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Reading and learning from screens versus print: a study in changing habits

Part 1 – Reading long information rich texts

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Abstract

Purpose – The purpose of this paper is to research the difference in reading and learning from print versus electronic media in a professional and educational setting. To what extent does the materiality of the medium influence the efficiency and effectiveness of the reader? What is needed to create “digital born” information rich texts? In Part 1, sustained reading of information and knowledge rich texts is addressed.

Design/methodology/approach – In-depth comparative tests with a great number of subjects between print-on-paper, e-ink screens and LCD screens. In Part 1 the results of tests with sustained reading of information and knowledge rich texts are reported.

Findings – All tests show that print-on-paper is still a superior medium for learning and digesting complicated and elaborate texts, whilst electronic screens are appreciated for quick information gathering, communication and navigation. Electronic representations of information and knowledge demand that the structure of the writing has to change.

Research limitations/implications – Given the rapid development in electronic displays, many issues – in particular ergonomical – become a “moving target”. An important limitation – which is one of the quests of this research – is the lack of sufficient genuine digital born texts.

Practical implications – The need to start and review the writing process; the appearance but also the structure of information and knowledge rich texts. A second issue is the need to develop easy capabilities to make an electronic text as easy a “tool” as the print text, with underlining, comments and notes.

Social implications – The development of novel ways of publishing educational texts.

Originality/value – Deep qualitative research in comparison with quantitative tests. Comparison between professional information acquisition and learning.

Keywords- Electronic publishing, Reading, Print media, Learning processes, e-books, Digital libraries,

Information dense texts

Paper type- Research paper

1. Introduction

In the authors' research programme Amsterdam E-Boekenstad (Amsterdam e-book city), a range of extensive tests was conducted on how professionals, as well as students, in higher education read e-texts. The authors investigated the use of e-reading devices in order to understand how authors and publishers must change their practices, traditionally based on a paper world, towards the flexible text-representations electronic rendering of text allows. Contrary to many informative large-scale surveys (Rowlands et al., 2007; Nicholas et al., 2008; Jamali et al., 2009), based on online questionnaires and more inclined towards measuring and forecasting the potential market, the authors tried to grasp the possible differences in understanding a text in its various presentation forms by direct interaction with the users. A methodical interesting study by Ackerman and Goldsmith (2011) shows that paper is still best suited for learning. A serious issue is the rapid pace of technical development and acceptance of electronic information and therefore an increasing acquaintance with electronic reading by students, which makes results of many studies (Heron et al., 2007; Letchumanan and Tarmzi, 2011), including this study, partly tentative. This rapidly changing technological field is also the reason why we cite mainly papers published over the last years. Cull (2011) is referred to for a good overview for the implications of digital text for reading in academe. In a recent paper, Daniel and Woody (2013) report an elaborate study in comparing the two reading modes of the same text (print versus screen) with about 300 students, although they do not report different performance in understanding, the act of reading was distinctly different.

The usage per se of e-books is also a serious concern for libraries, and various studies deal with the actual use of e-books available in the library. These studies are mostly carried out by means of questionnaires and show an increasing interest due to, among other factors, the ease of access (Christianson and Aucoin, 2005; Shelburne, 2009; Berg et al., 2010). Those e-books are mostly just electronic copies of the paper version, often enhanced with clickable references, etc. but which leave the structure of the book as it is. Thus, they only address a different way of accessing traditionally structured information and do not yet deal with the aspect of changing learning patterns through use of electronic materials. For a more general discussion on the tension between technology and communication using e-readers see Kircz (2012).

The Amsterdam E-Boekenstad project was funded by the SIA-RAAK foundation whose goal is to foster the relationship between knowledge-seeking companies and knowledge-generating schools. Hence, the tests were conducted in close collaboration with educational publishers and in the first phase of the project also with an e-reader manufacturer.

The importance for publishers is not only the transition of carrier (paper to screen) but also the ways in which content is consumed. In particular, in the case of distance learning, all document exchange tends now to go via electronic communications; however, does this mean that printing at the end-user site is obsolete? This question is highly dependent on the structure and quality of the texts dedicated to reading from screens. As our first ambition was to understand the different reading experiences between reading from screen and reading from paper, we were fortunate to be able to integrate a large project with city councils who also wanted to test the pros and cons of a changeover from paper to screen.

Interestingly, when the two-year project started on 1 January 2010, the interest was still rather lukewarm as the e-ink devices were just making inroads into the market. Despite the harsh winds of marketing, sales, and computer aficionados, the educational publishers' world did not advance very quickly in developing electronic teaching materials. The Amazon Kindle was launched in autumn 2007 and became a great success for reading novels. At the other end of the spectrum, the big scientific publishers already had their huge electronic repositories with scientific papers in HTML and PDF. For the educational market, it was not yet clear what the opportunities for e-readers were and to what extent this development would not only change the business model but also, and more importantly, the way students consume educational materials. After all, common knowledge, and also the research reported below, shows that centuries of refining paper publishing created a most versatile and uniquely usable product. In which sense, according to Hillesund (2010) reading is in a period of transition in the field of reading research.

Only after the introduction of Apple's iPad in April 2010, did a shockwave ripple through the publishing world. The tablet computer proved to be a portable multi-media device, outflanking the still relatively slow read-only e-ink readers, although e-ink readers are still superior for reading in an outdoor environment compared to backlit LCD displays. With the introduction of the tablet, the objectives were, therefore, extended from reading studies only to wider-scope efforts to understand educational knowledge transfer and the relationship between pure reading as a vehicle and the

introduction of multi-media aids, such as instruction films.

Unfortunately, not much research has yet been carried out and published on the actual use of e-reading devices under controlled conditions. Most of the published work is based on (large-scale) questionnaires or relatively small local tests. For example, the most recent large-scale American report on e-reading by Rainie et al. (2012) provides an in-depth overview of the ethnicity, the age, etc. of the users as well as the usage compared to print books, the purchasing patterns, etc. but does not break down the usages of e-books into genres. A major extra problem is that e-reading devices are developing so fast that many negative experiences of only a couple of years ago are now often no longer an issue at all, such as the loading time of a page, the speed of leafing through a text, etc. In this research programme, the authors tried to avoid the obvious and concentrate on a few fundamental aspects in the usage of e-reading devices. Our ultimate aim is to assist publishers of educational material on how to design, write, model and shape e-books for students. In order to do so, four major tests were executed. The first test was an attempt to measure the ease of reading huge amounts of content rich text from an e-ink reader. In this case, we did not use educational texts but political documents.

Here we used the IREX1000D e-ink reader (http://en.wikipedia.org/wiki/Digital_Reader_1000) which had a large screen of 26 cm (10.2 inches) diagonally, which made it an excellent device for reading PDF files in A4 format (the main paper size in Europe). In order to guarantee a heavy reading load as well as an enthusiastic and disciplined corpus of readers, we collaborated with nine city councils in and around Amsterdam. In these tests with 45 people over a period of two months, all the documents council members received for their meetings were uploaded on the Irex1000D readers. In conjunction with this test and apart from two device usability tests, not reported here[1], with students of the University of Applied Sciences in Amsterdam, whose qualitative results are interesting as a check list for designers, three major tests were performed comparing reading from a screen and reading from paper – in each test working with a different educational publisher. In the first test with students, a book was used that suited the study programme perfectly. This started with 80 students, who, for an examination, had to read a book of Van Duuren Media Publishers (www.vanduurenmedia.nl) from the Irex1000D, a laptop and on paper, respectively. Here, as in the above mentioned test with city councils, this deals with reading long informative texts.

In the two subsequent tests, reported in a second article (Stoop et al., 2013) the emphasis was more on learning from e-text per se, without prior knowledge of the subject. The choice for the specific study material (stimuli) was also dependent on what the publisher wanted to test and had available.

The choice for the Irex1000D (<http://support.irexnet.com>) was based on the fact that it had the largest screen available and hence full pages could be displayed equal in size to the paper book page. The Irex Technologies Company was also a partner in the project, but had to file bankruptcy in June 2010 due to the slow take-off of its sales in the USA. As an unfortunate result the authors did not have the opportunity to test the –much faster – successor (IREX DR800SG). This means that some negative reactions on the use of e-ink, in particular issues dealing with the speed of page loading and browsing, could not be re-evaluated.

1.1 Measuring usage

Research on reading from electronic devices is not straightforward. We must consider the following aspects: reading as such, navigation between documents, navigation within documents and technical aspects.

Reading as such has related ergonomical aspects, such as zooming, layout, sharpness, font design, etc. and physical aspects, such as wearing of the eyes, and the feel and smell of a book. These aspects have everything to do with the materiality of the device. On this issue, we see currently important neurological research, comprehensively presented by, for example, Wolf (2007) and Dehaene (2010). This research is closely related to the way we write and how texts are made and its materiality as discussed by Haas (1996). Mangen (2008, 2013) presents research about nonlinear reading. For educational texts, the issue becomes even more important as here we are dealing with an ever-stronger interaction between plain text, graphs, drawings and photos, captions, videos and increasingly interactive elements. The reader not only consumes the material, but must be able to internalize the content and also be able to reproduce it. Hillesund (2010) concludes that online immersion is very different from the hermeneutics of traditional reading. This is exactly what we try to understand, as making new – digitally born – learning materials must start from this observation. Noyes and Garland (2006) concluded from an elaborate questionnaire filled out by 274 participants that books are viewed more favourably than computers, primarily due to the physical and practical aspects of the two media. In their final conclusion they state that, as books and computers are different

tools and both are equally useful, we need to build upon this understanding in the learning situation. In other words – what content can be provided through computers and when is a print medium superior?

Navigational aspects linking between pages, such as flipping through the pages, skipping pages, book marking and dog-ears, searching for words, paragraphs, sections or chapters, etc. is manifestly evident. It is important to stress that reading an educational book, or as it is in the first test political documents, is different than reading a novel. In the latter case, we “thumb” through the pages,

eager to reach the conclusions. However, in these tests, consecutive page turning is not an issue at all. The rapid development of entertainment-driven devices makes it difficult to value all pros and cons of the various e-reading devices. For a recent comparative overview, see Gibson and Gibbs (2012).

Navigational aspects on the sentence level include references in the text to and from other text elements, illustrations, endnotes and footnotes, etc. This aspect deals with hyperlinks within a text, which is an essential feature of electronic publications. Nevertheless, given the materials tested, this aspect did not become a research object in the present study. For this discussion, see Kircz (1998), Kircz and Harmsze (2000) and Kircz and Den Boef (2013).

Ergonomical aspects include portability of the device, battery lifetime, the need for ambient light in the case of e-ink readers versus backlit screens in the case of LCD screens. Recent usability evaluations are given by Kang et al. (2009), with an overview by Cull (2011). This aspect is also a standard issue in many studies on the actual use and acceptance of e-reading devices, such as the large-scale surveys by the London CIBER group, already mentioned.

The list above is just a starting point, as presently most e-books are representations of paper versions. The basic format of a book is still the page, which is a strictly paper-oriented remnant of the past. The size of a paper page is typically a historical result of the human reading habit. The eye does not like over long sentences, and also very short lines are usually judged as unpleasant to read. In newspaper typography, there are clear rules for the column width and, as it turns out, left and right justification of the line of type reads more easily than ragged right line-endings. Moen (2000) names the following items: legibility is determined by at least eight factors: (1) type design; (2) type size; (3) line width; (4) word spacing and letter spacing; (5) leading, or line spacing; (6) form; (7) contrast; and (8) reproduction quality.

In the case of electronic devices, the page as a unit for information as well as a graphical container of content becomes obsolete – page-based standards such as PDF are like polaroids of oil paintings; they try to mimic the old, but do not share their intrinsic features. However, there is a good reason for doing so, as half a millennium of reading experiences with print resulted in many proven concepts of typography and layout. The biggest change to date is “reflowable” texts as in most e-book formats. Here, the page is often, but not always, kept as it was on paper, but enabling various physical formats of screens to represent the text. The big design challenge is not how to manipulate the sentences, but how to keep the unity of text, illustrations, tables, white lines, etc. which are essential for comprehension of most art, educational and scientific books as well as many poetic works.

The truism of this observation can be seen daily in the huge increase of sales of fiction books in an e-format like Epub, MobiPocket, etc. as reported by all internet bookshops. These books do not demand a fixed relationship between running text and illustrations.

Electronic schoolbooks are different and similarly to scientific books: the option of screen rotation, or switch between portrait and landscape modes, plays often havoc with the page layout in cases where lay-out is essential, as indeed it is in many fields.

The authors discuss four research studies. First, in part 1, two qualitative studies dealing with the issue of sustained reading from screens versus paper are reported.

Subsequently, in part 2, two studies under controlled conditions in which the authors also tried to address the differences in text structure between paper and electronic texts are reported. The reports are followed by a conclusion and recommendations for e-study books. The first test was conducted with professional readers, the others with students from the authors’ school, an institution of higher education for professionals.

2. First test: sustained reading from a screen by city council members

2.1 Introduction

This test, deals with the ease of use and the constraints of professional reading of large piles of documents on e-readers. The partners in this sub-project were the companies Notubiz

(<http://notubiz.nl/>) and Docwolves (<http://docwolves.nl/>). These collaborating companies in document management systems work for a great variety of, mainly public, organisations such as city councils. Originating from a minutes-taking company, they developed an elaborate document management system including the electronic distribution of all documents, covering the order of business of meetings, the archiving, as well as of now, the video registration and indexing of city council

meetings. Their research in the distribution of structured documents for reading from the screen dovetails with the needs and questions of educational publishers.

2.2 Research objective

The general research quest was to what extent the central distribution of all kinds of documents covering meetings from the council information system to individual council members could be organised using a paper-free e-reader environment. An important aspect for our partners, the registrars and commercial partners is the routing of versions and the dynamics of mailing lists as, in the process of policy-making, these lists change when confidentiality aspects change. This is not discussed this further in the present paper because it pertains more to information management systems than to reading content. However, even if all logistics were solved, the pertinent question of document consumption by reading remains the main issue. The preparations started in autumn 2009, whilst the actual tests were executed between August 2010 and March 2011.

The central quest was how do council members and members of the registry use and appreciate the use of an e-reader in their work, and what points for improvement could be identified. It is important to note that much information in council documents is new and of a high cognitive level. Hence, the difference between students education and the permanent education of working council members is not very large in practice.

2.3 Method

With the active participation of the registrars and their clerks, the authors approached various city councils in the Amsterdam area to interest council members in tests in which they would receive all documents on an e-reader during a period of about two months. In most cases, they also received the traditional pile of paper documents, but a few enthusiastic participants insisted on working electronically only. In most cases, the Irex1000D was used, as described above. During council meetings, constant reference is made to particular sentences, clauses and other items in documents. Furthermore, after deliberations, the various texts must be voted on. For that reason, the fixed page layout is essential.

Before the test, a questionnaire was sent to all 241 council members of the participating councils to find out how the actual document handling was performed. After the tests, evaluation discussions were held. The authors opted not to use a second questionnaire, as it was not a quantitative test but a qualitative one, to try and find out real usage and experiences. In this report the focus is on the qualitative conclusions as they inform about the possibilities of using e-readers in professional reading. As, during the tests, many council members became accustomed to reading from screens and now use notebooks, tablets, e-readers, etc. the interest was focused on what can be improved if we change from paper to screens. As mentioned in the introduction, the field is moving rapidly and many ergonomical and logistic aspects improve by the day.

So, those comments that are irrelevant for the appreciation of ever changing present-day e-readers are omitted.

2.4 Sample

Tests were conducted in nine cities and boroughs in the wider Amsterdam area. The participating council members and registrars received their documents via Notubiz' infrastructure by logging into a dedicated server. Depending on the enthusiasm, two to 11 people per council worked with e-readers within a minimum of nine weeks. This period was chosen because it allowed for a minimum of two commission meetings and two full council meetings.

In two cities, Amstelveen and Zaanstad, next to the Irex1000D, the authors also used the iPad1, which had just hit the market. In the case of Amstelveen, the test, which was more a first exploration, was not fully the same as with the others councils, but the results as expressed in the evaluation discussions in the conclusions are incorporated. In the case of Zandvoort, unfortunately no clear reportable results

emerged and they are omitted from the results. In Table I, an overview of the cities and participants who completed the test is provided.

2.5 Results

2.5.1 The document deluge.

At the start of the test, a questionnaire about the actual use of paper documents was sent to all council members of the participating cities, totaling 241 people, of which 90 returned it on paper and 22 digitally, (total 112 or 46 per cent).

On average, council members receive more than 100 pages of text per meeting. In meetings where complicated dossiers are discussed, such as budgets and zoning plans, the amount of paper can go up to several hundred pages per meeting. Often, (parts of) the documents – in an earlier version – are being distributed to council commission meetings before final versions reach the full council meeting. For council members, who in all cases are only part-time politicians, the information overload is large and storing and handling is complicated.

City	Inhabitants Rounded off	Council members	Participants	Percentage female	Youngest age (years)	Oldest age (years)
Almere	190,700	39	4	50%	33	71
Amstelveen	81,800	37	2	No data		
Amsterdam-Borough Centre	82,700	29	4	0%	25	61
Amsterdam Borough – West	13,000	29	6	16,6%	26	50
Edam-Volendam	28,600	21	5	60%	19	57
Waterland	17,100	17	4	50%	38	61
Zaanstad	146,900	39	11	45%	31	64
Zandvoort	16,600	17				
Zeevang	6,350	13	4	75%	51	68

In 80 per cent of the cases, council members received the documents on paper as well as electronically, per e-mail or as a file to be downloaded from the council web page; 13 per cent received a paper version only, and 7 per cent an electronic version only. The number of pages involved means that the logistics and paper consumption are considerable. This was one of the reasons for the registrars to participate in this project.

In the case of updates – for example new versions – an increase in electronic dissemination to only 17 per cent was seen. Interestingly 12 per cent of the respondents did not compare updates of the documents with the originals, whilst 15 per cent said that they compare new documents, line by line, with previous versions.

On average, council members spend 17 h per week on this work, most of the time in meetings. When a member is the spokesperson for a subject, 98 per cent will carefully read the documents. However, if a member is not the spokesperson, only 10 per cent of the members fully read the documents. As mentioned above, all documentation for this test, as well as documentation for the following tests, are available in Dutch on our web site.

2.5.2 Paper document use.

As with educational reading material, the documents are information-carrying tools and writing on the documents is part of the process of digestion of the content. More than 30 per cent of the respondents underlined sentences, scribbled in the margin, used markers, etc. About 7 per cent used post-it stickers or look-alike aids to mark text. 6 per cent make dog-ears to retrieve the relevant pages and 16 per cent used separate paper sheets to note all comments, often on the first or last page of the document in question.

It goes without saying that in a digital-only environment, this memorizing and commenting behaviour has to be transcended into electronic aids. Only 5 per cent of the respondents throw all paper documents away immediately after the meeting, independently of whether or not the issue at stake

will return to the agenda. 12 per cent retain those documents that deal with still-pending subjects. 60 per cent retain documents they consider important as such. 16 per cent retain all paper documents. In the case of electronic versions, which remain on the online archive of the council, 37 per cent of the members indicated that they retain everything on their own computer.

2.5.3 Electronic document usage.

As asked in the evaluation discussions, the participants rated the importance of the various functionalities typical for the Irex e-reader, targeted to their use as council member (and not, for example, by using the device for reading downloaded books). The answers are discussed below starting with the most important feature.

(1) Readability. Participants rated the legibility of the text and the ease of reading high. Unfortunately, if the letter size was enlarged (e.g., in order to read without spectacles), the overview of the page was lost. This is typically the dilemma between the order of the pages that must be the same for all users, and reflowable text as in e-novels where font size can be changed without consequences, but where the

coordination with other users gets lost. In that case, two or more readers cannot refer to the same page anymore.

(2) Search function. Searching in the documents hosted in the e-reader is possible. Although a strong opinion came to the fore that online searching for related information, not only in the council document archives but also on internet pages or services, was imperative. Here it can be seen that the step from paper to electronic immediately induces demands that belong to electronic storage as such. In the paper world, a simple index was considered sufficient, but as soon as the step to electronic is taken, all available electronic features are considered relevant and are demanded by all. Thus, when going over to an electronic document, all electronic capabilities have to be incorporated. Whilst the prime concern was the ease and quality of reading, these aspects became essential. Such as the demand for systematic indexing of documents by subject as free-text searching is not sufficient. At present, and also as result of these conclusions, Notubiz has all public information of the cities they work with in an online searchable archive (www.politiekarchief.nl/).

(3) Text editing. Text editing and making notes on the text were perfectly possible with a special stylus. Unfortunately, the speed of the stylus was too slow. This is a typical hardware and software problem on how overlays or changes in documents by the reader can be implemented and stored. This technical issue is still in full development in all e-reading device developments.

(4, 5, 6) Browsing speed, battery lifetime, and memory. These are typical issues that continuously improve performance.

(7) Screen size. Here the important issue of full-page presentations is touched upon. Present day tablets have about the same size as the Irex1000D and are well suited for full-page viewing. Because it was not rated as the most important feature might be induced by the fact that the pages were actually readable in full, and no tests with smaller screens were performed.

(8) Weight. This was considered no problem as the test people were used to stacks of paper.

(9) Private use. Interestingly, those testers using the e-ink-reader did not see a serious usage for private activities. It is necessary to take into account that the explosion of e-novels was still to come. However, the few users, in Zaandam and Amstelveen, who used the iPad1, did indicate that it would be good for usages other than only for reading official documents.

2.5.4 Conclusions of test one.

One of the aspects of this test was the logistics and coherence of the various documents streams. After all, a set of documents pertaining to various subjects is discussed and often voted on at meetings. Hence, the issues of version control can be seen, including auxiliary documents such as motions and amendments to policy papers that are often tied to a particular version of a document. Here we have a subject-related collection. On the other hand, we also have collections that overlap many subjects, such as all documents in preparation for budget and control meetings. On top of that, many policy papers are deeply related to others, for example, the budget for school building renovations with plans for a car-free street, the role and place of the public library and many aspects of social welfare. In that sense, we see an environment with a rich multi-dimensional structure, fit for structured hypertext. In the test, the documents for one meeting were integrated as one large file with internal hyperlinks. Nevertheless, people preferred to receive the documents piecemeal, in particular because most council members want to read documents and prepare interventions and possible amendments and motions stretched out over the week. Reading from an e-reader was certainly an advance as they could take, as

they say: “the whole pile of documents” wherever they went. The e-reader also mimics the private “archive” and enables one to look back at earlier related discussions, versions and drafts.

For all those reasons, the authors concluded that in order to go over to a digital-only environment, we have to start with a proper document management system and clear logistics that enable reading from multiple reading devices, including print on paper, as well as clear indexing of related documents. This last point is particularly tedious as, after new elections, the division of fields in commissions changes. A public space might be one with housing and squares and in a next phase in the same cluster as

traffic and the environment. Thus, the labels to documents in a parliamentary period, and even the way they are phrased (greens and parks, can be renamed in environmental planning) do not always guarantee a consistent wholeness with the contents discussed. For the registrars involved, it became crystal clear that the way documents are written and prepared must change. Traditionally, the documents are built up in a scheme that starts with a whole review of how this issue came into the discussion and what already has been said and done in the particular case. On paper people can simply skip those pages, in order to go to those parts that demand a vote. Browsing on a reader or scrolling on a screen is a different thing. The materiality of paper allows for quick flipping to and from pages with the traditional aids as dog-ears and sticky notes. In an electronic environment, it turned out to be much more cumbersome. This induces a discussion on the changing practice of the writing order and structure of a document.

It is important to note that these problems are obviously similar in current electronic educational environments, where courses can change, and often are renamed, whilst keeping large chunks of information unchanged. E-reading is not only a matter of reading, but is intrinsically deeply tied with the structure of the document and subdocument management. The pile of documents with a green marker for all documents dealing in some way with parks, greens and trees stowed away in the hall closet, cannot be transferred to an e-reader without a total redesign of the documents at issue.

3. Second test: reading a long text from: paper versus laptop versus e-ink e-reader

3.1 Introduction

In the second study, 81 students from the “marketing, media, publishing” programme participated. They had to read the marketing textbook “digitale marketing en communicatie” (digital marketing and communication) by Schuurmans (2008), which is part of the curriculum and required reading for the subject “online marketing”.

30 students studied from the printed book. Another 28 students received the material as a PDF file and studied the material on their own laptops. The last group of 23 students received the same PDF version, but used the e-ink Irex1000D e-reader, mentioned above. The important issue here is that the same page layout in all cases is dealt with. Interesting studies of Chong et al. (2008, 2009) report the student preferences for the pure navigation and layout aspects of PDF versions of books. These recommendations are important in order to convert a page to a web environment, but do not deal with the structure of the content.

3.2 Research objective

Here the research question was defined as:

How do students, who enrol on a course on the subject “online marketing”, experience and appreciate studying from their prescribed book by using a PDF file on an Irex1000D, the same PDF file on a laptop, and the print book version, respectively?

3.3 Method

As not much was yet known about the use and appreciation of e-books in higher education, this research project was exploratory and had a qualitative set-up. The primary goal was to gain insight and understanding. Before, during and after the test, group discussions were held. In the first round of discussions, before the experiment took place, 30 students participated, while 66 students participated in the discussions during and after the tests. Students were asked to keep a logbook. The discussions during and after the experiment were analysed together. The total duration of the test was 12 weeks. Just as in the first study, reading the material provided was needed in order to function in a real-life setting, rather than laboratory tests as the subsequent tests are. Participants were motivated to give it their best try as it affected their own functioning in school. The broad discussion meetings on the

teaching material and the reading experience showed sufficient insight to abstain from statistical analysis, which would not provide deeper knowledge about the issues at stake.

3.4 Results

3.4.1 Test group Irex users.

The students placed in the “Irex group” were very enthusiastic about it at the beginning, but when the actual experiment started and time passed, their enthusiasm diminished quickly.

The logbooks they kept told us that initially they used their Irex quite often, not so much to study from, but to show other interested people, who had never seen an e-reader before at that time. They tried and tested all functions and quickly became more negative. All in all, these students concluded that the PDF file on an Irex offered little to no added value compared to a paper book. This conclusion concurs with the conclusions of the first test.

During the test period, the students were asked to study only from the version they received at the beginning of the test. The most striking result was that almost none of the “e-reader group” students ended up studying from the Irex.

They felt using the Irex an obstacle to their learning process. The biggest obstacle was that as the Irex was relatively slow, both in starting up as well in processing and “turning pages”, they could not study properly with it. People studying do not read a book from cover to cover, but jump from page to page, and chapter to chapter. They go to and fro through texts and compare pages, pictures and tables. The e-reader was too slow for this type of reading. Another problem was that the e-version only shows one page at the time. It does not permit fingers or pieces of paper between pages, although bookmarks are available. This is a general problem of e-books. It looks more a scroll than a book. Furthermore, in the e-version, students could not make notes easily. The Irex does allow the making of notes with a special stylus, but writing legibly demanded serious training and patience. A remarkable insight was that the “e-reader group” postponed studying for their examination for a longer time than any other groups. The expectations they held beforehand about studying with an e-reader could not be met.

Apart from technological disadvantages, the design of the e-reader was not appealing either. They could not believe that it was in black and white only, and found it too large to take with them in their bags, which is remarkable as the paper book was not much smaller but heavier. The e-reader appeared not to be as cool a gadget as they thought it would be. E-ink readers are well suited for continuous reading, but lack the functions of a laptop. The perception of the students was that a novel device must incorporate all functions, something nobody expects from a book. Hence, the change from paper to

e-ink was considered old-fashioned and not useful. As it turned out, the students from the “e-reader group” either bought the paper book, used the e-book on a computer or laptop, or found ways to print the e-book.

3.4.2 Test group laptop users.

The students using a PDF file on their own laptops experimented with the possibilities of the e-book. They soon found out that there was not much they could do with the file. In their logbooks and in the group discussions, they complained that they could not mark, save changes, or copy and paste. The e-book was protected, so they could not “copy and paste” parts in order to make a personal summary, nor make notes in the document. Apart from technological constraints, another big disadvantage concerns the lack of easy reading. As the book has about 200 pages, many people complained about weary eyes. Most importantly, the laptop they needed for reading their book, turned out to be a very distracting medium. Pop-ups from e-mail, Facebook and other social media often spoiled their concentration. It was a disappointment that this “e-book” was nothing more than a scanned version of the paper book, whereas technology – in principle – would make it possible to add more dynamic functions such as audio or video.

The biggest advantage was that now their book was “mobile” and local, as it was downloadable from the web. In practice they always had it with them as they carried their laptops wherever they went.

Another advantage was the search function. The clickable index was also appreciated.

Interestingly, half of the “laptop group” students cracked the code of the protected e-book and printed it on paper. Learning such a large text from screen did not work for them.

The people who did learn from the screen either could not crack the code or considered buying the paper book as too expensive. As with the Irex group, the laptop group did not consider learning from screen an improvement, it did not provide any added value for the students who used them – it hindered them in their studies.

3.4.3 Test group paper book users.

Finally the paper group at first they thought they would miss out on an interesting experience, being in the “boring” group, but afterwards, they had nothing to complain about when they learned about the negative experiences of their fellow students. From their logbooks, it becomes clear that of all students, this group of students spent relatively the longest time studying. However, as many students from groups 1 and 2 switched back to paper during the experiment, data are hard to compare. Students studying the print book said they studied as they usually did, they did not meet obstacles, they read great parts of the prescribed texts and they made summaries. Their concentration during their studies was high, as they were not easily distracted by other functionalities of the “device”. The only disadvantage they could think of would be the weight of the book. However, as they were also used to carrying books, this was not considered a real disadvantage.

3.4.4 Conclusions of test two.

An important conclusion to be drawn from this experiment is that students were willing to try something new. Functionality turned out to be the key criterion for continued use or not. The functionality of both the e-book itself (an “ordinary” PDF file that was protected and therefore could not be manipulated) and the e-ink reader were very disappointing for these students and hindered them in their studies. Obviously, reading for study is something quite different from reading a novel. While studying one wants to be active with a text, as was the case with the test with council members – that means marking, making notes, copying and pasting. Furthermore, one does not start on page 1 to end at the last page, but one needs to go to and fro through a text. This is in line with the conclusion of

Ackerman and Goldsmith (2011, p. 29) that:

[. . .] the decisions to print digitally presented material before study might be viewed as a meta-metacognitive control decision that transfers the study materials to the more subjectively reliable context of paper learning.

So the navigation technology must be easy and speed must be high. Students of groups 1 and 2 experienced little to no added value – on the contrary they struggled with the immature technology. The “e-book” offered nothing more than the print book in a scanned version. Students from groups 1 and 2 experienced a lack of overview, due to much necessary scrolling in the PDF file on the laptop and due to technical imperfections, in particular page-turning speed of the Irex. This is also the conclusion of Woody et al. (2010, p. 945), in a test with 91 students half of whom used an e-book version. They also conclude, as we do in this paper, that “the design of an e-book may need to differ from that of a textbook to make a more constructive user experience”.

Furthermore, Brunet et al. (2011) conclude in a nine-month study with dental students that the electronic bookshelf leads to mixed opinions.

Thus, at the time of this research project, neither e-reader technology nor e-books were sufficiently advanced to add significant value when reading for study purposes. Apart from the required faster and more advanced technology, these students also expected the e-book content and design to be innovative. An e-book should be more than a simple digital version of a print book. It should also make use of opportunities such as adding sound and video and also linking it to internet. The Irex was not perceived as a “cool gadget” (whereas the iPhone is). The design reminded them of the first black-and-white televisions, which interestingly they do not know from their own experience. They talked about it as “that thing”, which shows that they did not find it especially appealing.

4. Summary, general conclusions and recommendations

In the programme, Amsterdam E-book City, the authors have tried to understand how reading from a digital screen could influence the quality of learning and how the learning material might be reconstructed in order to increase efficiency and effectiveness. With this in mind, the authors started with the issue of reading per se, using an e-ink reader known for its good large jitter free screen quality. The first test was with nine City Councils in the Amsterdam area. Council members are dedicated readers with a professionally high reading load. The question was to what extent the document flow and the handling of documents could be improved by electronic means. During this test period, with third generation e-ink readers, the iPad1 was introduced. In a way, this interfered with the original quest as now more functions, such as communication and web searching, became available. However, it sharpened the research goals. Reading from an e-ink reader turned out to be appreciated on essentially the same principles as why people love novels on an e-reader. It is portable,

clearly readable and a reader can host a great many documents. Apart from the more technical aspects of documents delivery in tune with the meetings scheme of the councils, using e-readers was considered an advantage compared to print, as long as dealing with the reading experience as such. The real problem turned out to be the capabilities of browsing, annotating and referencing. Despite electronic aids, dog ears and sticky notes are superior in re-finding a pertinent paragraph. Note taking could be done on the device but a piece of paper did better. Furthermore, the fixed format of an A4 print with hand written notes is easier to comprehend than electronic comments. The authors have to take into account that we used PDF files, in where, at that time, notes could not be integrated.

A more intrinsic aspect that emerged was the very structure of the documents. Parliamentary documents have a more-or-less fixed structure. People are used to skipping easily parts where they do not expect to find those particular aspects for which they are looking. Electronic documents can have a much more modular structure, enabling different readers to have different reading paths.

Furthermore,

switching to and fro between related pages and having various related documents “open” is an important demand. In discussions with the Council Registrars, this was considered an important issue in an attempt to reduce the workload of council-members while keeping the integrity of the completeness of the documents. These discussions dovetailed with the ideas developed earlier on the modularisation of academic texts (Kircz, 1998; Kircz and Harmsze, 2000; Kircz and Den Boef, 2013, and references therein).

Interestingly, and not unexpectedly, the results of this reading test also merged with the subsequent studies. Partly simultaneously, together with our partner Van Duuren Media, the authors tested 81 students divided into equally large groups. These students read a book that was preparatory for an examination. One group obtained the book as a PDF file on an e-reader, one as PDF on their laptop and one read the book from print. Here, reading as such also turned out not to be the main issue.

Again, browsing and annotating turned out to be essential. Interestingly, opposed to the council members who considered the integration of electronic documents with online searching an important novel asset, the professional students considered the pressure of online communications very distractive. Print won in all categories. Interestingly, in subsequent studies, students rated the integration of social media in the study material of great value in order to exchange findings and problems, although this could not be substantiated. In a way, one can phrase this as a tension between the discipline of the book as an independent object and the desire to share knowledge with peers, though within the context of the learning material.

In a second part of this research report to follow (Stoop et al., 2013), the results are given of two tests with each about 180 students. Here, under controlled conditions, different text structures of educational texts are compared in order to understand the difference between reading from paper and screen.

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Note

1. All full reports of the entire project are available in Dutch online at <http://eboekenstad.nl>

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