# An Experiment Using Electronic Books in the Classroom

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Electronic books are single-purpose hand-held computer devices designed to store and display reading material. The introduction of e-books into the classroom has been anticipated for years, but the technology has never quite been up to the task. This article will describe an experiment in which e-books were distributed to college introductory biology students in place of the traditional textbook. Student responses to anonymous questionnaires showed that the e-books were easy to use and offered several advantages over traditional texts. Data will be presented on initial learning curves, reading habits of e-book users, advantages and disadvantages of the electronic format, and overall levels of satisfaction. While some shortcomings were revealed, the results of this study suggested that students who used an e-book were eager to adopt this new technology on a larger scale.

The recent history of education is replete with examples of long-used classroom tools being replaced by improved technologies. Logarithmic tables and slide rules gave way to calculators, mimeograph machines were replaced by photocopiers, and traditional syllabi are being supplanted by dynamic websites, all to the benefit of both teachers and learners. Will the most universally utilized tool in the history of education, the printed textbook, go the way of these other outdated technologies? Or is the print medium so indispensable to the learning process that it can never be replaced?

Electronic books, or e-books, are hand-held computer devices with built-in LCD screens designed to store and display published material (Associated Press, 1998). About the size and slightly heftier than a paperback book, e-books are well designed for comfortable reading in almost any situation, free of power and Internet connections. This study addressed the suitability of electronic books as replacements for traditional printed texts in the college classroom.

Imagine the following scenario. At the start of the semester, students enter the bookstore and place their e-books into a dock. In minutes, a semester's worth of textbooks is downloaded into the hand-held easy-to-carry devices. The students now have access to all of their reading material at home, at work, during vacation, and while commuting. At the end of the semester, rather than resell the books for pennies on the dollar, the students archive their texts onto a floppy disk or hard drive. By the end of their college career, the students have built a library of all their textbooks to keep and access forever.

The preceding scenario is quite rosy, with clear benefits to the students. What is less clear, however, are the potential obstacles to implementing e-books in real college class settings. The present study addressed this concern by distributing e-books to student volunteers to use as their sole reading material in an introductory biology course. Student opinion about the e-books was determined through anonymous questionnaires. The results of these polls will be presented, with particular attention paid to how students used the e-books compared to traditional texts. The advantages and disadvantages of electronic books for the instructor and the students will be discussed.

### Background: The Rocket eBook

The present study used the Rocket eBook, produced by NuvoMedia, Inc. (NuvoMedia, 2000), one of several currently available models of e-books. The manufacturer loaned 10 e-books to Fordham College at Lincoln Center for use in this study.

Currently retailing for $199, the Rocket eBook (Figure 1) can download reading material from the Internet and store about 4,000 pages at a time in internal memory. Unlike laptop computers, the e-book LCD screen can be read at many angles and under all lighting conditions from total darkness (using a backlight) to direct sunlight. A built-in stylus allows users to underline, annotate, bookmark, and cross-reference to a dictionary. Perhaps the weakest feature of this model is its graphical display capabilities,

currently limited to black-and-white images. The screen resolution for images is only 312 pixels in width (NuvoMedia, 1999), although larger images can be viewed by scrolling.
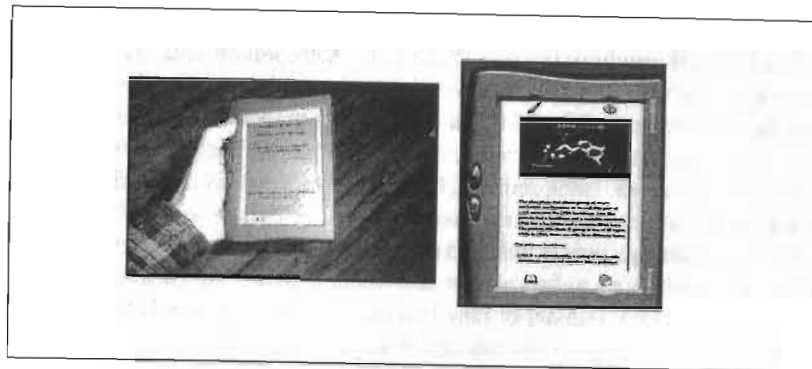


**Figure 1.** The Rocket eBook fits easily in the hand and can display printed text and limited-resolution visuals

The Rocket eBook comes with a leather carrying case, stylus, "getting started" manual, and dock that provides both power and the interface to a PC or Macintosh computer for transfer of documents using provided software. The built-in rechargeable battery provides about 25 hours of reading time. All documents transferred to the e-book are also archived on the computer hard drive.

Electronic versions of books can be purchased and downloaded from online commercial bookstores; there are currently approximately 50,000 titles available for the Rocket eBook. Recent releases of popular titles typically cost about 10% below the retail price of the printed version and may therefore actually be more expensive than the standard media, which is often deeply discounted. Periodicals such as the New York Times and Wall Street Journal can be downloaded from "e-newstands." Additionally, free reading materials can be obtained from public domain libraries or any accessible web page. It is important to note that, as far as the author can determine, no publishers currently offer e-book versions of high school or college textbooks, although many classic texts are available in the public domain.

### Background: Implementation

Fordham College at Lincoln Center is a four-year college in the Jesuit educational tradition located in midtown Manhattan. To complete the core

curriculum requirement, every student must enroll in two one-semester science courses. Included among their choices is Perspectives: Biology, a non-majors survey of life. Sections of this course are limited to 24 students, drawn from all class years. About half of Fordham's students commute to school from throughout the New York City metropolitan area, most of them by way of public transportation. This creates a population of students eager to use their travel time (typically about one hour) as productive schoolwork time.

The present study encompassed three sections of Perspectives: Biology, one each from fall 1999, spring 2000 and summer 2000. The first two of these sections were taught in a distance learning format with once-a-month in-person meetings, while the third was an in-class summer section taught at an accelerated pace.

## Motivation

When the author first taught Perspectives: Biology in 1997, a standard nonmajors textbook was supplemented by a basic course website was used. During subsequent semesters, the class website was expanded using collaborative website construction, a method whereby the creation of a content-heavy site becomes a group effort on the part of the instructor and all students (Simon, 2001). By the third semester, at the urging of the students, class sections began to use the technology as a replacement for, rather than a supplement to, the course text. This has continued ever since, with all course materials provided online or on CD-ROM.

Students expressed high levels of satisfaction with this process in anonymous questionnaires (Simon, 2000). When asked to list the primary advantages of using technology instead of a textbook, the students responded: (a) the cost savings when using instructor-written material, particularly important to nonmajors who resent the high cost and low resale values of college science texts; (b) the concise nature of instructor-written notes compared to a generalized text; and (c) the savings in weight, a consideration that is getting increased attention as a serious health concern for young students (Negrini & Carabalona, 1999; Lombardi, 2000).

When asked to list the primary disadvantages of technology compared to a traditional textbook, the overwhelming student response was difficulty of access. Students resented the fact that the technologies used relied upon physical access to a computer and/or the Internet. Common problems such as hardware failure, busy signals, lack of power connection, and Internet traffic delays frustrated the users. The primary motivation for the present

study was a desire to retain the benefits of technology usage for college students while eliminating the problem of access.

## Method

At the start of the present study, my sections of Perspectives: Biology used only instructor-written notes and not a published text. Therefore, the dearth of appropriate textbooks available in e-book format did not pose an impediment to experimenting with this new technology. My lectures notes were easily converted from HTML to the Rocket eBook format using software provided by the manufacturer. The visuals had to be converted to low resolution black-and-white image files and links to Internet websites removed.

Students were shown the e-book at the start of the semester, and volunteers were solicited to use one as their sole source of reading material for the course. The distance learning students downloaded lecture notes on a weekly basis from the class website through the docking port. The in-class summer students were provided with the e-book already loaded with the full semester's worth of notes; these students were not provided a dock, enabling me to confirm actual usage by periodically checking the remaining battery level on the units.

The students were polled twice during the semester using anonymous questionnaires. Near the beginning of each semester, participants were questioned about their learning curve with the new technology. At the end of each semester, polls were administered that were designed to compare usage of the e-book to a printed text and to discern the advantages and disadvantages of each format.

## Results: Learning Curve

The first significant finding was that a small subset of students (2 out of 22) quickly rejected the e-book. During each of the two school-year semesters, one student returned their e-book within the first month. When asked why, one student said "I just like books better" and the other commented "... the e-book wasn't very user friendly, the directions were somewhat unclear to me." Like all new technologies, it is perhaps inevitable that strong resistance will be exhibited on the part of some students.

Near the beginning of each semester, students were polled about their initial experience using the e-books ($n=22$). When asked "How much time

did you spend learning how to initially set up and use the Rocket e–Book?" 86% indicated 30 minutes or less, although one student did indicate significant trouble (Table 1). Similarly, when asked "How difficult was it to set up and use your Rocket e–Book?" only 18% said it was "very difficult" or "somewhat difficult," while the rest rated set-up as "not difficult" to "very easy" (Table 2). These results indicated that the learning curve for the e-book posed little problem to most but not quite all of the participating students.

### Table 1

An anonymous questionnaire was given to students near the start of the semester in order to gauge their learning curve with the e-books. This table lists responses to the question, "How much time did you spend learning how to initially set up and use the Rocket eBook?"

| Total | <15 mins. | 15-30 mins. | 30-60 mins. | 1-2 hours | >2 hours |
|-------|-----------|-------------|-------------|-----------|----------|
| 22    | 9         | 10          | 0           | 2         | 1        |

### Table 2

Responses to the question, "How difficult was it to set up and use your Rocket eBook?"

| Total | Very difficult | Somewhat difficult | Not difficult | Somewhat easy | Very easy |
|-------|----------------|--------------------|---------------|---------------|-----------|
| 22    | 3              | 1                  | 11            | 1             | 6         |

## Results: How the E-Books Were Used

At the end of each semester, students were polled with a second anonymous questionnaire ($n=20$). This poll contained questions designed to determine how students used their e-books, how their use compared to standard texts, and their levels of satisfaction with the experience.

First, the students were asked about the times and places where they used their e-books. When asked to "list every location you can think of where you used your e-book to read notes for class (e.g., home, train, work, bus, beach, etc…)," every one of the respondents mentioned travel time, including the train (70%), bus (40%), car (25% - one hopes not while actually driving!), and, less frequently, plane, subway, and taxi. Half of the respondents used the e-book at work, and 80% did so at home. Interestingly, 40% of students indicated they used the e-book during recreational activities, including

visiting the park, beach, and coffee shop. Other interesting responses included the hospital, while babysitting, while waiting at a service station, and at friend's homes.

When asked how they used their e-books in comparison to a standard book, 75% of respondents indicated that "the e-book increase(d) the number of locations" where they read lecture notes. But while the number of places spent with the material increased on average, the amount of time did not. Students responses to whether they used their e-books "more often, less often, or the same compared to … a standard textbook" varied evenly across all three choices (Figure 2).
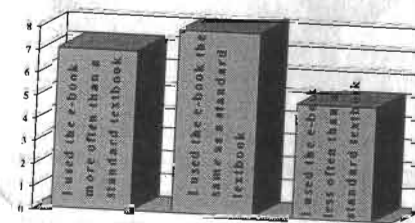


**Figure 2.** Student responses to the question, "… did you use your e-book … more often, less often, or the same compared to how often you use a standard textbook?" ($n=20$)

The e-book offers several features designed to mimic the utility of a printed book, including the ability to annotate, underline, add bookmarks, and cross-reference to a dictionary. Each of these tools was used by between 40 and 65% of respondents (Figure 3). The most used feature was the ability to cross-reference terms in the lecture notes to a dictionary, although most students noted that the built-in general-purpose dictionary did not include many science terms.
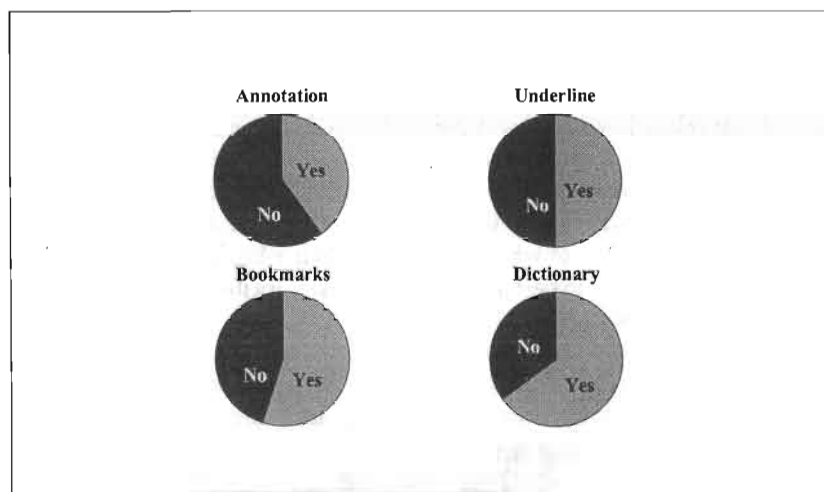
**Figure 3.** Responses to four questions about students' use of various features of the e-book: "Have you ever made use of the ability to add your own annotated notes to the lecture notes on your e-book?" "Have you ever made use of the ability to underline the lecture notes on your e-book?" "Have you ever made use of the ability to add bookmarks to the lecture notes on your e-book?" "Have you ever made use of the dictionary lookup feature on your e-book?" ($n=20$)

A few of the students incorporated the e-book into their daily lives. When asked, just over one third of the students said that they used their e-books to "read materials other than the course lecture notes." But most of these involved only the nicely illustrated version of "Alice in Wonderland" that comes with the unit. Several students downloaded daily newspapers and web articles into their e-books. Two of the students asked to buy their units at the end of the semester.

## Results: Measuring Satisfaction

The next set of questions aimed to determine the students' level of satisfaction with the experience of using an e-book. In terms of ease of reading, student responses were mixed when asked "Did you find the e-book easier or harder to read than a standard textbook?" (Figure 4). Most students (60%) found the e-book much or slightly easier than a textbook, but

some students clearly would have preferred printed texts. When asked t explain their answers, those who preferred the e-book mentioned the back light and ease of bookmarking specific information. The students who pre ferred printed books mentioned that it was easier to page through a bool than scroll through the e-book, and that the images were poor.
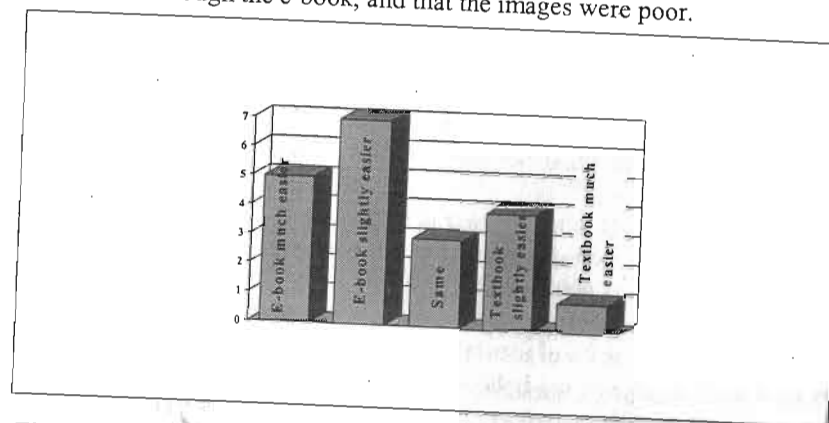


**Figure 4.** Student responses to the question, "Did you find the e-book easier or harder to read than a standard textbook?" ($n=20$)

A key set of questions asked the students to list the advantages and disadvantages of using the e-book compared to a standard textbook (Tables 3 & 4). The most frequently listed advantage, mentioned by 70% of respondents, was, not surprisingly, the size and weight of the e-book, considerably less cumbersome than a typical college science text. No other benefit was listed by more than 25% of the participants. Other features that received multiple mentions included the large storage capacity of the e-book (up to 4,000 pages at a time), the backlight for low-light reading, the dictionary (apparently considered useful despite the lack of specialized words), and the ability to bookmark. Responses that were listed just once can be found in Table 3.

## Table 3

Student responses to the question, "What advantages did the e-book have over a standard textbook?" listed in order of popularity (*n*=20)

| Response | # of times mentioned |
|---|---|
| Lighter / More portable / Smaller / Less cumbersome / More compact | 14 |
| Large storage capacity | 5 |
| Backlight | 4 |
| Dictionary | 3 |
| Bookmarks | 3 |
| Quick downloads | 1 |
| Changing size of text | 1 |
| Underlining | 1 |
| Trendiness | 1 |
| Interactivity | 1 |
| Annotation | 1 |

## Table 4

Student responses to the question, "What disadvantages did the e-book have over a standard textbook?" listed in order of popularity (*n*=20).

| Response | # of times mentioned |
|---|---|
| Poor graphics | 5 |
| Difficulty in random access | 4 |
| Charging | 3 |
| Difficult to write in | 2 |
| Dictionary inadequate | 2 |
| Lack of page headings | 1 |
| Dependence on cradle | 1 |
| Hard to read | 1 |
| Too heavy | 1 |
| Lack of available titles | 1 |

While the advantages of the e-book were clearly pinpointed, what price was paid for them? To address this, the students were asked "What disadvantages did the e-book have over a standard textbook?" These responses are listed in full in Table 4. The most common complaint was an expected one: poor display of visuals. Although none of the students specifically mentioned it, the e-book also suffered from an inability to display animations—a feature that is also absent from printed texts, but can be found in other computer-based formats such as CD-ROMs and websites.

Another commonly mentioned disadvantage of the e-book was the decreased ergonomics in accessing a particular location: flipping pages is much easier than moving a scrollbar with a stylus. One student helpfully

suggested the addition of a rolling knob to the unit's casing. The dependence on the dock for charging and transferring materials was cited. Students wished for longer battery life; the charge typically lasts about 25 hours without the backlight and about half that with the backlight. Students also felt that the writing interface could be improved; input is currently achieved by hunt-and-peck typing with a stylus that compared poorly with the handwriting-style interface of, for example, a Palm Pilot. Other disadvantages mentioned less often included the inadequacy of the dictionary, a lack of page headings, difficulty in reading the screen, a lack of available additional titles, and the e-book being a bit too heavy for comfortable bedtime reading.

A final set of questions sought to determine the general level of satisfaction with using the e-book as the sole reading source for the course. The three yes/no questions listed in Table 5 indicated that students were largely pleased with the experience. Every respondent (*n*=19) said that they would "recommend using an e-book in college courses to a friend." Every respondent but one indicated that they wished "other courses offered an e-book option," but only 58% said that "an e-book option [would] affect...selection of a course."

## Table 5

Student responses to three questions designed to judge overall satisfaction with the e-book: "Would you recommend using an e-book in college courses to a friend?" "Do you wish other courses offered an e-book option?" "Would an e-book option ever effect your selection of a course (i.e. would you ever be more inclined to take a particular section if it offered an e-book option)?" (*n*=19)

| Recommend to a friend | | Wish other courses offered | | Effect your selection of a course | |
|---|---|---|---|---|---|
| Yes | No | Yes | No | Yes | No |
| 19 | 0 | 18 | 1 | 11 | 8 |

The final question asked students to "rate [the] overall experience using the e-book in this course" using a Likert-scale format from 1 (extremely negative) to 5 (extremely positive). The average response (*n*=19) was 4.4, and only one student rated the experience as "negative" or "extremely negative" while 16 students rated it as "extremely positive" or "positive."

## CONCLUSIONS

Although the sample size of the present study was too small to draw significant quantitative conclusions, several trends were clearly apparent. First, most students had little or no difficulty learning how to set up and use their e-books. The data indicated that the current generation of e-books fulfills one of the most basic requirements for successful competition with traditional media: simplicity (Fidler, 1998). It is important to note, however, that, while generally simple to use, some students had to deal with a steep learning curve that, in two instances, resulted in rejection of the technology. It is also worth cautioning that these participants all volunteered after seeing the e-book and so may represent a technophilic, non-random sampling of college students.

The present results further suggested that the students used their e-books in basically the same way they used printed books. Roughly half of the participants took advantage of the features designed to make the e-book mimic the utility of a printed text (i.e., underlining, annotating, etc.). Having an e-book did not affect how often students read course material, but did increase the number of places they studied.

After years of promise but little success, has technology finally provided a viable alternative to print media? The results of this study indicate that the e-book has indeed caught up to the needs of today's college students: they maintain the benefits of technology usage (e.g., savings in weight) and simultaneously eliminate the large problem of computer and/or Internet access. The "load, charge, and carry" format of these e-books seems ideally suited to the on-the-go lifestyles of Fordham's student body.

There is room for improvement, however. The current model of the Rocket eBook is limited to black-and-white low-resolution (312 pixels across) images that cannot convey the full impact of a typical textbook illustration. This problem is presumably due to the expense of producing high quality LCD monitors and so is expected to be resolved over time as new models are released. But for now, the current consumer model suffers from a significant handicap that, for the many educational uses that depend on quality visuals, can only be overcome by external resources. For example, where important images would normally be found, my e-book lecture notes pointed the user to the class website for a full version of the picture. The ability to append the built-in dictionary with terms specific to a subject would be beneficial. Simplifying the random access capabilities could also improve ease of use, consistent with previous studies that highlighted the importance of navigability to students (Weardon, 1998).

Overall, the study participants were very satisfied with the e-book experience and overwhelmingly wished that it could be implemented on a wider scale. The obvious impediment at this time remains the lack of college textbooks published in e-book format. Classes that are not dependent on textbook publishers, such as those that use only instructor-written notes or classic texts in the public domain, could gain the benefits of e-book usage today. Many other courses, however, are dependent on the participation of publishers. Perhaps a critical mass of student e-book users is needed before publishers will act. The present work strongly suggests that the market is in place: students who used e-books wanted to use them more. Perhaps more studies like the present one will provide the motivation necessary for college textbook publishers to join their target audience in taking a big step towards accepting this new classroom tool.

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# What's a "Hit"? An Analysis of a Web-Based Learning Environment

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The purpose of this study was to conduct a qualitative and quantitative analysis of usage patterns at a virtual museum, a web-based learning environment. Specifically, this study sought to examine extant documents to profile users interaction patterns at a *SJSU Virtual Museum*. The quantitative portion of the study dealt with interactivity patterns; that is, electronic "browsing," "grazing," and "pogo sticking." The qualitative portion involved an analysis of e-mail correspondence directed to the site's webmaster. This analysis dealt with correspondence in six broad categories: (a) editorial assistance, (b) hyperlinking, (c) suggestions for expansion of the site, (d) acknowledgment of web site utility, (e) virtual scholarship requests, and (f) recalling personal histories.

The World Wide Web (WWW or Web) or Internet has become an integral tool in educational communities for dissemination of information, research, teaching, and communication. While many position papers have been written about web-based learning environments, little research has been conducted into the effectiveness of this media or milieu. Indeed, Windschitl (1998, p. 28) pointed out that "unfortunately, the uncritical, popular attention given to Internet initiatives is rapidly becoming disproportional