

EDUCAUSE Center for Applied Research

Research Bulletin

Volume 2006, Issue 20

September 26, 2006

Emerging Digital Content Delivery Technologies in Higher Education

Mark R. Nelson, National Association of College Stores
and ECAR



Overview

“...and what is the use of a book,’ thought Alice, ‘without pictures or conversation?’”
—Lewis Carroll, *Alice’s Adventures in Wonderland*, 1865

In the opening keynote session of the EDUCAUSE 2005 Annual Conference, Scott McNealy, then chief executive officer of Sun Microsystems, presented the Global Education and Learning Community (GELC) initiative (<http://gelc.org/>) as a response to one of his pet-peeves related to current course materials—specifically, textbooks. The initiative involves the sophisticated delivery of digital content that uses the convergence among several emerging technologies. While the stated goal of the initiative is to eliminate the digital divide on a global level, the initiative is but one of many in which the use of digitally delivered content could change the way learning occurs in higher education. Such emerging technologies could have significant implications for the role of higher education in learning and for information technology (IT) resource requirements in the short term.

To take advantage of the opportunities these new technologies bring, and to prepare for the challenges, higher education leaders must understand the breadth of initiatives that now cover the digital landscape. This research bulletin introduces a set of emerging technologies in the digital content delivery (DCD) space as they relate to higher education. The discussion of technologies is not intended to be exhaustive. Instead, the goal is to provide higher education leaders with an overview of developments in the DCD arena that could significantly impact their institutions within the coming decade. Many of the component technologies of the GELC initiative are discussed. This bulletin is a companion to *Digital Content Delivery Trends in Higher Education*, which introduced the concept of DCD and some related trends (Nelson, 2006).

Highlights of Developments in Digital Content Delivery

The DCD landscape evolves almost daily, and there are many examples of technologies that can be used to illustrate what is occurring with digital content across higher education. The examples here occur in no particular order and are simply representative. They provide a sense of the breadth and nature of initiatives in this area that could help transform the future learning environment.

Print on Demand

Print on demand (POD)¹ is a simple concept. In higher education, there are two approaches to POD. One is the “vanity press” model in which faculty, administrators, and students have the opportunity to publish their material or content for a fee. For example, as part of a course, students might develop an edited collection of contributions from members of the class, which could then be printed on demand at the end of the semester so that everyone can have a copy for his or her personal portfolio. The second approach to POD is the “instant” production of materials as needed, which

can include course slides, class materials, custom course packs, e-books, digitally delivered textbooks, and other course materials. In this approach, rather than printing textbooks or course materials in advance, content is sent to the destination in digital format. At the destination, the bookstore or other agent collects the agreed-upon price for the content, plus an additional amount for printing costs, labor, and profit. The content is then printed on the spot, typically with high-speed printers. In advanced setups, this service may include color printing and binding so that the book looks like it was shipped directly from the publisher. Costs are reduced throughout the supply chain because of reduced shipping, storage, and return costs. Significant time can be saved as well since there is no need to wait for books to be printed and shipped from the publisher.

POD is capable of serving as a bridge technology between traditional print materials and those that are completely electronic. This means that the technology can be used to convert digitally delivered content to print content for those who prefer printed material or for those who lack access to or comfort with computer resources. Faculty can select and produce custom textbooks at the local level, leveraging trends and technologies such as digital libraries (see below), kiosks, and advanced binding equipment. The department responsible for maintaining the POD facilities also monitors copyright issues, which can improve copyright compliance on campus.² POD models are being investigated by a number of publishing companies and resellers, such as Ingram (and its subsidiaries, most notably Lightning Source) and Amazon.com, in order to improve the economics of book production and distribution.

POD can be successful, and even profitable, on a college campus. An excellent example is the POD model in place at the University of Queensland (UQ) in Australia.³ UQ's POD model takes form in the POD Centre located in the campus bookstore, although the POD Centre is actually a collaboration among three campus units: the campus bookstore, the University Press, and the campus printing department. At the POD Centre, students and faculty can print a wide range of digital content quickly, easily, and affordably. Students can request printed content for pickup later, or they can wait for items to be printed. Many books, such as many of the trade books offered through an agreement with Penguin Books, can be printed in color and bound like the original in less than 20 minutes and at a lower cost than the original. UQ has found that it can produce some materials for students at less than half the cost of buying a traditional book while ensuring that the original publisher is properly reimbursed for the intellectual property. Moving to the POD model has freed up space in the campus bookstore to create a working space for students, and this increases traffic in the store. Increased store traffic is a positive result of the POD Centre, as it makes the bookstore a "campus destination" and supports the sale of other store items.

Course Materials

Publishers and faculty members have major interests in the domain of course materials. Digital custom publishing, assessment-based tools, and learning objects are three trends that are particularly worth observing because they represent a range of initiatives along the spectrum of digitized to born-digital content. Understanding these trends

provides insight into the motivations and mechanics for moving to greater degrees of DCD in higher education. Movement toward these and other forms of digitally assisted learning will not happen overnight, however, since we still have much to learn about how to effectively deliver digital content in a way that enhances learning and will be adopted by both students and faculty (Zemsky & Massy, 2004).

Digital Custom Publishing

Custom publishing provides more freedom of choice for the instructor. Custom texts might include two chapters from one textbook, three from another, and a collection of journal and magazine articles or case studies. This approach to producing course materials is of particular value in academic disciplines in which change is rapid and remaining current is a challenge. Faculty members have greater control over course materials and can tailor them to their own pedagogical styles. As faculty become increasingly comfortable selecting online course materials to supplement their classes, they will also expect greater control over the primary textbook content.

Custom course packs are nothing new, but digital publishing has introduced important developments. “Content chunking” or the offering of “microcontent” by Amazon.com and publishers allows students to purchase a portion of the content, such as a chapter or a set of pages. Students can buy a chapter or smaller chunk of content on demand for use electronically or via pay on delivery. Implications of this new model can potentially impact financial aid resources related to how course materials are disbursed and tracked, how much printing occurs on campus, and campus bookstore revenues. If financial aid transactions become involved, the number of external entities that campus systems may need to interface with could substantially increase.

Assessment-Based Tools

One of the complaints about current textbook options is the question of the value of textbook supplements (U.S. General Accounting Office, 2005). Publishers have recognized that for textbook supplements to add value, they must be used. Thus, the textbook publishing industry is moving forward with several initiatives to better demonstrate the value of supplements available with textbooks and to encourage their use. One promising concept for publishers is the development of tools that can assess what students have learned. Assessment-based tools are typically designed to be interactive. Some might be simple multiple-choice quizzes that students respond to in a linear fashion. Others might be more complex, asking students more difficult questions when they respond correctly or easier questions when they answer incorrectly, thereby gauging a student’s level of competency with the content. Other models under development include artificial intelligence elements intended to generate problems or exercises to match a student’s current level of comprehension or that assist a student with problem spots based on observed patterns in a student’s responses to study questions. These tools will eventually be able to provide professors with individual assessments of each student’s learning progress and provide individualized suggestions for helping the student improve.⁴ Institutions are under growing pressure from their accreditation organizations to prove they are delivering on their mission and on what

they say students gain from the educational process. As this pressure continues to rise, faculty and administrators may look toward computer-assisted assessment tools being developed by publishers as one measure that classes are delivering anticipated learning outcomes.

Learning Objects

Learning objects are instructional modules of reusable digital content that supplement or enhance student learning of course-related information. Learning objects have been the subject of two ECAR research bulletins (Metros & Bennett, 2002 and 2004) and many other papers and presentations. As the 2004 bulletin notes, the field of learning objects evolved rapidly in the 18 months between the two bulletins. It should not be surprising, then, to find that since 2004, more players continue to enter the learning object domain, and the number and range of learning object offerings continues to increase. It should be noted, however, that this proliferation continues to occur more rapidly in industry than in academic institutions. From a pure DCD perspective, however, *who* is producing the learning objects is of less interest than their growing sophistication and availability. As with many earlier computer developments, most learning object offerings are provided for free. They are often produced as part of consortia or alliances, although publishers have made a business of packaging learning objects of varying sophistication with existing print textbooks as value-added additions. Ultimately, collections of learning objects could replace traditional textbooks completely. For that to occur will require significant investment of time and resources, not to mention a substantive shift in adoption rates and comfort on behalf of faculty. However, students will increasingly demand such content as a matter of course, rather than as an occasional supplement, thereby pushing faculty adoption and exploration of learning objects.

Tracking development and usage of learning objects is therefore important to the higher education community. As the technology matures, standards will proliferate and adoption of the innovation will likely spread. We are still very early in the adoption cycle of learning objects, with most of the current users being the innovators and early adopters. This early adoption process will likely be slow (unfolding over the next three to five years) because the widespread integration of digital learning objects into the classroom environment represents a significant pedagogical and philosophical shift in terms of how instructors teach and how learning occurs. The shift seems almost certain, however, and over time commercial models will likely replace many of the current open source and consortia initiatives.

Course Management Systems

From *The New Landscape for Course Management Systems* (Gallagher, 2003) we learned that as of 2002, approximately 80 percent of academic institutions in the United States had adopted a course management system (CMS). The majority of those adoptions were either WebCT or Blackboard, although other significant players exist, including Jenzabar, eCollege, Desire2Learn, and Sakai. While many institutions have implemented a CMS, adoption rates among faculty are much lower. Just over a quarter (26.5 percent) of the eligible courses actually use the CMS tool, and even at the institutions where adoption is considered high, typically fewer than 50 percent of the

faculty use the CMS in their courses. Finally, nearly half of the academic institutions with a CMS have developed or are planning to develop a more strategic plan to get faculty to use the CMS in place, and there seems to be some expectation that with the next generation of CMS software, adoption rates among faculty will rise.

One of the critiques of traditional CMS tools is that they try to automate the traditional approach to teaching rather than contribute to pedagogical effectiveness or the learning outcomes of students (Weigel, 2005). Recognizing this limitation, and the greater potential of the technology, CMS vendors are working to develop the next generation of CMS, which may more often take on the name “learning management system” (LMS). The LMS will take greater advantage of the availability of learning objects and will be more specifically designed to enhance student learning. As an example, initiatives such as the Open Learning Management System at the University of Utah (<http://www.psych.utah.edu/learn/olms/>) link several of the existing learning object communities in an open source environment. Other industry experts predict that the rising costs and resource requirements of a CMS coupled with only marginally enthusiastic adoption by faculty will result in a large-scale change in CMS capabilities (Sausner, 2005). As the different components of DCD evolve and converge, the subsequent impact on learning and what it means to use course materials or content to supplement faculty instruction will change significantly, if not radically.

Course and learning management systems are well positioned to become a key channel for the delivery of digital content in higher education in the future. Most of the leading textbook publishers are working with the major CMS vendors in some capacity related to DCD, and the CMS vendors appear interested and ready to expand into the DCD space. This could be through providing direct linkages or the sale of course content via course registration and material usage, or providing the control and monitoring mechanism for digital assessment tools and learning objects. As CMS moves closer to the vision of LMS, adoption by faculty will most likely increase. The CMS/LMS vendor could then become the primary channel in higher education for commercial digital content offerings in the classroom, in conjunction with those offerings provided by campus libraries.

Digital Resources and Libraries

Another important player in this DCD space is the local campus library. In many ways campus libraries are far ahead of many industries in terms of producing, managing, and delivering digital content. Libraries are also the primary source of campus expertise in working with digital content. At many institutions, libraries have already leapfrogged college bookstores by more actively providing online course materials and related support services for students and faculty. Libraries have proven to be effective in collective bargaining with publishers and in working in consortia arrangements to increase access to digital content for patrons. In some instances, such as e-reserves, the progress of libraries at offering content digitally has gotten them into potential trouble (Carlson, 2005, April 22). More libraries are moving toward fully digital collections, and in doing so they are pioneering the legal and technical issues associated with DCD on college campuses and beyond.

Major concepts surrounding digital libraries include digital repositories and digital-asset management systems (specifically, content management systems). These applications are intended to help libraries cope with the growing digital collections at their institutions (Olsen, 2004). The primary current use of these tools is archival—to preserve things like campus documents, dissertations, and special collections. In the case of special collections, they may also serve to increase access by allowing individuals to access materials that may otherwise be restricted by virtue of age, value, special handling requirements, or storage location. Ultimately, these tools will interface with or capture the many other digital resources in the library and on campus, including online journal and e-book databases, course management systems, learning objects, and others. Convergence among institutional digital resources at some level is not only likely but also necessary to improve institutional return on investment (Digital Library Federation, 2004; Duncan, 2004). As libraries push various digital resources technologies toward convergence, they may establish the standards for DCD on campuses for the next decade and beyond.

Emerging Next-Generation Technologies

In addition to the next generation of CMS, learning objects, and digital repositories, other emerging technologies will enable changes and opportunities within the DCD landscape. Two examples of such technologies are the hardware and software that work with e-books, and the development of new collaborative communication tools such as wikis and the next generation of the Web as conceptualized by the Croquet Project (see Collaborative Communication Tools below). While not an exhaustive listing of relevant emerging technologies, these examples provide some interesting illustration as to what the future may hold for DCD.

The Future of E-Books

John Mutter, editor of *Shelf Awareness*, recently commented that “e-books seem simultaneously dead and the wave of the future” (Mutter, 2005). One frequently told industry joke goes something like, “We doubled our sales of e-books last year...we sold two units instead of one.” The barriers to e-book adoption are likely based at least in part on the fact that most e-books are more digitized than born digital—they take little advantage of multimedia or what the technology can provide (Becker, 2004; DeSouza, Hon, Kim, Lee, & Leong, 2004). It is also difficult for most people to read books at length online; paper is still more portable and more comfortable for many readers. While e-book adoption is growing, we still lack the right mix of user interface and hardware devices to encourage more general adoption. The absence of uniform standards for digital rights management and content delivery is also an issue. Interviews with some e-book providers find that most e-book users spend an average of seven to eight minutes with an e-book, and they follow a pattern similar to how individuals use reference books. This suggests that e-books work well for reference, but they are not the preferred format for reading. In fact, we find that the reference area is one of the segments where e-book adoption has been most successful.

Publishers continue to push e-book solutions forward, and we should expect that younger generations of students may increasingly welcome the format. This fall, MBS

Textbook Exchange began a pilot program with a select number of courses across 10 college campuses in the United States. The program offers students an option to buy a digital version of a textbook rather than the print edition, at a 33 percent savings (Borland, 2005; Foster, 2005). The program does place restrictions, however, that may affect its success, including a five-month expiration date and the inability to sell back the textbook for cash at the end of the semester. Despite some concern that e-books might cannibalize existing publisher book markets, efforts like the MBS project signal an effort by publishers to find ways to make e-books work, and the college student population is certainly likely to be among the early adopters of any technological advancements in this area. On the political front, nearly all states in the United States with textbook adoption policies at the K–12 level have added digital content, e-books, and other technology-based media to their definitions of allowable instructional materials (Brumfield, 2005). This provides publishers with increased incentives to develop effective e-book solutions for the educational market. As solutions for that market are developed, and as students arrive on college campuses, e-book and digital content solutions will be the expected form of content delivery.

In the short term, e-book adoption, even for electronic textbooks, is likely to continue to be slow. Even today's tech-savvy students appear to prefer printed textbooks to their online counterparts (Carlson, 2005, February 11). One explanation may be some feeling by students that e-books provide less value because they are less user-friendly. What we need to see are better technologies for reading and working with digital content. Technologies such as e-ink and e-paper⁵ as well as new enhanced three-dimensional and fabric-based displays⁶ will significantly address display resolution and power issues, along with portability. Almost anything can be a display. New directed audio technologies could further enhance the adoption and distribution of these technologies by adding sound that only the reader can hear—even if headphones are not in use (Gartner, 2002). The convergence of such technologies will provide further choice and flexibility to consumers as to how to use digital content and will ultimately help increase e-book adoption.

Collaborative Communication Tools

An emerging technology trend is the increase in communication tools designed to support collaborative knowledge projects among teams or groups of people. One example is a wiki, an easy to use, massively hyperlinked, Web-based database that allows open editing. Through a wiki, individuals can contribute content that is then edited by any other individual. This has both positive and negative impacts. On one hand, it provides for easy use, diversity, and potentially more current information. On the other, there are concerns over biases, accuracy, and the reliability of entries due to the potential absence of subject authority among contributors. Perhaps the most successful wiki to date is Wikipedia, a collaboratively developed encyclopedia whose English version now receives more than 600,000 hits per day.⁷ The Wikimedia Foundation, however, has recently announced the intention to develop “wikibooks” as a digital alternative to traditional textbooks (Terdiman, 2005). Such collaborative content-development models could contribute to new modes of knowledge development and delivery different from anything we have previously seen.

The Croquet Project (<http://www.opencroquet.org/>) is another example of new applications to enable group or team-based content sharing and knowledge development. As the Web site for the project explains, the new environment was developed beginning with the fundamental goal of “enabling deep collaboration between teams of users” through the “simulation and communication of complex ideas.” In an effort to redesign the basic operating system and user interface model that has dominated computing over the past two decades, Croquet brings together several other emerging technologies, including broadband conferencing, 3D user interfaces, and peer-to-peer networks. One of the most interesting aspects of the Croquet Project has been the focus on educational applications and the implicit premise that new content should be born digital. The Croquet Project is a prime example of how technology and the delivery of born-digital content could change the nature of learning from K–12 through higher education.

What It Means to Higher Education

Over the next 20 years, the publishing industry is expected to see changes to its structure and delivery channels unparalleled since the invention of the printing press more than 550 years ago.⁸ Although most of the major textbook publishers are pursuing a range of DCD initiatives, no dominant model has yet emerged. Higher education has an opportunity to help the publishing industry shape the future of the digital content it provides by helping it understand the learning styles and needs of students and how the educational environment is changing. If higher education and the publishing industry do not respond to the “born digital” requirements of the future, other companies and organizations will likely do so. Initiatives such as the Open Content Alliance, Wikibooks, Google Book Search (<http://print.google.com/googleprint/about.html>), and next\text (<http://www.futureofthebook.org/next/text/>) (Terdiman, 2005) are just a handful of the many new entrants ready to take on traditional publishers of course materials. As the new innovators emerge, higher education must consider new partnerships and new ways to participate in the learning landscape. The same is true of faculty who must learn to innovate and work with born-digital formats. Otherwise, they will become outdated as content and learning models shift to new formats and processes.

As this research bulletin demonstrates, many emerging DCD technologies are available. Institutions of higher education, which are fairly good at sharing best practices and knowledge about technology, must become even better at knowledge exchange. The traditional silos and cultural differences between organizational areas and institutions must be bridged to develop more collaborative problem-solving environments. The IT units have a critical role to play in this process and must continue to pursue climates supportive of innovation within their departments and institutions. Higher education must find ways to integrate and add value to DCD offerings so that core mission-related activities are not replaced with digital substitutes.

Key Questions to Ask

- What have we done to begin developing a climate supportive of innovation in our departments and institutions?
- How can we further improve knowledge transfer within our institution and among institutions to best leverage experiences gained and minimize unproductive IT investments?
- How would our institution and our learning processes change if the emerging technologies described in this bulletin become widespread and heavily adopted? What impact will each model have on campus computing resources?
- What are the resource implications for our institution as course content shifts increasingly from traditional print material to digitally delivered content?
- Who are the lead adopters of digital content on our campus? How are they using digital content in their classrooms, and how has that impacted resource or support consumption for the IT unit?

Where to Learn More

- Gyskiewicz, S. (1999). *Positive turbulence: Developing climates for creativity, innovation, and renewal*. San Francisco, CA: Jossey-Bass, Inc.
- O'Dell, C., & Grayson, C. J., Jr. (1998). *If only we knew what we know*. New York, NY: The Free Press.
- Rosenthal, M. (2004). *Print-on-demand book publishing: A new approach to printing and marketing books for publishers and authors*. Springfield, MA: Foner Books.

References

- Becker, D. (2004, August 27). Have e-books turned a page? *CNET news.com*. Retrieved June 22, 2006, from http://news.com.com/2102-1025_3-5326015.html
- Borland, J. (2005, August 9). Coming to campus: E-books with expiration dates. *CNET news.com*. Retrieved June 22, 2006, from http://news.com.com/2102-1025_3-5825301.html
- Brumfield, R. (2005, September 28). Study: States are slowly embracing eTexts. *eSchool News online*. Retrieved June 22, 2006, from <http://www.eschoolnews.com/news/PFshowstory.cfm?ArticleID=5883>
- DeSouza, T., Hon, C., Kim, J., Lee, E., & Leong, C. (2004, May). *eBook: An uphill battle for acceptance*. Rolling Hills Estates, CA: The Electronic Document System Foundation. Retrieved June 22, 2006, from http://www.edsf.org/images/EDSF_Ryerson.pdf

- Carlson, S. (2005, February 11). Online textbooks fail to make the grade: Students prefer handling pages the old-fashioned way. *Chronicle of Higher Education*, 51(23), p. A35.
- Carlson, S. (2005, April 22). Legal battle brews over availability of texts on online reserve at U. of California library. *Chronicle of Higher Education*, 51(33), p. A36.
- Digital Library Federation. (2004, July). *Digital library content and course management systems: Issues of interoperability*. Washington, DC: Digital Library Federation. Retrieved June 22, 2006, from <http://www.diglib.org/pubs/cmsdl0407/>
- Duncan, J. (2004, October 11). Convergence of libraries, digital repositories, & management of Web content. Report for the EDUCAUSE Evolving Technologies Committee. Retrieved June 22, 2006, from <http://www.educause.edu/ir/library/pdf/DEC0401.pdf>
- Foster, A. (2005, September 2). In a pilot project, 10 college bookstores begin selling digital textbooks. *Chronicle of Higher Education*, 52(2), p. A45.
- Gallagher, S. R. (2003, May 13). *The new landscape for course management systems*. (Research Bulletin, Issue 10). Boulder, CO: EDUCAUSE Center for Applied Research. Available from <http://www.educause.edu/ecar/>
- Gartner, J. (2002, February). Point-'n'-shoot sound makes waves. *Wired Magazine*. Retrieved June 22, 2006, from <http://www.wired.com/news/technology/0,1282,50483,00.html>
- Metros, S., & Bennett, K. (2002, October 1). *Learning objects in higher education*. (Research Bulletin, Issue 19). Boulder, CO: EDUCAUSE Center for Applied Research. Available from <http://www.educause.edu/ecar/>
- Metros, S., & Bennett, K. (2004, May 25). *Learning objects in higher education: The sequel*. (Research Bulletin, Issue 11). Boulder, CO: EDUCAUSE Center for Applied Research. Available from <http://www.educause.edu/ecar/>
- Mutter, J. (2005, October 6). Preparing for change: NACS's digital content "Czar." *Shelf Awareness*, 1(66). Available from <http://news.shelf-awareness.com/nview.jsp?appid=411&j=51129>
- Nelson, M. (2006, April 25). *Digital content delivery trends in higher education*. (Research Bulletin, Issue 9). Boulder, CO: EDUCAUSE Center for Applied Research. Available from <http://www.educause.edu/ecar/>
- Olsen, F. (2004, January 30). Digital archiving: Ensuring storage space and access. *Chronicle of Higher Education*, 50(21), p. B14.

- Sausner, R. (2005, May). Course management: Ready for prime time. *University Business*. Retrieved June 22, 2006, from <http://www.universitybusiness.com/page.cfm?p=791>
- Terdiman, D. (2005, September 28). Wikibooks takes on textbook industry. *CNET news.com*. Retrieved June 22, 2006, from http://beta.news.com.com/2102-1025_3-5884291.html
- U.S. Government Accountability Office. (2005, July 29). *College textbooks: Enhanced offerings appear to drive recent price increases*. [GAO-05-806]. Washington, D.C.: Government Accountability Office. Retrieved June 22, 2006, from <http://www.gao.gov/new.items/d05806.pdf>
- Weigel, V. (2005, May/June). From course management to curricular capabilities: A capabilities approach for the next-generation course management system. *EDUCAUSE Review*, 40(3), 54–67. Retrieved June 22, 2006, from <http://www.educause.edu/LibraryDetailPage/666?ID=ERM0533>
- Zemsky, R., & Massy, W. (2004, July 9). Why the e-learning boom went bust. *Chronicle of Higher Education*, 50(44), p. B6. Retrieved June 22, 2006, from <http://chronicle.com/weekly/v50/i44/44b00601.htm>

Endnotes

1. Print on demand is a registered trademark of Cygnus Business Media, Inc. There is also a patent on the concept of print on demand, which has been the subject of some legal action. For more information or details on that patent and lawsuit, see <http://entrepreneurs.about.com/b/a/069774.htm>.
2. This statement is based on evidence provided in a June 2005 interview with Greg Bain, deputy general manager of the University of Queensland Bookshop and Press.
3. The brief synopsis provided here is derived from interview data from June 2005. More information on the POD Centre at the University of Queensland is available by contacting Deputy General Manager Greg Bain (gbain@pod.uq.edu.au) or through its Web site at <http://pod.uq.edu.au/>. Stories about the POD Centre have also appeared in the press, including two articles by James Norman, "Print Up a Book While You Wait," *The Sydney Morning Herald*, March 30, 2002, and "Books to Order—Any Old Title," *The Age*, January 16, 2006, retrieved June 22, 2006, from <http://www.theage.com.au/articles/2002/03/29/1017206151437.html>.
4. An extensive body of literature is being developed that discusses computer-based training and assessment. Popular in industry for years and fine-tuned in companies like Cisco, these tools are gaining acceptance within the higher education community. Some sample resources on this topic include ask aster (<http://ctiwebct.york.ac.uk/aster/askaster/askaster.asp>) and their pages on computer-based assessment; the Computer Assisted Assessment Centre, which provides many links and references on the topic (<http://www.caacentre.ac.uk/>); and the Open Source Freeware Distributed Learning Content Management and Assessment System at Michigan State University (<http://www.lon-capa.org/>).
5. E-ink and e-paper are competing technologies based on similar principles. E-ink uses oil-filled capsules mixed with chemical particles that, when charged, create an image (see <http://www.eink.com/>). E-paper uses half-white and half-black electronically charged balls to create images (see

<http://en.wikipedia.org/wiki/Electronic_paper>). Both technologies provide lightweight, low-power, high-resolution solutions that could make e-book displays as easy to read as their traditional paper counterparts.

6. While these devices appeared everywhere in the movie *Minority Report* from billboards and newspapers to cereal boxes, advances are being made in the areas of e-textiles and 3D display devices. It is unlikely these newer technologies will reach commercial viability in the next three to five years. More likely we will first see highly flexible roll-up displays that can provide a light-weight, low-power, highly readable alternative to paper books, Tablet PCs, and existing e-readers. For an example of roll-up displays, see articles on displays using organic light-emitting diodes (OLED), such as "OLED: The thinnest of all," in *PC Magazine*, May 4, 2004, retrieved June 22, 2006, from <<http://www.pcmag.com/article2/0,1895,1566133,00.asp>>.
7. The English version of Wikipedia can be found at <http://en.wikipedia.org/wiki/Main_Page>.
8. An extreme but interesting perspective on this issue appears in an April 15, 2005, blog posting by Kim White, "The dinosaurs are myopic: Publishing industry clueless about the future of textbooks," retrieved June 22, 2006, from the if:book blog hosted by the Institute for the Future of the Book at <http://www.futureofthebook.org/blog/2005/04/the_dinosaurs_are_myopic_publi.html>.

About the Author

Mark R. Nelson (drmnelson@gmail.com) is the Digital Content Strategist for the National Association of College Stores (NACS) and an ECAR Fellow.

Copyright 2006 EDUCAUSE and Mark R. Nelson. All rights reserved. This ECAR research bulletin is proprietary and intended for use only by subscribers. Reproduction, or distribution of ECAR research bulletins to those not formally affiliated with the subscribing organization, is strictly prohibited unless prior permission is granted by EDUCAUSE and the author.