



A collaborative study: on the demands of mobile technology on virtual collection development

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Abstract:

New technologies create new challenges as well as great opportunities when libraries build their virtual collections. As e-book readers and other portable devices grow in popularity, collections can no longer be evaluated purely on the basis of content; their adaptability and ease of use on various platforms has to be taken to account.

Collaboration between libraries, users and usability professionals is paramount in building virtual collections of the future. Only users can tell how these platforms are going to be used, as mobile tools for study or as entertainment devices. It is important to learn how usable the e-collections really are and what essential materials are currently incompatible with these devices. Electronic rights management and technical compatibility issues should become standard considerations in all acquisition of electronic materials.

This paper will present a study conducted in the Helsinki University of Technology Library, now a part of the Aalto University, from autumn of 2009 until summer of 2010. In collaboration with the Strategic Usability Research Group, various e-book readers were tested by both professionals and students. In the study, e-book readers were given to students for one study period with all the course material provided in electronic format. Feedback from the students was collected through discussions, study diaries and questionnaires. In the library the e-book readers were tested in order to see what demands and restrictions they pose on e-materials and how well the library's current e-collections are usable on these

devices. Results suggest incompatibilities with many licensed e-materials, whereas most open access materials can be easily downloaded and used.

Introduction

Purpose of the study

Electronic books have been just around the corner for decades. Now finally, with the Amazon Kindle leading the way, e-reader technology has taken off. E-book readers are becoming everyday technology and we can expect to see much more of them in our libraries. Some libraries are already lending out e-readers and some universities are providing them to new students with the idea that all material would be provided on these platforms.

From the acquisition point of view it is no longer enough to consider which content is needed for the collections but also in which formats and on what platforms it is available. How does this new technology contribute to the way e-books are selected by the library? Until recently we have accepted the deficiencies of different platforms as long as the books were usable in one way or another. Most services required the installation of reader programs or plug-ins, some of which did not work with e.g. Linux. As we start to use e-books as substitutes for print, we need to be more demanding. We should be able to provide the content the user needs on a platform he or she prefers.

How compatible are the current e-resources, which are originally meant to be used on a computer, with this new technology? Do the license agreements even allow the transfer of e-books to these devices? If the customers asked which of the e-readers worked best with the library resources, would one know how to reply? In the first place, would the customers want to use these new devices for study or work, or will they be used purely for entertainment?

This study was conducted to answer the questions above and in general to increase the knowledge on e-readers in the library.

E-book collections in Aalto University Library

Aalto University was newly created from the merger of the Helsinki School of Economics, the University of Art and Design Helsinki and the Helsinki University of Technology. The libraries of the three former universities have also merged and strive to provide the best resources for strong multi-disciplinary education and research. The University has three schools and campuses: the School of Art and Design, the School of Economics and the School of Science and Technology. The same electronic collections are now available on all three campuses. This study was begun in the Helsinki University of Technology Library and continued in the Aalto University Library, Otaniemi, which is situated on the campus of the School of Science and Technology.

The Aalto University Library acquires e-books through 13 services, shown in table 1. About 50,000 of the e-books are subscribed to on annual bases, while perpetual access has been bought for 830 titles. In addition to these numbers, the Finnish consortium FinElib has provided access to the vast ECCO and EEBO collections of historic material. Some of the

services, such as Ebrary, provide big package deals, while others, like DawsonEra and Mylibrary are used to select individual titles. Acquisition of new e-books is done mostly to the platforms, which allow individual title purchases.

Table 1. E-book services in use and their characteristics.

Service	Amount of e-books in use at Aalto University	Subscription or perpetual use	Package or individual titles
DawsonEra	44	Perpetual use	Individual titles
Ebrary	45000	Subscription	Package
ECCO	150000	Perpetual use	Package
EEBO	100000	Perpetual use	Package
Ellibs	80	Perpetual use	Individual titles
Elsevier	400	Perpetual use	Package
Knovel	1800	Subscription	Package
LNCS (Springer)	6900	Subscription	Package
Mylibrary	200	Perpetual use	Individual titles
Safari	100	Subscription	Individual titles
OECD	20	Subscription	Package
Morgan & Claypool	108	Perpetual use	Package
WSOY	22	Subscription	Package

E-readers

Five different e-book readers were selected for the study and two copies of each were purchased to the library. The main criteria for the devices were their availability and reasonable pricing; consumer products in the 200-300 Euro range were chosen, i.e. devices designed for professional usage were not considered. The five evaluated devices were Foxit eSlick, Bookeen CyBook Opus, BeBook, Amazon Kindle, and Sony Reader Touch Edition PRS-600. Their main characteristics can be seen in Table 2.

All of the devices use the same E Ink Vizplex technology. They also all can hold over a thousand books, so the memory capacity was not an issue, especially when they all also had slots for memory cards.

Table 2. Main characteristics of the evaluated devices (sources: device packages, manuals and company web-pages).

Device	Bookeen CyBook Opus	Foxit eSlick	BeBook	Amazon Kindle	Sony Reader
Screen	5", 76×102 mm ²	6", 90×120 mm ²	6", 90×120 mm ²	6", 90×120 mm ²	6", 90×120 mm ²
Size / mm	151×108×10	188×118×9.2	184×120.5×9.9	203×135×9	175×122×9.7
Weight / g	150	180	220	289	285
Document type support	OEB-XHTML, TXT, HTML, PDF, EPUB, JPG, GIF, PNG, MP3	PDF/TXT/Any printable document (after pdf conversion with included program), GIF, BMP, JPEG and PNG, MP3	PDF, MOBI, PRC, DOC, LIT, EPUB, HTML, PPT, BMP, JPG, PNG, GIF, TIF, DJVU, FB2, WOL, CHM, MP3	Kindle (AZW and TOPAZ), PRC/MOBI, TXT, MP3, Audible (format 4, Audible Enhanced (AAX))	BBeB (LRF/LRX), PDF, EPUB, TXT, RTF, JPG, BMP, GIF, PNG, MP3, AAC
Battery Life	8 000 pages	8 000 pages	7 000 pages	Two weeks	7 500 pages
Memory Expansion Slots	MicroSD card	SD card	SD card	SD/MMC	MMC/SD/SDHC, Memory Stick Pro Duo
Supported DRM Formats	Adobe (EPUB/PDF) / Mobipocket	None	Adobe Digital Editions	AZW and TOPAZ	Marlin DRM (BBeB), Adobe ADEPT (EPUB/PDF)
Note taking / highlighting / underlining	No	No	No	Yes	Yes

Compatibility of e-materials with e-book readers

E-books, licenses and DRM

For the library e-books provide many improvements over print books. Usually many customers can use them simultaneously, each making their notes and highlights in their own virtual version, not in the only printed copy. They cause no physical storage problems and do not wear and tear with time. They can also be cost effective, providing more access with less funds. The publishers see this quite differently: the physical book is easy to manage as only one person can have it at a time and there is no easy way to copy and distribute it to others, whereas the electronic book is potentially easily redistributed to any number of people.

Digital Rights Management (DRM) is a general term for technologies, which restrict access to or use of digital content. Its applications in the music and film industries are well known but some publishers and distributors also apply DRM to e-books. Many e-book services have strict terms of use for use on any type of platform. Limitations on downloading, copying and printing frequently cause frustration in library users. The DRM solutions can also limit the usability of materials on e-readers.

As in the entertainment industry, the use of DRM in e-books is controversial, limiting usability in ways, which often seem unfair to users. From a user's point of view, if the library provides access to a given title, it should not matter if the material is read online, printed out or transferred to a reading device.

Questionnaire for e-book providers: e-book compatibility with e-reader devices

In order to assess the availability of electronic material for the e-book readers, a questionnaire was sent to 17 publishers or e-book providers about the usability of their materials on e-book readers. The questions were:

- 1) Do your library licence agreements allow for the books to be used on e-book readers?
- 2) What DRM is included in your e-books?
- 3) Which e-readers are the e-books compatible with?
- 4) Which extra programs are needed to use/transfer the e-books to the e-readers?
- 5) Does the e-reader require an Internet connection to allow the e-book to be read?
- 6) Will the e-books be usable on the iPad?
- 7) If the e-books are not yet compatible with any e-readers, are there plans to make them available during the next few years?

At the time of writing, full responses had been received from Elsevier, RSC, Ellibs, Morgan & Claypool, SPIE Digital Library, DawsonEra, Ebrary and Mylibrary.

DawsonEra replied that is possible to read their e-books on iPhones, but not on e-readers. All the other respondents stated that use of their materials on e-readers is allowed. However, this issue has not usually been separately considered in the license agreements. Furthermore, contradictory information may be obtained from the license agreement text, the web pages and the company representatives. For example, on the pages of one of the providers it is said that saving or uploading material to any other storage device is not allowed, but when asked, the representatives of the company told that use on e-readers is allowed. It is not always clear how the terms apply to this new technology and it is best to check directly with the publisher/provider.

Elsevier, RSC, Morgan & Claypool and SPIE use no DRM in their e-books. These platforms also allow the material to be downloaded in PDF form, which makes them compatible with most e-readers, including those assessed in this study. The DRM-free PDFs can be downloaded to an e-reader via a computer with Internet connection and then used offline.

Ellibs uses the Adobe Content Server 4 DRM protection. Their e-books are compatible with many readers such as the tested BeBook, Bookeen CyBook and Sony Reader. Downloading the books requires that the user creates and uses an Adobe account and the authorization of the e-reader for the Adobe DRM. This is done after connecting it with the Adobe Digital Editions software running on a PC or Mac. After the authorization procedure the e-book can be downloaded to the reader and used off-line. The Ellibs books use a loaning model and only one user can use a copy at a time. After the lending time expires the book will stop operating on the e-reader.

Ebrary and Mylibrary do not allow the downloading of the e-books and use strict DRM to restrict printing and copying of the material. They are only compatible with devices that have an Internet connection and can use of the original online platforms.

E-books from all of the platforms except Ellibs are available with the iPad, because of the Internet connection and web browser that allow the online use of the materials. Ebrary is planning for an application for the iPad and Elsevier is planning to launch an iPhone/iPad application to further improve the usability of the materials on these platforms. The Adobe DRM on the Ellibs books is not compatible with iPad, but Ellibs is discussing other DRM solutions with the publishers in order to offer the material on new platforms, including the iPad.

Many of the respondents pointed out that present time e-readers are designed for reading novels and are not well suited for academic material including charts, tables, equations and colour graphics. The smaller displays are also too small for comfortably viewing PDFs, which is the most common format of academic papers. It was also recognized that users prefer to use their materials on laptops due to the better functionality.

Usability of the Library resources on e-readers

In order to get a more comprehensive view on how much of the library's electronic materials could be used on e-readers, thirteen different e-book and several e-journal platforms were studied.

For all the enthusiasm about e-books on e-readers, the most used resources for research in the Aalto University are the journals. These are acquired in electronic format whenever possible and the library currently provides access to over 15,000 journals. Articles from these can almost without exception be downloaded as PDFs, which makes them easily usable resources.

Apart from Kindle, all of the tested e-readers allowed easy drag and drop addition of PDFs to the devices and had zooming functionalities enabling the use of PDFs. The tested version of Amazon Kindle did not directly allow the use of PDFs, but had a service to transform PDFs to a Kindle compatible format. However, at the time, no zoom options for PDF's were available on the Kindle and it was also excessively difficult to transfer the material to the reader. Similarly to the journal papers, the electronic books, which could be downloaded in

PDF format without restrictive DRM, worked well on all of the other devices, i.e. apart from the Kindle.

Problems were found, however, when trying to download and save e-books using DRM solutions. The Dawsonera books could not be used without a network connection as there was no way to retrieve the required DRM certificate to the e-reader. The books could in fact be moved to the readers, but the file would not open for use. The DRM on the Mylibrary, Ebrary, Safari and WSOY platform prevented the downloading of the material in the first place, so it was impossible to transfer the material to the readers.

Only one provider with DRM, Ellibs, supported the downloading of e-books to readers. However, other restrictions made the use of this service complicated. Two additional computer programs (Adobe Digital Editions and Sony Reader e-book library software) were required to download, save and transfer e-books to the reader. This process required several steps and stages (installation, configuration, connection, download and transfer of material with DRM) that one cannot expect ordinary library users to master.

The results of the testing are presented in Table 3. The table excludes the EEBO and ECCO packages, because of their historic nature, which makes them of lesser priority for the Aalto University. Including them in calculating the percentages of the full university collection that the service providers represent, would give misleading results.

Table 3. Compatibility of the Aalto University e-book collections with the tested e-readers.

Service	% of the Aalto University e-book collection	Compatibility with the e-readers
DawsonEra	< 1%	Not compatible
Ebrary	82 %	Not compatible
Ellibs	< 1%	Compatible, but very difficult to use
Elsevier	1 %	Fully compatible, easy to use
Knovel	3 %	Fully compatible, easy to use
LNCS (Springer)	13 %	Fully compatible, easy to use
Mylibrary	< 1%	Not compatible
Safari	< 1%	Not compatible
OECD	< 1%	Fully compatible, easy to use
Morgan & Claypool	< 1%	Fully compatible, easy to use
WSOY	< 1%	Not compatible

The packages fully compatible with the readers, which allowed the material to be easily transferred and used, were Elsevier, Knovel, Lecture Notes in Computer Science (Springer), OECD and Morgan & Claypool, the first four downloadable chapter by chapter, the last one

as single documents. The digitised material from ECCO could be also downloaded with up to 50 pages in one PDF document, whereas the images in EEBO could only be downloaded one page at a time.

The providers whose books could not be used at all were DawsonEra, Ebrary, Mylibrary, Safari and WSOY. The Ellibs service could not be used with reasonable ease. This meant that only 17% of the library's e-books were compatible with the tested devices.

E-book user experience study

The e-book user experience study was conducted during January-March 2010 at Aalto University School of Science and Technology. In the study, 5 masters' students from two study programmes (information networks and computer science) were recruited to test e-book readers in their studies during one study period of seven weeks. The aim of the study was to evaluate the potential usefulness and usability of e-book readers in an academic environment as well as the compatibility of the e-book readers with the electronic material provided by university's library, e.g. electronic versions of books, conference proceedings and journal articles.

Of the five selected devices only four were thoroughly evaluated. The Amazon Kindle testing was cancelled during the study as the process of transforming documents to a format suitable for the reader turned out to be too slow and cumbersome and the student did not wish to continue the testing.

In the beginning of the study a meeting with the students was arranged, in which the e-book readers were presented and the goals of the study were explained. Also technical support was promised to help the students in any problem situations throughout the testing period. During the meeting all the students were quite enthusiastic about the testing of the devices. None of the students had previous experience in e-book readers or e-ink technology.

During the two-and-a-half-month e-book reader testing period, the students were required to keep an informal experience diary (a weblog). The aim of the diaries was to allow researchers to keep track on students' actions with the devices and provide help in using the devices as well as ask questions about details of the usage.

After the testing period, another meeting was arranged to discuss the use experience of the devices. In the beginning of the meeting the students filled in a short questionnaire about their feelings of and comments about the e-book reader they had tried out. The rest of the meeting was organized as a semi-structured group interview. Each of the students presented his or her opinion of the tested device, as well as one's comprehension of its operations to the interviewer and other students. The aim of the protocol was to allow students to compare their own device specific experiences to other users experiences with other e-book readers. Additionally, to facilitate enhanced sharing of experiences, a short amount of time was also allocated for generating ideas for an ultimate e-book reader that would serve the students' needs perfectly.

Results

The e-book readers proved to be quite different from the students' expectations. The electronic paper technology (e-ink) was much more rough and non-display-like than the students had thought beforehand. As a result the students evaluated the devices as very slow and cumbersome to use. All of the students had expected the devices to be more computer-like in their interaction possibilities and capabilities.

The strengths of the e-ink technology, i.e. low power consumption resulting in good battery performance and a paper-like reading experience, were appreciated by the students but the strengths were not enough to turn the using of the devices to positive experiences.

Only one of the students would have considered buying the device he tested after the testing period. On the other hand, all but one student would consider buying a similar device in the near future for free time use after the most pressing technical problems are solved.

In a more detailed level the study provided information from three different perspectives relating to university studies and the university library's services; electronic paper as technology in study use, technological maturity of current e-book reader devices and their capabilities in study use, and the use electronic study materials in the university.

Electronic paper as technology

The study showed that the current software in e-book readers as well as the electronic paper technology incorporate major problems when used in a studying context. Students have a habit of browsing the reading material back and forth with both books and shorter articles. Browsing is used to get an overview of the material but it is also used during normal reading. In many cases there was e.g. a need to jump to a different part of a book to check how a previous piece of information fitted with the new one. While the technical solution in all of the tested devices allows the user to jump to any of the pages of the document, the jumping takes 1-3 seconds. However, the students did not usually know the exact page to which to jump. Therefore, they were required to jump and turn pages multiple times. This took too much time to get to the intended page. In leisure time usage, i.e. when reading a novel sequentially from the beginning to the end, there is no need for jumping from one page to another. Thus, the devices provide a better user experience for that purpose. The fact that most of the students considered purchasing an e-book reader for leisure time use in future, but did not see the devices suitable for studying purposes, supports this reasoning.

While turning pages was experienced to be too slow, the e-ink as a reading medium was considered to be very good and the experience was very similar to paper. Interestingly, the limited graphical capabilities of the devices, e.g. quite low resolution for images and no colour screen, did not seem to bother the students. However, the interactive features, e.g. making bookmarks and notes, were considered to be as cumbersome as the page turning. These results indicate incompatibilities between the students' mental models and the functionality of the e-book readers.

Current e-book reader devices

Although the devices in this study were not first generation e-book readers, the students felt that there were a lot of amateurish bugs in them. Since the devices and their displays are quite small and most of the study material was designed for A4 or other large page sizes, students had a recurring need to zoom in to parts of the pages. The zooming function varied a lot between devices but none of them tackled the problem in a good enough way. For example, one device lets the user to zoom in a page and navigate to different parts of the page, but not to turn to next page while zoomed in. In addition to zooming, also basic studying methods such as underlining and making notes were very cumbersome or lacking in the devices.

Another big issue with the devices was their interoperability with digital rights management (DMR) solutions used by service providers of electronic books. Different service providers use different DRM solutions and currently the e-book readers have problems with most of them. The major technological bottleneck is the lack of network connection. The current situation means that it is very difficult to get any other DRM material than material designed specially for a specific device to work with the devices. As a result majority of the libraries electronic books were not available on the devices.

Getting the reading material into the devices was considered a slow and somewhat annoying task. The materials needed to be first downloaded to a computer and then transferred from there to the devices.

The most positive surprise with the devices was the almost ever-lasting battery. The students are accustomed to mobile devices that need recurrent charging and the e-book readers provided a positive surprise as they were consuming very little energy and needed charging only once in a while. One student even told that he did not recharge the device once during the test period.

Use of electronic study materials

Although the study focused on e-book readers and their possibilities in study use, a lot of comments and information about the current state of electronic study materials in general was also obtained.

The most interesting finding was the students' habit of reading most of the material from computer displays. Usually computer displays are considered to provide quite a bad reading experience as the backlit display easily strains the eyes. However, as a big part of studies is about finding specific information from a large pile of documents, the strengths of electronic material, i.e. search functionalities, fast scrolling, and ability to handle very big amounts of documents, became more important than slight discomfort for the eyes.

When reading for studying, an important issue is the possibility to annotate the material. This is done by emphasising important parts of the text: underlining text and jotting down own notes relating to the reading. Since students consider the e-book readers as replacements of laptop computers, they miss the possibility to write their own notes about the read material. This lack of functionality (or degraded usability compared to laptops) in the e-book readers

may be considered to be a bigger issue than the paper-like e-ink screen. This could result in favouring the use of computers for handling study-related electronic material.

A big theme related to electronic study materials was the numerous different sources the students had to use to obtain the material. The lecture slides and material were provided from an online teaching portal, many of the books and academic articles were provided by the library from different article databases and e-book services, and in many courses there was also material that was from some free internet service. By far, the most cumbersome and disliked services were the e-book services with complicated DRM solutions. In many cases the students seemed to first look if the same material could be found freely from somewhere in the Internet, before reading it from DRM-protected e-book service.

Conclusions

E-readers are currently great for reading novels, but lack the functionality required for academic reading. The long battery life and easy reading are advantages in any use, but the inability for easy browsing, navigating, searching and zooming make them slow to use in non-linear reading. In addition, the readers are not well suited for material with colour graphics, tables, pictures and equations. In academic use students and researchers also use multiple resources and need the ability to jump from one document to another, making use of links and cross-references. This is not yet possible on most e-reader devices.

This study with Aalto University students gave useful information about the advances in e-book technology required before e-book readers can efficiently be used for study and research purposes. It also showed that the students still prefer to read e-material on their laptops, instead of the more eye-friendly e-readers, because of the more versatile functionality of computers. However, the students did show interest in using the e-reader technology for entertainment purposes.

From the viewpoint of the library services, many of the current academic e-resources are not compatible with the current e-readers. While the readers are not good enough in functionality to warrant materials being chosen purely on the basis of compatibility with these devices, the incompatibility does raise some important issues. Materials with strict DRMs limit the use of the materials in many ways, restricting also printing, downloading and other use of the materials as well as use on e-reader devices.

E-book services that provide e-books from many different publishers appear to have the most restrictive DRM. When purchasing the books directly from the publishers, one can often get much better usability also on the laptops. In addition to being available on the same familiar platforms as the e-journals, many publishers such as Elsevier, RSC, Morgan & Claypool, Springer, OECD and SPIE use no DRM on the e-books when purchased directly. This should definitely be considered when selecting new e-book suppliers. Many publishers do require minimum purchases or only sell packages, but if enough suitable material can be found, it can be worthwhile to acquire e-books directly from the publishers.

New devices such as the iPad make new resources available through the Internet connection. The future of the formats will also influence the scene, if one of the formats, for example ePub is made industry standard, this shall affect the DRM solutions and more generally compatible devices and DRMs can be expected.

Further studies are proposed to follow the changing e-reader scene and the applicability of the devices in an academic environment, as well as studies to chart the use of the new technologies by the university students and researchers.