The Reed College iPad Study

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Background

When Apple announced the release of its iPad tablet in late January 2010, Reed College had just completed a semester-long study of the Amazon Kindle DX eReader in which students and faculty in three upper-division seminars used the Kindle to read, annotate, and discuss books and articles for the courses.[1] While the Kindle DX failed to meet faculty and student needs in several important ways, most notably highlighting, annotation, and manipulation of texts, the study participants were optimistic enough about the long-term potential of eReader technology to prompt the College to continue its evaluation of emerging products.

Consequently, during the fall semester of 2010, we undertook a study parallel in structure to the 2009 Kindle DX study. Students in one upper-division seminar, Political Science 422: Nuclear Politics — *The origins and effects of the spread of nuclear weapons*,[2] used the iPad for all of their assigned readings. Since this was one of the courses included in the Kindle study and much of the reading list was unchanged, comparisons between student reactions were easy to make. We anticipated that a multipurpose device like the iPad would have different strengths and weaknesses than the Kindle DX, a dedicated eReader, and we were particularly interested in examining these differences.

This report summarizes the design and findings of our iPad study and discusses the future of tablet devices at Reed and in higher education more generally.[3]

Goals and format of the study

Reed began the iPad study with three major goals:

- to assess the status of multi-purpose tablet technology for curricular use
- to identify specific impacts (both positive and negative) of tablet technology on teaching and learning activities
- to evaluate how well features of the iPad addressed concerns raised by students and faculty who participated in the Kindle DX study.

Since the identity of the course that would be included in the iPad study was not revealed until the pre-registration period had ended, students signed up for the course without knowing that they would be invited to participate in the study. In July 2010, we sent information about the study to the enrolled students and advised them that participation was optional[4] and that if they chose not to take part, they would be able to read printed course materials in the usual manner.

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[1] A summary of Reed's findings from the Fall 2009 Kindle DX study is available at: http://web.reed.edu/cis/about/kindle_pilot/Reed_Kindle_report.pdf

[2] We are grateful to Alexander Montgomery-Amo and his Nuclear Politics students for their willingness to participate in the study and their thoughtful feedback throughout the semester.

[3] Questions about this report may be directed to: ipad_study@lists.reed.edu

[4] The format of the study was reviewed and approved in advance by Reed's *Human Subjects Research Committee*.

All but one of the students in the course elected to participate in the study. The student who declined indicated a preference for the use of paper for reading assignments.

We asked the students to provide feedback to us in three ways:

- an online survey at the beginning and middle of the semester
- free-form email feedback about their experiences with the iPad
- a group interview at the end of the semester

We advised students that if they provided all of the requested feedback and participated fully in the study by using the iPad versions of their texts whenever possible, they would be given the opportunity to purchase their iPads at a substantial discount at the end of the semester. We also informed them that they could withdraw from the study and return the iPad at any time. All participants met the feedback requirement; somewhat more surprisingly, everyone chose to purchase an iPad at the end of the semester.[5]

Aside from some basic "getting started" support when students picked up their iPads, the College provided them with very little technical support. The faculty member teaching the course gave a basic demonstration of iPad use on the first day of the semester and made software and file management recommendations throughout the semester.

Outcomes of the study

Participants in the study provided a great deal of valuable feedback, allowing us to get a clear sense of the advantages and disadvantages of using the first-generation iPad in an academic context. They identified the following as strengths of the iPad:

Legibility —— Participants were enthusiastic about the size, contrast, and resolution of the iPad's LCD screen. They found it to be very good at displaying standard text, and only slightly less well suited for data tables, mathematical or scientific formulas, and graphics. One student reported some eyestrain and fatigue from reading on the iPad (or on a computer screen) for extended periods, but the other students were able to read on the backlit screen without adverse effects. Contrary to some expectations, there did not seem to be a significant difference in text legibility, even for extended periods of time, between the iPad and the (e-Ink based) Kindle DX.

Touch screen —— The quick response time of the touch screen was highly praised and seemed to be extremely beneficial in class discussions because it allowed students to navigate rapidly between texts to reach specific passages. By contrast, students who participated in the Kindle DX study felt that the *joystick* approach to navigation was just barely adequate.

Form factor —— The iPad's size and weight made it very portable; students reported that they took their iPads virtually everywhere they went, both on and off campus, and found them easy to use in a variety of settings. There did not seem to be a noticeable difference in portability between the iPad and the Kindle DX, despite the fact that the iPad at 1.5 pounds is slightly heavier than the Kindle DX (1.2 pounds).

[5] Students were loaned 16GB Wi-Fi iPads for the duration of the study; most students ended up purchasing the iPads they used during the study, but some chose to purchase more expensive models with more storage and/or 3G capability. In those cases, the discount was applied as a credit toward the purchase.

Because the iPad made it easy for the students to have all of their course readings with them at all times, they found that they read and reviewed the materials more frequently than they would otherwise. The shape and size of the iPad also had a positive effect on classroom dynamics, since the device was either flat or at a slight angle to the desk surface and therefore did not create a barrier between seminar participants, as a laptop screen might.[6]

Battery life —— While the iPad's battery life was significantly shorter than that of the Kindle DX, students reported that it was at least twice as long as that of their laptop computers and that they did not experience problems with their iPads running short of power during classes.

Durability —— No iPads suffered any significant damage in the study; most students found the devices to be very durable. Students were given lightweight iPad cases when they picked up their iPads at the beginning of the semester and they unanimously reported that they continued to use the cases in most situations throughout the semester. There was no appreciable difference between the iPad and the Kindle DX with respect to durability.

Paper savings —— Students found that using the iPad allowed them to avoid printing thousands of pages during the semester; they were especially enthusiastic about this aspect of the device for both economic and environmental reasons. Many courses at Reed, including Nuclear Politics, assign journal articles and other texts via electronic reserve; students typically print these materials, either because they prefer reading and highlighting on paper or because their professors do not allow them to use laptops in class. The students in the study, however, found that they enjoyed reading on the iPad enough to use it for the electronic reserve materials not only for Nuclear Politics but for their other classes as well. Additionally, some faculty members who ban laptops in class were more accepting of iPads (and other devices with a similar form factor), which further increased the usefulness of the iPad as a substitute for paper texts.

There was no theoretical difference between the iPad and the Kindle DX on this point but, in practice, the iPad was superior since students in the Kindle study tended to print out all of their reading materials in order to annotate them effectively. They did not encounter a similar annotation barrier with the iPad, hence they felt little or no motivation to print .pdf or other files.

Single-function benefit —— The iPad differs significantly from the Kindle DX in that it is designed (and effective) for a variety of functions, including web browsing, email, video playback, and (limited) content creation, while the Kindle DX is primarily an eReader. The multifunction capabilities of the iPad seemed to offer a significant risk that students would become distracted while using the devices in class. For most of the fall 2010 semester, the multitasking capabilities introduced by the iOS 4.2 update were not available, and students and faculty reported that the process of switching between applications was cumbersome enough to minimize the risk of this kind of distraction. In cases where information from online sources was needed to enhance class discussions, however, students could switch from their texts to a web browser quickly enough to locate this information without interrupting the flow of conversation.

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[6] Dr. Paul Gronke, a faculty member evaluating the iPad in a related Reed study, made this point in a comment on the *Inside Higher Ed* website in December 2010:
http://www.insidehighered.com/news/2010/12/22/college_students_test_drive_the_apple_ipad

Student did speculate that in larger classes, and particularly in lecture halls, the temptation to switch to an email client or web browser might occasionally be irresistible.

Referring to texts in class —— One of the most significant academic advantages of the iPad over the Kindle DX is the ease with which the iPad allows students and faculty to refer to texts during in-class discussions.

- *Switching between texts* — Students read virtually all of the texts for Nuclear Politics in .pdf file format and were advised to use the Aji *iAnnotate PDF* annotation application, which allowed them to have up to six files open in tabs at any time and to switch rapidly among the documents.
- *Searching and navigating within texts* — The quick refresh rate and response time of the iPad's touch screen allowed students to use the search functions built into Aji *iAnnotate PDF* and other applications to move quickly from one portion of a text to another.

Students reported that they were able to switch between texts, locate relevant sections, and navigate to passages cited in class even more quickly with the iPad than they could using paper. As a result, class discussion was able to flow smoothly and naturally. The iPad also made it easy to refer to readings from previous class sessions, which might have been unavailable if in paper form. In the Kindle DX study, participants found that the relatively slow refresh rate of the screen, combined with the difficulty of using the keyboard and four-way *joystick* controller to activate the search function and enter text, made it almost impossible to locate and discuss specific passages in texts. This had the unfortunate consequence of making class discussions less grounded in textual analysis and more superficial than they would otherwise have been.

Highlighting and annotation —— Study participants reacted much more favorably to the annotation and highlighting capabilities of the iPad than the previous year's study participants had to the annotation and highlighting capabilities of the Kindle DX. The touch interface seemed to be much less cumbersome than the Kindle's keyboard and controller and the ability to include highlights and notes in several colors, as well as lines and freeform drawings, gave the iPad a real advantage. Furthermore, several iPad applications made it possible to annotate and highlight PDF documents, which had not been possible on the Kindle DX. Several students reported that during the semester, as they became more comfortable with the annotation software, the quantity and quality of their notes increased. Students found that with few exceptions (discussed in the next section) highlighting was easier on the iPad than on paper though they observed that paper was still the superior medium for general annotation.

Along with its many advantages, the current generation iPad has some weaknesses with respect to its academic use. Our study participants identified the following concerns:

PDF handling —— The faculty member who participated in the study took great care to provide his students with PDFs of the assigned texts optimized for the iPad: optical character recognition had been performed as needed, articles that had been scanned with two pages of a book or journal side by side were converted to single pages to make the text larger and more readable, and so forth. When students used the iPad to read PDFs for other classes that had not been prepared in this way, two main difficulties arose: (a) Students found that highlighting became

very difficult when they worked with certain scanned PDFs. (b) They noted that when they read documents with two pages scanned side by side, the size of the iPad required them to scroll horizontally in order to read all of the text. They suggested that both of these issues could be addressed by adopting college-wide standards for the preparation of PDF versions of assigned readings.

PDF distribution and syncing —— The study participants found that loading PDFs onto the iPad, and subsequently transferring annotated versions of the PDFs to a computer, was somewhat challenging, especially given the large number of assigned readings for the course. For example, the option of downloading PDFs one by one from an online source, opening them in a PDF reader, and then emailing the marked-up version back to oneself was prohibitively time-consuming and generally avoided. A second option, transferring files between computer and iPad via Apple's *iTunes* software, was also seen as needlessly complicated. Many of the students eventually opted to use cloud-based storage services like *Dropbox* to streamline file transfer and synchronization, but even these services did not always produce perfect results since they often failed to work seamlessly with PDF reading/annotation applications. The faculty member in the project[7] evaluated four PDF applications and came to the conclusion that, at least for now, none offers an optimal combination of annotation, document management, file transfer and synchronization capabilities.

File system —— The aforementioned difficulties with distributing and synchronizing PDFs are directly related to the iPad's lack of a centralized file system; copies of files are stored within the applications that create or make use of them. Many applications do allow files to be copied into another application and used there, which helps matters somewhat, but study participants indicated that the absence of a central, hierarchically organized file system made it difficult to locate important documents and occasionally hampered productivity.

Keyboard —— Our study participants found that the iPad's greatest shortcoming as a tool for academic work was its keyboard. While they appreciated that the absence of a physical keyboard made it possible to have a larger screen, they found the soft keyboard to be awkward to use, particularly in portrait orientation, and reported difficulty typing efficiently with it. Most students used the keyboard only to annotate texts outside of class, not to take notes in class or to write papers; many avoided composing anything longer than a brief email on the iPad. Several students expressed a desire to write directly on the screen of the iPad, rather than using a keyboard. None of the study participants had used an external keyboard or a stylus, but several were planning to do so.

Despite these drawbacks, students in our study reported not only that they hoped to continue using the iPad in their coursework but that they would encourage their friends to adopt the iPad for academic purposes as well.

[7] Alexander Montgomery-Amo, Associate Professor of Political Science, *http://academic.reed.edu/poli_sci/faculty/montgomery.html*

Accessibility
In order to be widely used in higher education, an eReader or tablet needs to be accessible to individuals with visual disabilities. As we learned during our 2009 evaluation of the Amazon Kindle DX, the Department of Education, the Department of Justice, and advocacy groups such as the National Federation for the Blind[8] are prepared to take aggressive measures to ensure that eReader and related tablet technologies are deployed at colleges and universities only if they meet accessibility standards. The Kindle DX did not meet these standards and, partly as a result of this deficiency, has not been recommended or widely adopted as a curricular platform in higher education.

By contrast, the iPad has been widely praised for its thorough integration of Apple's *VoiceOver* assistive technology and for the accessibility of its *iBooks* application. A reviewer for *AccessWorld*, a publication of the American Foundation for the Blind, characterized his first experience with purchasing and reading a book on *iBooks* as one of the "two transformative moments in [his] professional career that [he] associate[s] with gaining equal access to the printed word."[9] Likewise, The National Federation for the Blind commends Apple for including many powerful navigation and text to speech capabilities in the iOS operating system of the iPad.[10]

Impact of cost on student ownership
As we have already mentioned, participants in Reed's iPad study were delighted with the cost savings they realized by reading thousands of pages of documents on the iPad rather than printing them. Like the Kindle DX and other eReaders, the iPad has the potential to reduce the cost of textbooks and other printed course materials, but this may require significant changes in the ways in which colleges and universities make these materials available to students.

The pricing of the iPad has remained stable since its introduction in spring 2010; prices range from $499 for the 16GB Wi-Fi model to $829 for the 64GB Wi-Fi + 3G model. Students who completed our iPad study and satisfied the feedback requirement were given the opportunity to purchase their 16GB Wi-Fi iPads for $249; every student either purchased his or her iPad at this price or paid more for a higher-end model. While this is a very limited sample, it suggests that students are currently willing to pay at least $249 for a multi-function device that does not replace their laptop or desktop computers after having experienced the benefits of the tablet.

When we interviewed our study participants at the end of the semester, they speculated that students who did not participate in the study would pay up to $300 for such a device. Whether or not this is true remains to be seen. While we expect that the percentage of Reed students who own iPads or similar multi-purpose tablets will increase substantially by the next academic year, we doubt that student ownership will reach the level necessary for faculty to base assignments on the assumption of student access to this technology. Even at $300 per tablet, the collective cost of a laptop, a smartphone, and an iPad or other tablet is prohibitively high for the vast majority of students. And it is unlikely that — given current feature sets — iPads would be adopted as

[8] For a more thorough discussion of the accessibility issues associated with the Kindle DX study, see pages 7-8 of our report: *http://web.reed.edu/cis/about/kindle_pilot/Reed_Kindle_report.pdf*
[9] *http://www.afb.org/afbpress/pub.asp?DocID=aw110206*
[10] *http://www.nfb.org/nfb/NewsBot.asp?MODE=VIEW&ID=586&SnID=111103011*

replacements for either of the other types of devices. Eventually, either the declining cost of tablets or the augmentation of their features will change this picture. But that transition may take two or three (or more) years.

When the iPad was introduced in early 2010, many commentators predicted a quick demise for dedicated eReaders like the Amazon Kindle and the Barnes & Noble nook. They found it difficult to imagine that consumers would prefer a device optimized for a single function over one that provided a wider range of capabilities, even if the multi-function device was somewhat more expensive. In fact however, eReader sales have remained robust and during the fourteen months since the conclusion of the Kindle DX study, eReader manufacturers have introduced products with improved user interfaces, more responsive screens, increased functionality, and steadily declining prices.[11] The least expensive Kindle is now $139, while the larger Kindle DX has dropped in price from $489 at the time of our study to $379 today. A similar trend is likely to emerge in the tablet market. The iPad has had relatively little competition since its release, but recently announced tablets using the Android operating system, such as the Motorola *Xoom* and the LG *G-Slate*, threaten to give it a run for its money.

The 800 pound gorilla: e-content

While competition in the increasingly crowded field of eReaders and tablets continues to lead to improved functionality and reduced prices, the cost of eBooks themselves has remained relatively stable over the past year; publishers and eBook sellers show little inclination to reduce prices, even as new players like Google eBooks enter the fray. The cost of eTextbooks has also held steady. Many eTextbooks are considerably less expensive than their print counterparts, but the impossibility of reselling the electronic books at the end of a course means that the total cost to students is often comparable to that of a traditional textbook.

Instead of offering significant cost savings to students, textbook publishers seem to be hoping to add value to their electronic products by taking advantage of the interactive capabilities of computer and tablet interfaces. Several companies are partnering with textbook publishers to offer enhanced iPad versions of textbooks that include features such as shared notes and highlights, embedded video, and self-correcting quizzes.

The iPad's built-in App Store provides students with a wide array of free and inexpensive educational applications that can supplement their course materials. All but one of the students in our study purchased applications other than the required PDF annotation application to use on the iPad, and every student installed free applications on the device. A small but growing number of educational eBooks and articles are also freely available in both ePub and PDF formats on Apple's iTunes U platform and can be downloaded from iTunes on the iPad and opened in iBooks.

[11] As this report was being written, Amazon announced that page numbers corresponding to those of printed editions and optional public sharing of notes and highlights, two of the most frequently requested features during the Kindle DX study, had been added to the Kindle platform: *http://gadgetwise.blogs.nytimes.com/2011/02/07/kindle-books-get-page-numbers-and-social-features/*

Given the likelihood that both tablet and eReader technology will proliferate substantially, it is unfortunate that so little progress has been made toward resolving the concerns about digital rights management (DRM) and eBook file format standards that we raised a year ago. With the appearance of the iPad, the ePub format has made some progress towards becoming an eBook standard, but Amazon products, including dedicated eReaders and the Kindle applications for computers and mobile devices, do not support this format.[12] Since every eBook store has its own version of ePub DRM, one needs a different app (or device) to read each book.

Digital rights barriers continue to make it difficult or impossible to transfer purchased content between devices from different manufacturers. This problem is somewhat mitigated in multi-purpose devices; both Android and iOS have free applications that can read Kindle, nook, Google eBooks, and other formats. The existence of educational applications that can be purchased (or freely downloaded) and installed on tablets complicates matters further, since many such applications exist only in iOS- or Android-compatible formats and will not work on tablets running the other operating system.

Looking ahead[13]

In our Kindle study report, we proposed a distinction between the traditional *computer deployment model*, in which colleges and universities exercise control over and provide support for the computers that students use, and the *consumer cell phone model*, in which students make choices about which devices to purchase independent of their college's preferences.[14] It seems increasingly likely that the *consumer cell phone model* will prevail, as students arrive on campus equipped with tablets and eReaders from a variety of manufacturers. For the moment, the iPad dominates the tablet market, but the new wave of Android-based tablets seems likely to provide an appealing alternative that will result in the coexistence of at least two competing tablet operating systems. In addition, the newfound popularity of dedicated eReaders among children and young teenagers[15] may eventually mean that these devices will become common on college campuses and that students will look for ways to use them in their studies.

Based on the results of our iPad study we believe that the adoption and use of iPads and similar devices will grow rapidly, both at Reed and throughout higher education. The expectations for access to texts and other digital content initially sparked (but left unfulfilled) by eReader technologies are now poised to be satisfied by multi-purpose tablets such as the iPad.

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[12] ePub has other weaknesses as far as curricular use goes, including the lack of a standardized annotation format and page numbers.

[13] A second component of Reed's iPad evaluation is an assessment of the iPad by a group of twenty faculty members who collectively represent all curricular divisions. The reports generated from that assessment will be summarized and become part of a round-table discussion by Reed faculty regarding future uses of the iPad and similar tablet technologies at Reed.

[14] *http://web.reed.edu/cis/about/kindle_pilot/Reed_Kindle_report.pdf*, p. 10.

[15] "E-Readers Catch Younger Eyes and Go In Backpacks," The New York Times, February 4, 2011. *http://www.nytimes.com/2011/02/05/books/05ebooks.html*