Ebook Readers in Higher Education

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Abstract

Ebook readers have received a mixed press, with some hailing them as the future of reading and others believing that they will never be popular. The study outlined here aims to understand the attitudes of, and issues of importance to, lecturers in UK academia, with a view to improving the design of ebook readers for education in the future. An evaluation of five portable devices is presented, in which lecturers were given the opportunity to read an ebook and provide feedback via a questionnaire. Results are compared with concerns arising from other experiments in the same field, and recommendations are made for successful ebook design.

Keywords

Electronic books, Electronic textbooks, Evaluation, Usability

Introduction

Electronic book readers have been defined by Lemken (1999) as "mobile, physical devices to display electronic (i.e. digital) documents". In today's market, they can be one of three things (Wilson, 2001):

1. Dedicated ebook readers. Built solely for the purpose of book reading, these are small, lightweight devices (usually with larger screens than PDAs and Pocket PCs) with backlit screens and embedded dictionaries. Often they enable searching, bookmarking and annotating, and can either be connected to a PC or contain internal modems so that content can be downloaded from the Internet. The Rocket eBook and the SoftBook are the parents of the dedicated ebook reader, and have a steadily growing family, including the goReader and AlphaBook.
2. PDAs and Pocket PCs. These are usually smaller than dedicated ebook readers and primarily function as personal organisers. Often they also offer Internet access and word processing, spreadsheet and MP3 playing capabilities. Increasingly, as content and ebook reader software for these devices becomes available, they are now being used additionally to read books.
3. Hybrid devices. Several devices have emerged which cross these previously distinct boundaries between hardware designed especially for reading books, and hardware designed to perform personal organiser tasks, with ebook reading an added functionality. These "hybrid devices" look similar to dedicated readers, with larger screens intended for reading long streams of text, buttons placed for easy turning of pages, and with the usual ebook capabilities such as bookmarking and annotating, but may also contain address books and to do lists, and be used to perform the types of task normally associated with PDAs, such as email reading, Internet browsing and MP3 playing. Examples include the eBookMan, which supports audio files and contains an address book and a to do list, and MyFriend.

Ebook readers have received a very mixed press, with some authors believing they represent the future of reading (Midgley, 2002), and others claiming that reading long texts from a screen is an inherently unpleasant experience and, therefore, will never be popular (Weeks, 2002). In a 2001/2002 survey of lecturers at three UK universities (Wilson, 2003), of those who used electronic teaching resources only 9% delivered electronic books as course material, and 21% recommended them to students. Ebooks were not used at all in Computer and Information Sciences, Engineering, Mathematics and Statistics or Medicine.

The Electronic Book Group at the University of Strathclyde, UK, believes that the design of devices plays a crucial role in their acceptance (Wilson, 2002), and set about investigating this issue in a small-scale experiment focusing on the opinions and experiences of university staff. The group's EBONI (Electronic Books ON-screen Interface) Project (2002) studied the importance of design in an evaluation of five ebook readers. The aim was to investigate issues surrounding ebook reader design in general (such as ease of use, navigation, reactions to size, weight, display, and so on), as well as to discover, in more detail, opinions on the use of ebook readers in an academic setting. Details and results of the experiment are outlined below.

Methodology

The experiment employed EBONI's Ebook Evaluation methodology (Wilson and Landoni, 2001), which has been applied to other evaluations in the ebook arena and aims to produce results that are comparable across experiments. The methodology provides a flexible framework for selecting material and participants, defining criteria and measures, and implementing evaluation techniques such as "low cognitive skill" tasks set by lecturers to measure user understanding of concepts in the texts, and questionnaires designed to measure user satisfaction. By adopting these different techniques, the model aims to measure usability, relevance and satisfaction comprehensively and at a variety of levels, incorporating traditional Information Retrieval concepts as well as lecturers' objectives. Four general phases are involved:

1. Selection of material. Ebooks can be selected for evaluation according to three parameters: format/appearance, content and medium.
2. Selection of actors. Four possible actors in an experiment can be distinguished: the participants, the evaluators, the task developers and the task assessors.
3. Selection of tasks. The following task-types are proposed for gathering quantitative feedback from participants about the material:
   a. Scavenger hunts, which involve participants in hunting through the material selected for evaluation in search of specific facts.
   b. Exams, which involve the participant reading a chapter or a chunk of text for a short period of time, learning as much as possible in preparation for a short exam.
4. Selection of evaluation techniques, such as:
   a. Subjective satisfaction questionnaires.
   b. Think-aloud sessions.
   c. Interviews.

Details of the application of these four phases to the design of this evaluation of ebook readers are provided below.

Material

Five ebook readers were compared in this experiment: a SoftBook, a Rocket eBook, a Jornada 548, an eBookMan 900 and a Palm Vx.

The SoftBook, by SoftBook Press of Menlo Park, California, has a leather cover which, when opened, automatically starts up the book. It holds around 250 books, has a backlit, 8x6 inch grayscale screen, weighs nearly three pounds and, when available, cost around $600. Its battery provides up to five hours of viewing, and it offers a fast recharge of an hour. The SoftBook uses an HTML-based proprietary format for displaying books. Functions such as choosing a title, page turning, bookmarking and annotating are performed using touch-screen technology.

The Rocket eBook, by Nuvomedia, Inc. in Palo Alto, California, holds ten books (4,000 pages of text), weighs one pound and, when available, cost around $270. It has a 4.5x3 inch, high-resolution black-and-white screen, a number of font sizes can be selected, and it can be customised for left- or right-handed use. The battery lasts for about 20 hours when backlit, and 45 hours without being backlit. Like the SoftBook, the Rocket uses a proprietary ebook reader format.

The Jornada 548 by Hewlett-Packard is a Pocket PC with 32 MB RAM and a 134 MHz 32-bit processor, and cost, at the time of the evaluation, around $500. It has a 2.9x2.1 inch high-resolution, backlit colour screen and weighs 9 oz. The battery life is around 8 hours. In this experiment, titles were displayed using Microsoft Reader

software. The layout of a text in Microsoft Reader is very clean and simple: only the text of the book is displayed, and no icons are visible on screen; functions like highlighting and annotating only become visible when the reader interacts with the book by clicking on the screen.

The Franklin eBookMan 900 cost around $130 at the time of the evaluation, has a 240x240 pixel grayscale LCD screen, without backlighting, and weighs 7 oz. The device takes 2 AAA batteries. Content is downloaded to a PC running the eBookMan Desktop Manager, and sent to the eBookMan via a serial or USB connection. In this experiment, Franklin Reader software was used for reading books.

The Palm Vx weighs 4 oz and has 8MB RAM and a 2.5 inch grayscale, 160x160 resolution, backlit LCD screen. The rechargeable lithium ion battery lasts for 25 hours at a time. It cost, at the time of the experiment, around $210 to $230. Palm Reader (formerly Peanut Reader), an ebook reader for Palm and Windows CE devices, was used. This offers bookmarking, annotating and search facilities.

Table 1 provides a summary of the characteristics of the five ebook readers.

Table 1. Summary of ebook reader features

Device	Type	Weight (ounces)	Screen size (inches)	Colour/ grayscale	Resolution	Back-light	Battery life (hours)	Cost
SoftBook	dedicated	45	8x6	grayscale	640x480	yes	5	$600
Rocket	dedicated	16	4.5x3	grayscale	480x320	yes	20[*]	$270
Jornada	pocket PC	9	2.9x2.1	colour	320x240	yes	8	$500
eBookMan	hybrid	7	3.5x2.75	grayscale	240x200	no	15	$130
Palm	PDA	4	2.5x2.5	grayscale	160x160	yes	25	$220

* 45 hours when not backlit

Actors

18 participants took part in this experiment, comprising staff (primarily lecturers and researchers) in Strathclyde University's Centre for Digital Library Research (CDLR) and the Department of Computer and Information Sciences (CIS). A between-subjects design was adopted so that each participant was randomly assigned to just one condition.

Over a period of three months, each participant was lent one device with a book of his or her choice downloaded to it, for approximately seven to 14 days. Participants were provided with verbal instructions on how to perform basic functions with the ebook hardware, such as switching it on, turning pages and recharging the battery. One evaluator distributed the devices, provided operating instructions, and gathered feedback.

Four participants used the SoftBook, four used the Rocket eBook, three read a book on the Jornada, three used the Franklin eBookMan, and four the Palm.

Selection of Tasks

The only "task" assigned to participants was to attempt to read the selected book on the given device. Scavenger hunts and exams were inappropriate for this type of material (mainly fiction), and allowing participants to approach their books in a natural way, according to their own preferences, was felt to be important in gauging their responses to the medium; therefore, they were free to read the book at times and locations of their choice.

Evaluation Technique and Measures

At the end of their allotted timeframe, participants returned the ebook hardware to the evaluator, and were asked to complete an online questionnaire. Of the criteria outlined in EBONI's methodology, it was decided that simply measuring user satisfaction via a questionnaire would require minimum time and effort from busy

lecturers and researchers who had already committed energy to the experiment, and enable the collection of structured and unstructured data. Satisfaction was measured via the four properties of the questionnaire (quality, ease of use, likeability and user affect), and indicated participants' sense of engagement. (Sense of engagement is "the level of interest the system induces in the user" and is related to the level of interaction available and the novelty of the system (Landoni et. al., 2000).)

Since ebook readers were a relatively new area of research for EBONI, several open questions were included in the questionnaire, intended to provide fuller responses and highlight recurring themes.

Results and Discussion

Participants

The majority of participants were aged 21-50 and male; only three were female. All participants were university staff; most were lecturers or researchers. A combination of lecturers and researchers used each device.

Eight users had read an electronic book prior to this study, of whom three had used Microsoft Reader, two had used Palm/Peanut Reader, two had read Web-based books, and one had used early Hypercard products on a Mac.

The Electronic Reading Experience

Ten participants read a whole book using the device they were lent; eight did not. Users of the Jornada and the Rocket eBook who did not read a whole book gave reasons unrelated to the fact that it was presented in electronic format (such as "I didn't like all of the poems" or "I only read those short stories that grabbed my attention"). One Palm reader failed to complete the book because reading from the small screen was "painful", and one SoftBook user gave the reason that he found the electronic format, in general, unappealing. One user of the eBookMan did not read the whole book because the device crashed and the text was lost; another found it inconvenient to use.

After the verbal instructions provided by the evaluator, all participants learned to use the devices very quickly, quickly or quite quickly, compared to what they expected. All four SoftBook users learned to use it very quickly (see Figure 1).
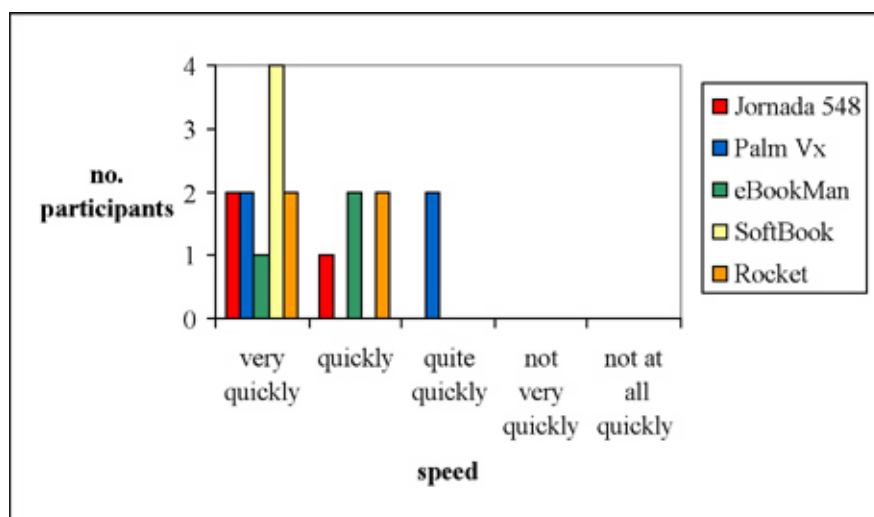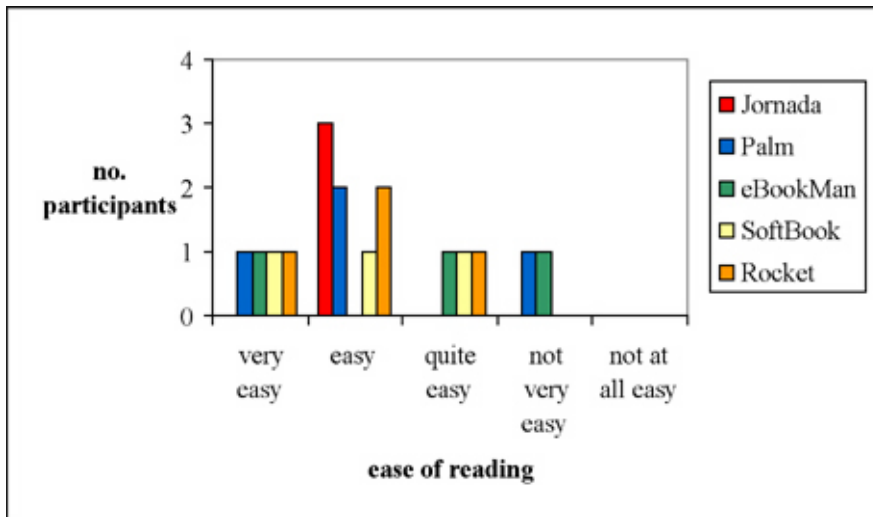

Figure 1. Speed with which participants learned to use devices

As shown in Figure 2, most participants found the text very easy, easy, or quite easy to read using their ebook reader. One Palm user and one eBookMan user found the text not very easy to read; these devices have lower resolution than the others.

**Figure 2.** Ease with which participants read the text

Most participants found the books easy to navigate (see Figure 3). Two SoftBook users and one Rocket user found them very easy to navigate; two Palm users, one eBookMan user and one Rocket user found navigation not very easy.
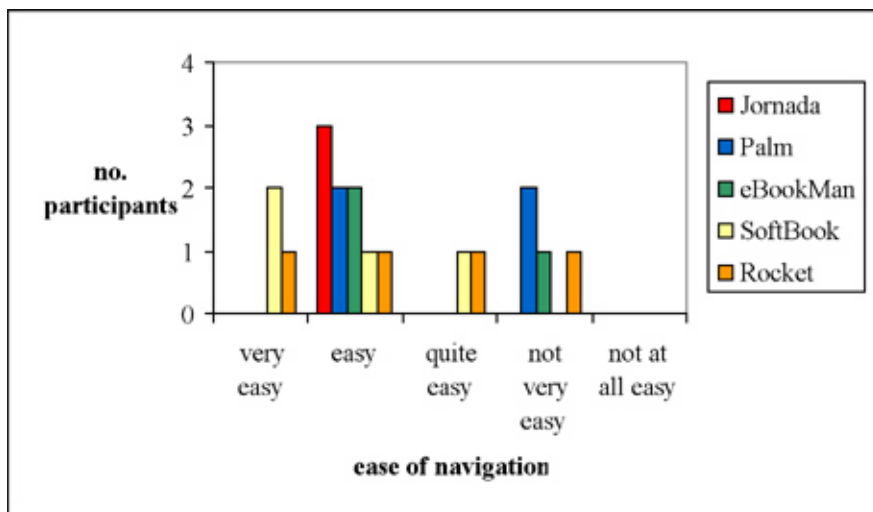
Figure 3. Ease with which participants navigated the books

Preferred E-Reading Material

Participants said they would read a variety of material on an ebook (see Figure 4). In addition to the suggestions provided in the questionnaire (novels, textbooks and reference books), non-fiction, maps, journal articles, magazines, user-generated material, minutes and reports were suggested by users as material they would like to read in digital form.
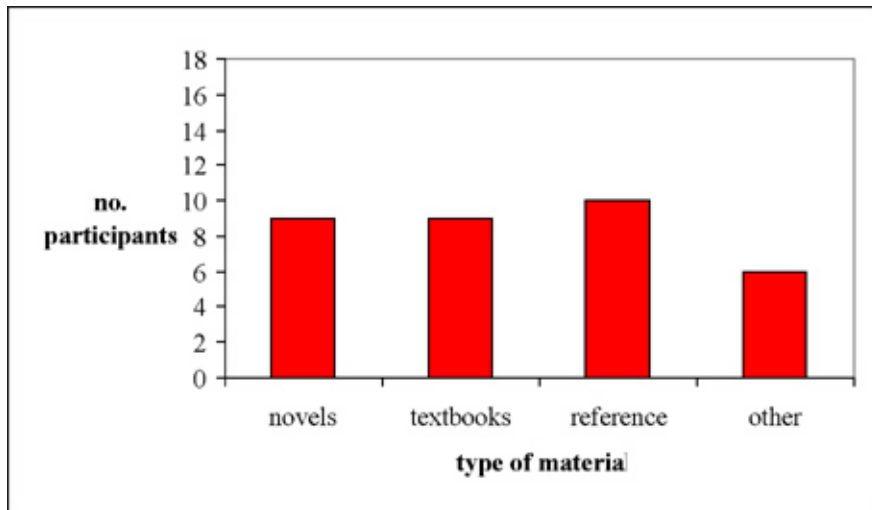
Figure 4. Type of material participants would read on ebooks

Build of the Physical Object

Size and weight provoked the greatest number of comments from participants, with users preferring small, slim, lightweight devices such as the eBookMan, the Jornada and especially the Palm. The SoftBook received the largest number of negative remarks in this area, particularly with regard to weight, and Rocket users also found their device too heavy.

It follows that these larger devices were also uncomfortable to hold, while the smaller, lighter devices, especially the Jornada, received positive feedback in this area. However, while users disliked the design of the Rocket, the SoftBook, with its leather cover, was considered visually appealing. Participants also liked the design of the Palm.

All the devices, except for the eBookMan which has rubber edges and a plastic flip cover, were criticised for being too fragile and thereby restricting usage. Generally, users disliked using styli to control the ebooks, finding them awkward to handle, and worrying about losing them. The Jornada's "wheel" for turning pages was liked by all its users (although the equivalent control on the eBookMan was felt to turn pages too slowly), with several commenting that they felt they could read faster using this method of page turning: "In turning a paper page you lose momentum, albeit for a second or two. I didn't find this at all with the ebook."

The SoftBook's and the Rocket's simple "page forward", "page back" buttons were felt to be intuitive, but the Palm's buttons were described as "too small and fiddly".

Overall, the Jornada received the most positive feedback in this category, closely followed by the Palm and the eBookMan. The largest and heaviest of the devices, the SoftBook, received the most negative feedback, while the Rocket was also felt to be too cumbersome: "The device itself was quite bulky and heavy. Some effort had obviously been put into the ergonomics of the device, but it just didn't feel right. I found myself constantly shifting it from hand to hand".

Display Technology

The Palm, while praised for its size and weight, was heavily criticised for the size of its screen and the fact that this restricted the amount of text displayed in any one "page", meaning that users had to turn pages very frequently ("Pages are too small - always turning the damn page!"). The larger devices, the SoftBook and the Rocket, received positive remarks about their screen size, while the Jornada and the eBookMan's screen size (larger than the Palm, smaller than the Softbook and Rocket) was not commented on.

The only device to receive positive feedback about the quality of its display was the Jornada. This has a high resolution colour screen and exploits ClearType technology which claims to triple the resolution of text by

smoothing the spaces between the pixels on a computer screen. The SoftBook was criticised most for its screen quality, one user complaining that "it was slightly hard on the eyes after an hour of reading", closely followed by the eBookMan and the Palm. Backlighting was felt to be an important feature; the eBookMan 900 was the only device used in the experiment which did not have this capability, although other eBookMan models do.

Overall, the Jornada was felt to have the best quality display, with the Rocket and the SoftBook successful in terms of the size of their displays. The Palm received the greatest number of negative remarks in this category.

Functionalities

Fuctionalities of the reader software such as searching, bookmarking and annotating were generally appreciated by participants, although it was frequently commented that these features were awkward, difficult or time-consuming to use. As one eBookMan user noted, "The search facility was useful for flicking back through the story, although it took a couple of attempts before I understood how to use it". The ability to search across all texts held on one device was suggested as a useful feature. Use of hypertext to link from the contents page to individual chapters, and from one chapter to another, was felt to be essential in an era where people are familiar with using the Web. The integration of dictionaries and thesauri was also felt to be important, particularly in situations where devices are being used for studying.

Overall, the Rocket, the SoftBook and the eBookMan were felt to have the best and easiest to use functions.

Presentation of Book Content

The Jornada (using Microsoft Reader software) and the SoftBook presented book content in the most satisfactory way, according to the participants, both using typographically sophisticated pages and navigation systems that are simple and intuitive. The Palm Vx (using Palm Reader software) and the Rocket were criticised most heavily for their unsophisticated typography, awkward navigation, and lack of "sense of place"; the eBookMan (using Franklin Reader software) was also criticised for the latter, as well as for its use of unintelligible icons.

Ebooks in an Academic Environment

Half the participants said they would use an electronic book for work; half said they would not. Those who said they would cited reasons such as portability, and advantages of the electronic medium such as hypertext and searchability. Those who said they would not use an electronic book for work gave reasons such as price, poor battery life (eBookMan) and weight (SoftBook); several users felt that portable electronic books offer no advantages over print or reading from a PC; some enjoyed reading fiction on their ebook device but said they would not enjoy reading textbooks or papers in this manner; and several said they would use ebooks for work if they had greater functionality.

The lecturers who participated in the study were divided in their opinion on whether students would find an ebook device useful. Those who believed students would use ebooks gave the following reasons:

➢ Portability – students could access large amounts of material "anytime, anywhere".
➢ Additional functions offered by some devices (diaries, notebooks) would help students become more organised.

Those who believed students would not find ebooks useful gave the following reasons:

➢ Devices are too difficult to use, especially for cross-referencing purposes.
➢ Devices are prone to damage, loss, or dead batteries.
➢ Ebook hardware is too expensive.

Comparison with Other Studies

The findings of EBONI's evaluation are corroborated by other studies of electronic books in academic settings. In the Electronic Books in Libraries (2002) project, the libraries of New York's University of Rochester and

Rochester Institute of Technology circulated SoftBooks and Rocket eBooks to their patrons. All participants were asked to complete a satisfaction questionnaire, and focus groups of patrons, librarians and educators provided supplemental feedback.

In another initiative (Peters, 2000), two Illinois colleges integrated the Franklin eBookMan 911 and the REB 1100 (which superseded the Rocket eBook) into their libraries and English classrooms, in Autumn 2001. Over an eight-week period, 35 students read novels on the two devices. A Yahoo! group discussion ran throughout the eight weeks, each participant submitted a two-page essay, and students were interviewed.

Marshall and Ruotolo (2002) describe a third study in which two University of Virginia classes were conducted using materials available in ebook format on Pocket PCs. The aim was to investigate whether students can and will read digital library materials on handhelds, and feedback was collected via observation and interviews.

And, in the UK in May 2000, students and staff at Loughborough University evaluated the Rocket eBook and the GlassBook (Dearnley and McKnight, 2001). 20 participants read Stephen King's *Riding the Bullet* for 30 minutes then completed a questionnaire.

The following findings complement the results of EBONI's experiment:

➢ The weight of the devices was commented on in three of the studies. In the Rochester study, the SoftBook in particular was felt to be too heavy, and users complained about the weight of the REB 1100 and the Rocket eBook in the Illinois and Loughborough experiments respectively.
➢ The second most common suggestion in the Rochester study for improving the devices was longer battery life. In the Illinois study, several students were irritated by having to pay attention to the state of the battery.
➢ In the Illinois and Virginia studies, the ability to locate the correct place within an e-text quickly, particularly in collaborative situations, was felt to be crucial to the success of ebook readers in an academic environment.
➢ Highlighting and underlining functions were considered useful in the University of Virginia study.
➢ Loughborough staff and students felt that glare and screen quality were a problem when reading ebooks. Backlighting was cited as a major advantage in the Rochester and Illinois studies.

In the Illinois study, many of the participating students noted that the speed with which they read seemed to increase with ebooks. Similarly, in the Rochester study, one reader noted about the Rocket, "It makes me read faster!" Participants in EBONI's evaluations made the same observation.

Further, the Illinois study drew some initial observations about the effectiveness of ebook readers in teaching students. It was found that use of ebook devices did not impede learning in these Higher Education courses, and may even offer improvements in terms of motivation, retention, and reading persistence. The achievement of pedagogical objectives did not appear to be impaired.

Recommendations

Overall, in EBONI's study, the Jornada with Microsoft Reader was found to be most satisfactory device by its three users, offering the most satisfying combination of weight, size, screen quality and presentation of content.

The feedback gathered from the evaluation points towards several elements as worthy of attention when designing ebook readers:

Display technology should be high resolution, with high contrast, minimal glare and backlighting.

➢ Finding the optimum size of ebook hardware is a question of balancing weight, portability and ergonomics against legibility and quantity of text on screen.
➢ Ebook hardware should be designed for comfort, and the ability to hold a device easily in one hand is considered an advantage.
➢ The number and diversity of situations in which ebooks can be read can be constrained when devices are delicate, fragile or costly.
➢ Certain aspects of the paper book metaphor should be adhered to:

- o Each book should have a "cover". This reinforces the user's perception that he or she is reading a unique set of pages which form a cohesive unit, and provides a point of recognition on return visits to the book.
- o "Opening" an electronic book at the correct page should be as quick and easy as opening a paper book.
- o The paper book metaphor should be considered in relation to the size of pages (the quantity of text visible on the screen at any one time).
- o Cross-referencing between pages in a book, and from one book to another, is considered important and should be made possible.
- o Indications of a reader's progress through the book should be accurate and visible.
- o Use of graphics, typography and layout should be as sophisticated as that of the paper book.
- o Bookmarking and annotating should be simple to achieve.
- ➢ Incorporation of hypertext (to move from the Table of Contents to individual chapters, for example) can improve navigation.
- ➢ Careful design of buttons or dials for turning pages can improve this aspect of the paper book metaphor, leading to a smoother, faster transition from one page to the next.
- ➢ Devices should contain thesauri and dictionaries.
- ➢ Font sizes should be manipulable to suit individual preferences.
- ➢ Icons should be explicit.
- ➢ Search facilities are appreciated.

Electronic Textbook Design Guidelines

These recommendations, together with those emerging from EBONI's other ebook evaluations, form a complete set of Electronic Textbook Design Guidelines (Landoni, et. al., 2002). Other evaluations focused on on-screen design issues and included:

- ➢ An evaluation of three textbooks in psychology, all of which have been published on the Internet by their authors and differ markedly in their appearance (Wilson, et. al., 2003).
- ➢ A comparison of three electronic encyclopaedias: *Encyclopaedia Britannica*, *The Columbia Encyclopaedia* and *Encarta*.
- ➢ A comparison of a title in geography which is available in three commercial formats: MobiPocket Reader, Adobe Acrobat Ebook Reader and Microsoft Reader.

In addition to the above recommendations, guidelines emerged with respect to the use of structural elements inherited from the paper medium, such as tables of contents and indexes, the provision of content summaries to enable scanning, the use of colour and images to break the flow of text, and implementing multimedia and interactive elements to engage users.

Conclusion

Just like the coverage that they have received in the press, this paper reveals a mixed set of views on ebook readers. A set of issues related to reading books on portable devices was uncovered, and recommendations for responding to these issues through good design were derived.

However, some concerns are difficult to resolve adequately with current technology. Users of electronic books would like screens that are large enough to read from comfortably, but do not want the associated bulk and weight. They want to read from screens as effortlessly as they do from paper, making notes and marks anywhere they like, and flicking through the pages naturally, browsing and glancing. In the words of Birgit Lemken, "Though we can look back at more than 35 years of computer supported document processing, paper is still the preferred media for reading. This is not only due to insufficient hardware but also to unsatisfactory interfaces and presentation principles" (Lemken, 1999).

Electronic paper, now being developed by several major companies, has the potential to combine the advantages of the electronic medium (instant updating of material, user of hypermedia, etc.) with those of the printed page (lightness, flexibility, legibility, typographical quality, and familiarity to the user). Possessing so many of the qualities of the print medium, perhaps it will bridge the divide between print and screen and make electronic books an appealing, realistic option for more people.

The study presented here was small-scale, involving 18 participants from homogeneous backgrounds. Future research will replicate this work on a larger scale, with a greater number of participants, including students, from heterogeneous backgrounds.

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