

The Reed College Kindle Study

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Background

In the fall of 2008 Reed College met with some fifteen other colleges and universities to discuss the possibility of evaluating a new eReader (later identified as the Kindle DX) in a higher education setting. Reed was subsequently selected by Amazon as one of seven institutions to participate in a pilot study. The other schools were: Arizona State University, Case Western Reserve University, Pace University, Princeton University, the University of Washington, and Darden School of Business at the University of Virginia.

Reed's study took place during the fall semester of 2009 and involved 43 students enrolled in three upper-level undergraduate courses:¹

- English 301: Junior Seminar in English — *Irony, Allegory, Epic, Novel*
- French 451: Special Topics in French Literature — *The History of Truth and Authenticity from Montaigne to Sartre*
- Political Science 422: Nuclear Politics — *The origins and effects of the spread of nuclear weapons*

This report summarizes the goals and format of the study, what we learned from student and faculty participants, and observations about the future of eReader technologies. We also discuss eReader accessibility issues and a Department of Justice investigation that focused on them.

Goals and Format of the Study

Reed accepted Amazon's invitation to participate in the Kindle DX study with three goals in mind:

- to evaluate the features of this particular platform
- to identify impacts of the Kindle DX on teaching and learning activities
- to assess the overall prospects of eReaders in higher education

Although we examined eReader devices from several vendors² the Kindle DX was the only device we evaluated in a live course setting.

¹ We are grateful to the students and faculty who participated in the Kindle study for all of their help and their thoughtful feedback. The faculty members were: Robert Knapp (English), Luc Monnin (French), and Alexander Montgomery-Amo (Political Science).

² Some of the devices we looked at included the iRex iLiad, the Interead COOL-ER, the ECTACO jetBook, the Barnes & Noble nook, and several Sony Readers.

The courses involved in the study were not made public until pre-registration had been completed, hence students enrolled in those classes did not learn about the project until summer 2009. At that time they were informed about the goals and nature of the study and advised that their participation was entirely voluntary. They were told that if they choose not to participate they would be able to obtain printed course materials in the usual manner. It was initially anticipated that perhaps half of eligible students would participate. To our surprise, roughly 95% of the students signed up for the pilot.

Students agreed to abide by the Amazon Kindle terms of use³ and to provide feedback by:

- responding to web surveys at the beginning and middle of the fall semester;
- participating in face-to-face group discussions; and
- responding to email queries during and at the end of the semester.

Students were informed that if they fulfilled the terms of the agreement they would be allowed to keep the Kindle at the conclusion of the study. They were also advised that they could return the Kindle and withdraw from the study at any time. Course materials, including texts and articles, were provided to the students at no charge.

A "getting started" sheet was distributed to students when they received their Kindles at the beginning of the semester. Beyond the help sheet and some very basic guidance, there was virtually no end-user support provided by the College. Questions about how to use the device were well answered by the documentation contained on the Kindle itself. In two cases there were device malfunctions that involved replacement of the hardware.

Outcomes of the Study

Feedback about the Kindle DX provided by students and faculty covered a wide range of issues. Items that elicited the most positive remarks included the following:

Legibility — There was general agreement that the Kindle display (based on technology provided by E-Ink Corporation⁴) was extremely legible. Although students observed that the light contrast between text and the (somewhat grayish) background of the Kindle display was less sharp than that of ordinary paper, they were able to read for many hours without visual fatigue. Some students expressed a clear preference for the Kindle display over conventional computer screens though a few felt that laptop LCD displays were as comfortable for reading text.

Form factor — The size, weight, and general configuration of the Kindle DX were well received. Students found that they could hold it comfortably for many hours of reading, carry it easily in their backpacks, and place it before them in class without cluttering their workspaces.

³ Kindle terms of use are at: <http://www.amazon.com/gp/help/customer/display.html?nodeId=200144530>

⁴ E-Ink Corporation is owned by Prime View International. For more information see:

http://www.eink.com/press/releases/PVI_E_Ink_press_release.htm?AD=1&ArticleID=22107&pg=2

Some students noted that smaller eReaders (such as the Kindle 2 or nook) might be better for traveling but preferred the larger screen of the DX for academic use.

Battery life — There was unanimous praise for the "long distance" battery life of the Kindle DX. With the Kindle wireless feature turned off, students reported that they could go for a week or more without needing to re-charge the battery. They also liked the fact that the external power supply was lightweight and well designed.

Durability — There was some initial concern that the Kindle DX might be too fragile to stand up to the rigors of college life. Accordingly, each student was given a padded Kindle cover (with the name and/or logo of the pilot institution) in order to protect the device from cracks, scratches, or other mishaps. As it turned out, the Kindle DX proved to be quite durable, even with the cover removed. Virtually no damage was reported during the semester. In fact, many students removed the cover in order to make the Kindle lighter and to allow it to fit more comfortably into their backpacks.



Paper savings — Students and faculty universally anticipated that the Kindle DX would enable them to cut down dramatically on printing and this proved to be the case. One course, for example, used nearly seventy articles that might have otherwise generated tens of thousands of printed pages. Most students, however, reported that they were able to read the articles in PDF format on the Kindle well enough to obviate the need for printing. Many students viewed this reduction in paper use as both an environmental and an economic benefit and one of the most promising impacts of eReader technology.

Over-the-air distribution — A number of students indicated that they purchased items (or acquired free texts) online for pleasure reading or other personal uses and were delighted to be able to download a text in a minute or less via the Kindle's cellular network.⁵ The ease of browsing books in the Kindle store, the wide selection of titles, the lack of cell charges, and the speed of downloading texts from any location were mentioned as compelling features of the Kindle DX. (We noted that platforms that required a computer connection for text downloading seemed cumbersome by contrast to the Kindle.)

Single-function benefit — There has been a great deal of discussion, especially following the announcement of the Apple iPad, about the long-term viability of a device designed primarily for a single function: reading text. Tablets and other multi-function devices that can be used for reading text as well as for web browsing, email, word processing and countless other functions would seem to have a clear advantage. Faculty in the pilot study noted, however, that use of the Kindle DX in class didn't lead to the distractions that are typical of laptop use. Students were not tempted to check their email, browse the web, or use the Kindle in class for anything except to refer to course materials. The functional limitations of the platform, generally viewed as a shortcoming, proved to be a real benefit to class discussion dynamics.

⁵ Amazon's over-the-air distribution, *Whispernet*, is provided by Sprint.

There were, however, a number of ways in which the Kindle DX failed to meet student and faculty expectations. Among the key problems encountered in the study were these:

Materials availability — Despite aggressive efforts, Amazon was unable to obtain all of the readings the faculty wished to assign in their courses. In the case of the French literature course (where all of the assigned readings were in French) the instructor had to provide most of the materials himself, relying primarily on public-domain electronic texts. We had hoped that an integrated, searchable French-English dictionary would be available in addition to the *New Oxford American Dictionary* included as a standard feature on the Kindle DX, but this was not the case.

The other two courses fared somewhat better: the assigned books were available—although not always in the faculty members' preferred editions. However, students were also expected to read a significant number of journal articles, which would normally be provided online through the college library's electronic journal subscriptions. Because of the limited capabilities of the Kindle DX's web browser, it was not possible to use the device to access the library's electronic journals; consequently, we needed to convert the articles into a Kindle DX-compatible (PDF or .prc) format.

PDF formatting — The Kindle DX is capable of displaying PDFs, but much of the device's functionality is lost: annotation, highlighting, text-resizing, text-to-speech, and other features are unavailable. To avoid this loss of functionality, we used the *Mobipocket* conversion utility to convert the assigned journal articles to the .prc eBook format. The conversion process required a significant amount of staff time to produce acceptable results, particularly for older articles that had been scanned as image PDFs without optical character recognition. Special care was also needed to accommodate footnotes, two-column page layouts, charts, and tables. File conversion took at least an hour, and often much longer, for each article. In the case of the Political Science course, whose readings included nearly seventy articles, the conversion process could not be completed in time for the start of classes.

PDF distribution — Amazon was not involved in the processing of assigned journal articles and we were hesitant to store copies of the articles on Amazon's servers, even temporarily, due to concerns about Fair Use. Consequently, it was not possible to have the articles delivered to the study participants' Kindle DXs via *Whispernet*. The articles had to be uploaded to the appropriate course areas in our learning management system (*Moodle*) so students could download them to their computers and then transfer them to their Kindles via USB connectors. This roundabout process made PDF distribution far more cumbersome than the over-the-air distribution of available Kindle texts.

Images and color — The Kindle DX's relatively low screen resolution and grayscale display made it ill suited to present the kinds of complex diagrams, charts, and images that are often vitally important in academic texts of all sorts, particularly in the sciences. Since the readings for the three courses involved in the study did not rely heavily on images or color, this shortcoming did not present an immediate problem, but it did contribute to the students' skepticism about their Kindle DXs' suitability for future academic work.

File system — Once all of the materials were loaded onto the Kindle DX, they proved difficult to locate because the DX's "home page" listed all of the materials the device contained in a linear fashion. The list could be sorted alphabetically by author or title, or chronologically by the date the item was added or last opened, but there was no provision for organizing materials in a conventional folder hierarchy. As the number of stored items grew, the need to scroll sequentially through lengthy title lists became a serious impediment to the use of the Kindle during classroom discussions. Amazon has since announced plans to implement a folder organization feature sometime in 2010.⁶

Page refresh and skimming — Although students enjoyed the long battery life afforded by the Kindle DX's E-Ink technology they were less enthusiastic about the page refresh rate. They found "page turning" on the Kindle to be appreciably slower than page turning for print materials or on their computers. Many students complained that the slowness of moving through a document on the Kindle DX kept them from skimming texts. When asked if the Kindle search function might replace the habit of skimming to find a specific passage, some students thought that it would—if the search function were easier and faster to use. Other students felt that "flipping through the pages" would continue to be important in order to get a general sense of a text's content and organization.

Referring to texts in class — All three courses in the study were upper-division seminars centered around careful reading and discussion of the assigned texts; in such courses, students typically are expected to support their claims with specific textual evidence, and everyone in the class needs to be able to quickly locate the same passages in the texts in order to keep the discussion moving. The Kindle DX did not facilitate either of these needs because of the difficulty of navigating from one point in a text to another.

Rather than using page numbers, Kindle eBooks use location numbers to overcome the idiosyncrasies of manipulating font size and word density on the screen. The Kindle's location numbers are tied to specific points in the texts, so in theory, if everyone in a class uses a Kindle they should be able to move to a specific location just as they would to a specific numbered page. In practice, however, the need to use the Kindle DX's five-way control and small keyboard to input a location number made the navigation process extremely slow, particularly since the keyboard's lack of dedicated number keys meant that the Shift key had to be depressed for each digit of a location number.⁷

Another problem that students encountered in the classroom was the difficulty of referring to multiple texts. The Kindle DX's screen displays only one text at a time, while it is common practice in Reed classes for students and instructors to discuss several primary and secondary texts in the course of a single session. Without the ability to open and switch between different windows (as students could easily do on their computers), it was virtually impossible to navigate smoothly between multiple texts. Because of these difficulties, students reported that their in-

⁶ <http://twitter.com/KindleReads/status/5868816483>: "We are working on a solution for you to organize your Kindle libraries, to be released as an over-the-air software update next year." (November 19, 2009)

⁷ In addition, the use of location numbers makes it more difficult to construct an adequate bibliographic citation to the material for use in scholarly papers.

class conversations were more superficial and less supported by texts than was normally the case. This became so frustrating that, after the first month of the semester, many students gave up using the Kindle in class in favor of paper texts.

Highlighting and annotation — The difficulty of manipulating the Kindle DX's five-way controller and keyboard meant that students were very unlikely to use the Kindle DX to annotate their texts, since entering text with the keyboard was too slow. In addition, notes could appear only at the bottom of the screen, not next to the portion of the text to which they pertained, which made them less useful than traditional, handwritten marginal notes.

Highlighting was less problematic, but still suffered from the difficulty of using the five-way controller to navigate to the appropriate location to begin highlighting. Consequently, some students found themselves writing their notes in notebooks that they kept alongside their Kindles; others marked up paper copies of the texts; still others drastically reduced the extent to which they annotated their texts at all, with troubling results (see below).

Interestingly, the Kindle application for the iPhone uses a structure identical to that of the Kindle DX software but is much better suited to academic reading, because the iPhone's touch navigation and keyboard make location numbers and notes considerably easier to enter than on the Kindle DX. One of the faculty participants in the study filmed an experiment in which he performed identical tasks—going to a specific location number, highlighting a passage, and adding a note—using the iPhone Kindle app and the Kindle DX. On the iPhone, he finished the tasks in roughly thirty seconds, while it took him twice as long to perform the same tasks on the Kindle DX. (While he did not perform the same tasks with an actual book as part of the experiment, he expected they would take even less time than they did on the iPhone.) Both students and faculty expressed their belief that in order for an eReader to be useful for academic purposes the technology will need to match the flexibility and ease of jotting notes on paper, flipping from page to page, and spreading multiple texts across a desk.

Content comprehension — By far the most troublesome feedback we received during the study was from a faculty member who felt that his students' comprehension of the reading materials suffered from use of the Kindle DX. He speculated that the difficulty students encountered with highlighting and taking notes on the device eventually caused them to read passively, thereby reducing their ability to reflect on and retain complex information. He saw evidence of this in assignments as well as in class discussion. He further noted that after a few weeks of trying to take notes by hand (or on their laptops), a number of students abandoned the Kindle DX (for coursework) altogether.

Both faculty and students agreed that this problem, though critical to the academic use of eReaders, could be easily addressed by technology that would allow quick and easy text highlighting and annotation. Indeed, they pointed out that effective digital highlighting and annotation would have the benefit of being easily searchable, shareable, and usable for doing research and writing papers. While the Kindle DX had a negative impact on content comprehension, there was considerable optimism that future eReaders would be able to overcome this problem and might actually help to increase comprehension.

Accessibility

Toward the end of the Kindle study at Reed stories began to appear in various media outlets and blogs regarding the issue of eReader accessibility for visually impaired or blind individuals. The stories focused a great deal of attention on the issue but engendered some confusion as well.

Accessibility features and concerns — The Kindle DX is equipped with a text-to-speech (TTS) feature for materials stored in its .AZW format, provided that the copyright holder has authorized Amazon to apply TTS. What the Kindle DX (and Kindle 2) lacked was an application of TTS to navigation and other controls. Hence, while a visually impaired or blind individual could listen to a text he or she could not navigate among stored texts, navigate within a text, browse the Kindle online bookstore, or utilize other features of the device.

Amazon's stance on the issue of accessibility was initially posted on its website in March 2009:

We've heard from many of our blind or vision impaired customers who are excited about Kindle 2's text to speech technology. Some of these customers have asked that we make Kindle even easier for them by adding navigation accessible to the blind. We want to let those customers know that this is something we are working on and we look forward to making it available in the future.⁸

While this statement expressed Amazon's intention to improve accessibility on the Kindle, two advocacy groups, the *American Council of the Blind* and the *National Federation of the Blind*, took steps to accelerate the development of eReader accessibility features by filing complaints with the Departments of Education and Justice about the Kindle pilot study. The complaints asserted that the schools participating in the study were violating the *Americans with Disabilities Act* (ADA) and the *Rehabilitation Act* of 1973. These statutes, among other things, require institutions of higher education to provide reasonable accommodation to students and other individuals with disabilities so as not to exclude them from the services or resources provided by the institution.

The fact that there were no visually impaired or blind students enrolled at Reed during the pilot study — hence no individuals to whom an accommodation could be provided — nor that the study was a temporary and limited product *evaluation* rather than an *adoption*⁹ of a new technology were insufficient to deflect the complaint.

The Department of Justice investigated the complaint and resolved the matter in January 2010, reaching written agreements with several of the pilot study institutions, including Reed. In the

⁸ <http://www.amazon.com/gp/blog/post/PLNK3LOIUHETXJZXJ>

⁹ A technology "adoption" can be variously construed as either: (a) purchasing and deploying a new technology for ongoing use; (b) subscribing to a technology (as in the case of cloud computing or a hosted service); (c) requiring students or and/or other individuals to use a specific technology; (d) providing support services for privately owned technologies; or (e) recommending the use of specific technologies. A technology "evaluation," by contrast, is of limited duration and scope and does not encompass any of the above-mentioned criteria.

agreements, each institution affirmed its commitment to comply with ADA and Rehabilitation Act requirements and to adopt policies expressing these commitments with specific reference to eReaders. Reed's agreement, for example, avows that the college will not purchase, promote, require, or recommend "dedicated electronic book readers" unless such devices are "fully accessible to students with visual impairments" or the college "provides reasonable accommodation or modification for this type of technology to its students with visual impairments."

Contrary to some public discussions of the matter, the Department of Justice agreement had "no effect on Reed College's... pilot program testing the Kindle DX" and was "not intended to preclude other pilot programs or product testing designed to evaluate the features, including accessibility features, of new technologies so long as reasonable accommodation or modification is provided."¹⁰

After receiving feedback from schools participating in the Kindle pilot study, Amazon posted a second statement about Kindle accessibility features in December 2009:

Blind and Vision-Impaired Readers to Benefit from New Kindle Features in 2010

SEATTLE--(BUSINESS WIRE)--Kindle, the #1 bestselling product across all of Amazon, has enabled many vision-impaired readers to enjoy books more easily than before, and has also helped dyslexic readers and those with learning disabilities improve their reading skills. Vision impaired customers benefit from Kindle's ability to change the font size – easily making any book a large print edition. Dyslexic readers benefit from being able to listen with Kindle's text-to-speech technology while simultaneously reading along with the synchronized text. Today, Amazon announced that it is working on a new set of features that will make Kindle even better for these readers as well as a meaningful breakthrough device for the blind.

“Kindle is for anyone who loves to read—in fact, we’ve heard from thousands of vision-impaired customers and customers with learning disabilities over the past two years who have been helped tremendously by Kindle,” said Ian Freed, Vice President, Amazon Kindle. “With some key modifications, we believe Kindle can be a breakthrough device for the blind, and the team is excited about making these enhancements.”¹¹

Whether or not future Kindles, other eReaders, or multi-function platforms such as the iPad provide the breakthrough that Amazon and other manufacturers envision, it is clear that accessibility for individuals with disabilities is a key condition for widespread adoption of eReader technologies in higher education.

¹⁰ This wording is drawn from the text of Reed's resolution letter, a copy of which is available online at:

http://www.ada.gov/reed_college.htm

¹¹ <http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1362556&highlight=>

Cost Considerations

One of the most appealing aspects of eReaders is their potential to reduce the costs of books and other course materials. With the average cost of course materials exceeding \$1,000 per year,¹² this is perhaps the most powerful factor driving both the development of the technology and student interest in eBooks and eReaders. Expectations abound that, if successful, this technology could decrease the cost of purchasing course materials by 50% or more. However, there are several factors that may complicate this prospect.

During the time of the study, the retail price of the Kindle DX was \$489. Other eReader pricing varied from \$199 to \$859.¹³ When students were asked if they would purchase a Kindle DX (or other *dedicated* eReader) for academic use, they indicated that the price would need to drop dramatically — to less than \$100 — in order for them to seriously consider purchasing one. However, many students suggested that they would be willing to spend considerably more for a multi-function device, such as a tablet or netbook, if it eliminated the need to own a laptop (and if it were as comfortable as an eReader for prolonged reading).

The question of whether dedicated eReaders such as the Kindle DX will continue to evolve and thrive or whether they will ultimately be replaced by more expensive (but more functional) tablets and/or netbooks is a provocative one. Dozens of hardware manufacturers and content providers are betting their futures on the answer. Some believe that the benefits of E-Ink technology, increases in functionality, improvements to the user interface, continued price reduction, and rich content offerings will make dedicated eReaders a hot commodity for years to come. Others believe that the maturity of LCD technology, its capacity for live video, the existing range of tablet/netbook functionality, the robustness of the touch interface, the availability of new content channels, and the potential to compete with laptops give tablets and netbooks a head start that dedicated eReaders will be unable to overcome.

Which of these perspectives will prevail is a purely empirical matter. But we shouldn't have to wait too long to learn the answer. During the next eighteen months both technologies will evolve significantly. The Apple iPad and other tablets will push the price/function envelope while eReaders are likely to gain color, a touch interface, and expanded functions (such as real web browsing).

For colleges and universities, the rapid development of eBook technology offers hope not only that course materials will become more affordable for students but also that libraries will be able to realize considerable reductions in their acquisition, preservation, and storage costs.

The future suggested by recent developments in eBook pricing, however, is less promising. Apple's agreements with several major publishers, including the Hachette Book Group and

¹² Estimates of textbook costs vary but several studies suggest that the \$1,000 mark was passed some years ago. See, for example: <http://www2.ed.gov/about/bdscomm/list/acsf/edlite-txtbkstudy.html> or http://campuslife.suite101.com/article.cfm/throwing_the_book_at_high_textbook_prices

¹³ A comprehensive comparison of eReader pricing and features is available online at: http://wiki.mobileread.com/wiki/E-book_Reader_Matrix

Macmillan, set prices for eBooks on the iPad that are considerably higher than Amazon's customary \$9.99 for new releases. They also established a commission-based sales model giving publishers much more control over eBook pricing than the wholesale model favored by Amazon.¹⁴ Macmillan's subsequent demand that Amazon match Apple's pricing and policies prompted a skirmish that resulted in a temporary removal of Macmillan titles from the Kindle store. Amazon and Macmillan eventually reached an agreement believed to include increased prices and Hachette announced that it would raise its eBook prices accordingly. Clearly, publishers will continue to exert upward pressure on the pricing of their products, regardless of their format.

At the same time, some publishers are proposing competing models for electronic textbooks; for instance, Macmillan recently announced its *DynamicBooks* project, which will allow instructors to freely edit and customize digital editions of textbooks and offer them to students at less than half the cost of a traditional printed textbook. The textbooks can currently be read on computers or on Apple's iPhone, and Macmillan hopes to make them available for the iPad as well. No plans to offer versions compatible with the Kindle or other dedicated eReaders have been announced as of the date of this report.¹⁵

Looking Ahead

During the Kindle pilot study we received numerous inquiries from journalists, publishers, politicians, advocacy groups, eReader manufacturers, bookstores, libraries, and other colleges and universities. The questions uppermost on everyone's mind were: What impact will eReaders have on higher education? How quickly and in what fashion will this technology be adopted?

A commonly held assumption was that the entry of eReaders into higher education would follow the traditional *computer deployment model* with colleges and universities purchasing their eReaders of choice, installing them throughout the institution, recommending or re-selling them to students, providing technical and user support, and in some cases requiring them for specific courses or degree programs.

While it is possible that this *computer deployment model* will apply, it is more likely that eReader technology will follow the *consumer cell phone model* wherein students, not colleges, will be the key decision-makers. If ownership of eReaders falls primarily to individuals, institutions may find themselves with little or no say in selecting, purchasing, recommending, or supporting eReader technology.

In order for the *consumer cell phone model* to succeed, however, it is essential that academic texts and other scholarly materials be equally readable, both technically and legally, on all eReaders. Currently, digital rights barriers and the absence of a universally accepted file format standard for eBooks makes this impossible. Without such a standard, or the ability of eReaders

¹⁴ According to a recent New York Times article, Apple's new iBooks application will charge between \$12.99 and \$14.99 for most new releases. It should be noted, however, that Apple appears to have reserved the right to reduce prices for best-selling books. See <http://www.nytimes.com/2010/02/18/technology/18apple.html>.

¹⁵ <http://www.nytimes.com/2010/02/22/business/media/22textbook.html>

to accommodate many different standards, faculty will find themselves faced with the prospect of selecting course readings based on their compatibility with a particular device rather than on the suitability of the material for the course. It is unlikely that faculty (or librarians) will tolerate such a restriction.

Establishing eBook file standards and resolving digital rights issues are apt to be more difficult and time-consuming to achieve than addressing the technical problems discussed above. While it won't be surprising to see rapid improvements in eReader technologies during the next two years, it will be extremely surprising to see comparable progress in the development of the file standards, content cost models, and rights policies needed to propel eReader technology to the forefront in higher education. Hopefully, pressure from colleges and universities will keep these efforts moving forward.

In closing, we may note that while students and faculty in Reed's Kindle study were unanimous in reporting that the Kindle DX — in its current incarnation — was unable to meet their academic needs, many felt that once technical and other issues have been addressed, eReaders will play a significant, possibly a transformative, role in higher education.