, digital text, or large print) (20 U.S.C. § 1474(e)(3)(D)). IDEA 2004 established the National Instructional Materials Accessibility Standard (NIMAS), a technical standard used in the conversion of print instructional materials into specialized formats (20 U.S.C. § 1474(e)(3)(B)), and the National

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Instructional Materials Access Center (NIMAC), a national repository for electronic files based on NIMAS (20 U.S.C. § 1474(e)(2)). IDEA regulations further reference the obligation of states and local districts to ensure that students who need instructional materials in accessible formats receive these materials in a timely manner (34 C.F.R. § 300.172(b)(3)). It is significant that this statement is not limited to print-based materials. Consequently, it can be concluded that other forms of materials, including digital text, also need to be provided in accessible formats in a timely manner.

Disability Civil Rights Laws: Section 504 and the ADA

Section 504 and the ADA are two disability civil rights laws that apply to the accessibility of digital learning materials at both the K–12 and higher education level. Individuals with disabilities who qualify under Section 504 and the ADA are those who 1) have a physical or mental impairment that substantially limits one or more of such person's major life activities; 2) have a record of such an impairment; or 3) are regarded as having such an impairment (42 U.S.C. § 12102(1)).

Section 504 prohibits discrimination on the basis of disability in programs and activities that receive federal funding (29 U.S.C § 794(a)). Section 504 regulations require the provision of comparable aids, benefits, and services and prohibit discriminatory criteria and methods of administration (34 C.F.R. § 104.4(b)(1)(i), (b)(4)). In order to be "equally effective," aids, benefits, and services must provide students with disabilities "an *equal opportunity* to obtain the same result, gain the same benefit, or reach the same level of achievement" (34 C.F.R. § 104.4(b)(2) (emphasis added)). For elementary and secondary students, Section 504 includes an additional obligation to provide FAPE (34 C.F.R. § 104.33(a)). At the postsecondary level, schools are required to provide "academic adjustments" and "auxiliary aids" (e.g., taped texts) that afford students with disabilities an equal opportunity to participate in the school's program (34 C.F.R. § 104.44).

Title II of the ADA applies to all public entities, regardless of whether they receive federal funding (42 U.S.C. § 12132). Title II regulations require that auxiliary aids and services be provided *in accessible formats* in a timely manner (28 C.F.R. § 35.160(b)(2)), and that public entities ensure that communications with individuals with disabilities are as effective as communications with others (28 C.F.R. § 35.160(a)(1)). Title III of the ADA applies to places of public accommodation, including private K–12 schools and private colleges and universities (42 U.S.C. § 12182(a)). Under Title III, students with disabilities must not be denied participation or receive an unequal or separate benefit from that provided to other students (28 C.F.R. § 36.202). All of the above legal requirements help to set the context for practitioners to understand the right of students with dyslexia to participate in and benefit from the use of digital learning materials.

Joint Guidance by the U.S. Departments of Justice and Education

In 2010, in response to a complaint filed by the National Federation of the Blind (NFB), the Department of Justice, Civil Rights Division (CRD), entered into a settlement with colleges and universities that had been using the Kindle DX e-reader as part of a pilot study with Amazon. The Kindle DX was inaccessible to blind students because the menu and control features of the device did not include text-to-speech functionality (CRD, 2010). A subsequent "Dear Colleague Letter" (DCL) to college and university presidents, issued jointly by CRD and the Department of Education, Office for Civil Rights (OCR), stated that requiring the use of emerging technology that is inaccessible to students with disabilities constitutes discrimination under Section 504 and the ADA, unless these students are provided accommodations or modifications that enable them to receive all the educational benefits afforded by the technology in an equally effective and equally integrated manner (CRD & OCR, 2010).

The next year, OCR (2011) issued a follow-up Frequently Asked Questions (FAQ) document clarifying that the DCL applied to both K–12 and postsecondary schools. The FAQ also provided a "functional definition of accessibility," according to which students with disabilities must be afforded the opportunity to acquire the same information, engage in the same interactions, and enjoy the same services as students without disabilities, with "substantially equivalent ease of use." Moreover, the FAQ specifically stated that the DCL applied to other students with print disabilities, including those with specific learning disabilities who may have difficulty acquiring information from printed text (OCR, 2011).

Standards for Accessibility

Guidelines for web accessibility can be found in the Web Content Accessibility Guidelines (WCAG) developed by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) (see *http://www.w3.org/WAI/*). These voluntary international guidelines, the most recent version of which is titled WCAG 2.0, consist of 12 broad guidelines categorized under four principles of accessibility. Note that the four principles are listed verbatim from the Web Accessibility Initiative, but we have summarized an example of a success criterion for each principle:

1. Perceivable - Information and user interface components must be presentable to users in ways they can perceive (e.g., provide text alternatives for any non-text content, such as graphics or audio).
2. Operable - User interface components and navigation must be operable (e.g., make sure that a user can access an entire web page using only a keyboard, in case the user is unable to utilize a pointing device).
3. Understandable - Information and the operation of user interface must be understandable (e.g., if a data entry error is identified, present the user with feedback about the cause of that error, in plain text).

4. Compatible - Maximize compatibility with current and future user agents, including assistive technologies (e.g., ensure that coding is done properly, using both beginning and end tags so that they will be parsed properly by assistive technology).

While the WCAG 2.0 applies specifically to web pages, the WAI has released guidance on applying the WCAG 2.0 standards to non-web information and communication technology (see *http://www.w3.org/TR/wcag2ict/* for more information).

Additionally, Section 508 of the Rehabilitation Act requires federal departments and agencies to ensure accessibility of their "electronic and information technology" to individuals with disabilities unless to do so would result in an undue burden (29 U.S.C. § 794d(1)). The U.S. Access Board creates the technical standards under Section 508 for electronic and information technology. The current Section 508 standards for web-based content are approximately consistent with an earlier version of the WCAG (WCAG 1.0) (see *http://www.section508.gov*) and are currently undergoing a "refresh" process to harmonize fully with the WCAG 2.0. Although Section 508 applies only to federal departments and agencies, the technical standards provide guidance to other entities dealing with accessibility issues. In addition, many states have adopted laws similar to Section 508 (Georgia Tech Research Institute, 2009).

Recent Policy Developments Regarding the Accessibility of Digital Learning Materials

In December 2011, the Advisory Commission on Accessible Instructional Materials (AIM) in Postsecondary Education for Students with Disabilities, which was convened under the Higher Education Opportunity Act of 2008, published a report with recommendations for addressing some of the challenges associated with the provision of AIM to students with print disabilities at the postsecondary level. These recommendations urged Congress to take action in such areas as establishing a process for developing uniform accessibility guidelines for AIM and establishing mechanisms to facilitate market solutions for AIM (AIM Commission, 2011). With respect to the former, in 2013, Congress introduced a bill, titled "Technology, Equality and Accessibility in College and Higher Education (TEACH) Act." This bill, which resulted from collaboration between the NFB and the Association of American Publishers (AAP), would require the Access Board to develop national guidelines for accessibility of electronic instructional materials and related information technologies for blind and other individuals with disabilities (see *https://nfb.org/national-federation-blind-and-association-american-publishers-applaud-introduction-%E2%80%9Cteach-act%E2%80%9D)*. A market solution would minimize the need for materials to be converted or retrofitted into accessible formats. Rather, under a market model, publishers would compete with each other to create accessible versions of instructional materials from the outset.

In October 2012, in a copyright infringement lawsuit brought by the Authors Guild, a federal district court judge ruled in favor of HathiTrust, a partnership of several research institutions and university libraries that had developed a shared library of millions of volumes of printed works that had been converted into digital materials. On a motion for summary judgment, the judge concluded that in making the digital copies, HathiTrust was exempt from copyright infringement liability under U.S. Copyright Law. In particular, the court found that the intended uses by HathiTrust—to promote superior search capabilities and to facilitate access for students with print disabilities—were transformative, and therefore exempt from infringement liability. The court also emphasized the importance of access to information for individuals with print disabilities as required by the ADA and Rehabilitation Act (*Authors Guild v. HathiTrust*, 2012). This case is currently on appeal before the Second Circuit; oral arguments were held on October 30, 2013.

In June 2013, the World Intellectual Property Organization (WIPO) adopted a treaty to facilitate access to copyrighted works for individuals who are blind, have visual impairments, or other print disabilities (WIPO, 2013). WIPO is a specialized agency of the United Nations that focuses on intellectual property, including copyright issues. The United States is a member state of WIPO, and the adoption of the treaty could have implications for individuals with print disabilities in the United States.

Also in 2013, the Department of Justice entered into a settlement agreement with Louisiana Tech University regarding the accessibility of course materials. In response to a complaint brought by a blind student, Louisiana Tech University agreed to engage in such actions as providing training for instructors and administrators on ADA requirements and conducting a review of the accessibility of its technology, "including websites, instructional materials and online courses, and other electronic and information technology for use by students or prospective students" (CRD, 2013).

Furthermore, in August 2013, Amazon, Kobo, and Sony, (the "Coalition of E-Reader Manufacturers") filed a petition with the Federal Communications Commission (FCC). The petition requested that e-reader devices such as Kindles be exempt from two provisions of the 2010 Twenty-First Century Communications and Video Accessibility Act that require that "equipment used for advanced communications services [ACS], including end user equipment" be "accessible to and usable by individuals with disabilities" (Coalition of E-Reader Manufacturers, 2013). The Coalition argued that to require compliance with these accessibility provisions would necessitate changes to e-readers that would essentially render them into tablets (despite the fact that some e-reader versions already have these features). The FCC solicited comments from the public. NFB, along with 22 additional organizations, submitted a joint statement opposing the petition (NFB *et al.*, 2013). On January 28, 2014, the FCC agreed to grant the waiver, but only for one year (see *http://www.fcc.gov/document/coalition-e-reader-manufacturers-petition-waiver-acs-rules*)

All of the above policy developments suggest that the accessibility of digital materials needs to be made a priority. As schools increasingly utilize digital learning materials as part of their instructional programming, it is important for practitioners to be cognizant of the underlying legal and policy parameters

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in order to ensure that their students with dyslexia are able to participate.

Recommendations for Making Digital Materials More Accessible and Effective for Individuals with Dyslexia

In light of the legal and policy context discussed above, this section provides recommendations for practitioners to help ensure that digital learning materials are accessible to individuals with text-related disabilities, including those with dyslexia. The first two recommendations address the human-computer interaction point of view—namely, 1) how to ensure that content is more flexible and 2) which assistive technology tools, whether providing alternate or multimodal approaches to input or output, can help students with dyslexia. The third recommendation focuses on actions that educators, families, students, and other stakeholders can take to promote the purchase of digital materials that are accessible from the outset.

Making Interfaces and Content More Flexible

In selecting and using digital learning materials, practitioners should try to make sure that interfaces and content are flexible for students with dyslexia. From the research literature, it seems that clearer content navigation, as well as flexibility in text size and text contrast, improves the user experience for people with dyslexia (McCarthy & Swierenga, 2010). Fonts that are sans serif (fonts that are without ornamentation) are superior to serif fonts, and we suggest reading (Rello & Baeza-Yates, 2013) for more information about 12 specific fonts and how they compare in terms of reading time for computer users with dyslexia. In general, having web-based (or other) interfaces that are flexible, allowing font size and color contrast of text to be easily manipulated, can be helpful for students with dyslexia (Gregg & Banerjee, 2009). It is important to ensure that, if students apply their own settings or style sheets to an interface (for instance, creating high contrast between text and background), a web page will still function properly. Another example is being aware that rapidly flashing images are distracting, and therefore should be avoided (this can also cause a problem for people with epilepsy). These core aspects of interface flexibility are all a part of existing interface standards for general accessibility from the WCAG 2.0 and also from Section 508. No specific approaches for these enhancements need to be developed specifically for people with dyslexia.

One aspect of interface design that is more specific to people with dyslexia is complexity of content. Content should be at an appropriate level, but written clearly and free of jargon. Text should, in a word, be readable. We want to be clear: we are not suggesting lowering the reading level of text; we are suggesting improving the clarity of text. From WCAG 2.0, success criteria 3.1.5 actually discusses different educational levels and the appropriateness of providing different sets of text, depending on educational level. Ironically enough, many of the advisory techniques for meeting 3.1.5 are listed as "future links," with little explanatory content provided. Again, we want to be clear: separating out and providing different versions of text based on educational or reading level or task knowledge (often known as audience-splitting) (Lazar, 2006) is different from what we are suggesting. We are suggesting clarity of text and succinctness, and avoiding the use of unnecessary words. A parallel movement, outside of the accessibility movement, is the plain language movement, which focuses on making sure that your reading audience can understand text the first time that they read or hear it, providing the necessary text without adding flourishes or unnecessary complication (see *http://www.plainlanguage.gov* for more information). This movement most closely relates to what we are suggesting about clarity of text. The Plain Writing Act of 2010 requires plain language in the communications of the U.S. government, but some have argued that this law has generally been ineffective in changing how the Federal government communicates with citizens (Steinmetz, 2013). Only a few Federal agencies have been successful with improving the delivery of plain language to citizens.

Using Appropriate Assistive Technology Devices

Practitioners should also keep in mind that students with dyslexia often need to use assistive technology tools in order to access digital text. Two of the most common assistive technologies utilized by students with dyslexia are screen readers (from companies such as Kurzweil or Texthelp) and speech recognition software (Price, 2006). The effectiveness of each assistive technology device depends on the individual and his or her specific challenges. In general, however, speech recognition (speech-to-text) helps with getting ideas written quickly and avoiding common problems with spelling that occur when typing, and both speech recognition and typing may be easier than handwriting (Draffen, 2002). Screen readers (text-to-speech) help by providing the same text that is visually presented, in an audio format, allowing the student both to see and hear the text at the same time (Draffen, 2002; Price, 2006). Screen readers are the most common approach for assisting students with dyslexia with reading (Gregg & Banerjee, 2009), although the screen readers maximized for use with blind users (such as JAWS) may not be as useful for people with dyslexia. This is because screen readers maximized for use with blind users simply read the text presented on the screen in computer-synthesized speech output. However, what is most useful for people with dyslexia is when the text on the screen is highlighted in sync with the computer-synthesized speech output of the text (a feature highlighted in other screen readers, such as Kurzweil 3000).

The provision of inaccessible screen reading technology by schools is an example of how a student's civil rights might be violated. As noted, there have been numerous accessibility-related problems with the Kindle family of e-reader devices, including the inability of blind people to turn the device on and off independently and to use the menu controls. There are additional aspects, however, that specifically have an impact on students with dyslexia. In 2009, Amazon released the Kindle 2, which allowed for text-to-speech, but the Authors Guild raised concerns about the text-to-speech feature, and so to this day publishers can disable the text-to-speech function on their Kindle books on a title by title basis, potentially affecting the ability of students with dyslexia to listen to their books. The Authors Guild went further, putting out a statement encouraging its members to negotiate contracts that prohibit books being read aloud by the Amazon Kindle 2 text-to-speech technology (NFB, 2009).

Promoting the Purchase of Accessible Digital Learning Materials

As schools at both the K–12 and postsecondary level begin to use more digital learning materials, it is critical that these materials be purchased in accessible formats from the outset. Unfortunately, not all digital formats or technologies are designed to be accessible, and attempts to retrofit digital materials after the fact are extremely difficult. Practitioners at all levels as well as additional stakeholders, including families and students, can work together to promote the purchase of digital materials that are accessible. Such collaborative efforts can ultimately help support the development of a more robust marketplace for flexible and accessible learning materials. The National AIM Center's PALM (Purchase Accessible Learning Materials) Initiative has developed a series of resources to support various stakeholders in promoting a campaign to encourage the purchase of digital materials that are accessible both in terms of the content of the materials and the technology delivery systems. Specific guidance for educators, families, advocates, and purchasers is available at *http://aim.cast.org/learn/practice/palm*. The PALM Initiative is consistent with additional recent actions taken by various groups to promote accessibility. For example, the AAP has come out in support of the EPUB3 (electronic publication) open standard for e-books, which enhances accessibility (see *http://publishers.org/epub3implementationproject/*), and the Association of Research Libraries (ARL) has set up a working group to improve accessibility (see *http://www.arl.org/focus-areas/accessibility*).

The key point to remember is that procurement processes at schools and universities can be effective levers of power to increase the accessibility of digital learning materials. Educating decision makers and advocating for improved accessibility of digital learning materials can make a major impact. Furthermore, the features that students with dyslexia need in digital learning materials fall under the greater umbrella of accessibility guidelines—there are not separate guidelines for students with dyslexia; rather, any type of digital learning material that is designed using international standards for accessibility should work properly with the assistive technologies (screen readers and speech recognition) often used by students with dyslexia.

Conclusion

This article has summarized the key legal and policy issues associated with the provision of digital learning materials to students with text-related disabilities, including dyslexia. It is helpful for practitioners to familiarize themselves with these issues as more schools begin to incorporate digital learning materials into their instructional programming. The article further provided specific recommendations for practitioners to keep in mind in order to help ensure that their students with dyslexia are able to utilize these new digital materials in an effective manner.

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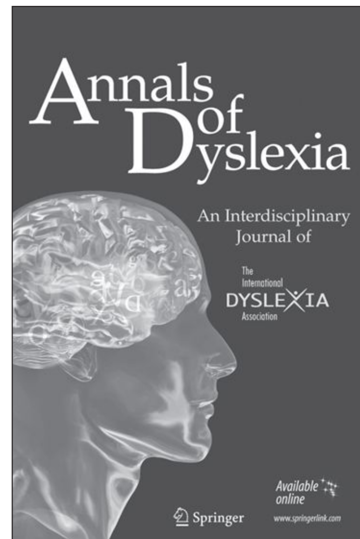

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Canaries in the Mine: Reading and Its Disabilities in a Post-Gutenberg World

by David H. Rose, Sam Catherine Johnston, and Amy E. Vanden Boogart

This issue of *Perspectives on Language and Literacy* and the fall 2013 issue that preceded it have given us a chance to hear from many of the most important researchers and practitioners at the intersection of reading disabilities and new technologies. We appreciate the time that each of these authors has taken to catch us up in their respective areas, and we appreciate even more their pioneering contributions to the field over many years.

In this final article, we would like to take their collective articles as a foundation for trying to look forward a bit, for imagining the future landscape based on the changes that we are seeing now.

The Future of Print and Its Disabilities

Blame it all on Gutenberg. Before his invention of printing technology opened the enormous opportunities of literacy to mass audiences, dyslexia would have been virtually unknown. With few hand-written manuscripts available to the public, and with early books so valuable that they were chained to desks in libraries, both the opportunities and the challenges of reading were inaccessible to most of the population. For most of the 500 years that followed Gutenberg, print as a medium for literacy and learning became so overwhelmingly important that it came to dominate the ways in which our culture educated itself and measured its learning.

In fact, print's strengths were so dominating that its weaknesses were barely noticeable to most of the population. During the last few decades of the 20th century, however, powerful alternatives to print began to emerge—voice recordings, video, digital talking books, multimedia games, simulations, etc. As those alternatives gained traction and accelerated, the limits of print became more and more apparent. At the risk of hyperbolizing, it is worth highlighting some of *print's disabilities* in the era ahead.

As we have seen, as a platform for expression, print is severely handicapped, inert, paralyzed. For example, print can capture some aspects of spoken language in text, but is unable to convey the richness of its dialect, intonation, gesture, flow, prosody. Similarly, printed images can capture, in a paralyzed view, flat representations of the visual landscape, but are unable to convey the motion, depth, sequence, sounds, textures, and full variability of visual phenomena. Most importantly for our purposes, print's paralysis as a medium means that it is unresponsive and inflexible: one size fits all. Printed text, for example, comes in one size, one font, one modality (vision), one code (alphabetic), and one language. As a result, individuals for whom that one size, font, modality, code, or language is not ideal, face barriers and obstacles that others do not face.

In contrast, a digital platform can carry all of the information of a print platform but with a much broader palette and with far greater flexibility. Text on a digital platform, for example, can easily be modified in size or font; read itself aloud (obviating the requirement for decoding); provide definitions for its vocabulary; change its contrast or highlighting; and be automatically transformed into voice, refreshable braille, and American Sign Language and even from one language into another. And, of course, digital platforms can carry much more than text or pictures, including video or aural recorded language with all of its rich intonation, prosody, and facial expression.

Furthermore, print is a static medium in time. Once text or images have been printed, they cannot be changed. As more options for representing information have become available, the dynamic and collaborative nature of knowledge formation and information dissemination comes into focus—more people can contribute to knowledge construction and dissemination, more frequently, and in more ways. Wikipedia and YouTube are merely the first drafts of a changed literacy future that, if anything, will require higher levels of critical literacy—in no small part because crowd-sourced media carry both the wisdom and the inaccuracy of the crowd.

With all of this potential, it is clear that the future of print's domination of literacy and learning is coming to an end. For those of us who grew up with it, print will retain an important residual role but it will have to share that role with many other media. For younger people, digital natives, print's centrality has already completely eroded and it will continue to decline as a primary medium, even for text. With the expansive new capabilities of digital media, print's disabilities will become ever more obvious, for all students.

For students with dyslexia, this radical shift in the literacy landscape will be an enormously good thing. They have, more than any other students, long been the casualties of print's requirements. Like the canaries that were sent down into the mines to alert workers when the air was toxic, students with dyslexia have inadvertently provided early warning signs that our learning environments can be narrow and toxic for the most vulnerable of students, disabling for many others, and far from optimal for almost anyone. Furthermore, like the vulnerable canaries in the mine, students who have difficulties with printed text highlight the weaknesses of print more quickly and obviously than other students. But all students will benefit from a broader and more flexible array of media for learning—there will be more good oxygen for everyone in the classrooms of tomorrow.

And that is the most important point. The legislation of the U.S. Congress that recently recognized "print disabilities" as an alternative to "learning disabilities" (IDEA, 2004) is a harbinger of an even more fundamental change. That change will come when schools, rather than children, are recognized as having "print disabilities." That change will help us remediate the disabling conditions of present schools and help them to prepare ALL students for the future in which they will actually live.

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The Future of Technology and Its Disabilities

E-books and multimedia textbooks are not where the radical change in education will happen. Those are merely new technologies for doing old things. The more radical educational technologies—those that are potentially disruptive for education—will not look like books at all.

Instead, truly revolutionary technologies for teaching—already evident in many new online programs and apps—will look much more dynamic and responsive, more like guided apprenticeships or graduated simulations where students can conduct virtual experiments or create their own media: where they can engage in active discovery or challenging games that develop skills; where they can find models, demonstrations, and progressive scaffolding to support practice; where they can find many alternatives, adaptations, and accommodations to suit their personal abilities and backgrounds.

Learners will be able to find these technologies and use them, and, increasingly, they will be able to adapt, repurpose, and reinvent them. These new environments can already, and will more often in the future, calculate and extrapolate, track progress and adapt, illuminate cause and effect, provide instructive—and immediate—feedback. They will blur the line between teaching and learning.

There are many advantages in these new kinds of "non-book" learning environments: 1) They can teach many things that are difficult or impossible to do with books or texts—skills and strategies, planning and goal-setting, problem solving, scientific methods, reflection and self-regulation; 2) They can more effectively reach students—including those with dyslexia—for whom traditional text-based learning environments have never been effective or well designed; and 3) They can provide a more social platform for learning where teachers, parents, and students can share, co-construct, revise, and repurpose many different kinds of resources for teaching and learning.

But, without proper design—universal design—new technologies will not automatically be better or more accessible to students with dyslexia or any other print disabilities. Like print technologies, any of the new technologies inevitably will bring both promise and compromise. As an immediate example, individuals who are blind typically find that the new multimedia environments are even more inaccessible and exclusionary than the old text-based environments. As a broader example, consider the World Wide Web, created by Tim Berners-Lee in the 1990s. There is no doubt that the Web has opened tremendous new avenues for learning and literacy throughout the world. But many individuals find themselves strangely "disabled" on the Web. For example, they cannot concentrate well, they get distracted easily, and they have to change their reading style to something more akin to skimming and reading short segments. To those individuals, it comes as no surprise that Sir Tim Berners-Lee is himself an example of someone with a learning disability that we typically describe as ADHD (he personally describes himself in that way). Indeed, it is probably true that only someone like Berners-Lee, who has a learning disability in traditional media, would have been motivated or enabled to invent the Web, where everything is connected to everything else and immediately available (and distracting). The irony is that his invention has made most of us feel like we have ADHD. Any new medium brings both abilities and disabilities.

So, new technologies typically will create not only new opportunities, but also new disabilities. The downside of future technologies is that the new kinds of barriers may be more difficult to remedy. Unlike textbooks, which are relatively easy to adapt for individuals with various disabilities—a powerful 3-D simulation or an interactive multi-player game—are not typically the kinds of things that can be adapted or modified easily by teachers, parents, or the students themselves. For blind students, the obstacles are presumptive and obvious. But when such learning environments embed cues, clues, or narratives in text that are not appropriately accessible, then students with dyslexia will face barriers and obstacles that limit their ability to learn from these new environments as well. And few parents or teachers will be able to "fix" or modify them.

As Karger and Lazar describe in this issue, there are now effective policies and processes in place to ensure that *textbooks* are equitably accessible to all students (see National Center on Accessible Instructional Media; http://aim.cast.org.). A newer initiative—PALMS (Purchase Accessible Learning Materials)—housed at CAST and sponsored by the U.S. Department of Education, provides support for states, districts, teachers, and parents to ensure that ALL the new learning technologies are universally designed for learning. For an equitable future for all children, it will be essential that ALL learning technologies, not just textbooks, are universally designed.

The Future of Reading and Its Disabilities

This essay has not focused on the role of new technologies in the early stages of learning to read. While several of the articles in these two issues address this area of rapid change, there are thousands of early reading apps and programs now available, more are coming every day, and they are of decidedly mixed quality (i.e., some are very promising, some are very terrible). Eventually the best will survive and will become a normal part of the way that every child learns to read.

But new technologies are not only changing the way that children learn to read, they are changing the way that we understand reading. Among the most important advances in understanding reading and its disabilities are the new digital tools that allow neuroscientists and reading scientists to study the living, working brain in ways that earlier imaging technologies—such as X-rays and CAT scans—could not. The new imaging technologies, such as PET, fMRI, and MEG, can provide dynamic interactive images of the brain as it works, allowing us to view not only the anatomy of the brain, but also its dynamics.

Several decades of using these new tools have resulted in one common finding: learning and cognition are both much more varied and differentiated than earlier imagined. It has been observed, for example, that there may be as many as 30 different areas in the brain devoted to vision, each likely to have a distinguishable contribution to learning about the world through sight. Not surprisingly, then, these new tools reveal that the ability to construct meaning from print is also much more complex than we had thought decades ago. Maryanne Wolf's (2007) recent review of the modern neuroscience of reading reveals the enormous range and variety of components in the brain that underlie successful reading.

The realization that there are a great many components to reading, rather than one or even several, leads inevitably to the conclusion that there are a great many potential barriers to successful reading and a great many ways to be disabled by those barriers. As just one simple example, students on the autism spectrum—called *hyperlexics* —are *precocious* decoders but are profoundly *disabled* in any test of reading comprehension. In this regard they have reading disabilities that are just as profound as students with dyslexia, but are profoundly different in their causes and effects. Most importantly, it is clear that no single method of teaching reading—or remediation—will be successful across those two populations. Differentiation will be critical.

The accumulating evidence from neuroscience, reading science, and teaching will continue to expand our understanding of the complexity of reading ability and disability. As a result, the convenient labels for those who have difficulties in learning to read, such as *dyslexia* or *learning disabilities*, will be increasingly recognized as describing very loose collections of individuals who share one commonality—they have difficulty in reading. But they are unlikely to share common causes, common patterns of specific abilities and disabilities, or common courses of remediation. That last realization will require better, more differentiated, methods for teaching ALL students. The same kinds of technologies that allow us to view the reading brain in all of its complexity, will allow us to differentiate our teaching to meet that challenge.

The principles of universal design for learning, based on the new learning sciences, provide a framework for differentiating instruction. The new technologies, properly designed to enable those principles, provide the flexible platform that makes differentiation possible.

Such advances are critical because the new media often place higher demands on reading, not lower. In the modern world of social media, critical reading and reflection, for example, are much more important than in world of carefully edited and properly vetted text. Our culture will need better readers—readers who can read critically and thoughtfully—for the future. Print is no longer a medium that is powerful or flexible enough to get us there—or at least to get *all* of us there.

The Future of Education and Its Disabilities

Schools, like cultures, are defined by the tools they use and by the cultural knowledge that makes those tools important and effective. Our present schools are largely defined by the possibilities and limits inherent in the tools of print. Although print's remarkable abilities were critical to the culture of early schooling, it is print's disabilities that now constrain our schooling and our children. Most importantly, at least for readers of this journal, it is print's disabilities that now constrain the ways in which schools can foster reading.

In that regard, students with print disabilities are indeed the canaries in the mine. They warn us that it is fundamentally our schools that are print disabled. Print's limitations interfere with a school's ability to teach any student optimally, to teach many subjects, such as math and science, adequately, to meet the challenge of individual differences, and to prepare any student for his or her future. Worse, it is print's "one-size-fits-all" quality that compels us toward standardization when our children, and our future children, beg for differentiation.

Remediating the print disabilities within our schools will require more than new technologies for students, it will require a new ecology for learning. The National Educational Technology Plan of 2010 provides a blueprint for changing the learning environment to an ecology that is based on the power and flexibility of new technologies rather than the limits of print. That plan makes it clear, however, that technology itself will not provide the remedy; indeed, new technologies can be just as rigid, inaccessible, and even toxic, as print. What new technologies can provide, however, is a flexible platform from which to create evidence-based learning designs that leverage the advances of modern learning sciences and recognize the diversity of our students. To ensure that the benefits of effective learning design are accessible to students with a wide range of abilities and disabilities, including those who are "print disabled," the National Educational Technology Plan emphasizes the centrality of adopting the principles of Universal Design for Learning (UDL). (See the National Center on Universal Design *http://www.udlcenter.org/*). In this new technology-rich environment, it is very likely that students with print disabilities will not provide just warning signals, but they will also help to invent the revolutionary new ways in which all students will benefit from a media-rich environment.

We can only prepare students, all students, for their future when we recognize that both our students *and* our schools must not be standardized by print. As the articles in this two-part series on technology demonstrate, new technologies are beginning to offer alternatives to the standardizing practices of schools to remediate school's print disabilities for the most vulnerable of students. Recognizing that those students are merely the canaries in the mine is the next step toward a better education for everyone.

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books, numerous award-winning educational technologies, and dozens of chapters and research journal articles. He has been the principal investigator on large grants from the National Science Foundation, the U.S. Department of Education, and many national foundations. In the policy arena, he was one of the authors of the recent National Educational Technology Plan, has testified before the U.S. Senate, and helped to lead the development of the National Instructional Materials Accessibility Standard. Dr. Rose has won many awards, including recently being honored at the White House as a "Champion of Change." Dr. Rose holds a B.A. in psychology from Harvard College, a master's in teaching from Reed College, and a doctorate from the Harvard Graduate School of Education.

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