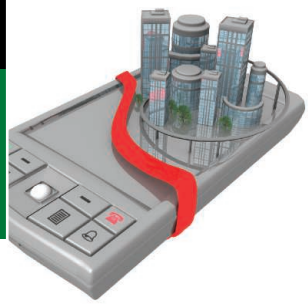


LETTERS

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. WILLINGHAM[2]

[1]Department of Psychology, James Madison University, Harrisonburg, VA 22801, USA. [2]Department 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=uIf2NoXApKQ%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).

CREDIT: ADRIANA ASSEMANY/ISTOCKPHOTO.COM

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.

Published by AAAS

Mangroves are among the most carbon-rich forests in the tropics (*8*), accounting for more than 50% of Earth's blue carbon sinks ("blue carbon" refers to carbon stored by coastal and marine ecosystems) and for 71% of all carbon storage in ocean sediments (*9*), which can remain stored for millennia. Brazil has the third-largest area of mangrove coverage in the world, including 50% of all of South America's mangroves (*10*, *11*). Given that the destruction of blue-carbon systems results in immediate greenhouse gases emissions (*12*), it is clear that Brazil plays a major role in CO_2 stabilization and therefore owes an explanation not only to its own people but to the international community.

Although Brazil's forest code was approved by the Senate, we hope that President Dilma Rousseff will honor the international agreements Brazil has made by rejecting the current code's version.

ANDRE SCARLATE ROVAI,[1]* RICARDO PALAMAR MENGHINI,[2] YARA SCHAEFFER-NOVELLI,[3] GILBERTO CINTRÓN MOLERO,[4] CLEMENTE COELHO JR.[5]

[1]Department of Ecology and Zoology, Federal University of Santa Catarina, ECZ-CCB-UFSC, Florianópolis-SC, 88010-970, Brazil. [2]Institute of Health Sciences, Paulista University UNIP, Sao Paulo, 04026-002, Brazil. [3]Instituto Bioma Brasil IBB, Sao Paulo, 05434-060, Brazil. [4]U.S. Fish and Wildlife Service, Arlington, VA 22203, USA. [5]Department of Biological Sciences, University of Pernambuco UPE, Recife, 52041-050, Brazil.

*To whom correspondence should be addressed. E-mail: asrovai@gmail.com

References

1. A. G. Nazareno, *Nature* **481**, 29 (2012).
2. J. P. Metzger *et al.*, *Science* **329**, 276 (2010).
3. F. Michalski, D. Norris, C. A. Peres, *Science* **329**, 1282 (2010).
4. A. M. Magris, R. Barreto, *Pan-Am. J. Aq. Sci.* **5**, 546 (2010).
5. Ministério do Meio Ambiente, in *Panorama da conservação dos ecossistemas costeiros e marinhos no Brasil*, A. P. L. Prates, M. A. Gonçalves, M. R. Rosa, Eds. (MMA/SBF/GBA, Brasília, ed. 1, 2010), p. 148.
6. P. W. M. Souza-Filho, *Rev. Bras. Geofísi.* **23**, 427 (2005).
7. N. C. Duke *et al.*, *Science* **317**, 41 (2007).
8. D. C. Donato *et al.*, *Nat. Geosci.* **4**, 293 (2011).
9. C. Nellemann *et al.*, *Blue Carbon: The Role of Healthy Oceans in Binding Carbon: A Rapid Response Assessment* (Birkeland Trykkeri AS, Birkeland, Norway, 2009), p. 78.
10. Food and Agriculture Organization of the United Nations, "The world's mangroves 1980–2005" (FAO Forestry paper 153, Rome, 2007).
11. C. Giri *et al.*, *Glob. Ecol. Biogeogr.* **20**, 154 (2010).
12. M. S. Copertino, *Nature* **473**, 255 (2011).

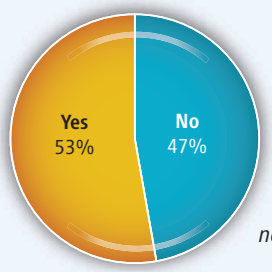
Readers' Poll Results

Bad Advice?

In the 17 February issue of *Science*, M. S. Cohen questioned the traditional advice that graduate students and postdocs should find their next position at a different institution. We asked you to weigh in by answering this question:

Does the standard practice of applying for postdoc and new faculty positions outside one's home institution make sense?*

More than 1700 of you responded, from dozens of countries all over the world. Here are your results.



A selection of your thoughts:

Maybe [moving locations] was the best way to network before we entered the future, but rest assured this is the future now, so I can talk to, connect with, and see pretty much anyone doing research throughout the world.

—reader Kyle McKeown

Long gone are the days where postdocs or junior faculty were well paid and spouses and children could tag along to work abroad. Dual incomes for faculty with spouses and child-raising commitments are the norm. Expecting faculty to put career above fulfilling personal life is unrealistic.

—reader Anonymous

I … stayed in the same institution (family keeps me in the area) but switched fields completely to do my postdoc. My postdoc lab is COMPLETELY different from my Ph.D. lab. I am challenged every day and have my own expertise to offer to my colleagues.

—reader Erica

Why is a broad range of experience only required for early-career investigators? It seems to me that the folks who need the most shaking up are the tenured faculty who have been doing the same research for 20 years.

—reader Shelley

Tradition's nemesis, flexibility, is what Cohen argues for, and I think he is right.

—reader Wayne Matten

You should be evaluated by your scientific expertise and not your willingness to change your home!

—reader Marten

If you stay at the same location, people begin to think alike, which stifles the advancement of research.

—reader Penny

The real winner from the standard advice may be the [scientific] enterprise as a whole. Unlike private enterprise, which maximizes the profitability of individual firms, publicly funded science should maximize the performance of the entire system rather than of individual laboratories.

—reader Bruce Hamilton

What we need to avoid is the opposite scenario, where it's preferable to stay in your own institute and scientists who want to move are looked at poorly.

—reader Caroline Angelard

Positions for young scientists such as junior group leader, junior professor, and assistant/associated research professor are already available in German and Chinese top universities/institutes for those who prove themselves during their postdoc. I think this is a good idea.

—reader Nashat Abumaria

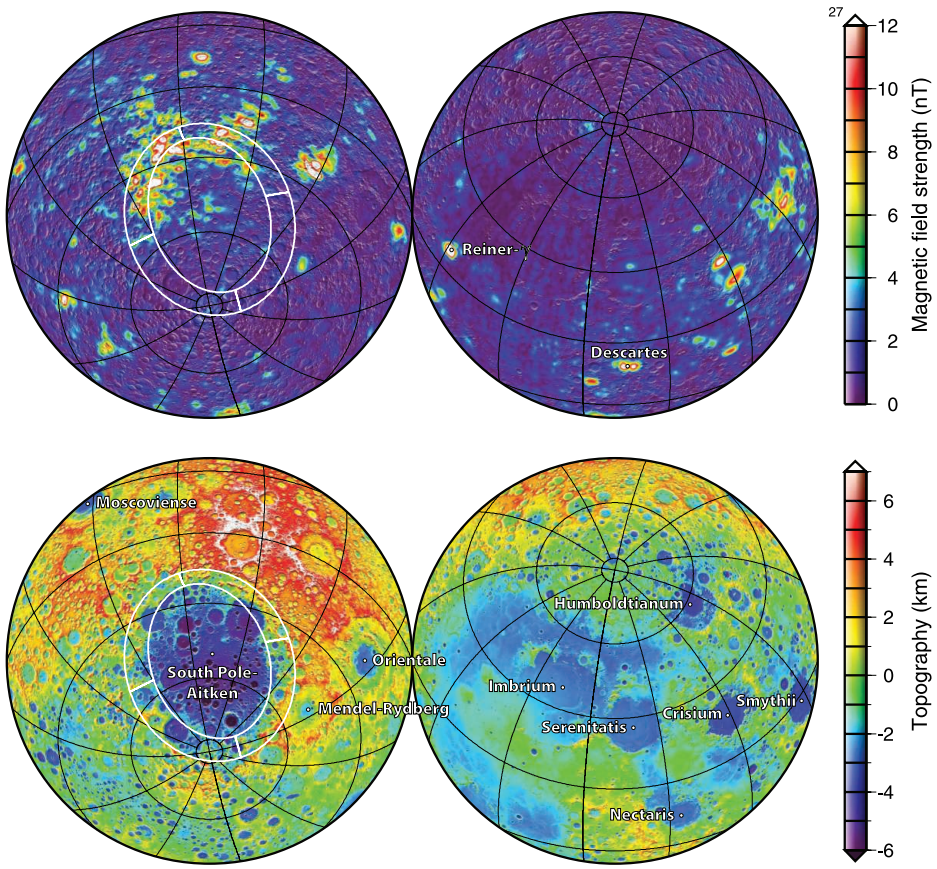
*See the poll at http://scim.ag/GRc4gg.

Polling results reflect those who chose to participate; they do not represent a random sample of the population.

Published by AAAS

CORRECTIONS AND CLARIFICATIONS

Reports: "An impactor origin for lunar magnetic anomalies" by M. A. Wieczorek *et al.* (9 March, p. 1212). Figure 1 did not correctly display latitude and longitude grid lines in three panels, and the ellipses outlining the South Pole–Aitken basin were missing from the left panels. The corrected figure is shown here. The figure has been corrected in the HTML and PDF versions online.



TECHNICAL COMMENT ABSTRACTS

Comment on "Disentangling the Drivers of β Diversity Along Latitudinal and Elevational Gradients"

Hong Qian, Xianli Wang, Yangjian Zhang

Kraft *et al*. (Report, 23 September 2011, p. 1755) analyzed two data sets and concluded that "there is no need to invoke differences in the mechanisms of community assembly in temperate versus tropical systems to explain these global-scale patterns of β diversity." We show that their conclusion is based on inappropriate data and inadequate methods of analysis.

Full text at www.sciencemag.org/cgi/content/full/335/6076/1573-b

Comment on "Disentangling the Drivers of β Diversity Along Latitudinal and Elevational Gradients"

Hanna Tuomisto and Kalle Ruokolainen

Kraft *et al*. (Report, 23 September 2011, p. 1755) argued that the latitudinal trend in β diversity is spurious and just reflects a trend in β diversity. Their results depend on the idiosyncrasies of their data, especially the latitudinally varying degree of undersampling and a local sampling setup that is not suitable for analyzing drivers of β diversity.

Full text at www.sciencemag.org/cgi/content/full/335/6076/1573-c

Response to Comments on "Disentangling the Drivers of β Diversity Along Latitudinal and Elevational Gradients"

Nathan J. B. Kraft, Nathan J. Sanders, James C. Stegen, Marti J. Anderson, Thomas O. Crist, Howard V. Cornell, Mark Vellend, Jonathan M. Chase, Liza S. Comita, Kendi F. Davies, Amy L. Freestone, Susan P. Harrison, Brian D. Inouye, Jonathan A. Myers, Nathan G. Swenson

Qian *et al*. and Tuomisto and Ruokolainen critique our analyses of elevational and latitudinal variation in tree diversity. We address their points by reanalyzing different subsets of our data and by clarifying certain misconceptions, and reiterate that gradients in β diversity can be explained in the elevational and latitudinal tree data sets by variation in the size of species pools.

Full text at www.sciencemag.org/cgi/content/full/335/6076/1573-d

India's Path to Knowledge

DEBATE ABOUT SCIENCE AND HIGHER EDUCATION in India needs to shift away from preoccupation with bureaucratic control, the likely emergence of India as a powerhouse of science, and allocation of resources to elite universities ("India rising," R. Stone, News Focus, 24 February, p. 904). Instead, the focus of the discussion should be on identifying the knowledge required to alleviate suffering from poverty, hunger, disease, injustice, and inequity; prevent environmental degradation; conserve the region's unique biological and cultural heritage; and meet developmental challenges. Such knowledge is not entirely built on the principles of natural sciences (the subject of the 24 February News special section on Science in India).

To make the vision of just and sustainable societies a reality, we will need a different kind of knowledge and institutions. Minimizing red tape and increasing expenditure in science and higher education will help, but will not necessarily reduce the deficit in the type of knowledge needed.

Institutions succeed in generating relevant knowledge when they take into account the economic, cultural, and social realms of their setting. Knowledge-generating institutions in the West played an important role in developing science and technology for the benefit of their people because of the historical, political, and economic context in which they were set up, and because continent-wide resources were available for the betterment of their people. Given that the world in the 21st century is crowded and resources in India are comparatively scarce, such institutions may not represent the best models for India to follow.

India must find its own path to knowledge generation based on its diverse beliefs, unique cultural heritage, rich and deep indigenous intellectual traditions, a vibrant civil society, and the enormous potential of its more than one billion people. In this quest for knowledge, modern science will be just one of the paths to solutions.

KAMALJIT S. BAWA

Department of Biology, University of Massachusetts, Boston, MA 02125, USA; Ashoka Trust for Research in Ecology and the Environment, Bangalore, 560 064 Karnataka, India. E-mail: kamal.bawa@umb.edu

Published by AAAS