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From Paper to Pixel: Digital Textbooks in Schools

A White Paper

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Digital textbooks will soon be part of every classroom in the United States. This trend accompanies an imperative for schools to facilitate 21st century learning in which educators prepare students to learn and live productively in a global society where accurate and current information is a meaningful part of everyday learning. School librarians can be key players in the successful implementation of digital textbooks.

What is a Digital Textbook?

Digital textbooks come in many forms such as electronic textbooks, read-on-demand computer-based textbooks, print-on-demand e-textbooks, and modular assemblages of audio, visual, interactive and text resources such as those through iTunesU, wikis and digital applications.

Textbooks and U.S. Public Education

Textbook adoption is most often considered a statewide activity; all states mandate some sort of state-level review of materials used in the classroom. In many instances, districts are given some discretion over some of the materials selected.

In public schools in the United States, textbooks are important supports for a number of teaching and learning activities. Textbooks help to standardize the material teachers present in content areas; ensure that classroom content is aligned to mandated curricula; provide a focal point for instructional activities; and support pedagogical approaches.

Momentum is Growing for Digital Textbooks

As technology and the Internet have gained presence in classrooms, instructional materials and activities have become digitally rich. The use of digital textbooks is rapidly gaining ground in education. While colleges and universities have moved headlong into digital textbooks as a means to reduce costs for students, K-12 education is venturing cautiously, but steadily, into using digital textbooks. State laws, many of which have been rewritten to include digital content as an acceptable use of state textbook funding, will serve as catalysts that spur the transition to digital textbooks.

Benefits of Digital Textbooks

Increase Opportunities to Learn and Promote Good Teaching

The interest in and growth of digital textbooks can be attributed to several perceived advantages for learners. Some possible advantages are obvious: digital textbooks are compact and light, making them easy to transport and store; many have search, highlight, and note-taking features

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convenient for studying and quick reference; and digital textbooks are immediately available anytime, anywhere. Digital textbooks are also appealing in that they support learning, teaching, and technology integration.

Digital textbooks can provide access to a wealth of information that is retrievable from the Internet. Rather than just providing versions of traditional textbooks, many companies are striving to provide schools with textbook reading devices that allow digitally-enhanced interactive functionalities. Often, there are supplemental companion Web sites available that are graphically rich and able to engage readers in numerous ways. This approach to delivering content will help to keep students motivated and engaged in learning through an interactive approach to delivering content.

Digital technology has transformed how our students communicate and should influence the way teachers teach. Teachers can use digital textbooks and materials to receive customized curriculum to complement and extend their state's standards. Though information is ever-changing and can be quickly outdated in print textbooks, students using digital textbooks can access news about current events and link to information and media that enrich learning experiences.

All teachers have an imperative to differentiate their instruction to meet the needs of all learners, but often they lack the resources and skill to do so. Digital textbooks provide support for students with various learning needs through flexibility and multimedia, including those students who have low vision, or who are physically unable to hold a book or turn pages, and English Language Learners.

Digital Textbooks Make Financial Sense

Billions of dollars are spent on print textbooks every year. As textbooks become more readily available in multiple formats, the difference in cost between the various formats can be quite significant. Textbooks are generally not replaced for several years due to cost issues, resulting in dated information, particularly in the subject areas of health, science and social studies. Student textbooks in use today, perhaps adopted in 2005, will not contain information about President Barrack Obama's first day in office in 2009, Hurricane Katrina in 2005, or the downgrade of Pluto from planet to dwarf planet in 2006. Schools using digital textbooks can receive updated information from the publisher in a timely manner, without having to replace the entire series.

Digital Textbooks Protect Children's Health and Safety

Bookbags with textbooks that are too heavy or are worn incorrectly can cause physical harm for youth. Digital textbooks would decrease the physical burden placed on students who use print textbooks. They are also accessible to students online at home or at school, eliminating the need to transport heavy print textbooks in their backpacks for use in homework assignments.

Challenges for Digital Textbooks

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The Hidden Costs of Digital Textbooks

Despite possible advantages, a move to digital textbooks poses challenges. The cost of hardware and software licenses as well as updating the technology infrastructure and bandwidth capacity of schools is costly. Putting a laptop or other reader device in the hands of every student could cost millions of dollars. For now, the financial savings and educational advantages of digital textbooks remain an aspiration and may pose hidden costs for learning, teaching, and implementation.

Digital Textbooks Compromise Comprehension And Engagement

A decade of research has consistently supported the conclusion that children perceive reading online text as different from reading printed text. The reading of fixed text is the dominant form of reading in non-digital environments, but multimedia digital textbooks require a different kind of reading across interactive layers consisting of visual clues, hypertext, images, audio, and digital paper.

This balance of focal and peripheral attention while reading digital media is not easily accomplished. Despite improvements in e-reader devices, users read 20-30% more slowly; use more effort; and are more tired than when reading on paper. Perhaps the greater reading effort required by digital texts explains why many students have remarked that digital textbook user interfaces do not seem designed for sustained in-depth reading and that they prefer to use them for shorter tasks like verifying facts

Digital Textbooks Exclude Visually-Impaired Learners

Accessibility of learning materials remains a concern for persons with disabilities. While many e-readers have text-to-speech capabilities, most notably menu selection, voice activated navigation, note taking, and bookmarking features, they are inaccessible to visually impaired users. Images are excluded from screen readers, thus obscuring a significant portion of digital content to low vision users.

Digital Textbooks Perpetuate Socioeconomic Gaps In Education

One of the main concerns with this program is its potential to negatively impact students from low socioeconomic backgrounds or children who lack equipment and connectivity at home.

Digital textbooks require student access to computers or other mobile devices, Internet connections, and hardware systems that require periodic upgrades and maintenance. And, in many instances, schools must absorb at least part of the cost of making materials accessible to all students through printing and reformatting.

Until a standard format for digital text is created, schools may have to invest in multiple readers. Some digital texts are formatted for specific e-reader devices; some others work on computers only. Reading devices, or e-readers, are available for netbooks, mobile devices, and tablets as well as dedicated e-book platforms and they continue to expand, leading schools to invest in multiple devices to provide content to learners and educators.

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Current Internet Connectivity Cannot Support Digital Textbook Use
Web-based learning resources demand high levels of bandwidth to ensure adequate speed and connectivity. Another issue is not all Americans have, or can afford internet access in their homes. Although access to the internet may be available through smartphones, data plans are expensive and some cell phone applications have an associated cost. The new "digital divide" may be an "app gap" in which high quality content cannot be used on mobile devices until a unique app is created for it.

Teachers Are Not Prepared To Make Best Use Of Digital Content
Adequate professional development is key to the success of digital innovations in schools and in order for technology to be successfully integrated into everyday classroom practice requires ongoing professional development. Often districts often do not plan for the substantial time and investment in professional development they will need to make to ensure the success of their digital textbook programs.

Digital Textbooks Will Not Resolve Flaws In Traditional Curricula
Before digital textbooks can be credited with enhancing learning, curricula must be reformed to focus in depth on topics and give students a common set of educational concepts upon which to build. Textbooks become an essential tool of curriculum and, as a result, teachers cover numerous topics shallowly in an effort to complete the range of material contained in the textbook. Splintered adoptions of digital textbooks without national or even statewide agreement upon the uses for and content in digital textbooks may only exacerbate this issue.

Digital Textbooks Can Extend School Librarians' Reach
Digital textbooks represent another opportunity for school librarians to enhance their leadership in teaching and learning. Librarians are experts at identifying, collecting, and organizing the best content, and digital textbooks could allow school librarians to use their knowledge as information experts to customize content and resources to the needs of the students. Digital textbooks, can link to an array of supplemental content from database articles to streaming media. Digital textbooks will represent an important transformation in the way school librarians are involved with the resources of the school.

School librarians have leadership roles as teacher, instructional partner, resource specialist and program leader as they pertain to four areas of digital textbook implementation in schools.

- Access - Promote teacher and student awareness of digital textbooks and relevant resources available in the school and school library; correlate physical and digital resources.
- Skill – design professional development using latest research about professional development for technology and; co-teach aspects of revamped lesson that include digital resources, digital textbooks, and 21st Century Skills.

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- Policy – educate students and teachers on capacity limitations, copyright and safety implications of digital textbook applications to promote digital citizenship broadband applications, perform ongoing measurements of policy impact and adjust on an ongoing basis.
- Motivation – share co-teaching successes using digital textbooks and relevant resources with other teachers; facilitate an online community for student learners to share ideas and projects as a result of using digital textbooks

School librarians can provide school-wide leadership to assist students, teachers, and parent concerns when transitioning to digital textbooks. Working in collaboration with teachers, school librarians promote comprehension through questioning, clarifying, seeking meaning, and discussion. Digital textbooks may represent a fresh way to continue advocacy for the importance of reading as well as for the school librarian's crucial leadership role in technology integration.

Recommendations

For Educational Policymakers

- Allow districts to retain control over local adoption of digital materials.
- Create guidelines for the adoption of open content and support the creation of a national or statewide clearinghouse of digital education material.
- Pilot the use of digital textbooks in a limited number of districts in order to measure the kinds of learning that results from print textbook-based activities and compare those results to similar activities based on digital texts.

For School Administrators

- Provide professional development to teachers to ease the transition to digital textbooks and revolutionize instructional design and technology implementation.
- Upgrade the district bandwidth to ensure that content remains readily accessible, even in peak use times.
- Utilize the expertise of the school librarian to promote integration and provide training.

For School Librarians

- Utilize resource selection expertise to actively participate in district digital textbook adoption.
- Identify resources, both digital and print, that can work together and create learning sets related to the curriculum.
- Catalog digital items in such a way that teachers and students can find the digital content they need in the collection.

References

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Churchill, D., & Hedberg, J. (2008). Learning object design considerations for small-screen handheld devices. *Computers & Education, 50*(3), 881-893.

Joint Information Systems Committee (JISC). (2009, November). *JISC national e-books observatory project: Key findings and recommendations*. Retrieved from http://www.jiscebooksproject.org/wp-content/JISC-e-books-observatory-final-report-Nov-09.pdf

Larson, L. (2009). e-Reading and e-Responding: New tools for the next generation of readers. *Journal of Adolescent & Adult Literacy, 53*(3), 255-258.

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