



LETTERS

edited by Jennifer Sills

Electronic Textbooks: Why the Rush?

THE RACE TO REPLACE TRADITIONAL TEXTBOOKS WITH ELECTRONIC VERSIONS IS ON. ALTHOUGH electronic textbooks have been most carefully tested in university students, the Obama Administration is advocating their use in elementary and secondary schools. In February, Secretary of Education Arne Duncan recommended that states allow school districts to spend money once reserved for textbooks on Kindles, Nooks, and iPads (1). As educational tools, electronic textbooks offer the promise of easy updates, cost savings compared with print, flexibility, and integrated features such as video, hyperlinks, and software that allows

students to collaborate. However, electronic textbook sales (2) have not followed the upward trend of e-books (3), and scientific studies of students reading and learning from e-readers suggest caution (4–11).

The difference in sales may reflect important differences in content and goals. Electronic textbooks typically present more information, much of it unfamiliar. Many e-books have a narrative structure, whereas electronic textbooks are more often structured hierarchically. Furthermore, e-books are typically read for

pleasure, whereas electronic textbooks are read for learning and retention.

Recent research shows that college students learn equally well from e-readers or printed text (4–6), but electronic textbooks carry a cost in efficiency. Reading electronic textbooks takes longer, on average, than reading print, and many students report higher levels of fatigue upon completion (7, 8). The source of this cost is unclear, but the effect is strong enough that the majority of college students prefer traditional print books when offered a choice (2, 4, 7). The preference for traditional textbooks is unrelated to previous experience with e-books, so it does not appear to be a matter of digital literacy (7).

Meanwhile, experiments with children in early grades more often show e-books equivalent to or even superior to traditional print (9). Younger children are offered simpler, narrative texts and are not asked to study and remember the content.

The features that e-book readers make possible seem like an obvious boon for e-textbooks. Surely students will learn more if they can, for example, click a hyperlink that defines an unfamiliar word, or if they can use a mouse to rotate a complex molecule in three dimensions. But years of research on computer learning shows that these opportunities can backfire. Students who click on too many hyperlinks may lose the thread of what they are reading (10). Three-dimensional figures can distract and confuse students with poor spatial abilities to such an extent that they learn better with a simple picture (11). The networking capability of e-readers is another advantage that can cut both ways. Although students can collaborate more easily, Facebook and other social media distractions are just a click away and are utilized at far higher rates while studying by students using electronic textbooks (6).

Electronic textbooks do offer substantial advantages over traditional printed text, such as the opportunity to make timely updates, adapt to learner preferences, and embed multimedia and learning activities—it's one thing to read about the fall of the Berlin Wall, but



it's quite another to see a video of it. However, research shows that students likely do not interact with electronic textbooks as they do with traditional print, and the broader research base on multimedia learning indicates that considerable care must go into the design of special features to ensure that they augment learning rather than detract from it. There is no indication that publishers are investing the time and hard work required to leverage this information into a new generation of electronic textbooks. Rather, it seems that most are taking the pedagogical devices from print books and putting them in digital format, with little evidence that they positively affect learning.

Federal Communications Commission Chairman Julius Genachowski recently said, "We absolutely want to push the process [of moving from print to electronic textbooks]" (1). If the federal government plans to push the process, it should take steps to promote the science and insist on the evidence that can ensure that electronic textbooks fulfill their potential.

DAVID B. DANIEL^{1*} AND DANIEL T. WILLINGHAM²

¹Department of Psychology, James Madison University, Harrisonburg, VA 22801, USA. ²Department of Psychology, University of Virginia, Charlottesville, VA 22904, USA.

*To whom correspondence should be addressed. E-mail: danieldb@jmu.edu

References

1. G. Toppo, "Obama wants schools to speed digital transition," *USA Today*, 31 January 2012 (www.usatoday.com/news/education/story/2012-01-31/schools-e-textbooks/52907492/1).
2. National Association of College Stores, OnCampus Research, "Update: Electronic book and eReader device report" (March 2011); www.nacs.org/LinkClick.aspx?fileticket=ulf2NoXApKQ%3D&tabid=2471&mid=3210.
3. Publisher's Weekly, "AAP estimates: E-book Sales rose 117% in 2011 as print fell" (27 February 2012); www.publishersweekly.com/pw/by-topic/industry-news/financial-reporting/article/50805-aap-estimates-e-book-sales-rose-117-in-2011-as-print-fell.html.
4. J. A. Shepperd, J. L. Grace, E. J. Koch, *Teach. Psychol.* **35**, 2 (2008).
5. A. K. Taylor, *Teach. Psychol.* **38**, 278 (2011).
6. W. D. Woody, D. B. Daniel, J. M. Stewart, in *Computers in Education*, S. Abramovich, Ed. (Nova Publishing, New York, 2011), pp. 43–58.
7. W. D. Woody, D. B. Daniel, C. Baker, *Comput. Educ.* **55**, 945 (2010).
8. A. Dillon, *Ergonomics* **35**, 1297 (1992).
9. A. K. Moody, *J. Lit. Technol.* **11**, 22 (2010).
10. J. L. Plass, D. M. Chun, R. E. Mayer, D. Leutner, *Comput. Hum. Behav.* **19**, 221 (2003).
11. T. Huk, *J. Comput. Assist. Learn.* **22**, 392 (2006).



Mangrove loss. Brazil's Forest Act threatens coastal wetlands.

Protecting Brazil's Coastal Wetlands

IN DECEMBER, BRAZIL'S SENATE PASSED controversial changes to the Forest Act ("Controversial changes to forest law pass Brazilian Senate," *News of the Week*, 16 December 2011, p. 1478). Much has appropriately been said about implications of Brazil's forest code revision over Atlantic and Amazon rainforest areas (1–3), but little focus has been given to potential effects on coastal wetlands. The forest code alterations propose the conversion of up to 10 and 35% of all salt flats along Brazil's northern and southern coasts, respectively, into shrimp ponds. Salt flats are one variation of the coastal wetland ecosystem, which has different names depending on its characteristics. ("Mangroves" have woody trees, "mud flats" lack woody trees, "salt marshes" are covered by herbaceous vegetation, and "salt flats" lack herbaceous vegetation. One area may fluctuate between these states over time.) Salt flats are a vital part of threatened mangrove ecosystems, yet major mangrove mapping programs (4, 5) did not compute their total area. Without knowing the exact extension of salt flats and their effects on the mangroves, it is impossible to manage these resources responsibly. The salt flat conversions outlined in the forest code could lead to staggering mangrove losses along the northern coast, given that 57% of the country's mangroves are located in this region (6). Along the southern coast, salt flat habitat conversion could be catastrophic, considering that most of the mangrove losses to date—50,000 ha during the past 25 years—have occurred in these regions (7).

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the past 3 months or matters of general interest. Letters are not acknowledged upon receipt. Whether published in full or in part, Letters are subject to editing for clarity and space. Letters submitted, published, or posted elsewhere, in print or online, will be disqualified. To submit a Letter, go to www.submit2science.org.