



An evaluation of second-generation ebook readers

Second-generation ebook readers

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Abstract

Purpose – This study seeks to evaluate a selection of second-generation ebook readers in order to determine which devices deliver the best experience for the user, in terms of functionality and overall experience. The technical and physical elements of the devices are also compared.

Design/methodology/approach – This paper starts with a brief discussion of the current ebook marketplace, and previous studies that evaluate ebook readers. It then reports on a study in which 33 Master's students from an Information and Library Studies course were each given an ebook reader and asked to complete a task designed to engage them with the device. The participants then evaluated the devices by completing a questionnaire. A discussion of the results of the study and implications for the development of ebook reading devices follows.

Findings – Although some issues, specifically size, weight, and screen quality, have been addressed in the new generation of ebook readers, some residual dissatisfaction remains. The participants in the study preferred to use devices with which they were familiar.

Originality/value – This study provides guidance on the usability of ebook readers and provides insights into the future of ebook reading devices. It will be of benefit to information professionals seeking to utilise ebook reading devices, and to designers of ebook readers.

Keywords Electronic books, Digital libraries

Paper type Research paper

1. Introduction

1.1 Market

Following the introduction of the first generation of ebook reading devices in the late 1990s manufacturers have made major advances in terms of the underlying technologies, and have invested in trying to design more effective interfaces for users. Ebook readers have yet to have their much anticipated iPod moment but the continuing increase of ebook sales, the success of new ebook reader devices, such as the Kindle and the Nook, and the excitement generated by the announcement of the Apple iPad suggest that the ebook concept may be about to reach critical mass and move from the early adopter to early majority phase of Moore's technology adoption curve (Moore, 1991).

While reliable data on ebook sale figures are not always easy to obtain (Vasileiou, 2009) there is evidence that the market is experiencing rapid growth. The International Digital Publishing Forum reported that sales of ebooks in America increased from 1.5 million dollars in 2002 to 55 million dollars in 2009 (US Trade Wholesale Electronic Book Sales, 2009), while the 13 publishers that report figures to the Association of American Publishers (AAP) recorded a 176.6 per cent increase in 2009, to \$169.5 million (Milliot, 2010). The first figures for 2010 from AAP show that this trend has continued with sales of \$31.9 million in January alone. Amazon, while avoiding



monetary figures, stated that of the 125,000 titles the company sold in both physical and electronic forms in 2008, the electronic ones accounted for 6 per cent of total sales (Weisenthal, 2008). However, by July 2010 Amazon claimed to have sold 143 ebooks for every 100 hardback books over the previous three months, and 180 ebooks for every 100 hardback books in the previous four weeks.

Figures for sales of readers are also difficult to obtain but in 2008 380,000 Amazon Kindles were sold (Marco, 2009), while in 2010 Jeff Bezos, the founder of Amazon, claimed in a press release that “millions of people now own Kindles” (Bezos, 2010). Forrester Research estimated that 900,000 units would be sold in 2009 and that sales would double to six million units in 2010, bringing cumulative sales of all readers to 10 million units (Lefkow, 2009). These sales reflect the availability of cheaper, more capable and more reliable readers, as well as a larger range of readily accessible ebooks, as major players jostle for position in a relatively undeveloped but high potential marketplace. They may also reflect improved consumer reactions to the technologies used for accessing ebook content. This has been most recently reflected in the launch of the iPad which generated sales of 300,000 units on its launch day, accompanied by over 600,000 downloads of ebooks (Tsai, 2010).

The development of ebooks can be traced back to the 1970s and the emergence of Project Gutenberg, with the first generation of ebook readers emerging in the 1990s. Since then another generation of readers can be identified and new products continue to appear on the market (see Figure 1).

When Wilson (2003) tested five ebook readers she was evaluating a selection of first generation devices. Wilson found that, despite positive feedback about the usability of the devices, the main issues were the size and weight of the devices, that they were too fragile, and that they had poor user interfaces. In addition Wilson identified general issues by comparing the results from the study with the results of other evaluations of ebook readers, including Dearnley and McKnight (2001). The issues that arose that were comparable to her study were size and weight, battery life, navigation within the ebook, cost, and screen glare. According to Herther (2008) the early models, such as the Rocket eBook and Softbook, were “clunky” but that successive generations have been getting progressively smaller in size, lighter in weight, and provide better readability, navigation, and features. Herther characterised the first generation of ebook readers – mainly in negative terms – listing the small size of screen, the need for heavy batteries, poor screen resolution, the inability to link to other computing devices, and limited multi-media capability, as reasons for the low take-up of devices.

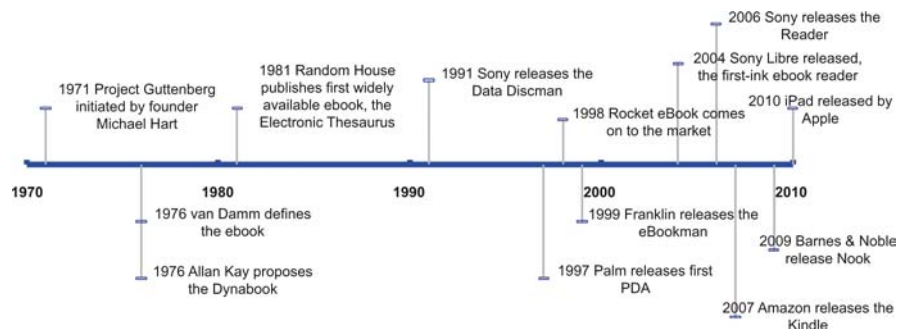


Figure 1.
Timeline of ebooks and
ebook readers

Ebook readers gradually improved in terms of features such as weight, screen size, and screen resolution but there were no significant technological innovations that could be taken to characterise a new generation of devices. These devices were able to store more titles, had better screen resolution, and were able to mimic aspects of the book metaphor through methods such as using buttons to turn pages. Hybrid devices (i.e. devices which were not designed as dedicated ebook readers, such as the PalmPilot Personal Digital Assistant) also emerged as alternative platforms upon which ebooks could be read.

More recently, we have seen the emergence of readers that claim to address many of the faults found in the earlier ebook readers and incorporate features such as e-ink displays, even lighter weights, larger storage capacities, and longer battery life. E-ink is an important technological development as it reduces screen glare and allows a display that possesses a paper-like high contrast appearance, ultra-low power consumption, and a thin, light device. This gives the viewer the experience of reading from paper, while having the power of updatable information; for instance, LG have announced a flexible 19" display which incorporates e-ink and which can substitute for a newspaper (Humphries, 2010). The authors suggest that this step change in technology, rather than incremental improvements in existing technologies, can be taken to characterise a new, second generation of readers.

1.2 Previous ebook evaluations

The objectives of the study reported here were to evaluate a selection of these second-generation ebook readers, to highlight user perceptions regarding relative strengths and weaknesses, and to see if there have been significant changes in terms of user acceptance. There have been numerous approaches taken when evaluating both ebooks and ebook readers in projects such as SuperBook and the Electronic Books ON-screen Interface (EBONI). For instance, Wilson *et al.* (2003) describe three evaluations of ebooks and provide a series of design recommendations, such as the inclusion of table of contents and full text searching, for electronic textbooks (It is interesting to note that some of the devices tested in this experiment still did not support functionalities such as full text searching).

A mixture of hybrid and dedicated ebook readers were evaluated as part of the EBONI project by Wilson and Landoni (2003) using staff from the University of Strathclyde who were lent devices for a period of one to two weeks, asked to download their choice of reading material, and to provide feedback in a questionnaire. The researchers aimed to measure the "sense of engagement" (Landoni *et al.*, 2000) the participants experienced. Landoni and Hanlon (2007) used two reading groups in public libraries to study perceptions of ebooks. Over a period of a month the groups read selected fiction on PDA devices and recorded their perceptions through questionnaires. It was concluded that the hardware/software utilised in the experiment was not yet adequate for widespread use but that it was improving. The participants in the study had positive experiences in terms of navigation and ease of use and enjoyed the lightweight and compact nature of the PDA devices but disliked the screen glare, size of text, size of screen, and the limited battery power. The participants also revealed that they did not consider ebook functionality as useful; this contrasts with the findings of Wilson *et al.* (2003), that functionalities are an important element of an electronic textbook, but can be explained by the difference between reading fiction and

non-fiction. As hypothesised the participants in Landoni and Hanlon's study retained a definite preference for paper text. The fact that all the participants were reading the same text eliminated differences that would occur from reading different texts (Wilson and Landoni, 2003) and has informed the methodology of this paper.

Malama *et al.* (2004) evaluated various ebook reading software in terms of ease of use and quality. Although specifically excluding the evaluation of hardware the methodology informed this study as each participant was given three versions of the same text to read. This was noted as a limitation as repetition of reading material was something the authors of this paper wished to avoid. Finally, the INEX Book Track is an international initiative that aims to "promote inter-disciplinary research and introduce cohesion to what is a well studied, but fragmented, area of research" (Landoni, 2008). The INEX book track was established to investigate a number of issues related to electronic and digitised books such as: book retrieval, focused book search, active reading, and structure extraction. The active reading task is of particular relevance to this study as it has been established to explore how and why readers use ebooks in specific scenarios (Kazai *et al.*, 2009). At the time of writing results were not yet available for this track but it is interesting to note that it has adopted and adapted questionnaires from the EBONI project (Wilson, 2003), which has also informed this study.

1.3 Definitions

Wilson (2001) defines three types of ebook readers:

- (1) dedicated ebook readers;
- (2) PDAs and Pocket PCs; and
- (3) hybrid devices.

However, ebooks can now be read on a large number of devices including PCs, laptops, netbooks, tablet computers, mobile 'phones, PDAs, and portable games consoles. It is therefore more convenient, given the spectrum of devices which are available, to narrow these categories to two: dedicated ebook readers and multi-purpose devices, one of whose capabilities is support for ebooks, and to define an ebook reader as "a device on which one reads an ebook".

This definition, of course, is dependent on a clear definition of an ebook. Abdullah and Gibb (2008) note that the term ebook has been used to refer variously to the "hardware, software and/or document content" but that there is a clear need to separate the content from the platform on which the content is delivered, and the technologies used to access that content. Armstrong (2008) provides the following definition, which is an updated version from work in Armstrong *et al.* (2002):

[...]any content that is recognisably "book-like", regardless of size, origin or composition, but excluding journal publications, made available electronically for reference on any device (handheld or desk-bound) that includes a screen (Armstrong, 2008).

Although the use of the concept "reference" is perhaps slightly ambiguous (as several studies have compared the use of ebooks purely for reference purposes in contrast to prolonged reading) this definition provides an informal, common sense view of how to recognise an e-book. A complementary two-part definition has been proposed by

Vasileiou and Rowley (2008) following content analysis of collected definitions in academic literature:

Part 1: An e-book is a digital object with textual and or/other content, which arises as a result of integrating the familiar concept of a book with features that can be provided in an electronic environment.

Part 2: E-books typically have in-use features such as search and cross reference functions, hypertext links, bookmarks, annotations, highlights, multimedia objects and interactive tools.

Vasileiou and Rowley state that “many earlier definitions have become outdated due to heavy reference to specific reader or access technologies, and sometimes their specific use features”. They noted that the second part of their definition, which mentions specific use features, might become less accurate and require updating as ebook technology evolves.

A formal definition of an ebook is a complex matter and this paper therefore takes a simpler route and takes an ebook to be “a digital object that is recognisably book-like”.

1.4 Research questions and objectives

The rapid development of ebook readers means that there have been limited studies on the latest generation of devices to enter the marketplace. The drivers of this research were therefore a desire to obtain a contemporary evaluation of current ebook technologies, to assess the degree to which previously identified limitations have been addressed, and to assess whether and how user perceptions regarding ebook readers have altered. However, in any experiment involving evaluation of ebooks there are a number of elements which can be varied: the ebook reader, the ebook reading software, the content, the file format, the task, and the user. The researcher is therefore presented with the problem of deciding on which elements to vary and which to keep constant, bearing in mind the objectives of the study, and the complexity introduced to, and reliability of, the analysis if there are too many variables. As the main objective of this study was to explore how different users reacted to different ebook readers it was decided to keep the file format, content, and tasks constant, and to vary the ebook reader provided to each user, and by implication the ebook reading software. It was felt that this would provide greater control over the data, avoid learning effects, and allow the researchers to exploit Nielsen’s (1989) discount usability testing approach.

More specifically, the study was designed to address the following research questions:

RQ1. Which devices deliver the best overall experience for the user?

RQ2. Which devices deliver the best experiences in terms of functionality?

RQ3. How do the technical and physical elements of the devices compare?

Based on these questions, the objectives of this study were to evaluate a selection of third generation ebook readers and to rank them in terms of functionality and overall impressions of the user. The study also collected data on the attitudes of the participants with regards to several areas of ebook use and the characteristics of ebook readers. The participants were issued with an ebook reader, given a common task to complete, and asked to fill in a questionnaire designed to test the functionality of the

device, the ease of use of the device, and the overall impression the user formed about the device.

There were three main expectations of the researchers from this study:

- (1) That users would demonstrate a greater sense of engagement with the new generation of readers as they would be more familiar with ebooks in an academic context and with the consumption of electronic texts through hand-held devices in general.
- (2) That manufacturers would have responded to the criticisms of earlier generation devices.
- (3) That e-ink would be perceived as a major improvement over back-lit screens in terms of readability and ease on the eye.

2. Methodology

2.1 Actors

The participants in this study consisted of Masters students on the Information and Library Studies course in the Department of Computer and Information Sciences at Strathclyde University. This course incorporates significant use of information technologies and it was therefore assumed that all the participants had sufficient and appropriate ICT skills to operate the devices. Although the participants had general ICT skills they were judged to be real, rather than expert, users (Barnum, 2002). A potential limitation in using such participants is that they will bring their knowledge and experience of using a range of interfaces to the experiment and that the intuitiveness of the interface will not be tested as rigorously. However, this knowledge and experience also allows the participants to judge the relative efficiency and effectiveness of the interface. There have also been a number of other studies into the use of ebooks in the higher education sector and the research reported here, while not necessarily generalisable to other user groups, should add to our understanding of that specific sector.

Usability testing will depend on a number of factors, such as the experimental design, the statistical methods employed, and the availability of resources, and in particular having sufficient participants. The number of participants can, however, be addressed through use of the discount usability testing concept, which was suggested by Nielsen (1989). Using this concept it is claimed that a small number of participants can produce usable results in areas such as the software development process, user interface design, and web site usability. Virzi (1990) highlighted that in the discount usability testing model:

- with between four and five subjects, 80 per cent of the usability problems are detected; and
- additional subjects are less and less likely to reveal new information.

Rubin (1994) suggests using at least eight participants as he found that the first four participants revealed 80 per cent of the usability problems, but the eighth participant revealed the most important issue with respect to usability. Dix *et al.* (2003) also suggest that 8-10 participants should be used for usability testing. This study was in line with these recommendations as it used a total of 33 participants spread across four different devices; i.e. eight or nine participants per device.

2.2 Task

The participants were asked to read two short stories: one provided as a paper copy and a different, but comparable, story provided as an ebook on the readers. Short stories were selected to make the task achievable within a reasonable timeframe. The stories were taken from *The Memoirs of Sherlock Holmes* by Arthur Conan Doyle. The story provided as a paper copy was *The Musgrave Ritual* and the story read on the ebook reader was *The Gloria Scott*. The stories were of approximately the same length: 7,557 and 7,895 words respectively. *The Gloria Scott* was provided on the ebook readers as a PDF file as this has been identified as the format through which most users read ebooks provided by libraries (Highwire, 2009) and was a format supported by all the devices used. The participants received short instructions on how to turn their device on and off but were not instructed in how to use the device. This was designed to test the usability of the reader and how intuitive the interface was for the participants. The participants were asked to complete the task over a period of three to four days and to fill in a questionnaire after completing the task.

Each participant was randomly assigned an ebook reader to ensure an equal distribution of participants across devices. Other research methods were considered, such as allowing each participant to evaluate each of the four devices, and reading different short stories on each device. These were rejected due to time constraints and to avoid learning effects. A total of 33 students were involved in the study which was considered sufficient based on the “discount usability testing” concept suggested by Nielsen.

2.3 Questionnaire

The questionnaire used to gather data was paper based and issued to the participants along with the ebook reader and the paper version of the short story. The questionnaire contained 39 questions, the majority of which required answers using a five-point Likert scale. In addition there were a small number of yes/no and open-ended questions designed to gather qualitative data about the ebook reader experience.

The questionnaire was composed of questions designed to evaluate the functionality and the overall impressions of the various ebook readers. When Wilson (2003) investigated the “sense of engagement” with the device as developed in the EBONI experiments for evaluation of electronic textbooks, the four themes explored were quality, ease of use, likeability, and user affect. The authors aimed to emulate aspects of Wilson’s (2003) experiment, which included speed of reading and the time taken to learn how to use the device. Wilson also evaluated the build of the physical object, which was replicated in this study, and the display technology. The functionalities of full text search and annotation were not tested in this study as it was not felt that a fiction reading task should contain such elements, and because Landoni and Hanlon (2007) identified that readers in a fiction reading task were indifferent toward such functionalities.

The participants were asked for demographic information, and then questions were grouped under five main themes:

- (1) *The experience of reading the selected ebook compared with the paper book version.* This focused on the following criteria:
 - learning times;
 - reading rates;

- navigation and page turn rates;
 - likes and dislikes; and
 - functionality gaps.
- (2) *Assessment of the ebook reader used.* This focused on the following criteria:
- weight;
 - display quality;
 - size; and
 - robustness of devices.
- (3) *Attitudes to reading ebooks in general.* This focused on the following criteria:
- prior experience;
 - utility;
 - desirability;
 - use related to content types;
 - mode and place of use; and
 - advantages and disadvantages.
- (4) *Piracy and environmental issues.* This focused on the following criteria:
- attitudes to copyrighted material; and
 - perceived greenness of technology.
- (5) *Terminology.* This focused on the following criteria:
- preferences; and
 - interpretation.

Criteria also emerged from the qualitative responses from the users themselves and provided an additional set of issues that will be explored in future studies. These included reactions to how pages turn, storage expectations, damage, loss of tactility, and economics.

2.4 Technologies

Three dedicated ebook readers and a netbook were evaluated in this experiment (see Table I for a summary of features):

- (1) Sony PRS 505 Reader;
- (2) Cybook Gen3;
- (3) Iliad; and
- (4) Eee PC 105HA netbook.

The Sony PRS 505 is a dedicated ebook reader which has an e-ink display on a screen measuring 90 × 120 mm and storage capacity of 192 MB which the manufacturers claim is capable of storing approximately 160 ebooks. It has a rechargeable lithium-ion battery that is capable of approximately 6,800 page turns before requiring a recharge, which takes four hours. It is 175 × 122 × 8 mm in size, weighs 250 grams, and comes with a separate soft, protective cover. It supports a variety of different formats

Manufacturer	Sony	Netronix	iRex Technologies	Asus
Brand name	Portable Reader	Bookreen	iRex	Eee PC
Model	PRS 505	Cybook Gen 3	iLiad	105HA
Dimensions	175 × 122 × 8 mm	188 × 118 × 8.5 mm	216 × 155 × 16 mm	262 × 178 × 37 mm
Weight	250 g	174 g	388 g	1275 g
Screen type	E-ink	E-ink	E-ink	1024 x 600 pixel LCD
Display size	90 × 120 mm	90 × 120 mm	122 x 163 mm	225 x 133 mm
Refresh rate	0.8s	0.9s	1.3s	na
Battery life	6,800 pages	8,000 pages	15 hrs	8.5 hrs
OS	Linux	Linux	Linux	Windows XP
Boot time	0s	20s	44s	na
Memory	192 MB	32 MB	64 MB	1 GB
Font sizes	3	12	16	na
Search	No	No	Yes	Yes
Note taking	No	No	Yes	Yes

Table I.
Summary of ebook reader features

including: AKW, EPUB, BBeB, PDF, Microsoft Word, TXT, and RTF. It does not have wireless connectivity, search, or note taking functions.

The Cybook Gen3 is manufactured by Netronix and is a dedicated ebook reader. It has an e-ink display on a screen measuring 90×120 mm and has a storage capacity of 32 MB, which, according to its web site, can hold “several tens of books”. It has a Li-Polymer battery capable of over 8,000 page turns. It is $188 \times 118 \times 8.5$ mm in size, weighs 174 grams, and has a black carry case. It supports the Mobipocket format but can be altered to run with PDF and EPUB formats. It does not have wireless connectivity, note taking function, or search functions.

The iLiad is manufactured by iRex technologies and is a dedicated ebook reader. It has an e-ink display on a screen measuring 122×163 mm and has a storage capacity of 64 MB. Although no claims are made about the number of books that it can store it is assumed that this is proportionate to the number held by the Sony (i.e. ~ 40). It has a lithium-ion battery with a life of 15 hours and takes approximately three hours to recharge. It is $216 \times 155 \times 16$ mm in size and weighs 388 grams. It supports PDF, HTML, TXT, BMP, PNG, and Mobipocket formats. It has wireless connectivity as well as supporting note taking and search functions. It comes with a stylus and has touch screen technology.

The Eee PC 105HA is manufactured by Asus and is a netbook (a netbook is a small laptop computer). It has a 1024×600 pixel display on a screen measuring 225×133 mm, a storage capacity of 1 GB, and a battery life of 8.5 hours. It is $262 \times 178 \times 37$ mm in size and weighs 1275 grams. It comes with Windows XP pre-installed and has the capacity to support a multitude of ebook formats. For this experiment Adobe Acrobat reader was installed allowing for the viewing of PDF documents. The Eee PC has wireless connectivity and fully supports searching and note taking as well as having the functionality of a typical laptop computer.

The Eee PC is the heaviest device in the study, as well as being the largest. Although it is a netbook (and hence designed for the mobile user, and to be lighter than conventional laptops), it is inherently less portable than the other devices. The size of the Eee PC does give it the advantage of having the largest screen and memory capacity but it also has the shortest battery life.

The Sony and the Cybook are of comparable size and weight, with the Sony being slightly larger and heavier. The Sony and the Cybook have exactly the same size of display screen but the Cybook has a longer battery life. The iLiad is the largest of the dedicated ebook readers and trades low weight and size for a larger display screen than either the Sony or the Cybook. The refresh rates, i.e. the time it takes to shift between pages, of the Sony and the Cybook are very similar, 0.8 seconds and 0.9 seconds respectively, and both are faster than the iLiad which takes 1.3 seconds. The Sony boots up instantaneously while the Cybook takes approximately 20 seconds and the iLiad something over 44. The Sony has the largest memory capacity (192 MB) of the three dedicated readers though the memory capacity of all the devices can be increased with the use of additional hardware. The Sony and the Cybook are the only devices not to have search and note taking facilities (although previous studies suggest that these are desirable features in an ebook reader) and they also have the lowest number of font sizes available, which are important for increasing the size of the text to make it more readable for particular users.

3. Results

The questionnaire was completed by 33 participants with eight results returned for the Eee PC, iLiad, and Cybook and nine results for the Sony. The majority of the participants were female, 85 per cent, reflecting the gender distribution in the class of 2010 (80 per cent female, 20 per cent male). The majority, 14, of the participants were aged 18-24, 13 participants were aged 25-34, four aged 35-44, and two aged 45-54.

3.1 Functionality

The functionality of the devices was evaluated using a variety of questions on a five-point Likert scale. These questions (numbers indicated in brackets) included an assessment of how long it took to use the device (3), the ease with which a user could navigate through the story (5), how long the page took to turn (6), how long the page took to turn in comparison to turning the page of a book (7), how long it took to read the text (9), how well the text looked on the screen (13), and the size of the screen (14).

When the results were aggregated it was clear that the Eee PC was the device which the participants ranked as being the most functional. The Sony and the iLiad were ranked as being equal, and the Cybook as the least functional (see Table II for a summary of responses).

3.2 Overall impressions

The overall impressions the participants had of the devices were ascertained using a variety of questions on a five-point Likert scale. The questions asked were concerned with how reading the device compared to a paper book (4), the overall experience of using the ebook reader (10), how heavy the device was (11), how sturdy the device felt (12), the overall visual experience (15), and the appearance of the device (24). It was again clear that the participants ranked the Eee PC as the device that gave the best overall impression. The Sony was ranked second, the iLiad third and the Cybook was again ranked last (see Table III for a summary of responses).

Question number	Individual rank							Mean	Overall rank
	3	5	6	7	9	13	14		
Eee PC	1	1	1	2	2	1	2	1.43	1
Cybook	3	3	2	3	3	4	4	3.12	3
Sony	2	2	3	4	1	3	3	2.57	2
iLiad	3	3	4	1	4	2	1	2.57	2

Table II.
Summary of responses regarding functionality

Question number	Individual rank						Mean	Overall rank
	4	10	11	12	15	24		
Eee PC	1	1	1	1	2	2	1.33	1
Cybook	3	4	4	4	3	2	3.33	4
Sony	2	2	3	2	1	1	1.83	2
iLiad	4	3	2	3	3	3	3	3

Table III.
Summary of responses regarding overall impressions

3.3 Qualitative responses

3.3.1 Advantages over paper books. The qualitative responses were analysed and plotted onto graphs. The responses were coded using a controlled vocabulary within NVivo with any response that was provided by more than one participant in the study being included in the content analysis. Summaries of the responses are provided in Figures 2-5.

Figure 2.
Advantages of ebooks
over paper books

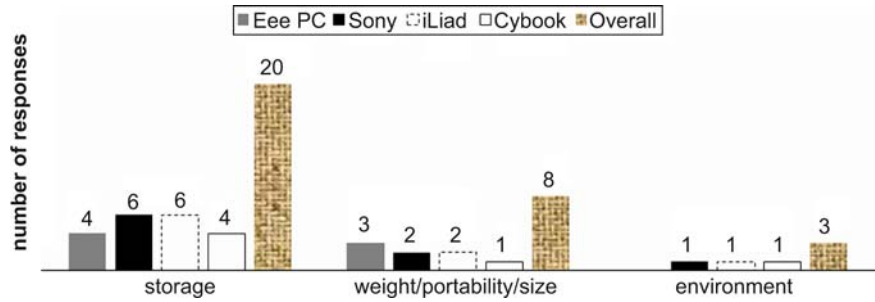


Figure 3.
Disadvantages of ebooks
over paper books

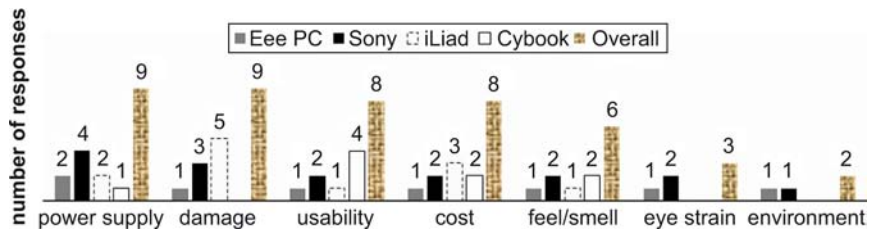


Figure 4.
Ebook features that were
liked

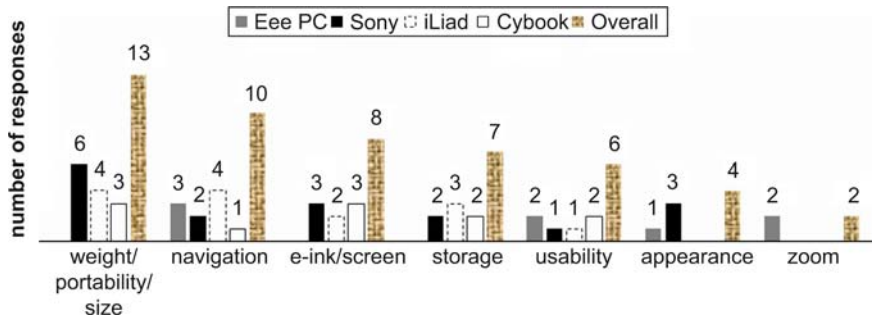
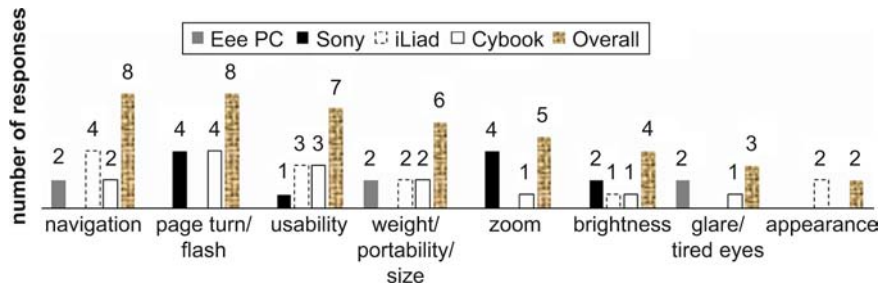


Figure 5.
Ebook features that were
disliked



It is clear that the participants in the study felt that storage was the clearest advantage that ebook readers held over books. One participant noted that “(you) can store more books on an ebook reader so it does not take up as much room . . . also all your books will be in one place and not scattered all over the house” (Sony). The next advantage was felt to be the portability associated with ebook readers, “more compact, more comfortable to read on a packed train” (Cybook). The portability of ebook readers was also heavily associated with being on the move, with seven participants commenting on the usefulness of ebook readers for holidays or for travel. Of the respondents, three thought that there would be an environmental benefit to using ebook readers.

3.3.2 Disadvantages over paper books. The participants of the study felt that the two clearest disadvantages (see Figure 3) were the limited battery life: “reliance on battery power – you can finish a paper book but not an ebook if the battery runs out!” (Sony), and the fact that damage to the ebook reader would be a more significant problem: “it would cost substantially more to replace than a paper book” (Cybook). These were closely followed by the relatively high cost of ebook readers and the fact that the devices were still not as usable as desired or expected. Participants also remarked on the loss of physical book characteristics (e.g. paper texture and smell), strain on the eyes, and potentially adverse effects on the environment.

3.3.3 What did you like about the readers? The participants highlighted slightly fewer features that they liked in ebooks than they disliked (see Figure 5). In particular, they liked the lightness and portability of the ebook readers, as well as commenting favourably on navigation capability, ease of use, storage capacity, and the use of e-ink for displaying content on the screen. Participants commented that “the screen was not wearing on the eyes” (iLiad) and that it was a “straightforward operation” (Sony), and that “the non glare screen made the text as easy to read as ink” (iLiad).

3.3.4 What did you dislike about the reader? The Eee PC was the only non-dedicated reader to be tested and the qualitative data reflected this in that particular aspects that were liked or disliked were associated with the Eee PC when compared to the other devices, and vice versa. For instance, the zoom function was exclusively liked on the Eee PC and disliked only on other devices. Similarly, screen glare was almost exclusively associated with the Eee PC. The Eee PC was also the only device not to incorporate e-ink, which was strongly liked by users (see Figure 4).

Overall, feature that participants liked least was that when the page turned on the e-ink ebook readers there was a noticeable “flash” and that “the way the screen lit up between turning the page was irritating and quite distracting” (Cybook). Other features that were disliked were the user interface and the inadequate brightness of the screen on the ebook reader. Participants commented that “the zoom didn’t seem to work well” (Sony), that “there is glare off the screen which I think would make it uncomfortable to use a long period of time (Eee PC), and that “learning to use was not intuitive, took ages to work out how to turn a page. The stylus sometimes didn’t work” (iLiad).

4. Discussion and conclusions

When a selection of first-generation ebook readers was evaluated by Wilson (2003) certain issues with the devices were identified. Wilson found that, despite getting positive feedback about the usability of the devices, the main issues were the size and weight of the devices, that they were too fragile, and that they had poor user interfaces. Wilson also compared the results from the study with the results of other evaluations

of ebook readers, including Dearnley and McKnight (2001). This led to the identification of the following issues (many of which were issues also identified by Herther (2008)):

- size and weight;
- battery life;
- navigation within the ebook;
- cost; and
- screen glare.

When the qualitative responses to the study reported here were analysed the positive features of the ebook readers were found to be large storage capacity, lightness, and screen quality (i.e. e-ink). This suggests that the issues of size and weight and screen quality are being addressed in the latest generation of devices, and that users are favourably disposed to improvements in storage capacity. On the other hand, limited battery life and lack of an appropriate degree of usability are still seen as issues which need to be addressed, even though the new generation of ebook readers have vastly increased battery life; this may reflect general expectations of battery life relative to other devices to which users have been exposed. Interestingly the main positive attribute of the earlier readers, usability, received both positive and negative responses: “it was relatively simple to use” (Sony), “learning to use it was not intuitive” (iLiad).

There were also issues regarding which there remained some residual dissatisfaction. For instance, although the majority of users felt that ebook readers were not as vulnerable as in previous studies (with 21 stating that they were either sturdy or very sturdy, eight giving a neutral response) four stated that they felt fragile. The screen quality issue has also been partially addressed by e-ink technology but this itself has produced another issue, as eight participants in this study commented on the flash that occurred when turning the page on the ebook readers (see below for discussion). A potentially irresolvable issue was the loss of the feel and smell of a book.

The results of the study show that in the majority of cases, both in terms of functionality and overall impression, the Eee PC was the preferred device. This was surprising in part as the lightness and portability of dedicated readers was strongly liked by respondents. However, this can be explained by the facts that the netbook design and layout was more familiar to participants, and that only 15 per cent of the participants had used an ebook reader before while 59 per cent had read an ebook before and on a platform similar to the netbook. The EeePC was also rated as having the best appearance of text on screen, despite not using e-ink technology.

The incorporation of e-ink technology on ebook readers has created a new issue while solving an old one. The flash that occurs when a page turns was listed as negative feature for all three e-ink devices and although e-ink may address the problem of screen glare, it clearly carries with it user acceptance problems that will have to be addressed: “the screen flashed and it was uncomfortable to watch and made you go cross-eyed” (Sony) and “I didn’t like the screen when the pages turned, it looks horrible” (Cybook). In addition to the flash, e-ink is currently unable to display colour, which limits the multi-media capability of the devices.

Although the new generation of ebook readers have attempted to address issues to do with usability and the quality of the text displayed on the screen it remains to be

seen whether they will compete with other devices such as netbooks, tablet computers, and smart phones, which offer complementary functionality. Despite the advantage of e-ink displays, which eliminate the problem of screen glare, participants in this study preferred to use the Eee PC, a device with which they were familiar. There is also an issue of what size a dedicated reader can usefully be. Devices which are too small are in direct competition with smart phones and the iTouch, while devices which are too large lose their portability and users may prefer to use trade off weight against the flexibility of lighter laptops using solid state drives or new products such as the iPad tablet computer.

There are four final results from the study are also worthy of mention, First, paper books were still preferred to e-books when reading the stories. This confirms an earlier study (Abdullah and Gibb, 2008), which demonstrated that students preferred paper books when reading longer sections of continuous text. Second, the majority of respondents (55 per cent) preferred the form “e-book”, over the alternative spellings of “eBook” and “ebook”. Third, the majority of respondents (again 55 per cent) considered an ebook to be the electronic version of a text. Finally, the environmental issue was an area where respondents held divergent views, as about one third felt that they would use ebooks because they would be better for the environment, while others were either unsure or unconvinced.

In summary, this study has confirmed some of the findings from previous studies, but has also highlighted new issues related to zooming and page turning, and has also explored copyright, environmental factors, and terminology with respect to ebooks. It has also shown that while manufacturers have addressed some of the perceived limitations of ebooks, there are other issues that remain unresolved or do not match user expectations. It is felt that the original aspects of this study are a focus on the separation of hardware, software, content, file format, and user as distinct elements when studying ebook readers. It should be emphasised that the objectives of this study were to explore reactions to the latest generation of readers, rather than to investigate how attitudes might alter depending upon the content that was being accessed, or the task that was being undertaken. This might be considered a limitation, as the reading experience will be influenced by the motivation, knowledge, skills and perceptions of the reader. However, this was done in order to reduce the number of variables that were in play, and to focus on the engagement of the user with the technology, rather than with the content. A complementary study is therefore planned to explore this latter aspect by keeping the ebook reader, ebook reading software, and file format constant, while varying the content, task and user.

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Further reading

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