

**Instellingsbreed Programma Onderwijs IPO
Open Universiteit Nederland**

Towards an educational model of eReaders in education

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IPO rapportenreeks

De Open Universiteit Nederland ontwikkelt en verzorgt open hoger afstandsonderwijs. Omdat de Open Universiteit wil transformeren van een instelling van voornamelijk schriftelijk afstandsonderwijs met face-to-face begeleiding naar een instelling waarbij sturing via het web centraal staat, is een Instellingsbreed Programma Onderwijs (IPO) in het leven geroepen. Alle centrale innovatieve onderwijsprojecten van de Open Universiteit Nederland zijn in dit programma samengebracht. Het doel van het programma is een bijdrage leveren aan de onderwijskwaliteit van het onderwijs van de Open Universiteit en aan de transitie van de Open Universiteit naar een Instelling die kwalitatief hoogstaand flexibel, open, gedigitaliseerd (webgestuurd) afstandsonderwijs aanbiedt. In het programma staan de volgende thema's centraal: de elektronische leeromgeving, begeleiding, toetsing en tentaminering, kwaliteitszorg, multimedia en onderwijsontwikkeling.

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This report is an internal report for the Instellingsbreed Programma Onderwijs (IPO) subproject 'E-Book' from the Open University of the Netherlands. The goal of this subproject is to examine the possibilities of creating electronic educational material for the Open University of the Netherlands and distribute that to mobile devices of students and teachers. The goal of this report is to scope the market for eReader hardware and application possibilities.

Summary

The use of eReaders is expected to grow significantly in the near future. And there are a number of different application options for eReaders. The application option that is the main focus of this report is, the use of eReaders in education. At this moment there seem to be two different classes of eReaders. The main difference between the two lays in their service functionalities. The first group of eReaders, the eBook Readers, are mainly meant to substitute reading *printed* books, and the second group, the ePaper devices, aim at substituting *paper* in general. For both classes usage models are presented. These eReaders have the potential to become very successful, in and outside of education. However, that potential success depends upon a number of factors, and how a number of issues are resolved. For eReaders to truly be a success in education, one of the crucial factors will be, the way eReaders are integrated and connected to the content of the courses.

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Introduction

Once in a while a new technological development can create a revolution. One of the most recent examples can be found in the music industry. It was the brilliant combination of the internet, mp3, and the iPod that created a massive change in the music industry, and in the way consumers buy and listen to their music. When looking closely into the matter of the publishing industry, we can almost feel that something similar is about to happen. Through the internet, many people have access to a huge range of electronic documents. The PDF format can almost be seen as the mp3 equivalent of the publishing industry. The only thing that seemed to have been missing for a while, was a new piece of hardware that could do for electronic texts, what the iPod did for mp3's. In the last few years, a number of different devices (eReaders) have made been introduced in this market. However none of them has taken the lead. The main objective of this report is to analyse and compare the use of these already developed eReaders, with a specific focus on their use in educational settings.

What is an eReader?

The definitions used in literature, articles and on the internet, are often confusing because different people tend to use different definitions when talking about eReaders, E-Books, etc. To create some clarity in this confusion, the definitions that will be used in the current article will first be explained.

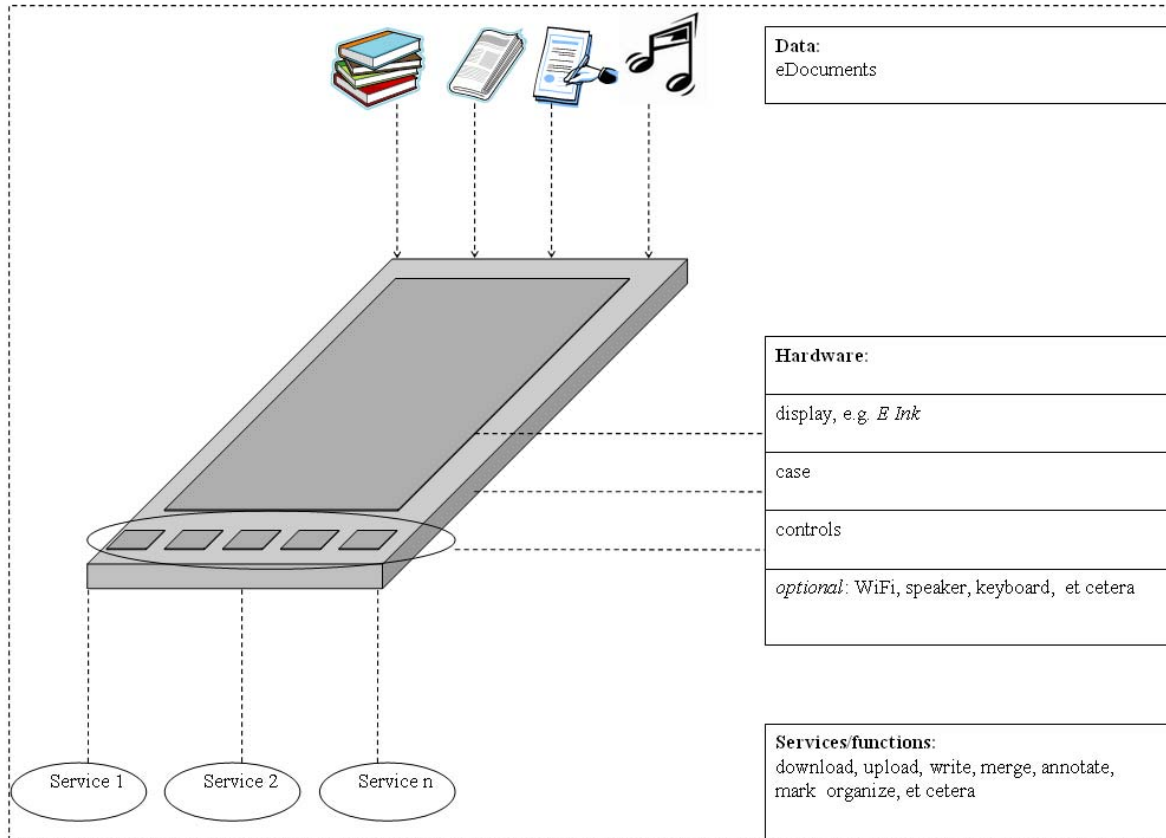
In this report when addressing the actual devices (hardware), on which ebooks, newspapers or other electronic documents can be stored and read, the umbrella term eReader will be subdivided into the more specific categories eBook Reader and ePaper device. The reason for this distinction will be explained thoroughly later on in this report.

When addressing to the content on those eBook Readers and ePaper devices, the term eDocuments will be used. An eDocument in turn can be a number of different things. It can be an eBook (electronic version of a book), some PDF file, a Word document, a graphic, an index, et cetera. Then there are the possible derivatives from those eDocuments like podcasts. For practical reasons the scope of this report will be limited to eDocuments (eBooks, PDF, Word documents, etc.) and not the derivatives.

So, coming back to the question; what is an eReader? An eReader is a device, a piece of hardware, developed for reading electronic documents. It is a flat, lightweight device, which mainly consists of a screen and some navigation controls. It looks a bit like a tablet-pc. Most eReaders have a large memory (internal or external), so a large number of books and/or other documents can be stored. The main new technological feature of the eReaders is the screen, which is an electrophoretic display often called electronic paper. The type of electronic paper that is most often used is E Ink.

One of the main reasons why none of the already developed eReaders have taken the lead in the market, may be the fact, that there is lack of open, standardized document formats. Several proprietary formats have been developed that can only be used by one type of eReader. One of the crucial developments to make the phenomenon eReader a success depends upon the standardization of formats needed for the documents, and the support of these formats by the eReader manufacturers.

Terms and definitions represented in a layered model.



Why use an eReader?

Different people may want to use electronic texts for different reasons. But the main reason for reading an electronic document on an eReader instead of a laptop, is the display technology (*electronic paper*). Where regular laptops and other similar devices use a backlight to illuminate its pixels, electronic paper reflects light like ordinary paper and is capable of holding text and images indefinitely without drawing electricity, while allowing the image to be changed later. The electronic paper is considered to be much easier on the eyes, compared to computer screens, and is therefore much more comfortable. Also, specific controls in the hardware make it possible to move back- and forward through the pages, in a natural way (actually flipping the pages). As usual, specialized devices have the advantage of doing one thing well.

There are a number of different application options for the eReaders. But basically these devices are interesting for everyone who wants, or has to *read* a lot. One of the first application options can focus on the recreational reading of books. The main advantage for

this type of users lies in the fact that they can now easily carry a large number of books with them at the same time, while it is only a fraction of the weight.

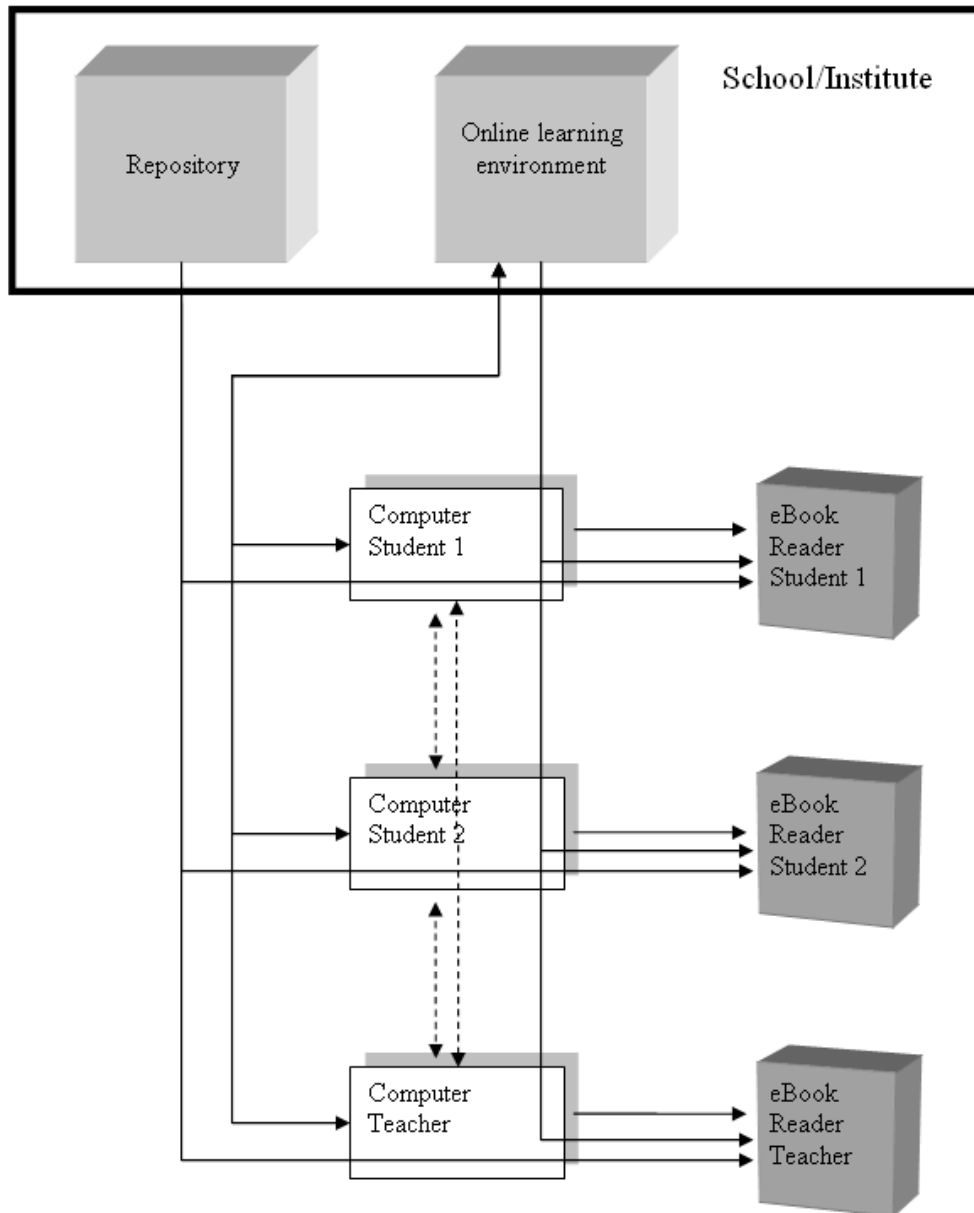
A totally different opportunity for these devices lies in the features they possess which are very useful for people with certain disabilities. For example, the ability to magnify the texts opens up the use of eReaders for older people, people with visual impairments or dyslexia.

Another big opportunity lies in education, and the professional world. Especially for students and professionals (who have to read a lot), these devices could come in handy. As mentioned above, in this report the main focus lies on the usability of the eReader in educational settings: what it can do for education, and how it can be used. First the distinction between the two types of eReaders will be explained by using different models. Then the consequences these models have, for education, will be discussed. Additionally the already existing types of hardware will be positioned into the models.

Two different eReader Models

At this moment there seem to be two different classes of eReaders. The main difference between the two lies in their service functionalities, which may also be a reflection of their goals. Where the first group of eReaders, the eBook Readers, mainly are meant to substitute reading *printed* books, the second group, the ePaper devices, aim at substituting *paper* in general. (See appendix 1 for a list of devices and their position in the two classes.)

The first group of eReader devices can be classified as eBook Readers. They have been designed for reading books and electronic documents. The use of the eReaders in this first class, within an online learning context, can be described by *Model 1*.

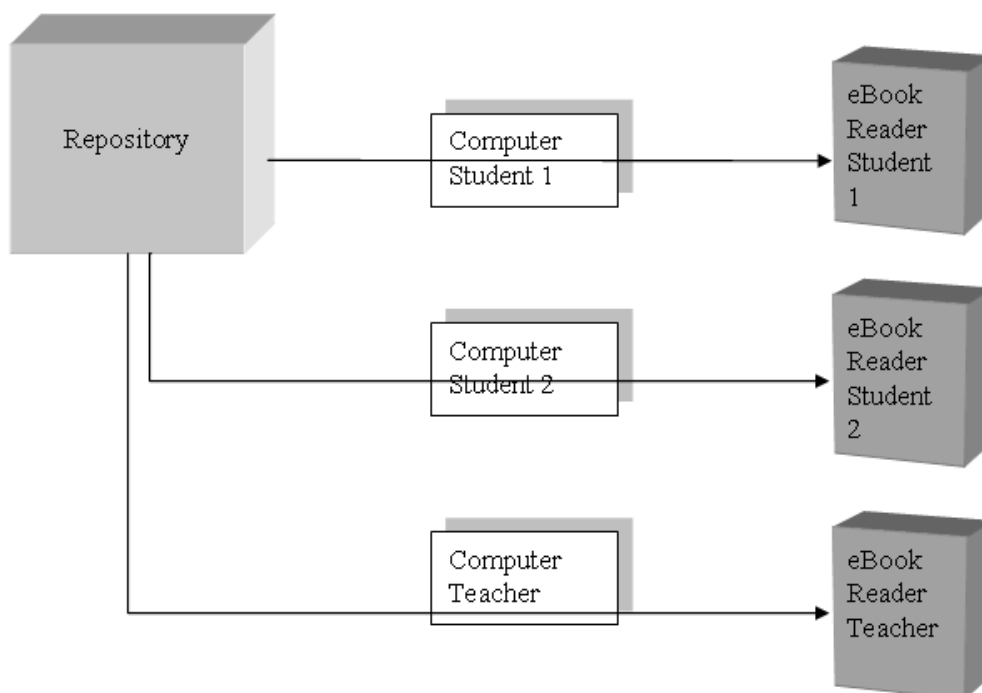


Model 1. Use of eBook Readers in education

The model starts with the school or institute in which a student is enrolled. This school or institute may provide a general repository of eDocuments, a collection of electronic, downloadable study books, articles and other artifacts. From this repository a student may retrieve eDocuments either free of for a fee. Usually the student will need a computer as an intermediate device to download the documents to his/her eBook Reader. Beside documents from the repository, a student may also transfer other documents to be read from his or her computer to the eBook Reader. These documents can be of any kind, as long as the document format is supported by the eBook Reader. A student may read an assignment that he or she produced on the computer, on the eBook Reader. Similarly, that same student can also read documents from other students, or teacher comments, sent through e-mail and transferred to the eBook Reader. In turn, teachers may also read their students' documents/assignments on the eBook Reader.

Another type of application may lay in the delivery of eDocuments though the institute's online virtual learning environment (VLE). Within this VLE students may interact with each other, share documents and find all kinds of information about the courses they are enrolled in. The eDocuments belonging to the several courses can be downloaded from the VLE to the students' computers and transferred to the connected eBook Reader.

However, since these eBook Readers have only been designed for *reading*, it may be expected that the actual practical use of this class of eReaders will be limited to the model presented below (*Model 1**).



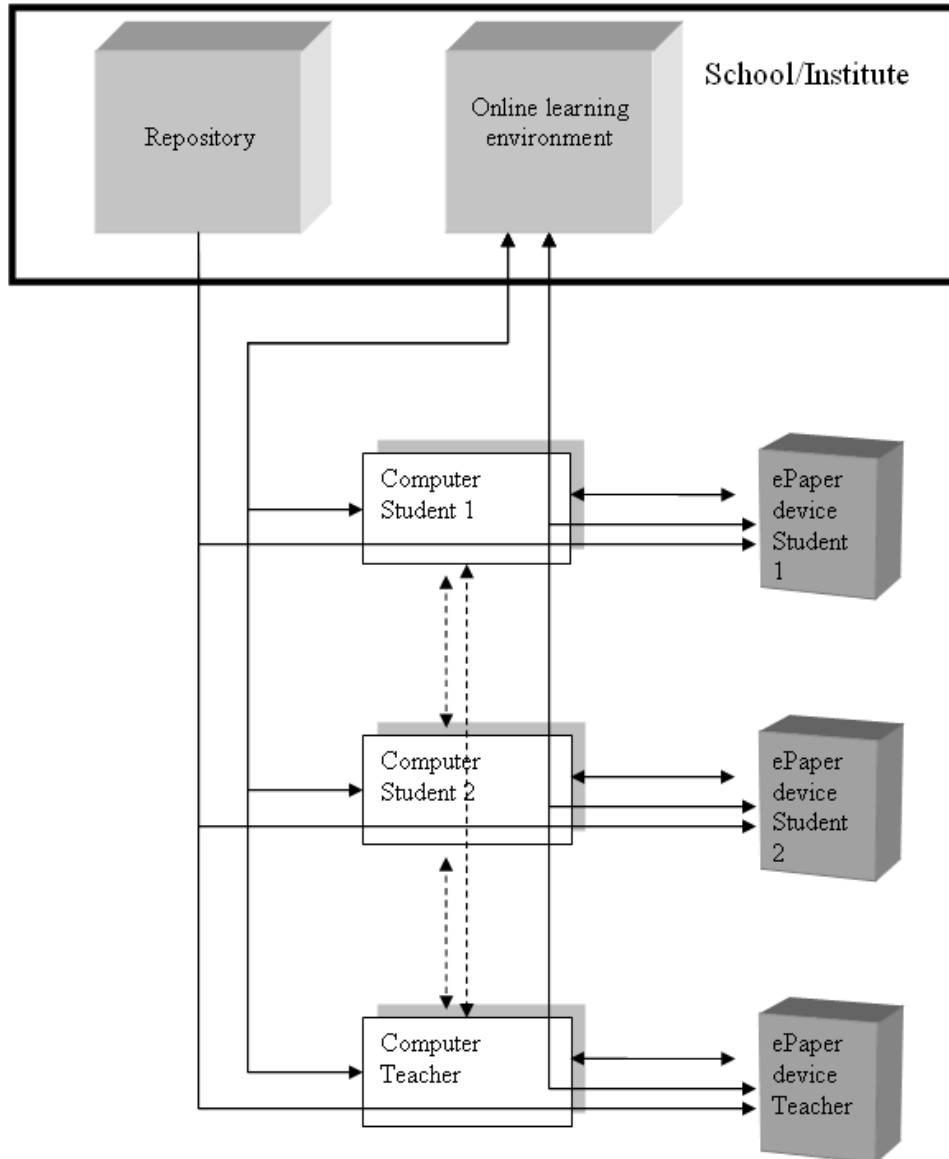
Model 1: Use of eBook Readers in education*

Although it is perfectly possible to read one's own documents or those of other students on an eBook Reader, it is not possible to comment on documents or highlight text, using this type of devices. It is not very practical for a teacher to read a student's assignment on an eBook Reader when he or she cannot write comments or corrections on it. Similarly, it is not practical as a students to read your own documents on an eBook Reader if you cannot edit them. So, the main use of this eBook Reader will probably be limited to reading books or static study materials.

An additional complication for the use of these devices in education lies in the fact that most eBook Reader have a rather small display size, where most PDF files have been optimized for delivery and reading on A4 format. It needs a lot of effort to change the documents to the proper format. In some devices input of textual content is possible, either by a physical keyboard or a virtual keyboard. The practical use of such keyboard input is often limited. So, the best way to use this kind of eReaders is probably just to read recreational books.

As mentioned earlier, the second class of eReaders is being designed as a substitute for paper in general. This means that besides *reading* texts, like on an eBook Reader, you'll be able to

do almost anything you can do with ‘traditional’ paper. For this reason this type of devices will be addressed as *ePaper devices*. Services that are already present for this kind of devices are highlighting words and sentences, making notes, drawing, et cetera. This user input can be saved along with the original document, or as a new document. The potential use of these ePaper devices is illustrated in *Model 2*.



Model 2: Use of ePaper devices in education

This second model may look somewhat the same as the first model. However, because of several additional functions or services, its use gets a whole new perspective. The repository in the model still holds the schools or institutes online collection of downloadable study books and materials. Students can still retrieve eDocuments from this repository, in the same way as in model 1. The main difference when using ePaper devices, opposed to eBook readers, is that students can interact with the content through these devices, and not only read the documents. This functionality may increase the functional use of these devices substantially. Additionally, because the highlights, notes, and drawings can be saved as a part of the original documents, or as a new documents, the ePaper devices not only seem to be substituting traditional paper,

but also provide the advantages of using electronic documents on a computer. In a web2.0 fashion, students may share their notes on their ePaper devices, simply by uploading their annotated eDocuments into some kind of workspace in the online virtual learning environment.

This is a clear advantage over using traditional paper, because usually the notes scribbled down while reading study material are not easily shared with other students. Notes made on ePaper devices however, can be easily uploaded and shared within the course community. This functionality may be particularly interesting for use in distance education. (See appendix 2 for a flowchart of what the usage of ePaper devices in education will look like.)

Discussion and conclusions

In general, eReaders have the potential to become very successful. However, that potential success depends upon a number of things. For one, the development of document standards for eBooks, and the support of those standards by device manufacturers is a crucial factor. Also, problems concerning copyrights have to be resolved. This issue however, will not be discussed further, for it is beyond the scope of this report. Second the current price of eReaders is conceived too high. At this moment eReaders in general and ePaper devices in particular, are very expensive. For eReaders to become interesting for a large audience, the price will have to drop significantly, probably half of the introduction price. The tendency is now for rising prices for the top models. Third, in particular ePaper devices are in an early stage of development, and there are still major new developments going on in this field. New models of these devices with additional functions are following each other very quickly. Last, new devices and interfaces are coming up in the market, and eReaders will have to compete with them.

What also will be critical for the success of eReaders are the ‘services’ that will be available along with the device. For example, if someone has purchased an eBook in an online bookstore, and accidentally deletes it from the eReader, is it clear that the owner should be able to download the book again, have access to a back-up copy and should not have to buy the book again? Also, can you ‘borrow’ an eBook or eNewspaper from other people as you would with a traditional book or newspaper, or does each member of a household have to buy the book/newspaper separately? Providers of eBooks have to rethink their business models with respect to these questions.

In education the use of ePaper devices can have obviously advantages. Especially the ePaper devices create challenges for reshaping educational processes, as user interaction and document sharing features increase. Besides that, there are also practical advantages to using eReaders in education. Consider the case in face to face education, where children and students won’t have to carry those enormous amounts of books with them; instead they just need one eReader. They will have all their electronic study material available, or may easily download it just in time. So, no more excuses for ‘accidentally’ leaving books at home. Electronic versions of books also tend to be a lot cheaper compared to traditionally printed books, simply because they are easier and cheaper to produce. In addition there are positive environmental side-effects. Production and distribution of eDocuments reduce the need of storage and shipping of printed books. This reduces woods to be cut, and fossil fuels or chemicals used in their creation. And they're infinitely reproducible for free.

However, besides these advantages, attention has to be paid to the pedagogical side of the story. Technology is a means, not a goal in itself that can facilitate or impede the pedagogy. Before one starts implementing new technological devices, it should be clear why this would facilitate the learning process. Working from a technological point of view, designing a new technological device and then try to fit it in education, is pedagogically not very inspiring and is it is not likely to lead to better learning outcomes. Also, the content of what is learned and the way in which it is learned are very much related to each other. So, when designing new methods of learning, the content of what is learned also tends to be altered. Traditional courses cannot simply be copied into online learning, for example (Li & Akins, 2004). Although this is often the case. For eReaders to truly be a success in education, it is therefore for the main part dependent on the connection to the content of the courses. Meaning, that the way eReaders are used in education is crucial for its success. As Richard

Mayer said in an interview (Suomala & Shaighnessy, 2000), 'Technology per se will not improve education; improvements will come from insightful pedagogy - including the appropriate use of technology- based on an understanding of how students learn. (p. 483)'

On the other hand, new technological developments do have the possibility of opening up totally new perspectives. For example, the introduction of the internet opened up a totally new range of possibilities. New applications that were not even thought of before are now becoming available and this process will go on. It is believed that this will lead to a complete redesign of educational approaches and processes.

In the application of new technologies three phases may be identified in general. The first phase is characterized by *substitution*. Here the main objective is to replace an existing technology by a new technology, e.g. printed document by an eDocuments. The second phase is *innovation*. In this phase new applications for the new technology are being developed, explored and implemented. Eventually this may bring the new technology to a third phase, called *transformation*. Here the application of new technology is becoming more and more accepted, processes change, and the focus is shifting away from the old technology. This doesn't have to imply, that the 'old' technology has become redundant or useless.

One other thing that is in need for more research concerns to what extent the technological tools such as E-Readers should be used in education. A pilot study from the Maastricht University (Lutgens & Van Berkel), showed that students, without doubt, liked to use electronic documents (although they did not have an E-Reader device). However, the output did not compensate the efforts needed to realize the digitalization of all study material. They do suggest however, that the only cases in which it would be worth the effort would be in situations such as distance education or for part time students. A critical note that can be made here is that this particular study is a typical example of substitution. The only thing they have done here, is replacing the old material with electronic versions of the same material. So, this should not be considered as a reason not to use more electronic documents in education, because it does not include the benefits that the innovation and transformation aspects of technology can bring.

For distance education the use of ePaper devices may have additional advantages compared to those for 'regular' educational settings. A problem distance education often faces, is a high level of dropouts. Successfully completing a whole program requires more determination and motivation in distance education compared to face-to-face education. Literature shows that many students in a distance situation feel isolated and do not feel like a part of a community (Rovai & Lucking, 2003). Keegan (1986) believed that the separation of student and teacher caused the removal of a vital communication link. According to Keegan, students are less likely to experience complete academic and social integration if they do not receive adequate reintegration measures. Such a situation can lead to feelings of loneliness, low self-esteem, isolation, and low motivation to learn (Frymier, 1993). Students with low sense of community are also more likely to become dropouts (Sheets, 1992). According to Rovai and Lucking (2003), for distance education to reach an optimal success, a sense of community among the students must be sustained. Strong feelings of community can be build and sustained by increasing the flow of information among all learners, the availability of support, the commitment to group goals, and the cooperation among members (Frymier, 1993; Rovai & Lucking, 2003; Sheets, 1992).

The application of social media and the use of e.g. ePaper devices for uploading and exchanging notes, annotated documents, or summaries within an online course however promise new opportunities for students to become more socially integrated. The use of ePaper

devices may contribute to increase the flow of information, and as a result contribute to a greater sense of community. This may influence positively drop-out rates.

Concluding, eReaders, and mainly ePaper devices, have the potential to become very useful in education. What type of eReader people will buy will depend on what they want to use it for. However, as described in the usage models presented in this report, it may be expected that the ePaper devices will become more popular in specific markets, because of the additional functions. For educational purposes ePaper devices clearly have the upper hand over the eBook readers. (See appendix 2 for a flowchart of what the usage of ePaper devices in education will look like.)

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Appendix 1: Hardware and Standards

This section contains a list of the most promising/successful eReaders, divided into the two model categories which were described above.

Category 1: eBook Readers

- **Amazon Kindle**

Company: Amazon

Display Size: 6 inch

Price (in December 2008): \$ 359, Kindle 2; \$ 359

Formats supported:

Users can download content from Amazon in the proprietary Kindle format (AZW), or load unprotected Mobipocket (PRC, MOBI) or plain text content. Amazon offers an email-based service that will convert HTML, DOC (Microsoft Word), PDF, JPEG, GIF, PNG, and BMP documents to AZW. It also supports audio in the form of MP3s and Audible 2, 3, and 4 audiobooks. It does not fully support PDF, but Amazon provides "experimental" conversion to the native AZW format. Users may also convert PDF files to supported formats using third-party software. Free wireless access to Wikipedia.org.

- **Hanlin eReader v3**

The Hanlin eReader V3 is sold under various names: IBook V3 (Ukraine, Russia), Walkbook (Turkey), BEBOOK (Netherlands), Papyre 6.1 (Spain)

Company: Tianjin Jinke Electronics Co.

Display Size: 6 inch

Price (in December 2008): \$ 299

Formats supported:

PDF, DOC, WOLF, MP3, HTML, TXT, CHM, FB2, Djvu, PNG, TIF, GIF, BMP, JPG, PPT, EPUB, LIT, PRC, MOBI.

- **Sony Reader**

Company: Sony

Display Size: 6 inch

Price (in December 2008): \$ 299

Formats supported:

The reader uses an iTunes Store-like interface to purchase books from Sony Connect eBook store. It also can display BBeB Book (LRF), PDF, TXT, RTF, ePub, MP3, AAC, JPEG, GIF, PNG, BMP, RSS.

- **Cybook Gen 3**

Company: Bookeen

Display Size: 6 inch

Price (in December 2008): \$ 280 (Deluxe: \$ 380)

Formats supported:

Mobipocket, PalmDoc, HTML, TXT, PDF, JPG, GIF, PNG, MP3, TTF

Category 2: ePaper devices

- **Plastic Logic Reader** (Pilot market introduction Spring 2009, general market 2010)

Company: Plastic Logic

Display Size: 10.7 inch

Price (in December 2008): Will be brought to market in 2010

Formats supported:

MS Office documents (Excel, PowerPoint, Word), PDF files and it will support digital rights managed content, the specific formats will be announced in Spring 2009.

- **Digital Reader 1000/ 1000S/ 1000SW**

There are three Versions:

DR1000S (with tablet functionality, Market introduction 22nd September 2008)

DR1000 (without tablet functionality, Market introduction late 2008)

DR1000SW (with tablet functionality and wireless & Bluetooth connectivity, market introduction spring 2009)

Company: IRex

Display Size: 10.2 inch

Price (in December 2008): DR1000S: €699, Other versions not yet available.

Formats supported:

PDF, PPT, HTML, TXT, Mobipocket, JPEG, PNG, GIF, TIFF, BMP

- **iLiad**

Company: IRex

Display Size: 8.1 inch

Price (in December 2008): €599

Formats supported:

PDF, HTML, TXT, JPG, BMP, PNG, PRC (Mobipocket).

Discussion types of readers

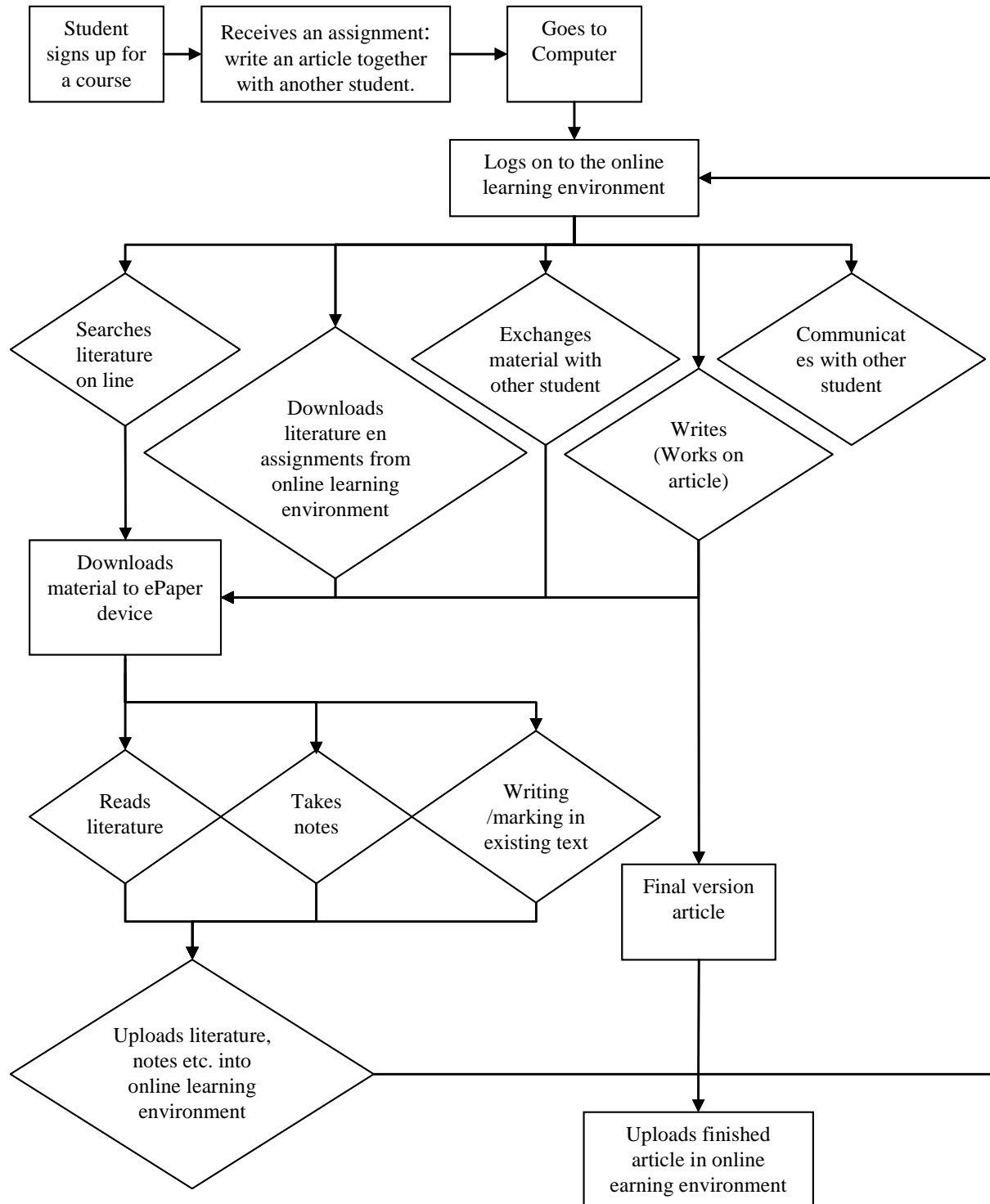
The number of eReaders discussed above are only a few of the devices that are available. As mentioned at the beginning of this report, none of these devices have taken the lead in the market, yet. However, the types mentioned above are at this moment the more popular and more promising models. For education and for professionals the ePaper devices look most promising, because of their additional functions such as writing and highlighting. Which allows to actually work on the texts in stead of just reading. One of the limitations for these ePaper devices, for now, is that they do not support MP3's. MP3's can be useful in education to listen to recorded lectures, or audio-books. However, this limitation is very likely to be solved in the near future.

The distinction made between the two types of eReaders is not always as clear as presented above. Some devices may be something in between. For example, the Kindle from Amazon also contains the function to make notes, highlights etc. However, in this report the Kindle is considered to be more of an eReader instead of an ePaper devices. The notes made on the Kindle can only be made by the use of a keypad, and not with a stylus, as is the case with the ePaper devices. Which means that with the ePaper devices you can actually write in the margins of a text, as you would normally do with paper, and with the Kindle you can type a few words and attach them to a piece of text like a tag. Also the content that can be read on the Kindle is very limited, it only supports E-Books from Amazon.com in an optimal way, other documents need to be converted first, which does not have optimal results. This means that the use of the Kindle will probably be limited to reading E-Books from Amazon.com,

which is why, in this report, the Kindle is considered to be more of an eBook Reader than a ePaper device.

Appendix 2: Flowchart: use of ePaper devices in Education

Student Perspective



Teacher Perspective

