CHAPTER 24

Reading Digital

Teaching and Learning with eBooks and Digital Text

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An eBook is like a garden, carried on your mobile device.
—BRIDGET DALTON (update of a Chinese proverb)

We live, work, and play in a digital world using our computers, cell phones, tablets, and eReader devices. We read books in print and digital formats, on- and offline. We read texts that rely on written language (verbal) and we read, view, and interact with etexts that are predominantly visual in nature, communicating through multiple modes—image, sound, movement, and words—and in nonlinear, interactive hypertext formats. Although reading print-based materials will remain an important aspect of being literate for decades to come, there is no doubt that the landscape of reading is undergoing a seismic change.

In the United States, the Common Core State Standards Initiative (2010; *www.corestandards.org*) offers a vision of the successful 21st-century learner as one who is able to read and evaluate text critically in print and digital multimodal formats. There is the expectation that we will prepare K–12 students to be successful readers, composers, and designers of meaning, even while technology, media, and literacy practices are in a state of constant innovation and change. Clearly, teaching students how to "read digital," and especially for academic learning purposes, is an instructional priority. This means it is also a priority to support teachers in successfully integrating digital literacies as part of classroom learning. In this revision of our 2008 chapter in the previous edition of this volume, we focus on reading for understanding with etext and highlight the following:

- Universal Design for Learning and the design of enhanced etexts.
- Teaching and learning practices with ebooks and etexts.

We offer recommendations for the selection and evaluation of ebooks/etext for students with diverse learning needs and close with what we believe are top priorities for teaching with etext.

Research from the 1990s to 2007

During this period, socio-cognitive models of reading comprehension were influential in providing a framework for thinking about how etext might be designed to support readers, including students with reading difficulties and bilingual learners. For example, the RAND Reading Study Group (RRSG; Snow, 2002) reading comprehension heuristic describes understanding as an interactive, reciprocal relationship among reader, text, and activity factors. It also acknowledges that comprehension of a specific text is situated within a particular sociocultural context, a premise that is taken up much more strongly in sociocultural models that emphasize literacy as practices that are historically and socially constructed (Gee, 2012).

A reader who has a purpose for reading, relevant background knowledge, strategies for monitoring and addressing potential confusions, and an adequate level of fluency for the text being read is likely to read with understanding. Conversely, a reader who struggles to decode, has undeveloped background knowledge and vocabulary, and/or limited knowledge and use of monitoring strategies is likely to have difficulty comprehending. For both of these readers, affect plays a key role in their reading process. Arguing with a parent, feeling anxious about an upcoming test, or a general feeling that reading is irrelevant for you and your peers might also impede comprehension.

From 1990 to 2007, researchers studied the effects of etexts enhanced with different kinds of reading supports, such as hyperlinked glossary items, text-to-speech (TTS) read-aloud options, embedded questions and strategy prompts, and pedagogical agents to model strategic reading processes (for reviews, see Dalton & Proctor, 2008; MacArthur, Ferretti, Okolo, & Cavalier, 2001). Much of this work involved transforming the text to reduce potential barriers to understanding. Considering again the RRSG reading comprehension heuristic (Snow, 2002), the flexibility of digital text makes it possible to design text with enhancements that potentially offer a more productive match among reader, task, and activity factors, thereby expanding the reader's capacity for understanding (Dalton & Proctor, 2008).

Universal Design for Learning

It was also during this time that Universal Design for Learning (UDL) developed as an influential framework to guide the design of learning environments (Rose & Meyer, 2002). UDL draws on research about how the brain learns to offer three design principles:

1. To support diverse recognition networks, provide multiple means of representation.
2. To support diverse strategic networks, provide multiple means of action and expression.
3. To support diverse affective networks, provide multiple means of engagement (to learn more about UDL, visit *www.cast.org*).

At its heart, UDL champions diversity, arguing that society, as well as individual learners, benefit from curriculum, instruction, and assessments that are built to be responsive to the full range of differences present in any group of students.

In applying UDL principles to the design of etext, multiple means of representation might include multimedia vocabulary links or language translation; multiple means of expression might include reading strategy prompts and options to audio-record, write, or draw responses to text; and multiple means of engagement might include choice of text and response options, varied levels of text difficulty, and so forth (Dalton & Rose, 2008). In each case, the digital text has been designed to provide multiple pathways for learning and engagement so that students with diverse needs and interests are able to access and learn from text, including grade-level text. The latter is especially important given the emphasis on learning from grade-level text in the Common Core State Standards Initiative (2010).

Enhancing Etext with Decoding and Fluency Support

Comprehension depends on fluent reading; students who struggle to decode or who have basic decoding skills but read slowly have a diminished capacity to read for meaning. A series of studies has examined the effect of read-aloud functionality (either TTS tools or digitized human voice) on students' comprehension. In their review, Dalton and Strangman (2006) found the results to be variable, with some studies indicating no effect and others showing a positive effect, including two studies in which students demonstrated not only improved understanding of etexts but also improved comprehension without audio-narration (Aist & Mostow, 1997; Elbro, Rasmussen, & Spelling, 1996).

The strongest evidence was obtained with older students with reading difficulties who were able to read with TTS over an extended period of time. For these adolescents with reading difficulties, using TTS may have reduced a substantial gap between reading and listening comprehension levels and given them access to grade-level text over a long enough period that they were able to make reading improvements.

Enhancing Etext with Comprehension Supports

Several key studies during this period demonstrated the value of embedding multiple supports for comprehension within a digital text, such as vocabulary definitions, additional background information, highlighting of main ideas and critical information, and reading strategy prompts and models (Anderson-Inman & Horney, 1998; Higgins, Boone, & Lovitt, 1996; MacArthur & Haynes, 1995; Salomon, Globerson, & Guterman, 1989; Reinking, 1988; Reinking & Schreiner, 1985). Typically, these etexts were based on print-based stories and textbooks that were transformed into digital texts with embedded supports.

The Thinking Reader project (Dalton, Pisha, Eagleton, Coyne, & Deysher, 2002) is of particular interest because of its application of UDL principles and the well-validated Reciprocal Teaching strategy instruction approach (Palincsar & Brown, 1984) to the design of ebook versions of award-winning novels. Furthermore, this research prototype provided the foundation for the Thinking Reader novels published by Tom Snyder Productions, Scholastic, Inc. (2004). The enhanced ebooks offered a TTS tool that allowed students to click on a word, phrase, or passage and have it read aloud, multimedia glossary hyperlinks, and embedded strategy instruction. In addition to the four reciprocal teaching strategies of predict, question, clarify, and summarize, we added visualization (Pressley, 2006) and a feeling response option to encourage students to make a personal connection to the text (Rosenblatt, 1978). As students read the etext, they were periodically prompted to stop and apply a strategy. They could click on a pedagogical agent to hear a hint or see a model response, and then entered their responses in writing or

audio-recording and saved it to an electronic work log that could be viewed at any time by the student and teacher.

In a quasi-experimental study with 102 middle school struggling readers, students reading the enhanced ebook novels demonstrated significantly greater gains in comprehension on the Gates–MacGinitie Reading Achievement Test, after controlling for gender, than did their peers in the traditional reciprocal teaching group (Dalton et al., 2002). The effect size was moderate, equating to approximately half a grade level of reading achievement gain. The Thinking Reader project was followed by three studies demonstrating the positive impact of universally designed enhanced ebooks on comprehension for middle school students who are deaf or hard of hearing (Dalton, Schleper, Kennedy, Lutz, & Strangman, 2005) and for urban middle school students who are typically achieving readers (Dalton, Pisha, Poniatowski, Concha, & Robinson, 2007). However, in the latter study, the struggling readers group gained more from print-based strategy instruction. This finding is somewhat puzzling and may have been due in part to the design, where teachers served as their own controls (they reported feeling in competition with the computer), or it may be that the struggling readers in the control group received more individualized feedback from their teacher.

In a third development study, we expanded the ebook supports to include interactive vocabulary and Spanish-language supports for fourth-grade bilingual students (Proctor, Dalton & Grisham, 2007). Correlation analyses of pre- and posttest standardized reading vocabulary gain scores revealed that vocabulary gain was associated, though not significantly, with the frequency of access of hyperlinked glossary items throughout the intervention, and that lower pretest vocabulary knowledge was associated with positive vocabulary gains. A similar pattern was detected for comprehension gains, which were significantly associated with the frequency of access of coaching avatars that provided support around the productive use of reading comprehension strategies.

Two other lines of research during this period took a similar tack in applying a comprehension strategy that had proven very successful with print texts to the reading of digital texts in an interactive learning environment. McNamara (2007; McNamara, O'Reilly, Best, & Ozuru, 2006) created and tested an intelligent tutoring system, iStart, with positive results. Students learned key reading strategies and inferencing as they interacted with pedagogical agents who modeled their thinking process and provided ongoing feedback. Meyer and Wijekumar (2007) applied Meyer's extensive research on the structure comprehension strategy to the design of an intelligent tutoring program that taught students to apply the structure strategy to short texts through a series of leveled lessons with pedagogical agents and feedback. The results of these two intelligent tutoring reading programs for secondary students yielded strong positive gains in comprehension.

Research from 2008 to 2014

An Update on UDL

UDL theory, practices, and technologies have developed over the last decade. The National Education Technology Plan (U.S. Department of Education, 2010) offered UDL as a promising framework for integrating technology to benefit all students, and especially those who have been underserved and are at risk for school failure. In 2014, Meyer, Rose, and Gordon released a new version of their 2002 book on UDL that highlights key developments in the field (a free version of this text is available online at *cast.org*). Three UDL developments are particularly relevant to our thinking about how to design ebooks to

enhance comprehension. First, variability is the "new normal." UDL initially emphasized individual differences. As Meyer et al. explain, recent neuroscience research suggests that differences are predictable and variability is distributed across individuals. Thus, etext could be designed to offer a range of supports that will address the variability present in a range of readers, with options to customize at the individual level. Second, the situated nature of learning is emphasized. Reading a text is not solely a reader–text interaction. Instead, understanding is mediated by the larger learning environment and developed as part of a social community. This suggests the potential of designing etext features that support socially constructed practices of understanding and interpreting text and media. Finally, affect is positioned even more strongly in relation to learning, with a focus on the interdependence of affect and cognition that is based on recent neuroscience research showing how social-emotional experiences change brain structure and function. It is telling that Rose and Meyer (2002) now position the UDL principle "provide multiple means of engagement" as first in their list of principles. With regard to etext design, building in supports and practices that promote learner self-efficacy and allow students to follow interests in selecting and using texts may potentially improve comprehension.

Ebook/Etext Reading

The last several years have seen an explosion in reading ebooks on mobile devices such as iPads and other tablets, Kindles, Nooks, and even cell phones, as well as continued digital reading on desktop and laptop computers. Digital reading is happening in and out of school, with many districts moving from a reliance on print textbooks to digital textbooks and curriculum. The Digital Textbook Collaborative (2012) offers a vision for designing and integrating etexts that take advantage of Internet connectivity, provide interactive and personalized content, include video and games, encourage collaboration and reflection, provide feedback, and are intellectually rich, supported, and engaging to the full range of learners in today's classrooms. Furthermore, well-designed etext should also support students' self-assessment and teachers' formative evaluation, so that data are used in an ongoing manner to improve learning and teaching processes.

Since 2007, there have been important advances in research on etext/ebook reading, including studies of researcher-designed ebooks that draw on literacy theory and evidence-based practice, studies of reading with commercially available ebooks, and studies of reading on the Internet, typically in service of inquiry-based learning. Across these studies, it is clear that we are making progress in understanding how to design etext, as well as the various ways that readers interact with and use these etexts for a variety of purposes. We highlight key findings in the following section.

Ebooks and Young Children

There is a growing body of work investigating young children's interactive reading with ebooks in school and at home. Studies with researcher-designed ebooks that embed audio-narration support for word reading and passage listening, multimedia vocabulary support, and question–response options have been shown to have positive effects on young children's language and literacy development (Shamir & Korat, 2008; Verhallen & Bus, 2010). Repeated readings of etext can further heighten the positive effects on vocabulary, phonological awareness, and word reading (Korat & Blau, 2010), while embedding questions with feedback that require the reader to exert more effort in processing the text also increases the impact on vocabulary knowledge (Smeets & Bus, 2012).

Studies of commercially available ebooks have highlighted the need for "considerate" ebooks, an issue first raised by Labbo and Kuhn (2000), who found that ebook enhancements that either contradicted or were irrelevant to the story line impaired children's comprehension. For example, clicking an illustration hotspot to see flowers dance is not particularly useful if the flowers don't dance in the story. In contrast, clicking on a bumble bee and watching how it gathers pollen might be a very useful comprehension aid in a text about flowers. The detrimental comprehension effect of irrelevant enhancements has been found across PreK to grade 5 (for a review, see Zucker, Moody, & McKenna, 2009). A recent study examining parent–child reading of basic ebooks with audionarration, word highlighting, and sounding out word features found that parents and children engaged in conversations similar to those with print books (Chiong, Ree, Takeuchi, & Erickson, 2012). However, when reading enhanced ebooks that also included animations, games, and videos, the conversation shifted to focus less on story content and resulted in less recall of story details. The authors offered the caveat to which we should pay attention given the importance of affect in learning. Although the enhanced ebooks served to distract readers from story content, they also heightened readers' engagement with the text, suggesting that animations, games, and videos in and of themselves are not detrimental, but they need to be designed to support both engagement and understanding.

An important aspect of becoming a digital reader is learning how to use strategically the tools provided in an ereading device such as a Kindle or Nook. Larson's (2010) study of two second-grade girls reading a chapter book on their Kindles demonstrated how these young readers were able to use the read-aloud tool and dictionary independently to help them with unfamiliar vocabulary, and responded to the story with the notes tool, making connections, retelling, asking questions, and so forth. Again, to highlight the affective effect of digital reading on some children, the child who reported disliking reading at the beginning of the study moved to being highly engaged and more confident in reading.

Universally Designed Ebooks

Research on universally designed ebooks has continued to advance, with several studies showing positive effects on comprehension and vocabulary. Enhanced ebook supports range from digital picture books embedded with decoding, fluency, vocabulary, and comprehension supports for young children with significant cognitive disabilities (Coyne, Pisha, Dalton, Zeph, & Cook Smith, 2012) to science texts enhanced with interactive diagrams and pedagogical agent support (Dalton & Palincsar, 2013). The potential to support bilingual learners' comprehension and vocabulary development with universally designed folktales that offered Spanish-language translations, interactive vocabulary, reading strategy supports, and TTS was further demonstrated in fifth-grade classrooms (Dalton, Proctor, Uccelli, Mo, & Snow, 2011; Proctor et al., 2011). Adding progress monitoring as an ebook enhancement has resulted in improved comprehension for adolescents (Hall, Cohen, Vue, & Ganley, 2014).

In contrast to these studies reporting positive results, a randomized controlled trial of the effect of Thinking Reader on middle school students' comprehension showed no differences between control and comparison groups (Drummond et al., 2011), suggesting the need for more research on the design and use of enhanced ebooks in classrooms. In one of the few studies to focus on UDL and affect, Rose, Hasselbring, Rappolt-Schlichtmann, and Daley (2014) and colleagues are currently investigating the role of reader interest,

providing students, many of whom are reading below grade level, with wide access to ebooks and digital text of their own choosing.

Summary and Recommendations

That Was Then . . . This Is Now

It used to be that once a particular reading comprehension strategy was developed and validated across multiple research studies, we could apply it across texts, with some customization for genre and age of the reader. Visualizing a scene from *The Giver* novel was not that different from visualizing a scene from *The Magic School Bus* book: Both required the reader to integrate the information in the text (written text, graphics) with his or her prior knowledge, beliefs, and values to construct a new understanding or insight. That was then.

Today, students read ebooks and etexts enhanced with tools and features to develop decoding, fluency, vocabulary, comprehension, and engagement. The research thus far generally shows the positive effects of ebooks/etexts on students' literacy (there are exceptions, of course). The specific ebook features and the ways they operate range widely. Some supports are hidden; others are explicit. Some enhancements are well-designed and "considerate" of the reader, contributing to understanding; others are "inconsiderate," distracting from comprehension (for reviews, see Moran, Ferdig, Pearson, Wardrup, & Blomeyer, 2008; Zucker et al., 2009). The one constant we know is that ebooks/etexts will continue to evolve in concert with developments in technology, media, and online social literacy practices. This is now.

So what's a teacher to do in this time of Common Core State Standards and the importance of reading complex text in print and multimodal formats? In our response to this question, it will become obvious that we hold a positive disposition toward the integration of ebooks and digital content, and believe that it will support the important goal of making education more equitable for all students.

Select Well-Designed Ebooks/Etexts

Integrating ebooks/etexts into the curriculum is a necessity. As outlined here, UDL principles offer a general framework for evaluating the potential of specific ebooks/etexts for your students. Additional UDL guidelines are freely available online (see *www.cast.org*). In addition, Dobler (2013) offers a digital book evaluation rubric to guide your selection of quality ebooks (available online at *http://literacybeat.com/2013/01/30/let-the-reader-beware-evaluating-digital-books*), and the Digital Textbook Collaborative (2012) offers suggestions for selection and integration of etexts in schools. For students who are reading below grade level, it is an absolute priority to make grade-level texts available in digital format with TTS support and hyperlinked vocabulary. This will ensure that they have access to the general education curriculum (Individuals with Disabilities Education Act Amendments, 1997) and can meet Common Core State Standards expectations that all students engage with grade-level text.

Teach with and about Ebooks/Etexts

Some schools rely heavily on etext, whereas others rely on printed texts. Often, the read-aloud and guided reading lessons are based on print books, with students assigned time

to read digital texts on a computer or tablet. Whatever the context, it is essential to teach the new literacies of digital reading, in addition to helping students transfer and adapt print-based conventions and strategies to ebooks. This involves introducing etext features and enhancements, explaining the strengths and limitations of the features, modeling how to use the features, and guiding students in how to vary their use strategically in relation to their reading purpose, needs, and interests. In this age of "do it yourself," there are also multiple tools for teachers to develop and publish their own ebooks with supports customized for their students (Dalton, 2014; try out CAST's (2006) free UDL Book Builder tool at *http://bookbuilder.cast.org*). Finally, students become better digital readers when reading digital, multimodal text is connected with composing multimodal text, just as they connect reading texts with writing.

Develop a Community of Digital Readers in Which Students Are Experts

Today, students are digital natives. Students who avoid picking up a book will often immerse themselves in an interactive ebook on an iPad. Take advantage of students' knowledge and engagement with technology and media, while also developing new digital literacies in school. Position students as experts on different devices, ebook genres, and ways of interacting and learning in digital environments. Be explicit about the rapid changes that are happening in the digital world and the importance of continually developing as digital readers. Share your own ebook experiences and inspire students to be successful digital readers, too.

INTEGRATE, INVESTIGATE, AND INITIATE: QUESTIONS FOR DISCUSSION

1. How are you currently integrating ebooks and etext in your classroom? From a UDL perspective, how might you use ebooks to support students with diverse reading needs and interests (e.g., struggling readers, good readers who don't enjoy reading, and avid readers who are reading advanced books)?
2. Research shows that "unfriendly" ebooks enhanced with distracting media can interfere with comprehension, and "friendly" ebooks enhanced with relevant media and interactivity can improve comprehension. Try reviewing some of the ebooks in your class collection (or perhaps ebooks you are planning to purchase) and evaluate whether they are friendly or unfriendly texts. How will you teach your students to take advantage of the embedded tools and supports?

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