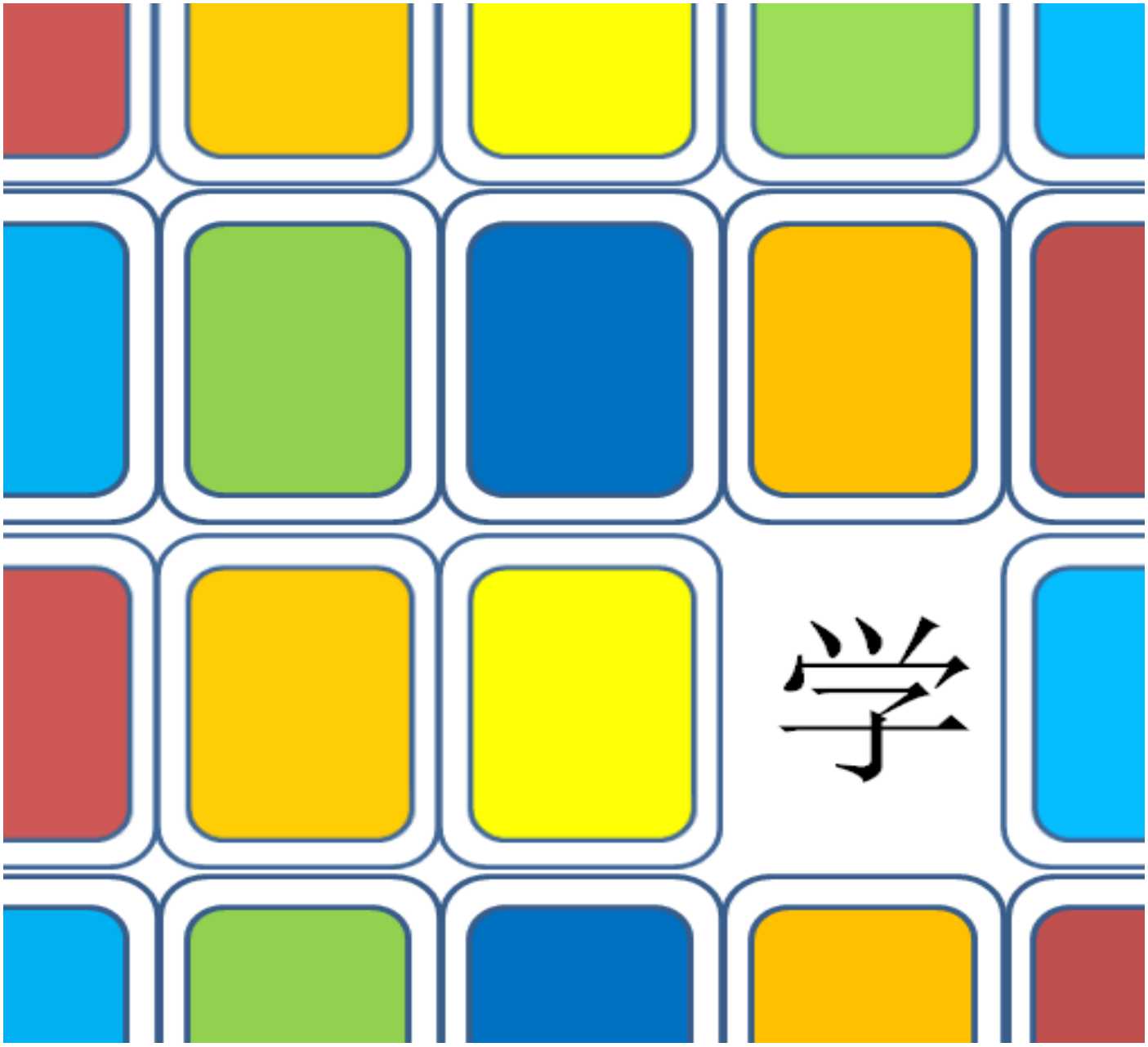
Educational use cases from a shared exploration of e-books and iPads

Book Chapter



E-Books & E-Readers for E-Learning

Editors

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E-Books & E-Readers for E-Learning

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Table of Contents

Foreword

Rapid development of educational technology in the last decade has already reshaped in many ways how people teach and learn. The increasing availability of e-book and e-reader devices in the consumer sector is transforming the fundamental way in which people consume knowledge in the digital era, especially for 'digital natives'. Once our formal educational systems embrace e-textbooks in the traditional school settings, wider adoption and change will inevitably happen. One typical example is the provision of full e-textbooks for all subject courses for students at the Mount Gravatt State High School in Queensland, Australia.

However, there are critical challenges and issues that need to be addressed in order to maximize the educational potential of e-books and e-reader devices. These issues include pedagogical designs with respect to different age groups of e-readers, the roles of educators in adopting e-textbooks, the support of adaptive and personalized reading experiences, and the pace of assessing cloud-based e-book content through various types of client-side e-reader devices.

This collection of articles about e-books and e-readers for e-learning is an ideal source for researchers and educators to further explore these critical issues.

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Preface

E-book and e-reader devices are new and exciting technologies with great potential to enhance education. These technologies are not only changing the way we read, but also the way we teach and learn. While adoption of new technologies in learning may encounter some challenges initially, research has long demonstrated that continuous innovation can overcome these challenges and generate better teaching and learning experiences.

As e-books and e-readers become more and more popular, they are likely to be adopted in the classroom, opening up new and exciting opportunities for researchers and educators to take advantage of the latest technologies and platforms. Researchers and educators can explore and identify pedagogies and develop interactive, personalised, re-usable and smart content that is highly motivating and effective for all levels of learners.

This e-book discusses several key areas including content development cases, implementation studies, long term national strategies, Arabic culture environment, e-learning ecosystem, pedagogical considerations, emotion detection for enhanced e-learning, and usability studies of new devices.

One important aspect with limited research is the application of the technologies in collaborative learning scenarios. Another aspect is using the technologies for pre-school learners, and researchers may wish to follow up with more vigorous studies.

This e-book will certainly be beneficial to a range of audiences on how innovative and effective learning can be achieved through e-book and e-reader devices. We hope that this peer reviewed and edited book will facilitate further collaboration between researchers from different countries to accelerate learning, research and adoption of e-book and e-reader devices in a new learning environment.

Dr Tiong-Thye Goh, Dr Boon-Chong Seet, Dr Pei-Chen Sun

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Foreword

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Chapter 1

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Walther Nagler is agent of the Department for Social Learning at Graz University of Technology since 2006. His research focuses on the didactical development, realization and management of multimedia content in the meaning of e-learning and Web 2.0 technologies for teaching and learning purposes.

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Anna Page is the Client Relations Officer for the Institute of Educational Technology at The Open University. Her role involves developing and implementing the strategy for liaison with IET's clients within and beyond the University, and acting as a key point of contact for faculties and service units across the OU for IET's pedagogic innovations. She promotes the Jennie Lee Research Laboratories and leads the organising team for the annual 'Learn About' Fair for university staff. She is responsible for developing the content of IET's websites and writing news stories. Her Learning and Teaching Development role includes evaluation and testing for various OU projects, such as the eBooks and Mobiles project.

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Chapter 5

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Mari Aaltonen works as the electronic resources team leader in the Aalto University Library, Finland. She deals with the testing and acquisition of electronic journals, books and databases and makes these available to the users. She is looking for better functionality of the resources as well as new ways of delivering the information. Aaltonen has worked at the Aalto University library since 2006, before which she was a researcher at the university.

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Chapter 8

Ann-Marie Horcher is a doctoral candidate in Information Systems at Nova Southeastern University in Fort Lauderdale, FL. She has been working with producing and managing digital content for over a decade, previously as an information architect for a Fortune 100 chemical company. Her research with the Amazon Kindle and B&N e-book readers and usability of the most recent generation of e-book readers has led her to further exploration of usability for all mobile devices. She has integrated e-book content into the classes she teaches at Saginaw Valley State University for the Computer Science Department, and instructs with exclusively electronic content.

Guivrender Tejay is currently an Assistant Professor at the Graduate School of Computer and Information Science. Dr. Tejay's research interests include information system security, information technology strategy, and information quality. His research has been presented in various conferences including the International Federation for Information Processing, Hawaii International Conference on System Sciences, and Americas Conference on Information Systems.

E-Books and E-Reader Devices for E-Learning in Higher Education: The Case of Graz University of Technology

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Graz University of Technology

Abstract

This contribution discusses the problem of how to manage multimedia content for educational purposes via Internet access using mobile devices such as e-readers, the iPad, or smart phones. A strategy is recommended that enables the one-off creation of content and its multiple uses for different online variants. As an example an authoring tool, named the ABC-Manager, for creating content for teaching and learning purposes at universities on the meaning of e-learning 2.0, is introduced. The ABC-Manager has been developed at the Department for Social Learning (DSL) at Graz University of Technology (TU Graz). The paper focuses on the advantages of the tool as well as its didactical background and overall statistics of its usage. The current use of the ABC-Manager as an integrated part of the e-learning strategy of TU Graz especially in the face of its online version, the e-book platform of the Learning Management System in use at TU Graz called TU Graz TeachCentre is discussed. Furthermore special attention is paid to the development of different output variants for e-readers or other mobile devices in regard to their format such as ePub or Mobipocket. The paper concludes with a preview of the new version of the ABC-Manager to be launched in spring 2012.

Keywords: e-book, e-reader, learning management system authoring tool, mobile device

Since 2007 when Amazon launched its Kindle e-reader a new era for e-books has begun. Although some may think of e-books solely for the use of e-readers, the term e-book enjoys a long tradition in the field of computer based training of the 1980s as well as web based learning starting in the later 1990s. In the meantime a lot has changed (Hillesund, 2001). The idea of Web 2.0 (O'Reilly, 2006) revolutionized the way the user (Grossmann, 2006) deals with the World Wide Web. It has become very simple for the Internet user to take an active part in the web and share or manage content using the modern Internet. Online editing is no big deal any longer. Moreover, we notice a booming market for e-readers, smart tablets, and smart phones. Apple's iPad gave the subject a further boost. Such progress is not limited to education (Ebner, 2007). Schooling today has to face the new challenges arising from the possibilities provided by Web 2.0 and new mobile devices. Before going into detail about the way the subject is being treated at Graz University of Technology (TU Graz) a short look at e-books in general is required to avoid misunderstandings due to various terms and meanings.

What Is Meant by e-Books?

As mentioned, the term e-book has experienced many different interpretations and its first appearance may never be definitively found. However we can consider e-books to have begun with Project Gutenberg back in 1971[1]. It is said to be the oldest digital library aiming to digitize printed books. As of November 2011, Project Gutenberg claimed over 38,000 titles offered in plain text, as well as other formats, such as HTML and PDF as well as e-reader formats ePub and Mobipocket. Project Gutenberg is a good example of the different meanings of e-books today. The oldest meaning of e-books relates to the digitization of printed books. An e-book therefore is the electronic version of a printed book produced by scanning it. Many libraries (including university libraries) today offer e-books in that sense alongside their stock of real books. Most commonly those e-books are offered as PDFs; e-

reader formats are slowly being integrated. The second meaning of e-book applies to use with e-readers. Though e-readers are becoming more and more popular these days their origin goes back to the beginnings of e-books long before the Internet and can be compared to Project Gutenberg. The first attempt at turning real books into electronic variants led directly into the development of special devices with which to read them such as the Dynabook by PARC (a division of Xerox) in the late 1960s which had astounding affinities with today's e-readers. The difference and at the same time exclusive attribute of modern e-readers in the narrower sense is their special surface using e-ink technology (since the late 1990s). An e-ink display only requires energy when the displayed content changes ("turning pages"). It has very low energy consumption as well as not reflecting sunlight and therefore is best suited for mobile outdoor usage. For a very long time e-ink technology only enabled black and white tones; by November 2010 the third generation called E-Ink Triton could also display thousands of colours. In the broader sense any mobile device that can read e-reader formats is called an e-reader or even an e-book itself. The number of such devices is constantly growing as along with the number of formats. Nevertheless, two formats stand out against the others: the comparatively young ePub standard (released in 2007 by the International Digital Publishing Forum) and the French format Mobipocket (2000). More or less regardless of the format, interactivity and multimedia competence – especially for video content – is rather low or not provided at all. The PDF format needs Flash to embed videos; only the latest ePub 3 version (recommended specification 11 October 2011[2]) supports embedded audio and video using HTML 5 but Mobipocket cannot interpret audio data. Though annotation support and bookmarking is generally provided, interactivity is only enabled by a few formats. Thus e-readers do not support multimedia content sufficiently[3], which is a serious disadvantage for teaching and learning content and at the same time very challenging to create and prepare. The third meaning of e-books goes back to the times of Computer Based Training in the late

1970s when technology enhanced learning (e-learning) was in its infancy. It involved content distributed on a data medium (e.g. CD ROM) offered within a kind of course structure. With the invention and rise of the Internet this principle has been adapted to online usage. Especially for distance learning and lifelong learning, such courses enjoy great popularity but still remain very time-consuming to create due to their complexity (Klamma et al., 2007). For classroom teaching at universities they are less common although their interactive and flexible character offers new ways to work with the content. Today all three definitions of e-books merge into each other. Considerable work has been undertaken to make e-books on the meaning of online courses readable for e-readers. This contribution focuses on the efforts made by the Department for Social Learning (DSL) at Graz University of Technology (TU Graz) in this context.

The TU Graz E-Book Systems

Overall Aspects of Development and Methods

Starting in 2001, at TU Graz this e-reader trend has been picked up and combined with the development of an e-book authoring tool and corresponding e-book environment. Retrospectively these efforts can be subsumed into three major steps of development: development of the authoring tool, – IFEA ABC-Manager –to be used at the Institute of Electrical Power Systems (IFEA) at TU Graz from 2001 to 2006; adaption and redesign of the IFEA ABC-Manager to be used by the entire university (ABC-Manager) since 2006, and further development to enable the content created with the ABC-Manager to be read on e-readers since 2008 (Nagler, Ebner, & Scerbakov, 2011) [4]. At the same time the Learning Management System (LMS) of TU Graz, the TU Graz TeachCentre (TUGTC) [5] has been constantly adapted and enhanced to meet the requirements for the generation of outputs according to e-reader formats independently from the ABC-Manager. Consequently both developments became partners and have cooperated since the new ABC-Manager was ready

to be used (Huber, Nagler, & Ebner, 2008). Figure 1 shows the different possibilities and the workflow of creating e-books as well as their several output formats in principle using either the ABC-Manager or TUGTC.

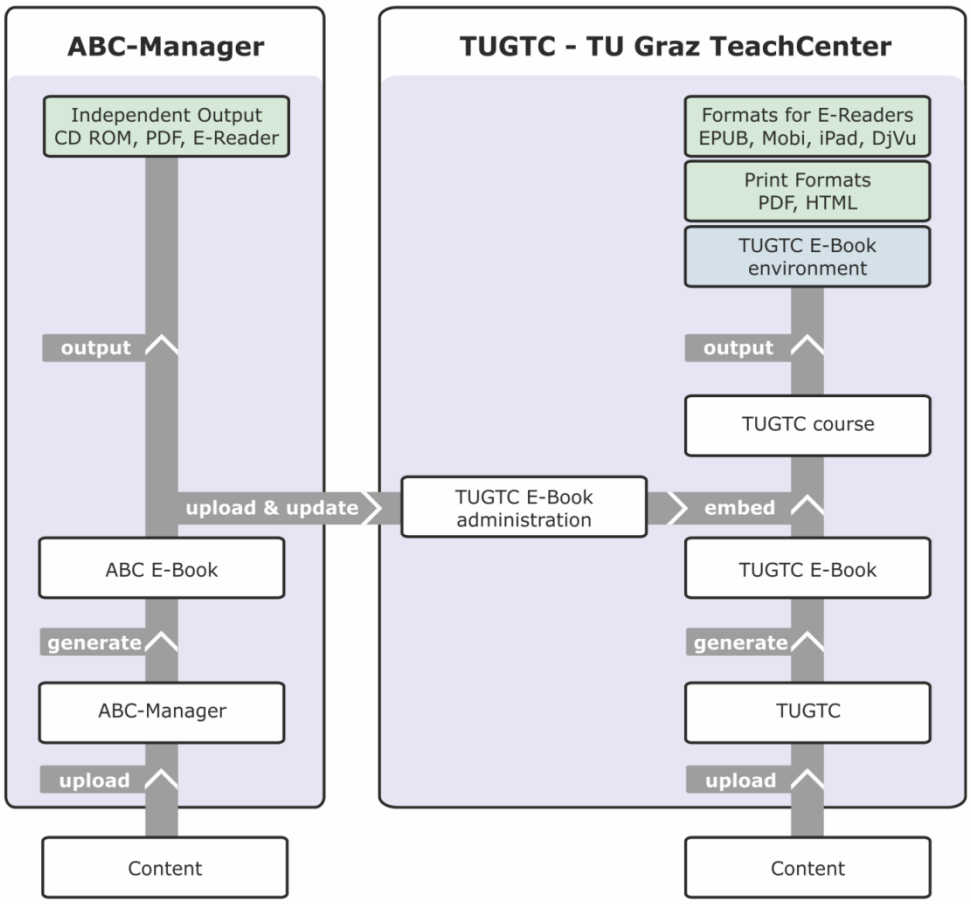

Figure 1

Different possibilities and the workflow of creating e-books as well as their several output formats in principle using either the ABC-Manager or TUGTC

The IFEA ABC-Manager

The aim of the first step was to create a design for teaching and learning content that can be used for classroom lecturing as well as for learning using a printed version of it. The basis and core of any teaching and learning is high quality content in an appropriate didactic

meaningful format to ensure collaborative work. Within university education the conventional (school-) book has been completed by using digital tools such as Microsoft Word, Adobe PDF, LaTex or other text formats. Even they are provided to the students using a LMS it is still very common to learn from a printed version. The haptic feeling of a printout and the ease of note-taking as well as the unfamiliar and uncomfortable way of learning content read on a display are main reasons for such a practice. Furthermore presentation formats such as Microsoft PowerPoint or Apple Keynote very often are not convenient for learning purposes at all. So the gap between a presentation format and a well-structured script had to be closed.. Nevertheless creating and managing content as well as collaborating with it should be as simple as the ABC, instinctually, and without any special system-syntax (Fickert, Schmautzer, Nagler, Kamrat, & Stojke, 2006). The result of the first development phase was called IFEA ABC-Manager because it was developed by employees of IFEA. The term ABC relates to the didactical principles the design is based upon (Barton, Fuchs, Kuhn, Lämmel, & Müller, 2009; Garrod, 2003; Rowhani & Sedig, 2005; Weitl, Süß, & Kammerl, 2002). The primary idea was to split teaching content into small pieces of micro-content which can be individually and interchangeably arranged together later on when needed. The content needed to be graded according to its relevance for teaching and learning where A matches the topics, B helps to understand A, and C sums up all further related content but is of no importance for passing exams. As a result of these two requirements the content had to be split into “ABC-screens” on a base of HTML. Single ABC-screens then were assembled into an “ABC-course”. On the base of this ABC-course a couple of different output formats could be created, including an online variant (HTML) to be embedded into the LMS of TU Graz, an offline variant (CD ROM), and a printed variant (PDF). A single ABC-screen has standardized characteristics such as fixed dimensions to avoid scrolling and to fit to the printed version in the way that two ABC-screens fill one printed A4 paper page. Further each

screen has a part A and a part B at minimum. Content that had been defined as part C was added to the actual A and B content as a link. An auxiliary ABC-screen could be added with footnotes and questions relating to the content of the screen. These additional features were called wildcards. Figure 2 shows a typical IFEA ABC-screen and its main components.

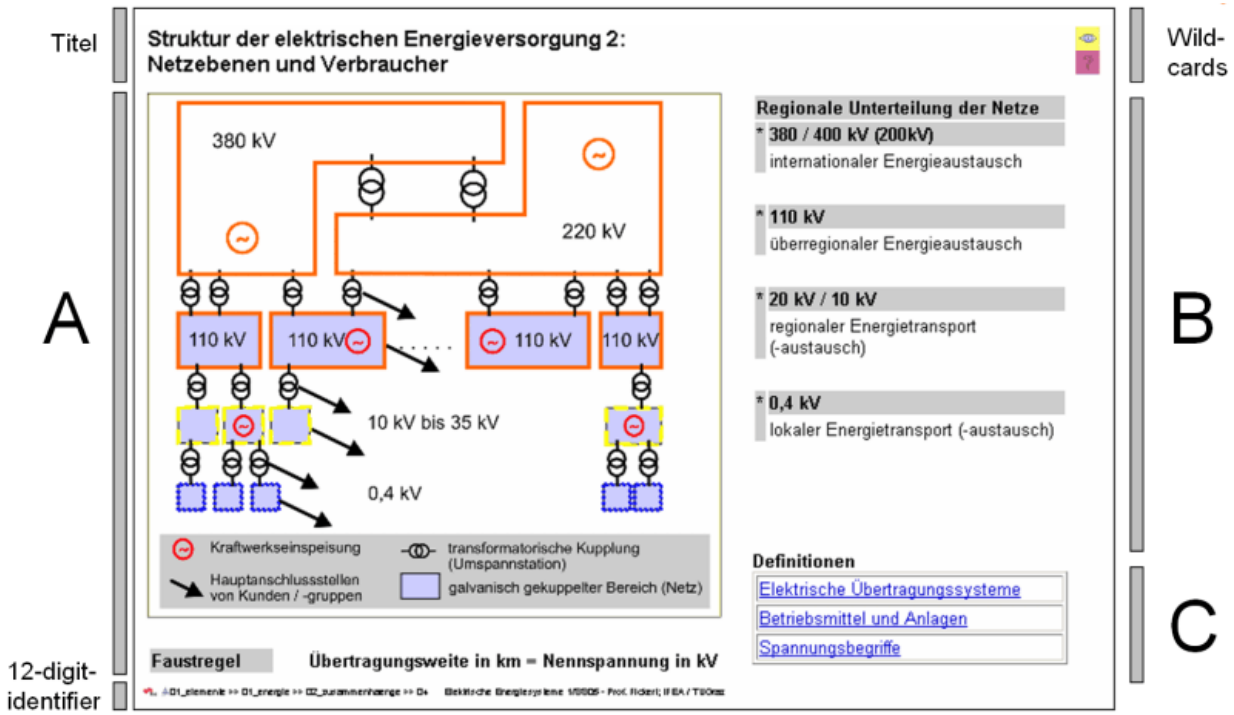

Figure 2

IFEA ABC-screen and its main components; A holds the main content, B explains A deeper, and C (additional content) can only be reached over linking

For the ABC-course consisting of single ABC-screens there was a distinct structure to be followed. An ABC-course had to be structured into chapters, modules, and units. The units then carried the ABC-screens. One unit should have as many ABC-screens as were used during one lecture in the classroom. For the online version of an ABC-course it had to be uploaded and embedded into the LMS of TU Graz which had been the called the eLearning Suite by Hyperwave until summer 2006. From autumn 2006 onwards the TeachCentre

became the new LMS of TU Graz. The TeachCentre will be described later on. The ABC-Manager was a special development for a single institute, the IFEA, but was not ready to be used by the entire university. It lacked usability and was rather clumsy to handle. Nevertheless the concept was convincing as it had been used in practice for over 5 years although the task of having both a presentation and a script was not completely achieved.

The New ABC-Manager and the TUGTC E-book Environment

With the foundation of the Department for Social Learning (DSL) in autumn 2006 as a new subgroup of Information Technology Services (ITS) at TU Graz many aspects of e-learning at TU Graz changed. DSL became the official centre for e-learning at TU Graz and the TU Graz Teaching and Learning Service System was initiated. Figure 3 gives an idea of the overall strategy.

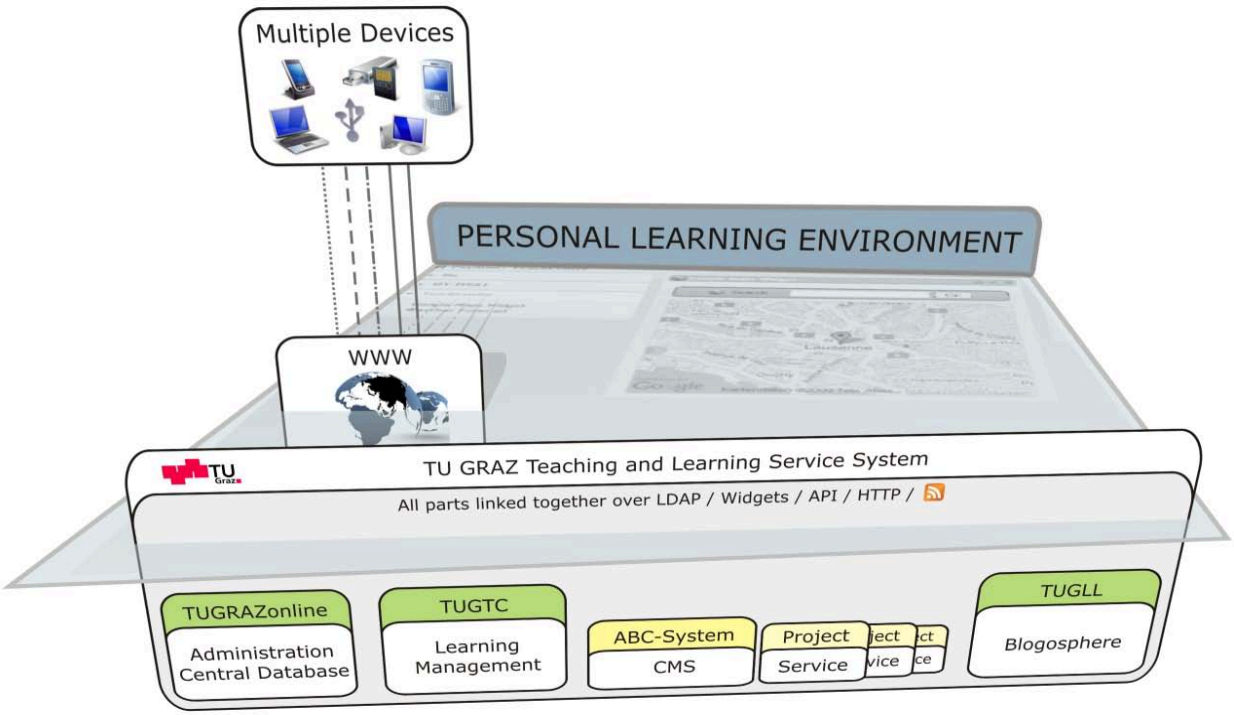

Figure 3

The TU Graz Teaching and Learning Service System with its main portals, platforms, and main projects of DSL such as the ABC-Manager

Note that there is a Personal Learning Environment (PLE) covering all provided platforms and services of TU Graz using modern widget technology (Taraghi, Ebner, Till, & Mühlburger, 2009). The IFEA ABC-Manager became one part of it but badly needed a complete redesign to enjoy broader acceptance. The new ABC-Manager extends and deepens the concept of the IFEA ABC-Manager and is the first high functioning authoring tool in that context. The didactical ABC-screen design has been adopted; the course structure has been made more flexible. The core of the new ABC-Manager is the pool concept. All screens edited within the ABC-Manager are saved in pools. Generally one institute holds one pool of screens. For assembling screens into courses the screens are placed by dragging and dropping them within the course structure prepared previously. Even entire structural elements of a course (e.g. chapter, module, or unit) can be easily reassembled in that way. Furthermore the output of a course is now embedded in the new LMS used at TU Graz, the TU Graz TeachCentre.

The TUGTC is based on the "WBTmaster" system that has been developed by the team of Professor Nikolai Scerbakov at the Institute for Information Systems and Computer Media of TU Graz (IICM) since the late 1990s (Helic, Maurer, & Scerbakov, 2004; Maurer & Scerbakov, 1996). In 2006 it became the official e-learning platform of TU Graz. It consists of multiple addable possibilities to individualize teachers' requirements and can be compared to any other LMS according to its functionalities and basic structure of single courses. Within the TUGTC there are a couple of ways to implement editable and adjustable content as well as to generate output formats from that content, also supporting ePub, Mobipocket and others for content to be consumed on e-readers. TUGTC offers an environment for the embedding of e-books. This environment provides many possibilities for individual interaction. The TUGTC e-book environment offers a microblogging area to discuss the content online overtime. Unlike a standard chat room, the microblogging area can be contributed to via

several channels. It is possible to post from a PDA screening the appropriate QR-code, to post using the e-book interface also over a Metaweblog API, to post using an e-mailing system by addressing the right course, or to post via SMS message from any mobile using a course code. Regardless of the channel used for posting, the single microblogs are listed and displayed in the e-book. Furthermore the user may edit annotations to a screen (Dietinger & Maurer, 1998). Any single element or the whole screen in general can be annotated by the user. The annotation can be a fully edited contribution with images or files added as well as spoken voice annotation. The annotation may be set as private so only the author may read it. Thus the student can take notes during the lecture. There is also a print option that includes those annotations if wanted. The student receives a PDF version of the e-book including his/her personal notes and public ones that were written on paper during the lesson.

The ABC-Manager and e-Reader Formats

The third step in the course of the development of e-books at TU Graz focuses on the readability of e-books generated using the ABC-Manager or the TUGTC itself for e-readers to keep up with the emerging market of mobile devices. It is possible within TUGTC to collect content of any format together simply by dragging and dropping from a local disk or from already existing content on TUGTC and release it in different outputs. Depending on the device not every format can be displayed or is displayed poorly, but plain text and images are already working very well on all devices. This conversion functionality is implemented within TUGTC in several positions where it makes sense. In general it is within print functionalities on TUGTC. The formats that can be created so far are PDF, HTML, ePub, Mobipocket, a mobile version for smart phones, iPad, DjVu, and variants of them. As mentioned above, the quality of post-conversion content strongly depends on the chosen format. For example, all interactivities or multimedia input except images may be missing if the format DjVu is chosen. Otherwise the DjVu format allows the conversion of images of

huge size (gigabyte) to small excellent readable ones and runs on a couple of modern e-readers as well as on iPhones. There is even an ePub validator available to check the content according to its ePub capability. The user can edit the content in regard to the validation to become readable on e-readers supporting ePub. The ABC-Manager supports the generation of e-books for use within TUGTC, a PDF version, and ePub as well as Mobipocket at a trial stage so far. The upcoming release of the ABC-Manager will also have a standalone online and offline version of an ABC-course to enable independence from TUGTC in order to enable use outside TU Graz.

Before we go into more detail about the ABC-Manager and the e-book environment of the TUGTC it must be noted that the redesigned ABC-Manager solved the discrepancy between presentation and script by introducing classifications to each screen. In the course of editing a screen the author has to assign the screen to one of the given classifications. For example, there is a classification called “PowerPoint-Style” and another called “PDF-Style”. In the later e-book the user may then choose which classifications will be shown. So, if all screens assigned to “PowerPoint-Style” were edited just like PowerPoint slides, the user gets the impression of looking at a PowerPoint presentation if this classification is chosen. All other screens of different classifications are hidden. In that way one e-book offers both the presentation for the teacher in the classroom as well as the script for the student at home. Moreover, within the TUGTC there is a presentation viewer for e-books which only displays the screens of the e-book without the rest of the environment. This optimizes a presentation’s look and feel. Another viewer compiles the content into a mobile version to be displayed via mobile devices like smart phones or PDAs (Ebner, Scerbakov, Stickel, & Maurer, 2008).

Details of Development, Implementation, and Practice of the ABC-Manager

The following concentrates on the ABC-Manager, its usage and aspects of programming. The ABC-Manager by now (January 2012) consists of two main parts: an

administration area and the actual content-related areas. The administration area is designed for managing the different pools, the various users, and their authorizations. The ABC-Manager knows three different kinds of users according to their authorizations: root, administrator, and author. Root users have the highest grade of authorization and can manage the ABC-Manager overall. Root users must be DSL staff members. Administrators are owners of at least one pool. Generally one pool corresponds to one institute of TU Graz. The authoring software allows only one administrator to be responsible for one pool, whereas the number of authors is not limited to a pool. The administrator of a pool chooses further users to be authors of the pool. Authors of a pool are allowed to generate content and courses as well as produce outputs within the pool they have been assigned to. They are not allowed to manage the pool. Any person can be assigned to any pool in principle; the number of pools a person has access to is not limited.

As the ABC-Manager is an open online authoring system, TU Graz members are not the only people who may use it. After registering to the ABC-Manager a new pool can be requested but must be confirmed by root users. Root users assign administration rights. If no pool is selected during the login the user may enter the administration area of the ABC-Manager with gradual authorization. There he/she can change personal data, may apply to become an author of another pool, and finally enter his/her pools. After selecting a pool the user may easily switch between the various possibilities. As mentioned above, each pool offers a page for screen editing, one for course editing, and one page for output generation. By selecting the screen option of the menu, the user can choose whether to generate a new ABC-screen or to edit an already existing one. The course option of the menu offers the user the ability to set up a new course, to edit an existing one, and to define settings for a course. Within the course settings the different classifications are adjusted. The output option of the menu directs the user to the different versions of possible output. The generation of a single

ABC-screen has become totally independent from the generation of an ABC-course or its structure and vice versa. The same ABC-screen can be used in different ABC-courses.

By selecting the screen options, the user enters the screen editing page of the ABC-Manager. Figure 4 shows that there are different areas to be described.

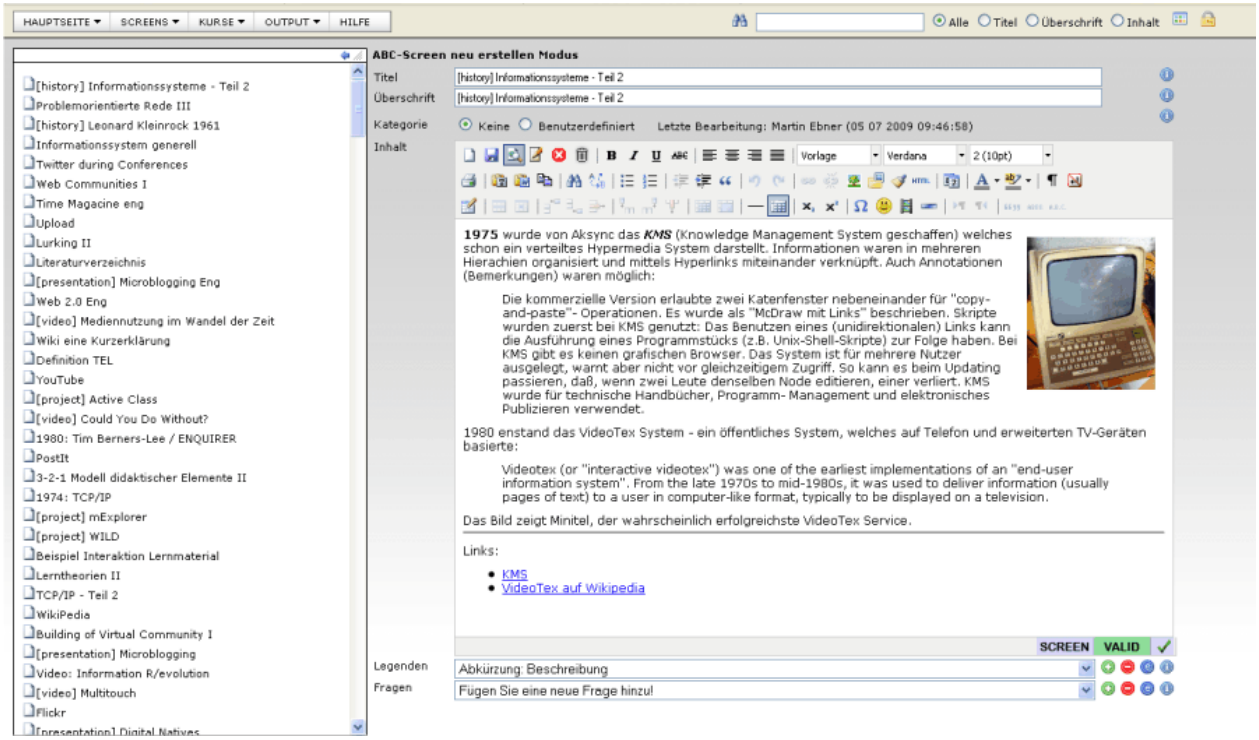

Figure 4

Screen-editing page of the ABC-Manager; list of screens on the left side, the WYGIWYS editor TinyMCE in the middle, screen headings above, additional data below.

Note: The displayed screen edited is valid; note the green mark at the right bottom corner. The displayed screen differs from the original IFEA ABC-design.

On the very top of the page there is the pool menu described before. Within that menu bar there is search functionality and the button to return to the administration area of the ABC-Manager. On the left side there is a list of all screens of the current pool. The display of this list can be switched between a text mode and a thumbnail mode. The whole list may be

hidden and shown again. The rest of the page is for editing the current screen. Making of an ABC-screen only needs multimedia input from the author. For each part of an ABC-screen there is a single area that can be edited; some are compulsory (title, headline, and actual content of the screen) while others are optional (footnotes, questions …). The actual content of the screen is edited with the TinyMCE editor. Embedding an image (or another media file) can be done in the form of a mashup by embedding some HTML code automatically allocated by the source website of the media file. Such a media file will not be displayed in an offline version or in e-reader versions. Alternatively a media file may be added to the screen using the media import functionality of the TinyMCE. Any media uploaded to the system are stored within the current pool and may be used for any screen of that pool. The splitting of the content into A, B, and C parts as was done by the IFEA-ABC system can be kept but is not obligatory. If any part of the screen content is marked as any kind of citation – a functionality offered by the editor – it is automatically added to the list of citations that is generated during the output process. The wildcards used in the IFEA-ABC system are also integrated into the new ABC-Manager. Below the editor there are text areas for editing the footnotes and questions regarding the current screen. If done so, the output of the screen has tiny wildcards signalling that there is further information to the screen. Finally the fixed dimension principle has been taken from the IFEA-ABC system too. The green coloured term "valid" at the bottom right corner of the editor (Figure 4) tells the user that the screen fits the right dimensions. In case the content goes beyond the dimensions "invalid" is shown in red and the screen cannot be saved.

The making of an ABC-course out of screens is realized in three steps. A new course is initiated by editing some data describing the course: current semester of the study year, unique identifier, title, author, institute, and a short summary of the content. The title is the one displayed in the course editing page and outputs. The information is saved in an XML

file within a new course root directory. The next step is shown in Figure 5, the filling of the course with screens of the current pool.

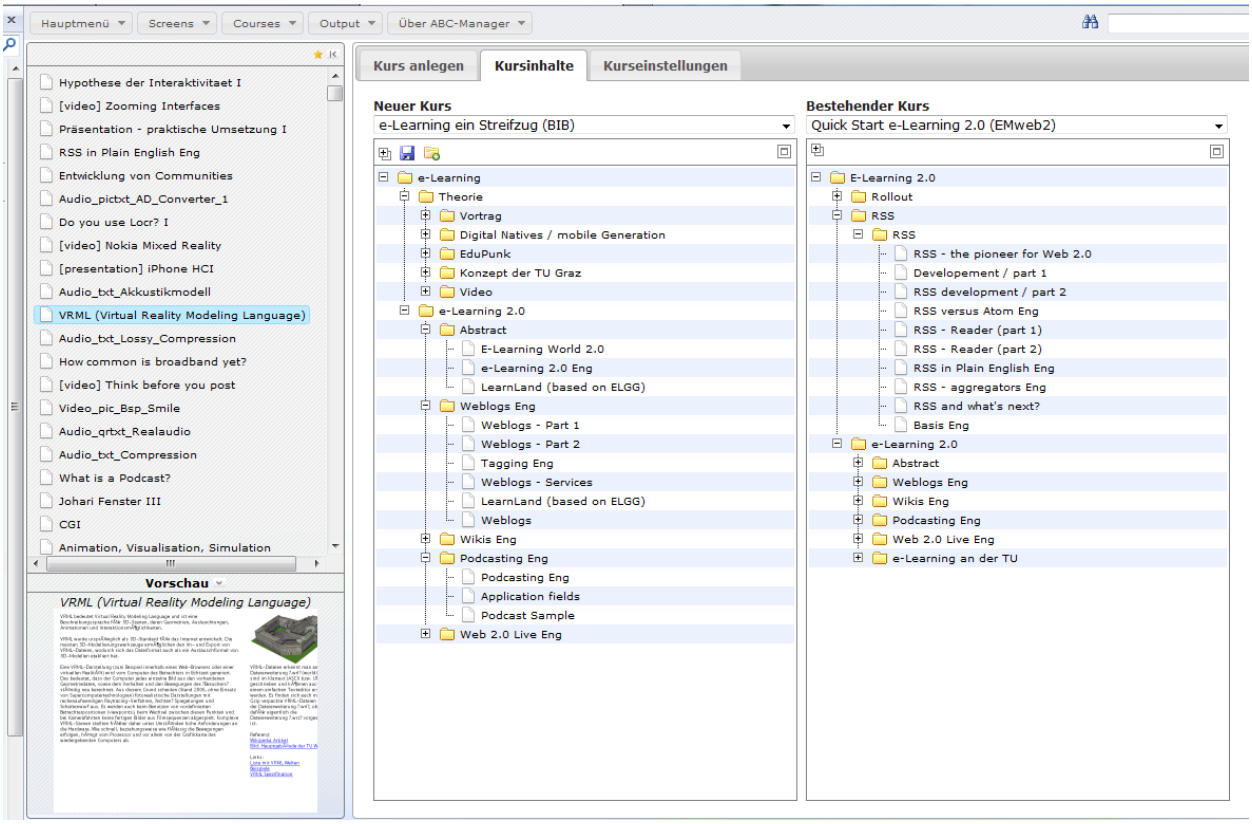

Figure 5

Course editing page of the ABC-Manager; list of screens on the left side with a thumbnail preview of the current selected screen below, the course currently edited listed in the middle, and a further course selected from a list of all courses of that pool on the right .

Already existing courses are listed within a dropdown selection in the right column of the course editing page. By selecting an existing course of the pool its structure (layers and screens) is displayed in that column. For the new course first a structure has to be set. Following the didactical principle of IFEA-ABC courses the three layers – chapters, modules, and units – may be created. The chosen screens are then added to the units by dragging and dropping from the list of screens on the left or from an already existing course displayed on

the right. Even entire layers can be added to a current course from an existing course by dragging and dropping. The sequence and position of the different layers as well as single screens can be easily reordered by dragging and dropping afterwards too. The final step is to generate outputs. This is managed using the output page of the ABC-Manager. The ABC-Manager checks all the relevant relations of the chosen screens or layers and copies related files to the new course during the output process. The author may select some additional options specifying the output more precisely. Depending on the chosen output the options differ. For example, citations and information saved within the wildcard functionality are added as special pages at the end of the PDF version in the form of listings relating to their corresponding pages, whereas such information is displayed within the relevant screen in the online and offline versions.

Seen from the programmer's view, the ABC-Manager is a server-side Content Management System (CMS). Thus the user only needs a browser that supports JavaScript to work with it. The ABC-Manager system itself is implemented on an Apache Tomcat server which is technically configured for full Java support. To create a better, faster and more user friendly web application AJAX has been integrated. The combination of these standards results in high performance and high quality in usability and flexibility. To meet all requirements, only standard web implementations are used that work on most browsers without installing any other application excluding Suns JRE (Ebner, 2007). The basically new approach is the content pool belonging to a user (or a group of users sharing one pool). Server-side each ABC-pool consists of the following main components: ABC-templates, courses, media, and screens. The ABC-templates are used to store standard information needed in any course. This information consists of cascading style sheets, images, scripts, and a screen's classification. With the screens edited and stored in a pool, the user is able to create various courses. The metadata of these courses is stored in this section too. Multimedia

support for screens is stored in a special folder. To simplify the media handling, the user simply uploads or embeds the file to a screen. When uploading, the ABC-Manager automatically categorizes and saves the file according to its media type. Screens of pools are saved in a special XML format that is used by the ABC-Manager. This increases the compatibility and fast integration with other systems such as the TUGTC. For creating, adding, and deleting screens, multimedia files or other user-determined content, the Java Servlet technology is applied. Classes are implemented to control and manage these requests. These promising technologies guarantee easy add-on extensions as well as simple and high quality support possibilities over the years.

Although the ABC-Manager is able to generate a couple of different versions the main aim is to produce interactive online e-books to be mainly used within the TUGTC. As mentioned above, the TUGTC e-book environment makes it possible to generate e-books without the help of other special authoring software like the ABC-Manager. Once an e-book has been generated it can be used for the e-book environment of the TUGTC. If generated through the ABC-Manager, the ABC e-book needs to be uploaded to the TUGTC. For this purpose the TUGTC e-book administration page has been developed. All e-books belonging to the currently logged in user are listed. For each e-book listed, the user can edit some metadata about the e-book. The user may add or delete additional users (teachers and authors) to manage the e-books as well as set the e-book audience as available to be consumed by anybody or restricted to limited usage within the TUGTC only. It is even possible to edit the content as well as the structure of an e-book with the TUGTC e-book administration page. So this page helps teachers and authors of e-books to keep track of their e-books, lets them upload new e-books or update already existing ones easily by drag and drop. So if an author of an ABC-course wants the course to be embedded to the TUGTC, the corresponding output variant of the course is chosen. A downloadable ZIP file is assembled by the ABC-Manager

based on the course's XML file that has been generated by saving a course's structure in the course editing page of the ABC-Manager. Thus all the data needed are copied from the user's ABC-pool to the pool's output directory on the server during the processing of the ZIP file. After generation of the ABC e-book as a ZIP package, this ZIP file is uploaded to the TUGTC system using the drag and drop functionality of the TUGTC e-book administration. The administration page automatically identifies whether the uploaded files belong to an already existing e-book or not; e-book updating becomes very easy. A new e-book can also be implemented to the TUGTC e-book system. Figure 6 shows the main page of the TUGTC e-book environment.

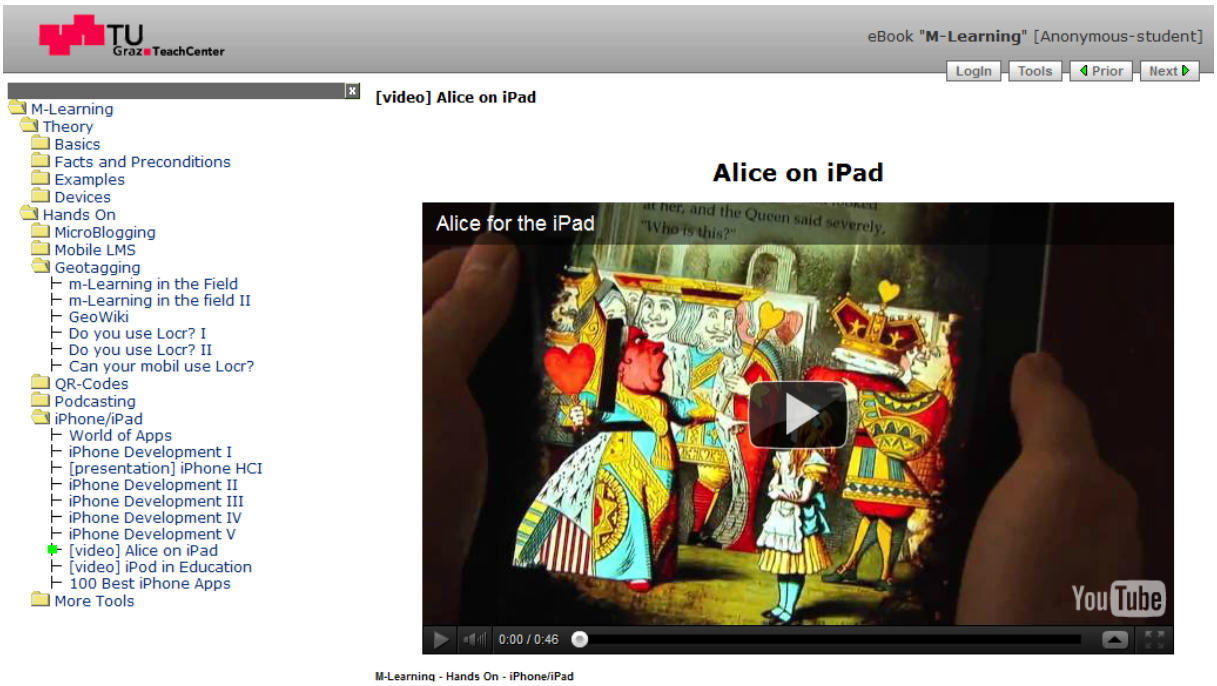

Figure 6

ABC e-book within the TUGTC e-book environment: Navigation map of the e-book on the left, ABC screen in the middle, interactions in the menu above.

Note: The displayed screen shows an embedded video. According to the different output variants this video will not be shown choosing e-reader formats or PDF by default so far.

On the left side there is the structure of the e-book for main navigation. The actual content, the ABC-screen, is framed by a small black square. Below the screen there are the wildcards listed. If there is a footnote as well as questions about the screen edited by the author, they all are placed with tiny icons right under the content. If there is none, there is no icon. Citations are additionally marked with a blue dotted line at the content cited within the screen regardless of whether the content is an image, a text passage or an embedded movie.

Aspects of Usage

During the first step of development 25 individual e-books were generated with the IFEA ABC-Manager for the benefit of IFEA. Some are still in use for teaching and learning at IFEA and have been updated several times so far. Regarding this phase the usage of IFEA ABC-courses was highly appreciated by students. Evaluations during the first 3 years of the implementation of the ABC-system into the teaching of IFEA showed a slow shift in the students' learning habits. The acceptance of using a CD ROM version for learning efforts increased during these years on account of a printed paper version. Although the evaluations were devised and conducted by independent psychologists the rather small number of polled students (150) must be taken into account (Fickert et al., 2004). Since the launch of the new ABC-Manager in autumn 2008 33 pools have been created. The most extensively used pool carries over 3,000 individual screens assembled to more than 20 e-books; the smallest pool carries at least three e-books. Nevertheless most of those e-books are limited to TUGTC only and therefore are not free for others. The e-books created with the ABC-Manager and published on TU Graz follow the licenses of GNU Public License Version 3 and Creative Commons.

Discussion

Although the e-reader market has not boomed in Austria so far, it is easily conceivable that modern e-books and e-readers as well as their further development of formats are only in their infancy. With Amazon's Kindle the initial challenge was given; with Apple's iPad the next generation of multimedia devices reading e-books has begun. Lately Apple has entered the market of e-book generation too by launching its "iBooks Author" software for free but is limited to Apple devices. Thus the e-book market is an emerging one and must be seriously taken into account regarding several aspects for teaching and learning. Moreover, in times of rapidly growing information input there is a rising call for methods to manage information. Flexible and reasonable management of content for learning purposes becomes more important. The efforts of Web 2.0 make it easier for teachers to structure and redesign their teaching processes. The reuse of content in different meanings and the multiple adaptability of content are easier to manage the smaller these pieces of contents are. The developments and systems described in this contribution reflect the progress and adaptions of an ongoing project which has become one of the central tasks of the Department for Social Learning at TU Graz. The aim was to find a concept of displaying content online and offline, a system that allows using content for presentation purposes as well as for detailed teaching and learning, a system that opens multiple ways of interacting and is supported by modern mobile devices as well as possible. By the date of this contribution the authoring tool offered by DSL, called ABC-Manager, allows the creation and generation of e-books on the basis of didactical principles for its usage within the LMS of TU Graz (TUGTC) for teaching and learning purposes. Its main characteristics are high usability in editing and assembling content to courses realized through single micro-content elements accumulated within pool architecture (Nagler, Ebner, & Scerbakov, 2007; Kulathuramaiyer & Maurer, 2007). The idea of flagging such micro-content elements by allocating them to classifications finally solved

the problem of presentation versus full information content. Furthermore TUGTC offers a variety of possibilities to have online content converted and released for the usage of e-readers and other mobile devices in principle. It allows users to work very actively and personally with content online and to interact and communicate in real-time with other users of e-books in ways never implemented before on any other CMS. Thus we recommend addressing the following (didactical) aspects when introducing e-books and e-readers for university usage:

- Use standard formats for editing the teaching and learning content: for best further use and flexibility towards multimedia HTML is strongly recommended;
- Enable easy editing of the teaching and learning content: use an adequate editor such as the very common and adaptable WYGIWYS editor TinyMCE;
- Work with micro-content: micro-content follows the ideas of recombination and mashup of content;
- Offer an API: it will allow other software to cooperate with the one you are using;
- Be aware that not all multimedia content can be converted to every e-book format: offer possibilities for the authors to check the various format compatibilities;
- Constantly have a look at e-book formats and mobile devices: they are rapidly changing.

The focus of the ongoing project is the next release of the ABC-Manager which will be in spring 2012. The new version of it will include an online and offline e-book viewer independent from TUGTC with a couple of advanced functionalities. Furthermore the usability will be enhanced as well as the administrational possibilities. Moreover the new release will offer an API to be used by other software to push the principles of mashup environments. The second focus concentrates on the optimization of the output formats for e-readers which is a very fast growing and changing area; the upcoming release will support the

various output variants especially for e-reader formats at the state of the art. However, the results of converting any multimedia content are limited by the e-reader formats and are not totally satisfying so far; they definitely need to be enhanced.

Footnotes

[1] http://www.gutenberg.org/

[2] http://idpf.org/epub/30

[3] http://en.wikipedia.org/wiki/Comparison_of_e-book_formats#cite_ref-22

[4] http://ebook.tugraz.at/

[5] http://tugtc.tugraz.at

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Educational Use Cases from a Shared Exploration of e-Books and iPads

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Abstract

E-books and e-book readers are becoming increasingly widely available, particularly for the general reader, and there have been many studies on their adoption. However, less is known about their use for educational and academic purposes. We report here on work carried out on e-books and e-book applications using iPads by academic and teaching staff. After considering pedagogical issues and reporting survey results, we identify a spiral of six key use case areas for e-books. This spiral of use cases moves from basic e-book use, through situational reading, e-books and learning, using multiple learning resources, collaborative/group learning, to e-book production. We discuss each of these use case areas and provide guidelines that will be of interest to practitioners and researchers alike.

Keywords: e-books, collaborative learning, situated learning, academic staff development, distance education

Introduction

Despite the growing popularity of e-books and e-book readers, and the perceived value of e-books as relatively low-cost, easily accessible resources in education, a compelling pedagogical rationale and methodology for the adoption of these technologies is yet to be articulated in relation to contemporary teaching philosophies and practices. Occasional published evidence that students still prefer print texts for learning (Shepperd, Grace, & Koch, 2008; Woody, Daniel, & Baker, 2010) casts doubt on the advisability of e-book use in

education, even though such evidence may be derived from limited and context-specific samples. It has also been noted that e-textbooks specifically have not received sufficient attention in terms of making them readable on various devices, which creates barriers to access, and furthermore, that the interactive and multimedia elements of more advanced formats are considered by some as nothing more than an unwelcome distraction (Volkov, 2012).

An underlying weakness of e-book adoption or implementation strategies could be attempts to offer e-books in place of printed books without rethinking the educational practices which underpin the use of these resources. Such educational practices concern students and teachers, as well as the institutional and external systems which support, or fail to support, the changing nature of teaching and learning materials, how they are developed, appropriated and used. It is no simple matter to understand and influence these evolving practices, however our experience creating small communities of academic staff (faculty) with the explicit purpose of collectively exploring new mobile technologies for teaching and learning has in the past proved effective (Kukulska-Hulme & Pettit, 2008).

In this chapter we look at how innovative learning can be achieved through a shared exploration of e-books and iPads among a group of academic staff in Higher Education who are interested in changing their teaching and student support practices. We report on the results of an 18 month project (2010-12) led by The Institute of Educational Technology (IET) at The Open University, UK, as part of the university's strategic Building Mobile Learning Capacity initiative. Apple's iPads are acknowledged to be a popular colour tablet device, used for many purposes including commonly as an e-book reader. In 2010, The Open University was one of the first universities worldwide to make its in-house developed interactive e-books available on iTunes U, and it continues to innovate in this area. The project has focused on the academic value of both the iPads and a variety of academic e-

books that can be read on these devices, although we have also included leisure activities and workflow productivity issues.

The chapter will serve to inform others who wish to incorporate the use of e-books and tablet computers in their own learning activities. In addition, the project has created a rich source of data detailing the evolution of the Academic's understanding and use of e-books and tablets, including the causes of reluctant participation by some academic staff. This will help others as they introduce these tools to their own faculty. We identify innovative uses of e-books and tablet computers in various learning situations and consider the implications for the design of new learning materials, activities and programmes. Throughout this chapter we have used the phrase 'e-book reader' to encompass both a dedicated hardware device and a software reading application on a device such as an iPad; where a distinction is required, it is developed in the text.

Background and Literature

The project has built on existing expertise in pedagogical and usability evaluations of e-book use and other research in mobile learning in the Institute of Educational Technology (e.g. Kukulska-Hulme, 2005; Kukulska-Hulme & Pettit, 2009; Kukulska-Hulme et al., 2011; Twining et al., 2005; Waycott & Kukulska-Hulme, 2003), alongside technological innovation expertise from the university's Knowledge Media Institute, and the Learning and Teaching Solutions unit where new learning systems are developed and supported. Our previous research indicated that e-books on portable devices fit in well with the lifestyle needs of distance education students, who often combine work with study and may have to share desktop computers with other members of the family. The research established that reading e-books and academic papers on personal mobile devices is already a popular activity among Masters level students in some parts of the world (Kukulska-Hulme *et al*., 2011). Distance education students were also the focus of research carried out by Nie, Armellini, Witthaus

and Barklamb (2011), who found that work-based distance education students appreciated the flexibility and improved use of available time that e-books offered them.

Studies on e-book use in education have largely focused on students' views and students' use of the technology (Cutshall, Mollick, & Bland, 2009; Woody, Daniel, & Baker, 2010; Foasberg, 2011), and consequently there is a lack of data concerning educators' experiences with e-book readers and e-books. Some studies have published the outcomes of research on educators' perspectives, but these perspectives chiefly amount to opinions about advantages and disadvantages (e.g. Jamali, Nicholas, & Rowlands, 2009; Bierman, Ortega, & Rupp-Serrano, 2010), rather than being based on accounts of hands-on experience. While students' experiences deliver important insights, they need to be complemented by the experiences of teachers. The success of any educational technology depends in part on how its use fits in with the overall design of a programme of study and the educational goals of learning activities that employ the technology. If teachers are distanced from learners because they have little or no experience of the e-books and e-book readers learners are increasingly using, the whole educational enterprise is at risk.

We resolved to work together with a group of academics for whom experimentation with e-books and iPads represents not only an opportunity to develop their teaching, but also a new way to engage with personal and professional development. As has been argued elsewhere by Kukulska-Hulme (2012), faculty engagement with mobile technologies should go beyond adoption in teaching to adoption in their own professional learning. In her work with distance educators wishing to become more proficient in online teaching, Powell (2010) has used a similar tactic of putting each faculty member in the position of online student, giving them some direct experience of using the online medium for personally relevant learning.

The use of e-books in teaching and learning is positioned at the intersection of mobile learning, multimedia learning, and the movement towards open educational resources. Pedagogies associated with mobile learning, and by implication with e-book use on mobile devices, typically centre on the learner's active role and his/her value as a distinctive kind of node in a labile network of people, places and resources (see Pachler, Bachmair, Cook, & Kress, 2010). Aspects of this are reflected in descriptors such as connectivism, collaborative learning, situated learning, inquiry learning, self-directed learning, resource-based learning, disruptive learning and ubiquitous learning. Weller has recently written about 'a pedagogy of abundance' (Weller, 2011), where proliferation of easily accessible content leads to new economic models which have abundance as an assumption. Collections of e-books, some of which may be learner-generated, can fit into this vision of abundance but must also face the challenges that such abundance inevitably creates.

From the educator's point of view, there is also a need to describe the activity of generating new educational designs and selecting or authoring new types of learning materials that will be accessed on mobile devices. The IMPALA project coined the term 'podagogy' to denote 'the art or science of using podcasts for educational purposes' (IMPALA, 2006), in recognition of the fact that a new type of content required new thinking and expertise around the creation and use of such content. Similarly, the proliferation of increasingly interactive e-books and e-book collections calls for an examination of their evolving pedagogical purposes. We propose that e-books may be conceptualized in several different ways:

- as stand-alone resources to be consulted by individual learners, for convenience or for reasons of preference;
- as part of an ecology or abundance of resources;
- as a bridge between informal and formal learning;

- as new cognitive tools that exploit multimedia capabilities to engage and reinforce learning;
- as social tools enabling community-building through sharing or collaborative annotation;
- as a further step towards greater inclusion and accessibility;
- as part of an emerging industry of self-publishing and disaggregated content

Interaction with e-books involves new skills and literacies encompassing gesture-based interaction, annotating, collating, tagging, exporting notes, and so on; as well as working with multiple e-books in varied formats from different providers. Accessibility and usability challenges exist in this medium as in many others; for example, a study by Kang, Wang and Lin (2009) reported that reading an e-book causes significantly higher eye fatigue than reading a conventional book. Even before an e-book can be read and used, the learner engages with the technical process of selecting, downloading and opening e-books, which currently presents some barriers. It is recognized that "…there are significant challenges in the technology itself and the approaches needed in the pre-reading process; these will need to be overcome before users will adopt [e-book] technology." (Lam, Lam, & McNaught, 2010). Interaction with a tablet device, such as the iPad, presents an additional layer of challenge to those who are not completely familiar with its features and the effects of various gestures. The next section details our method of working with the academic staff involved in our project and presents their experiences with using interactive e-books on iPads.

Evaluating Associate Lecturer Perspectives

In reporting our evaluation of Associate Lecturer (AL) perspectives, we are able to draw on survey results, focus group meetings, 18 months of online forum postings and blog posts in an online community, as well as wikis created during the project. This approach

enabled a good degree of triangulation and the opportunity for participants to enter a cycle of reflection on their experiences.

The method of gathering data and enabling collaboration between the ALs was chosen because it was already familiar to all of them. Many Open University modules use AL moderated student forums and wikis as teaching and learning aids so these online tools needed no introduction and the ALs were comfortable using them, though some were more regular users than others. Some Open University modules use blogs as a way of encouraging reflective learning. Therefore giving each AL a private blog, only visible to themselves and the project leaders, was a useful contrast to the group forum where idea exchanging took place. When the first survey data was collated, responses were compared with what had been recorded in the blogs and the forum to clarify some of the points made in the survey. Survey results were made anonymous for reporting within the university; however the ALs were able to recognise themselves and sometimes each other in the data when they discussed the results at a focus group meeting. This resulted in further reflective learning, exchange and development of ideas of how to use e-books for teaching and learning. Another online questionnaire completed the study, summing up their experiences of using e-books for learning and teaching.

iPads were distributed to 12 of our ALs covering a range of academic disciplines. In the context of The Open University, a distance learning institution, the Associate Lecturers are academic tutors who support student learning directly by guiding students through their module activities, animating discussion forums, giving feedback and contributing to assessment, amongst other duties. The ALs have worked together to develop and evolve an understanding of how e-books, e-book readers and tablet computers can be used to enhance their own and their students' learning. The project has also identified challenges to the wider use of these technologies.

In July 2011 the ALs were asked to complete an online questionnaire about their first 3 months of using the iPad. In addition, their blogs and the forum were monitored, and provided some detail to their questionnaire responses. The ALs came from the following faculties at the University:

- Arts Faculty (A1, A2)
- Social Science Faculty (D1, D2)
- Faculty of Education and Language Studies (E1, E2)
- Mathematics, Computing and Technology Faculty (M1, M2, M3, M4)
- Science Faculty (S1, S2)

Key Early Survey Findings Relating to e-Books

The most used source of e-book content was the Apple iBooks store, followed by online commercial sellers. Two ALs had downloaded OU e-books. Some ALs were very happy with the iBooks application, some were satisfied with it and two had downloaded and preferred alternative applications for e-book reading. ALs had used the iPad as e-book reader for personal reading at home, travelling or on holiday. Some had used it as a research tool whilst on location in a library and in preparation for module production or teaching; some of this involved e-book reading.

At this early stage in the project a few ALs had introduced e-books to their students in tutorials by showing them e-books and module materials on the iPad and held discussions with their students about potential uses for learning. Because the e-book applications have minimal annotation functionality, several ALs had downloaded apps to enable them to annotate PDFs, e-books and other documents.

Key Early Survey Findings Relating to iPads

The most popular locations for using the iPad were at home, whilst travelling, and in a cafe. One AL had used the iPad as a marking tool at an OU marking co-ordination meeting

(saving himself a lot of printing). Most had used it for work email (nine used it for private email too); searching/browsing the internet, accessing OU module websites/materials and using downloaded apps. The BBC iPlayer app was mentioned by several ALs as an application they used the most. Their families were using the iPad as well, mainly for games, homework, searching the internet, photographic display and listening to audio books (whilst doing home decorating).

ALs identified that the biggest benefit of the iPad was the portability and mobility of the device, the ability to share with small groups of others, the aid to marking assignments, new ways of doing things such as note taking, and the internet connection (when wifi was available). However some had experienced slow or interrupted internet connection on their iPad, with some having difficulty with wifi connectivity and synchronising the iPad with their computer, and one had given up synchronising at all. Most of the ALs wanted the iPad to have Flash and 3G. One AL all but gave up using the iPad as it was not compatible with Java programming (her teaching subject). The lack of set up instructions was problematic, especially for those more familiar with PC rather than Apple devices.

At this early stage in the study, four ALs considered that the iPad had a positive effect on their teaching practice, with the others being neutral – some had managed to find effective ways of using it as a teaching aid, while others were unsure. They were split about equally regarding whether it was a time saving or time wasting device; some felt that it was bound to be time consuming learning to use a new device, so they did not view this as time lost.

ALs Surveying the Students

One Associate Lecturer took the initiative to create a short online survey which several of the ALs circulated to their tutor groups. This impromptu survey was conducted twice, 10 months apart, with different groups of students. It explored actual student use and experience of e-books and e-book readers for academic purposes. Between the two surveys

there was a big international marketing campaign which resulted in millions of Kindle readers being purchased; this was reflected in the second survey where the percentage of students owning an e-Reader device jumped significantly, though this may also have been influenced by more students from the Computing and Technology category participating than in the first, which was dominated by Arts students. There was also a rise in the number expecting to have a device by the following year.

When asked what advantages they could foresee in having OU materials accessible through an e-book reader, portability and ease of access were seen as the greatest advantages:

"I didn't need to carry so many books … all in one little thin pad, otherwise I prefer normal books" (Student Survey 1)

"I travel a lot for work … ideal opportunity to study … downloaded the course material as pdf … Not quite as convenient as e-books" (Student Survey 1)

"… latest course … materials … only available as web-pages … would be much easier to read on an e-book reader … down side … Kindle does not support re-production of colour images" (Student Survey 2)

"E-Readers … much easier to carry round a large amount of course materials … much easier to search course and research materials" (Student Survey 2)

"… advantages … a digital back-up of study materials … being able to adjust the setting of eBook Readers … preference of font size, brightness, etc" (Student Survey 2)

Some students were not entirely convinced of the benefit of downloading electronic course materials to a portable device, especially if they had heard mixed reviews of their usability; indeed by the second survey views seemed more polarized, and there was a very slight increase in the percentage of students wishing to continue receiving hard-copy of module materials:

"… have only used the course book PDFs [on a PC] … invaluable for … search facility … type size on e-book readers is not great … have eyesight problems so have avoided them." (Student Survey 1)

"I can't! … screens are too small … with paper books … can take notes in margins." (Student Survey 1)

"… e-Readers … advantage for additional material … if students could choose e-books instead of printed materials as a cheaper course version … much prefer book versions at least for core texts, to touch, annotate, draw on ... They also don't give me headaches" (Student Survey 2)

"… option … to learn from both study materials … like to highlight key phrases … cannot concentrate for long periods … on the e-reader … therefore … course books would be beneficial" (Student Survey 2)

"… use my kindle a lot … have emailed … OU pdf files to it … downloaded several set books … would welcome e-reader versions of course books & readers" (Student Survey 2)

"… not my reading material of choice … prefer books … like flicking … pages, referencing several sections at the same time … having them all available to view" (Student Survey 2)

"… find the tangible quality of books preferable … but enjoy the scope, variety of material and immediacy that e-Readers provide" (Student Survey 2)

Some of the ALs held discussions in their tutorials with students about the potential advantages of using e-book readers and e-books for studying and in one such discussion revealed that the transience and potential for losing data with electronic devices was a significant barrier to student willingness to adopt e-books for their studies:

"Paper books can be carried around with pride, - when they arrive I feel motivated to study, the feel and smell of a book creates memories" (Science student discussion, reported by S1)

"There was also a concern expressed in the discussion about things that could go wrong – for example having to re-download a book and finding any notes they had made being lost, the device being lost, broken or stolen and so they lost everything." (Science student discussion, reported by S1)

Another AL (A1) reported that Kindle users in her tutor group used their e-book readers to *"dip into the book quickly whilst on a commute or at work in more privacy than a paper book allowed*" with *"more structured study"* taking place at home where they made notes on paper rather than annotating the e-book; she described their use of the e-reader as a *"stand alone book rather than an integrated study tool"*. A third AL (M1) reported that even her technology students who used a variety of mobile devices in their every day lives preferred print material for studying, with one printing out the online-only materials for studying.

Use Cases

Our project has identified six key aspects to be considered for e-book use in academic and non-academic use. The order of these six aspects as listed below is that of a widening spiral moving from the intrinsic features of e-books and e-book readers, to looking at their advantages and disadvantages for reading. We then consider issues around learning using a single device/resource followed by the issues around learning using multiple resources. The spiral then moves away from the individual learner to collaborative learning. We finish by considering the role of the academic in producing their own e-books.

- Basic e-Book Use
- Situational Reading

- e-Book and Learning
- Using Multiple Learning Resources
- Collaborative/Group Learning
- e-Book Production

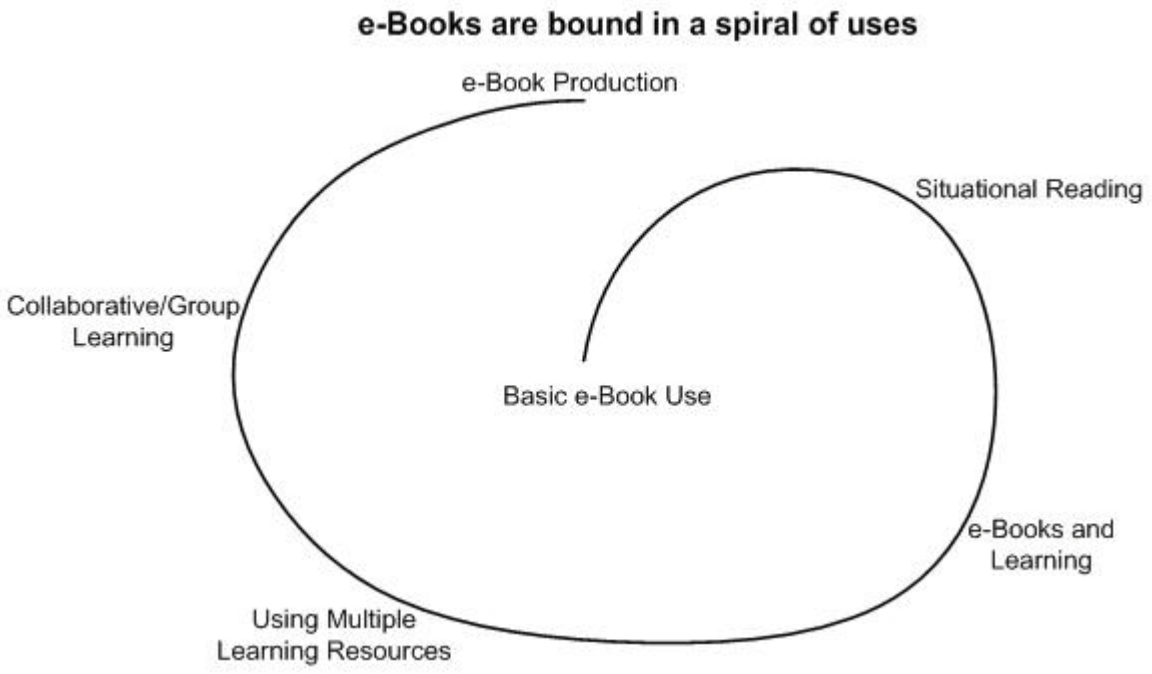

Figure 1

E-book use cases forming a spiral

Basic e-Book Use

The key selling point made for the majority of e-book readers is their ability to hold large numbers of books without the inconvenience of bulk and weight. However, for our purposes we are much more interested in features related to reading and in particular academic reading. Below we consider some of the key intrinsic features of e-books from this point of view.

The new affordances offered by e-book readers were some of the most important aspects of e-book use. Features such as the ability to re-size text and to read in subdued lighting were not only convenient but have important accessibility issues. Most e-book readers offer the simple facility to change the size of the font; many tablets also have the ability to zoom documents e.g. PDFs

"Beyond this, however, I do feel that the iPad's excellent image display capabilities - and especially the 'zoom' facility …" (A2)

"You needed to zoom to read it comfortably so if the OU were expecting people to read in this way routinely they'd need to put less on each page so you could still see a whole page when zoomed. (M2)

However, this zoom feature can be the source of irritation and inconvenience when the authors do not take the need for zooming into consideration.

"As an eReader I've been using the iPad to read the course texts for block 1 & 2 of TU100. Each page has to be enlarged slightly to read comfortably and then either flicked to turn the page or shrunk back so you can tap the corner. Either is a nuisance and when you get to the next page you are back to the old level of magnification." (M2)

Related to this is the common feature of being able to adjust the brightness of the screen – again a valuable accessibility feature.

An important feature for academic use is that many e-book readers allow not only text searching through a book but also a dictionary to look up word definitions.

"I have started to enjoy some advantages that can be gained from having module set books available …. Perhaps the most significant of these, so far, is the 'Search' facility, providing the opportunity to find specific words/phrases very quickly and efficiently." (A2)

"Searching - very easy indeed, almost no need for an index" (D1)

"I found that the e-books Search function works well for individual words. E.g. I was able to confirm that in ASH, Holmes says "my dear Watson" 5 times (and find the references immediately); "Elementary" once, but never says "Elementary, my dear Watson".” (E2)

Related to the search feature were annotation and highlighting features, although exporting and sharing was sometimes problematic.

"I am also beginning to develop the habit of bookmarking specific pages, as well as highlighting key words and creating on-text 'Notes” (A2)

"I am gradually transferring on to the iPad pdf copies of all the course/module material I teach, and then going through highlighting and making notes on the content. This is so searchable, so collectable and so easy to organise compared to any other method of highlighting and noting that I have ever tried.” (D1)

Problems that became apparent were:

"I did email just the annotations to myself and with a bit of tidying up that will produce a set of fairly respectable notes but I'm not convinced it wouldn't have been as fast to print out the papers and attack them with a highlighter, then type up notes afterwards.” (M2)

"My first response was that although it is possible to annotate e-books, there is not the same range of possibilities or flexibility that I find with print. My print annotations included highlighting, underlining, colours, bracketing, notes in margins and inside front and back covers. I didn't find this as easy with e-books.” (E2)

"Also I couldn't reproduce the musical notes and staff so couldn't always make the notes that I wanted to! I also tried making my notes in Pages but didn't find that any better - took up too much time and couldn't always write in the form I wanted too. Have now abandoned this in favour of writing notes by hand (on paper) as this is much quicker,

easier to use my own words and also the only satisfactory way I have found of writing music. (It occurs to me that students of maths and science are going to find making notes on the iPad quite fiddly for this reason).” (S1)

Another common feature is the ability of e-book readers to remember the last page you were at on all of the books that you have opened in the device’s library. Many also have simple bookmarking facilities.

An interesting response was:

“… but emailing the annotations to myself is less successful as I tend to underline key words rather than writing a lot of notes and they don't make a great deal of sense in isolation. I still find it disconcerting that you can't feel the weight of print still to read in order to pace yourself. I'm saving a lot on printing and in theory could pick the work up anywhere more easily, but in practice, because the books aren't sitting there staring at me it's all too easy to fall behind!” (M2)

On a higher level, organising of e-book collections could be problematic. Individual e-book readers provide simple organisation often through a book shelf type metaphor, but organising e-books read in different readers was not possible and collating annotations from several sources was difficult without the use of other software.

“Having already put three of the set texts into a new iBooks 'Collection' (a useful storage method), I was pleased to discover that downloading the first Module book allowed me to put copies into both PDF Expert and iBooks.” (A2)

Where enabled by the e-book reader, one of the most exciting affordances of e-books was through the possibilities offered by multimedia resources embedded within the e-book. Many readers don’t support these features at the moment but through the use of a device such as the iPad it is possible to have sound and motion embedded into the e-book. So, rather than asking students to stop reading and switch to another device such as a computer screen, audio

device or TV, all of the resources can be in the single e-book. It is also possible to have interactive features within the e-book such as quizzes with links to the answers or links out of the e-book to internet resources. As part of other projects within the Open University there are a wide range of interactive e-books available which incorporate audio, video and interactive features such as self-assessment questions.

Guidelines for Basic e-Book Use

We have identified many valuable features of e-books, particularly the ability to resize text and in some cases to zoom in on text and images. However, authors need to be aware of the limitations of such features if they are needed constantly and the wide range of devices available makes it difficult to anticipate how they will be used. This is particularly true when authors wish to include multimedia features and in some case even colour will not be rendered on some devices. However, authors should be very alert to the motivating potential of including multimedia elements into their e-books.

The basic search facility offered by most e-books was seen to be very valuable and to a large extent replaces the need for authors to create detailed indexes although the search facilities did not cover concepts as opposed to just simple word matching. This suggests that certainly for academic texts there is still a need for index creation.

In a similar vein, many e-books provide simple bookmarking and some form of annotation. However, this is often far less sophisticated than many people would like to use for academic purposes. So authors and particularly educators need to appreciate that students will still need to make notes, possibly using other packages or on paper.

Situational Reading

The general findings of the project were that e-books can be read in most of the situations in which traditional books can be used. However, there were differences on both

sides. Electrical devices tended not to be used near water, whereas as mentioned earlier, reading under subdued lighting was possible with most e-book readers.

The most often mentioned value of e-book readers was their ability to hold large numbers of books with no additional weight.

"I was able to appreciate that a big advantage of e-books is their portability. I don't mind carrying a single printed volume around (no more inconvenient than an e-book reader). But I could carry round hundreds of e-books without any increase in bulk." (E2)

This portability then encourages use in a wide range of situations.

"… Without even thinking today I popped it in my bag 'because I wanted something to read on the train'!" (A1)

"I did take it on holiday and did my favourite of sitting outside in the twilight to read a book." (A1)

"…especially on holiday (including a French campsite and bed and breakfasts in the UK)" (S2)

However, some were not happy to use it on some occasions.

"The iPad's place at night I've decided is on-charge. It's not soft and cuddly enough to want to use it to read a novel and I'm not ditching the paperbacks for it" (M2)

Most use of e-books focuses on reading books previously downloaded onto a device. However, in our increasingly connected world there are many opportunities for e-books to be downloaded on the move.

"Well the wi fi on the train wasn't as generous as hoped only half an hour free. But I did manage to download two OU course units. Dr. Faustus and Approaching Poetry, both useful for teaching. Especially the Faustus book which has the full play text embedded within it" (A1)

"I have been downloading books from Gutenburg and am so impressed by the stuff available. … I've always wanted to read all of his stuff but again, impossible as it has been out of print. They even have all the volumes of his Arabian Nights... Lots to keep me amused." (A1)

And there are opportunities to download spontaneously, as a need arises.

"At the end of August I had a canal holiday … and since this was a new area to me - Birmingham rather than the canals of the NW or further south - I decided to read up on them. I looked around for suitable sources and found that Birmingham City Council offer a book in ePub free of charge from their website." (M4)

Guidelines for Situational Reading

Portability is the key message here. Texts are easily transported and read irrespective of their size and weight. Internet access also allows for just in time downloading and use. For academic use in particular this is an unalloyed advantage of e-books. Academic texts tend to be heavy and unwieldy but as e-books they can be the size of a standard paperback book. So all other things being equal, a move to e-books is to be recommended.

e-Books and Learning

After looking at some of the basic features of e-books and their general use, we now consider their use specifically as learning resources. Whilst there has been widespread acceptance of e-books for the general consumer, there is some resistance to their use for academic purposes. The experience described below shows that with purpose made e-books there are real strengths in the technology but that there are problems inherent in the devices, particularly around annotation and sharing. These issues have been mentioned above and will be more fully explored in later sections.

At the Open University we have produced a great number (in excess of 400) of e-books based around our modules and these make use of interactive features and multimedia.

These resources are increasingly being provided for module use. Students can make simple notes and use highlighting within the e-books themselves and there is a book marking system. The particular value of these e-books is that they encapsulate all of the resources needed to study the module on a single device and hence allow students to access the materials in a wide variety of locations and on a wide range of devices including mobile phones. All of the points made earlier about features of e-books and situational use can be made in relation to learning as well.

An early issue for academic work which has been identified is the lack of page numbers for referencing purposes. Much of academic work requires the specific identification of the location of quotations and so on. With different aspect ratios, font types and sizes, e-books do not allow for page number referencing. A further academic issue for some modules/courses is that a student may work on an e-book throughout their course and then not be able to take the text into an exam when paper-based books are allowed.

Guidelines for e-Books and Learning

For simple access to content, the e-book approach has much to recommend it. By carefully constructing e-books they can incorporate all of the resources needed by the student in one package. However, beyond this there can be difficulties. For academic purposes all e-books whether 'off the shelf' or tailor made need to have sophisticated annotation facilities including the easy export of these notes and annotations to other packages without the need for further extensive editing.

A more substantial issue is the need for referencing quotations especially for assessment and academic writing in general. None of the e-books considered here had a mechanism for easily producing page references in any absolute manner and no progress on this point appears to be on the horizon.

The final point is the use of e-books in controlled examinations. Many modules allow students to use either clean copies of text books or copies annotated to a greater or lesser extent in examinations. However, there is considerable resistance to allowing e-books of any level of functionality into the examination environment.

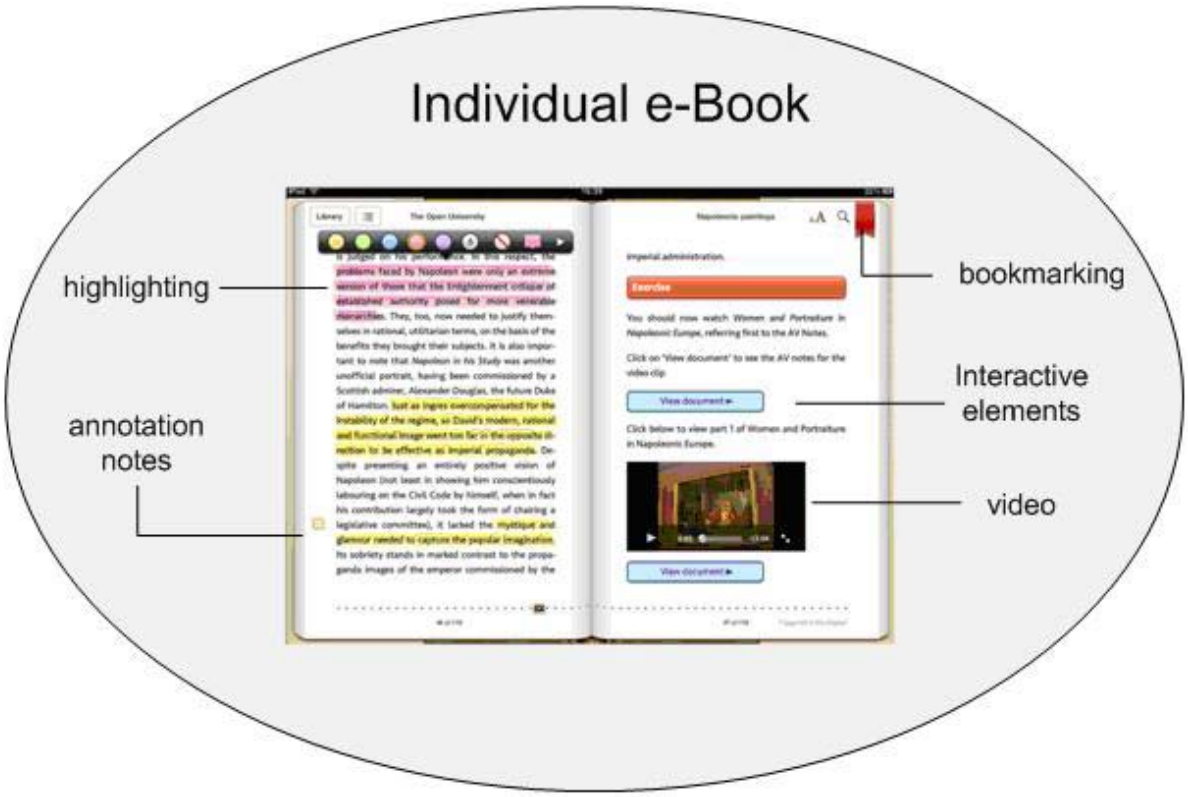

Figure 2

Individual e-book produced at The Open University

Using Multiple Learning Resources

Within much of the first year university level work of the Open University, module resources are provided for students that contain almost all of the material that the student needs for study and when converted into e-books the result is a very compact and portable resource incorporating, text, audio and video as well as interactive elements. However, when

using multiple e-books from a variety of sources, or with other resources, problems begin to surface.

Whilst using a single e-book/e-book reader is straightforward and has many of the advantages listed above, when it comes to using an e-book with other resources, particularly other e-books, then problems can arise. If all of the resources are encompassed within a single e-book (through the use of multimedia/internet links) then there are no difficulties. However, when using multiple e-books particularly across several e-book readers then considerable difficulties arise even when all of the e-book readers are situated on the same device as is possible through the use of e-book reader apps on the iPad. Difficulties include: switching from one e-book to another, needing to understand and be competent in the various annotating features of each reader, and issues around exporting and collating the notes made. Equally, there is a real need for e-books to be able to import annotations previously created elsewhere.

Quite often:

"The first thing that struck me was when I did this work using hard copy books, I usually had several printed copies open simultaneously." (E2)

Multiple e-books from multiple sources do not easily lend themselves to resolving this issue. Even when the e-books are being accessed on the same device, there are problems of sharing and collating annotations and these are problems that many providers have not yet addressed, presumably due to the comparatively small number of academic readers when compared to the number of leisure readers.

When engaged in academic reading there are often many activities going on simultaneously: cross referencing, bookmarking, skimming, scanning, reading for detail and annotating:

"My immediate impression was that it is not as easy to "flick" through e-books or jump between pages as easily as with a printed book" (E2)

"My first response was that although it is possible to annotate e-books, there is not the same range of possibilities or flexibility that I find with print. My print annotations included highlighting, underlining, colours, bracketing, notes in margins and inside front and back covers. I didn't find this as easy with e-books." (E2)

"You can make notes, but it's difficult. Underlining or highlighting with a marker is easier, more natural and more effective. With electronic texts it is difficult to 'scan-read' - very important for a first reading and for revision." (E2 – quoted from the experience of a student)

And perhaps most tellingly:

"In my opinion, they are very well adapted for reading in a "linear" fashion, e.g. a novel. However, this is rarely what we do when we study." (E2)

Guidelines for Using Multiple Learning Resources

Individually, there are many attractive features to e-books for learning. The search facilities of most e-books make them very useful for finding information – at least using terms that directly appear in the text. Many also have contents pages that allow the student to jump directly to a particular page and to bookmark that page. There are also often simple annotation and comment making features. However, the key difficulty is in having several e-books open at once. Annotating over several e-books is problematic but usually notes can be combined, in a separate word processing package for example. But much of academic study involves students having several e-books open at once or at least to be able to switch from one to another effortlessly. From this current study we do not see that the market is at this state and any guidelines will need to await further developments in the e-book market.

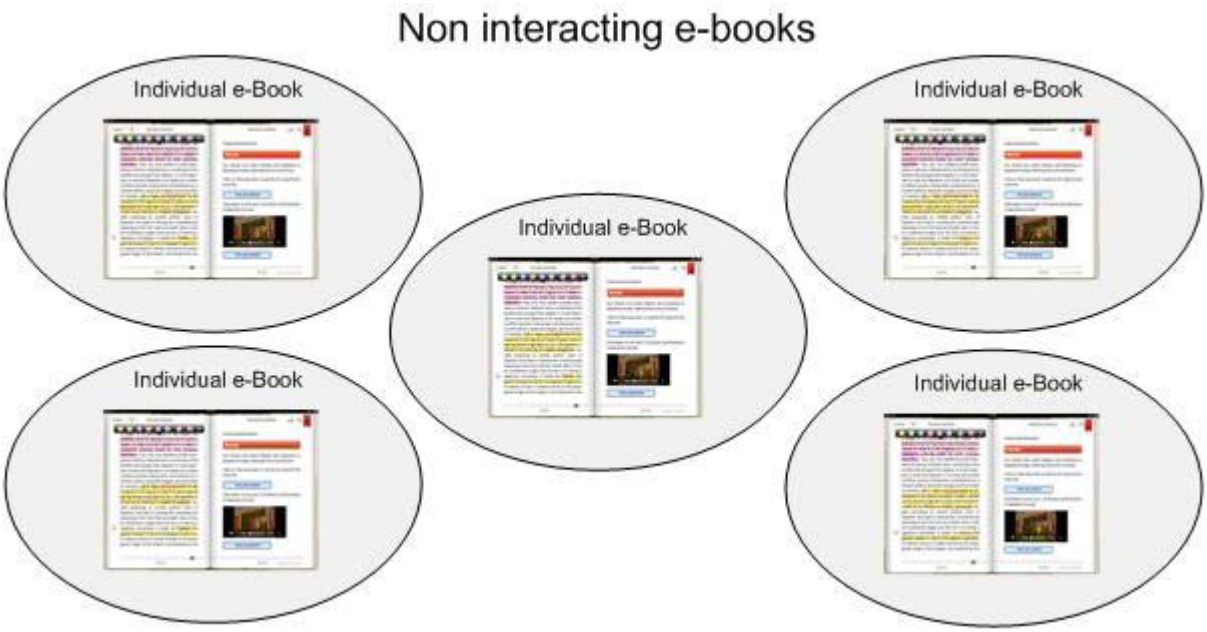

Figure 3

Non interacting e-books

Collaborative/Group Learning

The traditional view and approach to e-book use has focussed on individual use. What we were keen to explore in our project were the opportunities for groups of learners to work together with e-books.

We were particularly interested in whether and how e-books could be used for group work. With only one device, there were inevitably problems with a number of students trying to see a single screen. However, there were a several occasions where a small number of students were able to beneficially view specific elements of an e-book such as illustrations or multimedia elements. As an example, one AL was able to use an e-book during a tour of an art gallery to show comparative images.

"Calling up pictures of other items can really help a discussion go well ..." (A1)

With only one e-book available, group work was limited to using the device to display images, video or audio elements. When several devices were available, then using free e-books, several learners could gather around each device. This encouraged discussion and when done on a tablet in a wi-fi area, it allowed online work to be carried out at the same time.

Guidelines for Collaborative/Group Learning

Beyond using the e-book device as a small display unit to display audio/static images/video images to small groups, collaborative learning requires there to be a number of devices available, but not necessarily one per person. The advantages of using e-books over print based books in these situations is seen when interactive elements are incorporated. In particular, bespoke e-books can contain links to, for example, online forums where students can interact with each other in real time. The Open University also has a web based tool called Annotate that allows for the sharing of comments, tags and bookmarks on websites. Tools such as this can more fully realise the potential of collaborative/group learning using e-books. These more advanced features are of course device dependent with many dedicated e-book readers not able to make use of e.g. linking out to web based forums.

e-Book Production

One of the surprising developments from the project was the creation of e-books by the academics themselves. Through various 'apps' and other software it is increasingly easy to produce simple e-books using one of the widely used ePUB formats which can include sound and video resources. This aspect of the work is still in its early stages but has been used by two of the academics for their field trip work – allowing students to have access to relevant resources whilst carrying out field work. The academics produced their own resources and then bundled them together as an e-book. There are limits to the range of

features that can be incorporated in these simple packages, nevertheless there is clear potential.

Guidelines for e-Book Production

The issue of bespoke e-books has been touched upon earlier. In that context the idea was that a publisher or a module team would produce e-books for large numbers of students covering a substantial portion of a module's materials. However, the availability of relatively simple and cheap software for e-book creation means that this ability can be brought down the production chain, to the level of the individual AL. This allows for ALs to package their materials in an e-book format for their own students with all of the attendant advantages of the e-book format. General purpose devices such as the iPad have apps which allow e-books to be produced on the device itself. However, there are also straightforward routes to self publication through various book sellers' systems.

Doing Things Differently and Doing Different Things

Whenever a new tool or technology comes along there is the potential for disruption to the existing order. E-books are disruptive in many ways. At the simplest level they are re-making the entire publishing industry. For our project we were interested in the disruption caused to the arena of education. This disruption comes in two forms: e-books can enable us to do the same things but in different ways, but they can also enable us to do different things – things that we were not able to easily do before they arrived or even do at all.

ALs have seen that e-books allow them to continue to carry many texts but without the weight traditionally associated with academic texts. They can add bookmarks, annotate and add comments just as they have always done with pencils in the margins. However, with e-books they can zoom in on images and re-size text, they can rapidly search the whole of a text. Their annotations and comments can be relatively easily shared with a wide circle of colleagues through a simple email.

Through careful construction, e-books can incorporate all of the resources needed by the student in one package. This type of artefact goes further than simply being the equivalent of giving a student a book, a DVD and a computer simulation package, since an e-book with these elements forms a seamless blend of learning resources with all of the elements integrated at the appropriate point in the students' learning journey. The student does not have to stop reading to switch on their DVD player to watch the first few minutes of a film before having to open their book again and then returning to the DVD player before starting their computer to run a simulation package – instead, with an e-book all of these elements are in the same place and the student is able to move naturally from one to the other.

Using e-books in group situations can be the equivalent of using paper based books. Each student has their own copy and uses it in a traditional group fashion, perhaps reading a short section and then discussing with those around them. This is followed by reading some more, perhaps making their own notes as they go along. However, now imagine the same scene using e-books containing external links and in particular links to an online module forum; now the class can include those not present in the room and even those not present at that particular time. Comments can be left on the forum as the students interact with the text both synchronously and asynchronously collectively making sense (and notes) of the text.

Lecturers have always produced their own notes, or their students have done so, in more or less sophisticated ways. In one sense, lecturer produced e-books are just the same, except that they can now contain audio and video material, interactive elements and links to external websites and by using standard formats these can be made available for a wide range of reading devices.

Conclusions

For The Open University as a distance education institution, the starting point for an e-book pedagogy is to identify and analyze the range of scenarios of use, since these will

comprise e-book use in tutorials, at day schools, in outdoor activities, in the home, at work, and during periods of movement and travel (in UK and abroad). This requires close work with representative groups of ALs and students. Second, it is important to observe interactions between portable devices (such as the iPad) and other technologies available to students, for example the use of interactive e-books in conjunction with a desktop PC, print resources and a mobile phone, hence the initial impetus for this project.

E-books have a tremendous potential especially when full advantage is taken of the digital nature of the medium to incorporate multimedia and interactive elements to enhance the student learning experience. Such features require more sophisticated e-book readers but enable educators to structure and deliver a learning experience far richer than any possible through a paper based system. In 2009, Warren wrote that the majority of e-books are simply digitized versions of print books, mimicking what students and researchers have traditionally done with printed texts. Based on a review of three innovative e-book models, he predicted that the future of e-books would be in more interactive formats that would include hyperlinks and multimedia assets. Furthermore, he drew attention to the authors of e-books, who would be likely to "explore collaborative models, seeking input on their creative process, allowing others to remix or re-use their work, and teaming up with other authors or fans to create new content" (*op cit*., p. 91). Our findings about academics' experiments with e-book creation suggest that this may well be the direction of future developments.

However, there are currently important problems around the use of e-books for academic purposes. Individual e-books often stand isolated from other e-books especially if on a different e-book reader. But also, in many cases even when e-books are on the same reader, it is impossible to have several e-books open and viewable at the same time for study. Making and collating digital annotations and notes can also be challenging. For academic purposes the difficulties in producing definitive page references is a serious issue. All of

these issues will probably have to await a common format across all e-books along with tools for manipulating multiple resources including annotation and collation of notes.

Many of these problems can be alleviated by bundling resources together to create a seamless learning experience. The Open University currently creates a wide range of such e-books. However, one of the downsides to this is that students may be tempted to stay in the 'walled garden' that has been provided for them and be less inclined to venture further afield. This project is part of a wider effort by The Open University and future work will concentrate more directly on the student experience of using e-books.

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A New Paradigm for e-Learning in the Arab Middle East: Reflections on e-Books and e-Reader Devices

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Abstract

This study investigates the status of higher education in the Arab states. It argues that e-books in the area of e-Learning have the potential to iron out illiteracy to a great extent and contribute positively to knowledge-based socio-economic development in the Arab states. Although education appears to be a high priority in some countries including the oil-rich Gulf Co-operation Council (GCC) countries, considerable ground has to be covered to make rapid progress in terms of popularizing e-books and e-reader devices. Survey findings suggest that e-books and e-reader devices are of great importance, particularly for in-career personnel. It is also remarkable that the respondents generally thought that the Open Educational Resources (OERs) available through e-learning devices were of utmost importance. During the qualitative interviews, some learners explicitly mentioned that e-books would be cost-effective for them. However, access to learning materials available on iPad and smart phones would be limited to those who could afford to buy those devices, some respondents observed.

Keywords: E-books, e-Learning, Arab nations, Virtual learning environment, Hamdan Bin Mohammed e-University

Introduction

The Arab Human Development Report 2012 (UNDP, 2012) and the Arab Knowledge Report 2010-2011(UNDP, 2011) have highlighted the strategic significance of education in the context of the evolving knowledge economies in the Arab World. However, drastic changes must be made in the education sector to achieve even basic education (Daniel, 2005).

There are 22 Arab states in the Arab League starting from Morocco and Mauritania in the west, through North Africa and the Levant, stretching to the Arabian Gulf in the east. Curiously enough, great variations exist among the Arab states in their literacy rates. Available data presented in Table 1 suggest that literacy rates range from 80% and above in nine countries to less than 75% in some other heavily-populated countries, with Iraq, Sudan and Somalia standing as low as 65%, 50% and 25% respectively.

According to the Global Competitiveness Report 2010-2011(WEF, 2010), the Gulf Co-operation Council (GCC) countries endowed with oil and gas reserves have made considerable headway in improving the quality of education. Although education appears to be a high priority in the GCC countries, considerable ground has to be covered to make rapid progress in terms of both enrolment and quality enhancement.

Table 1

Literacy rates in Arab states

Country	Adult literacy rate (15+ years)				Gross school enrolment ratio						
					Primary			Secondary			
	T (%)	M (%)	F (%)	Y	T	M	F	T	M	F	Y
Afghanistan	27	39	13	2008	65	75	66	34	44	22	2008
Bahrain	…	…	…	…	125	124	126	102	100	104	2006

Djibouti	63	63	64	2006	52	54	50	32	37	26	2006
Egypt	71	78	63	2006	94	95	93	92	93	91	2006
Iran, Islamic Republic of	82	87	77	2006	…	…	…	…	…	…	…
Iraq	65	65	65	2006	104	113	96	49	56	41	2009
Jordan	93	96	89	2009	102	101	103	82	79	86	2007
Kuwait	95	96	94	2008	100	100	100	100	100	100	2008
Lebanon	…	…	…	…	108	110	105	79	74	84	2007
Libyan Arab Jamahiriya	89	94	83	2006	97	97	97	…	…	…	2008
Morocco	56	69	44	2009	91	…	…	44	…	…	2009
Oman	…	…	…	…	99	99	99	91	93	89	2009
Pakistan	56	69	44	2009	91	97	83	47	55	36	2009
Palestine	94	97	90	2007	90	88	90	75	70	80	2007
Qatar	91	94	88	2006	103	105	102	105	102	109	2005
Saudi Arabia	88	90	85	2008	99	100	97	94	99	90	2008
Somalia	25	…	…	2006	7	…	…	…	…	…	2006
Sudan	50	51	49	2007	71	77	65	30	31	29	2008
Syrian Arab Republic	83	90	76	2008	100	100	100	37	35	38	2006
Tunisia	78	86	69	2008	98	97	97	75	72	79	2009
United Arab Emirates	92	92	93	2008	86	84	88	63	61	65	2008
Yemen	…	…	…	…	75	85	66	37	47	27	2009

Source: WHO, Demographic, Social and Health Indicators for Countries of the Eastern Mediterranean, Cairo, Regional Office for the Eastern Mediterranean, 2009

Table 2

Education rank for GCC countries among 134 countries

Country	Quality of Primary Education	Secondary Enrolment	Tertiary Enrolment	Quality of the Educational System
Bahrain	41	36	74	38
Kuwait	79	62	92	88
Oman	48	70	81	43
Qatar	5	49	106	4
Saudi Arabia	54	43	75	41
UAE	29	46	84	27

Source: *The Global Competitiveness Report 2010-2011*, World Economic Forum, 2010

There appears to be a limited financial support for education in a large number of Arab countries. The rate of total expenditure on education relative to GDP in all Arab countries is nearly 1.3 % (World Bank, 2007). In the emerging paradigm of education, however, this kind of ratio appears to be rather insignificant. Generally speaking, educational trends in the Arab region are characterized by a low quality of research. The scientific publications in Arab countries lag far behind those published in developed and fast-developing countries. Most universities are teaching-based, rather than research-oriented. The World Bank (2007) has pointed out the following.

- Investment in research and development is less than one-seventh of the world average.

- The rate of researchers in Arab universities as compared with employees is 2.7 per 10,000
- The total expenditure on scientific research in the Arab countries is around 0.15% of the GDP, which is considered far behind the advanced countries which exceeded Arab countries by 15-20 times.

The educational sector in the Arab states, according to the World Bank (*ibid*) is also experiencing (a) lack of planning and strategies for education at all levels, (b) lack of information and communications technology (ICT) integration into new forms of education, (c) weaker linkages between education and labour markets, (d) centralization of education, and (e) intellectual migration.

Admittedly, several initiatives have been taken by the Arab states (depending on their circumstances and availability of resources) to improve literacy in line with recommendations from UNESCO, UNDP and the World Bank. These initiatives have included establishment of national and regional forums, proliferation of e-books and e-learning devices, availability of incentive systems to promote education (particularly in the GCC countries), and flexible access to distance-education programmes. However, a key question still lingers in the Arab states: Can e-books and e-reader devices in the context of e-Learning provide a paradigm shift in the area of education in the Arab states?

Arguably, decision-makers can best respond to this question by exploring the potential of electronic communication for spreading education in the Arab nations. Electronics can produce total communications anywhere in the world. The rise of the Internet surely is a major trend in modern times. There is certainly a close and mutually-reinforcing relationship between the Internet and education. Internet makes education easier, cheaper and more possible through global connectivity (AACSB International, 2005). Consider, for instance, Phoenix University, America's largest university having nearly 280,000 students,

234 campuses and branches around the world including some in China and India. Case studies from rapidly developing countries such as India, China and South Africa indicate positive trends in e-learning. The Open University of China, for instance, is educating nearly one million students by using e-learning technologies effectively.

Some Arab countries such as Libya, Saudi Arabia, Sudan, Kuwait, Lebanon, Bahrain, Oman, Palestine, and UAE have taken advantage of the availability of distance-education technology and established e-learning institutions to enhance literacy. The potential of distance education can be gauged by reviewing an imaginative approach adopted by Sudan to educate the displaced people living in camps due to political conflict, by providing informal education (UNESCO, 2006). The Open University in Libya set up in the late 1980s has been expanding and is supported by a satellite channel to spread education in various parts of the country. The Al-Quds University in Palestine and the Arab Open University established in collaboration with the Open University, UK (with branches in several Arab countries) have also been serving the cause of higher education in the Arab states.

Hamdan Bin Mohammed e-University (HBMeU) in the UAE has indeed come a long way in designing a unique life-long learning model to provide learning opportunities for everyone in the Arab states by laying out an effective architecture for e-learning. Its pioneering initiatives have helped the Ministry of Higher Education and Scientific Research in the UAE to prepare the *Standards* for e-learning programme accreditation.

There are several powerful forces lending support to e-learning in the Arab states: the illiteracy-eradicating potential of e-learning, enhancement of e-Learning technology due the proliferation of e-learning institutions, learner-centric nature of e-Learning, the availability of e-books and e-reader devices, and the facilitation of economic development process as a consequence of e-learning contributing to improvement in literacy rates. Interestingly, the

emerging forces of education and technology are indeed mutually reinforcing as shown in Figure 1.

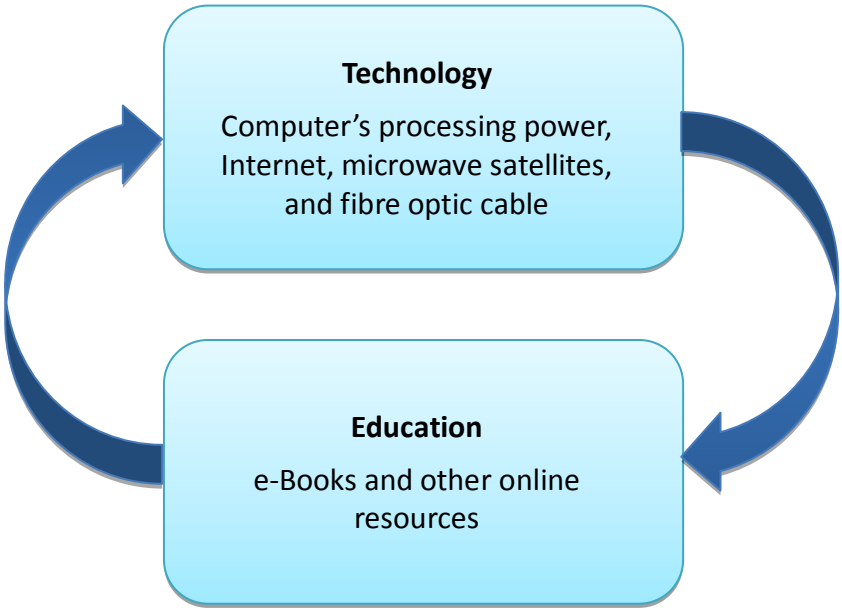

Figure 1

The technology-education reinforcing circle

Figure 1 explicitly suggests that technology and education go hand-in-hand in the contemporary world. Surely, information technology (combining computer's processing power with microwave satellites and fibre optic cables) has come to produce total communications. The Internet lends great support to education through global connectivity at all time.

Towards a Paradigm Shift

The *e-Learning Declaration* crafted by HBMeU at the 2008 e-Learning Forum held in Dubai calls for more active learners as well as a different model of education. The new educational model, which is based on research about how active learning takes place, requires a shift in focus from the traditional approach. The new model of education requires faculty and trainers to understand the promising ideas behind active learning so that they can

incorporate them into their curricula and delivery systems. Active learning must be supported in the following way.

- Faculty as facilitators must create an environment within which learners can discover, construct and transform knowledge by processing it through existing cognitive structures and then retain it in long-term memory where it is available for further processing and reconstruction (Annegret, Coldwell, & Annemieke, 2010).
- Learners actively construct their own knowledge. Learning is something that a learner does, rather than something that is done to a learner.
- Faculty must adopt a "cultivate and develop" philosophy rather than "select and weed out approach".
- Education is seen as a social process that can only take place through interpersonal interaction between students and faculty. Individuals must cooperate and communicate to construct shared understandings and knowledge.

A formidable body of research has been built up in recent years to suggest the following reasons for developing online courses in the emerging paradigm of higher education characterized *inter alia* by learner-centricity: (1) self-paced learning stimulates critical thinking and increased concept retention (Kane, 2004); (2) online courses offer pedagogical flexibility (Kent, Gilbertson, & Hunt,1997); technology can facilitate learner's engagement in diverse and dispersed real- life situations (AC Nielsen, 2000), and ICTs can of course help learners interact with faculty and practitioners in any part of the world (Cantor, 2001).

The e-Books and e-Reader Devices Project

Being a pioneer in e-Learning, HBMeU has launched an e-book and e-reader device project to help learners gain access to learning resources through iPad/iPhone, and e-books available on the e-store (Figure 8). This project was initiated in February, 2010 in

collaboration with a company called Flagship. There are 15 e-books and a large number of Arabized articles available for distribution and sale through Rufoof.com

Interestingly, e-books and e-Learning devices can facilitate the design and implementation of HBMeUs life-long learning model (Figure 2) by addressing the needs of various categories of learners as follows. For casual learners, open access education is provided through e-books used for short courses, seminars, workshops, conferences and other activities. Competency-based programs including professional diplomas and certificates are designed for committed learners. These programs quite often address the needs of practicing professionals, who need to acquire new knowledge and competencies. The concentration learners are actually those who need research-driven innovative academic degree programs. Finally, customized and solution-driven programs are designed for continuing learners who have management development needs. All the schools of HBMeU are committed through their strategic plans to implement the lifelong learning model.

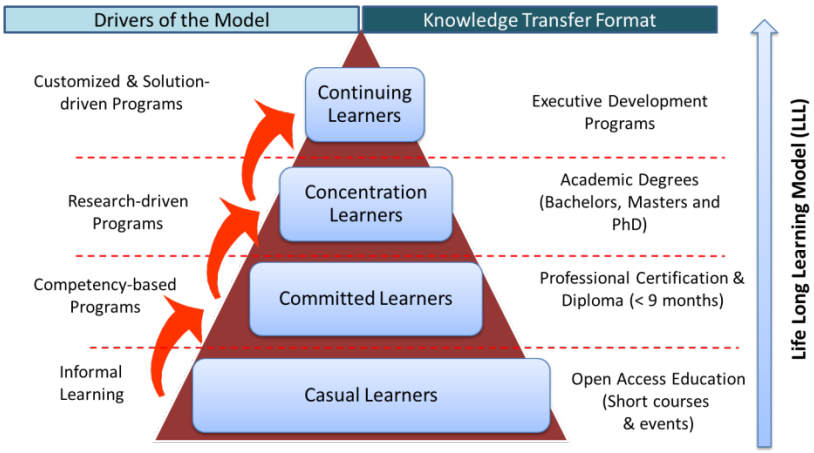

Figure 2

HBMeU's Lifelong Learning Model

The task of designing and developing online courses is complex and challenging. For instance, it is difficult to bring real life experience in an online setting (Brooks, Nocks, Farris, & Cunningham, 2002). Effective real world learning requires hands-on experience and

utilization of broad and dynamic perspective (Allard-Poesi, 2005), and it is quite a challenge to cultivate this kind of experience in an online course. Despite these challenges, HBMeU has adopted a systematic approach to design and develop courses. The approach is presented in Figure 3.

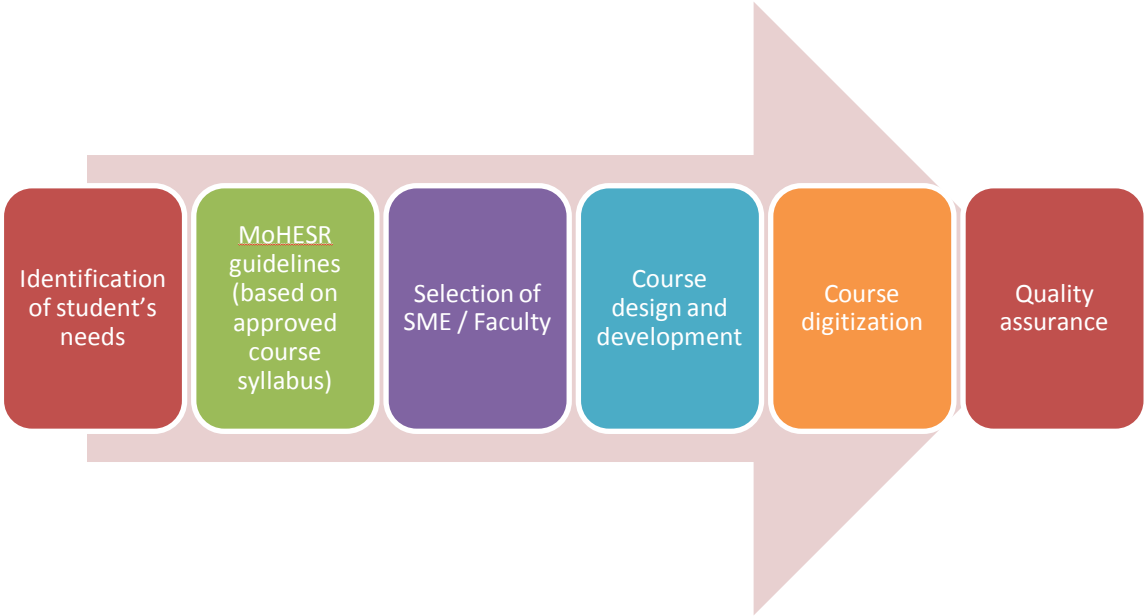

Figure 3

Designing online courses

At its most basic level, HBMeU's course development approach (depicted in Figure 3) is built upon a number of straightforward propositions. One is that it is the learner-centricity that must pave way for the design and development of courses in line with the *Standards* of the Ministry of Higher Education and Scientific Research (MOHESR) in the UAE. A second is that knowledge and skills of a subject matter expert are invaluable in creating knowledge of differential quality. A third proposition is that the digitization of courses and creation of e-books go beyond the Web and even information technology (IT); it is about creating the desired pedagogical impact in a specific context. Finally, Quality Assurance is a building block of HBMeU's course design and development strategy. Since

HBMeU has a distinct expertise and experience in TQM, it has taken systematic steps for ensuring that its service offerings will satisfy the stakeholders' needs effectively. HBMeU's comprehensive Quality Assurance system defines the level of quality at a point in time, prepares a strategic plan to reach the level of quality desired, and designs and integrates the processes throughout the university for translating quality plans into reality.

A review of literature suggests that the dimensions of course design and development, including e-study books have been a subject of intense discussion and educational concern (Chang, 2010; Chapla, 2011; Cox, 2010). Arguably, some of the learning dimensions of course design – based on various versions of Bloom's (1956) taxonomy – may be perceived as effective among learners and faculty, while some others may be perceived as unsuccessful. In the light of this argument, we organized a focus group session including six learners. Two learners were from the Master of Science in Organizational Excellence programme, and the remaining four came from the Bachelor of Business and Quality Management programme. They were all holding managerial positions in the government and private sectors. They were briefed about the purpose of the focus group meeting. The guidelines developed by Morgan (1988) were used during the focus group discussion meeting held at HBMeU. The discussion lasting nearly 2 hours was moderated by the Dean of Scientific Research and Doctoral Studies of HBMeU. A list of constructs related to online course design and development, including e-study books at HBMeU was revealed to the participants in the focus group. They were asked to select and assess the variables they felt were important when assessing the effectiveness of an online course. Table 3 presents the responses of learners to the questions related to course dimensions.

Table 3

Course dimensions evaluated by learners

Course Dimension	Learners' Responses	Implications for Course Design

Objectives	Good course have well-defined and measurable objectives	Emphasize skills that are a priority in the course
Contents	Local contexts and cases make the course exciting	Consider learners' preferences and use local case studies
Course outcomes	Courses must be results-driven	Consider designing courses that have measurable outcomes
Learning outcomes	Good courses address the needs of both slow and fast learners. They transform learners needing 'spoon-feeding' into those who are able to learn on their own.	Let learners participate in defining learning outcomes
Assessment	Final exams hardly serve any purpose. Do not assess learning at one point in time.	Use continuous assessment approach
Application of learning	Interesting course are those that provide opportunities for real-world or hands-on experiences	Explore additional practical situations where learners can practice what they have learned.
Course delivery format	Different topics need different formats of delivery	Let topics be aligned with different delivery formats
Course requirement	Too many pre-requisites are not helpful	Avoid creating unnecessary pre-requisites for courses
Digitization and e-study books	Amazing opportunity to enjoy story boards and learning objects	Consider digitization an de-study books as a lively process
Meeting time	One semester is not enough for research-based courses	Create tutorial opportunities for learners

Course budget	Online courses and e-books need additional budgetary support	Create additional budgets for e-books and e-reader devices (iPad, tablets, smartphones, etc.)
Course resources	One best way'-type resource is unhelpful	Create a mix of resources to let learners explore different ways of learning. Create opportunities for m-Learning
Career impact	Courses must help careers	Match course and learning outcomes to current and future career needs of learners

Surely, the emerging paradigm of e-Learning offers new, significant, varied and challenging opportunities for designing and developing courses. HBMeU has taken important steps to contribute to the emerging paradigm of e-learning by a adopting a comprehensive framework for designing and developing courses.

Learning Innovations and Strategies Office

The Learning Innovations and Strategies Office (LIS) Office plays a pivotal role in shaping the pedagogy framework at HBMeU. Its role involves the following:

- To develop and implement capacity building programs for faculty and staff on e-Learning, teaching and learning related certification programs and workshops ;
- To develop an integrated Quality Assurance framework for e-Learning, which will allow assessment and continuous improvement of all the e-practices of the university;
- To advance e-Learning practice in the Arab region through associations and international links;

- To develop appropriate policies and strategic direction that support the design and development of e-learning practices;
- To benchmark HBMeU against e-Learning institutions regionally and globally;
- To develop policies and procedures pertinent to the development, implementation and assessment of e-learning initiatives, including e-books and e-reader devices across HBMeU;
- To engage HBMeU in various international competitive awards in e-Learning and related applications, and
- To conduct research documenting HBMeU's experience as well as international best practices.

The Office works closely with the Knowledge and Technology Development division in digitizing course material and making it available to faculty and learners through the Virtual Learning Environment (VLE).

HBMeU's Approach

A critical function of the LIS Office is to digitize curriculum in a way that engages learners actively. Although the importance of engaging learners in the learning process through interactivity is well documented, faculty and instructional developers often do not succeed in considering learning design during the curriculum design process (Salter & Richards, 2004). Much research informs that successful online learning requires rethinking about the learning process and the role of educators in rethinking content development (Comeaux & McKenna-Byington, 2003; Garrison, 2006; McShane, 2006; Pallof & Pratt, 2003; Wiesenberg, 1999).

The goal of any instructional system is to promote learning. Therefore, before any e-books or e-reader devices are developed, educators must, tacitly or explicitly, imbed the principles of learning and how learners learn in their practice. This is especially true for

online learning, where the faculty member and the learner are most of the time separated by time and space. The development of effective online learning materials is premised on proven and contextualized learning theories. The delivery medium is not the only factor determining the quality of learning but also the design of the course which determines the effectiveness of the learning (Rovai, 2002).

HBMeU's courses are designed and developed in accordance with the theoretical framework discussed above and the delivery strategy is identified as part of the overall teaching and learning strategy and the outcomes of each of the programs offered. HBMeU adopts a blended learning approach (Figure 4) instead of a completely online delivery strategy. In this kind of approach, courses are delivered through three distinct components: *face-to-face learning* (maintained to a minimum of 2-3 sessions per course per semester), *online collaboration* where interaction occurs between faculty members and learners in either a synchronous mode (using live virtual classes and chat rooms) or asynchronous mode (through the use of tools such as e-mails, discussion forums, blogs, etc) and *self-paced learning*, where learners learn at their own pace, quite often using tools such as e-books, digitized courses content, recordings, etc. It is important that all three components complement each other and represent an integral part of the delivery strategy of the course.

The delivery strategy aims to promote 'deep' rather than surface learning and engages the learner through positive learning experience. It aims to be congruent with course learning outcomes to enhance learning and support effective teaching practice. Assessment strategies are designed authentically and are structured in a way that provides learners with meaningful online activities with opportunities for receiving ongoing feedback. Such a blended approach equips learners with a range of transferable skills to develop highly motivated and committed life-long-learners.

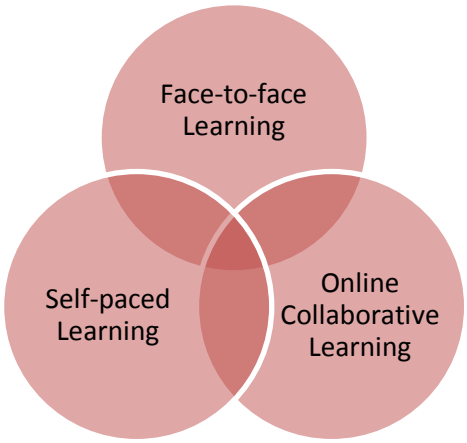

Figure 4

HBMeU's blended learning approach

Online courses involve consideration of not only pedagogical aspects but also technological issues when compared with design and development of traditional print-based resources. Towards this, the SMEs, while developing content for HBMeU online courses must ensure higher levels of communication and interaction between learners and content to impart good and effective online learning.

Thus, HBMeU makes effective use of ICT to support delivery of its courses. Drawing on modern approaches to e-learning, the mode of delivery adopted by the university makes an effective use of physical classroom interaction, online collaborative learning using a virtual classroom environment supported by an e-learning platform, and asynchronous study that is enabled by interactions with the professor, and access to electronic materials.

The Virtual Learning Environment (VLE) using a Moodle Learning Management System enables effective two-way communication between the faculty and learners and the exchange of files. For example, learners may upload their assignments and other forum discussions electronically and the faculty may in turn mark them and enclose his/her comments within the assignments. The VLE also enables the uploading of other curriculum materials, case studies, and Power-point presentations for the convenience of learners.

To adopt the blended strategy, HBMeU develops its learning materials (curriculum) in digitized electronic format. Currently, the institution packages its digitized content using the Shareable Content Object Reference Model (SCORM) which is congruent with the Learning Management System utilized. SCORM allows the developer or content author to create learning materials in collaboration with the subject matter expert using the technologies which are pedagogically suitable and relevant to learners.

All course materials at HBMeU have the following common elements:

- Course Outlines
- Chapter Outlines
- Study Books (organized on a chapter by chapter basis)
- Presentations (organized on a chapter by chapter basis)
- Assessment Booklet (detailing all course assessment in accordance with the assessment strategy described in the course outline).

The SME at the beginning of course content development is provided with the course outline and new course proposal documents (containing measurable assessment strategies and their logical connection with course outcomes) and is expected to develop content in alignment with those documents.

The content provided by the SME is then designed and organized in line with the learning outcomes of the program. This is then mapped to the learning outcomes of the course, teaching and learning strategies as well as aligned to learning activities and assessment.

This Instructional Systems Design (ISD) process ensures that learning does not occur in a haphazard manner, but is developed using a process with specific measurable learning outcomes. The responsibility of the instructional designer is to create an instructional experience, which ensures that the learners will achieve the goals of instruction. The ADDIE

model (Figure 5) provides a systematic approach to the instructional design process and thus provisional support for instructional designers as it equips them with a framework in order to ensure alignment between learning outcomes, teaching and learning strategies as well as assessment. This ensures that learners can effectively navigate the content.

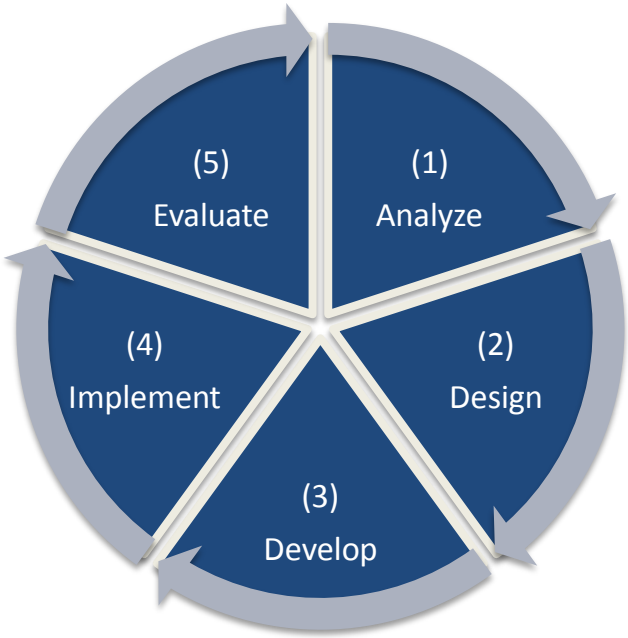

Figure 5

The ADDIE Model

Each phase of the ADDIE model is an important element of the instructional design process. In each phase, the SME and the instructional designer(s) make decisions that are critical for ensuring the effectiveness of the instructional experience.

The Virtual Learning Environment

Moodle is HBMeU's Learning Management System and online learning platform and constitutes the Virtual Learning Environment (VLE). The digitized SCORM pack is accessed by faculty, staff and learners using this platform. The VLE is customized as a collaborative learning (forums, wikis, discussions, etc) space and is the means through which content is

delivered to learners and assessed using online assessment submission mechanisms. Faculty members actively engage and interact with learners via the VLE, accessing various technological functionalities and applications to encourage active learning and support learners using effective online teaching and learning strategies. Curriculum is integrated into technological tools through the Learning Management System (LMS), Moodle and the Virtual Classroom (Wimba) to enhance learning and improve the learner experience.

Faculty members communicate and collaborate in an online environment to support and improve the learner experience through engagement in an online community of practice within HBMeU. The utilization of communicative tools – both synchronous and asynchronous – allows for effective blended approaches where learners can work at their own pace and meet in real time in the virtual classroom to collaborate and deal with constructs dynamically and interactively with faculty and other learners.

Through the VLE, learners are encouraged to gain a meaningful understanding of the discipline by actively applying knowledge and skills related to their discipline. Through asynchronous and synchronous discussions and structured assessment, learners critically reflect and solve problems, participate in lifelong learning through participation and involvement in the learning process. The promotion of collaborative and individual learning, using learner-centric approaches is thus utilized in this manner.

Learning communities of practice (Figure 6) is the gathering of people, in an online 'space' where they meet to communicate, connect, collaborate, share knowledge and resources in study groups, socialize and learn together. Examples of tools may include discussion and chat forums, blogs and wikis to share research and knowledge.

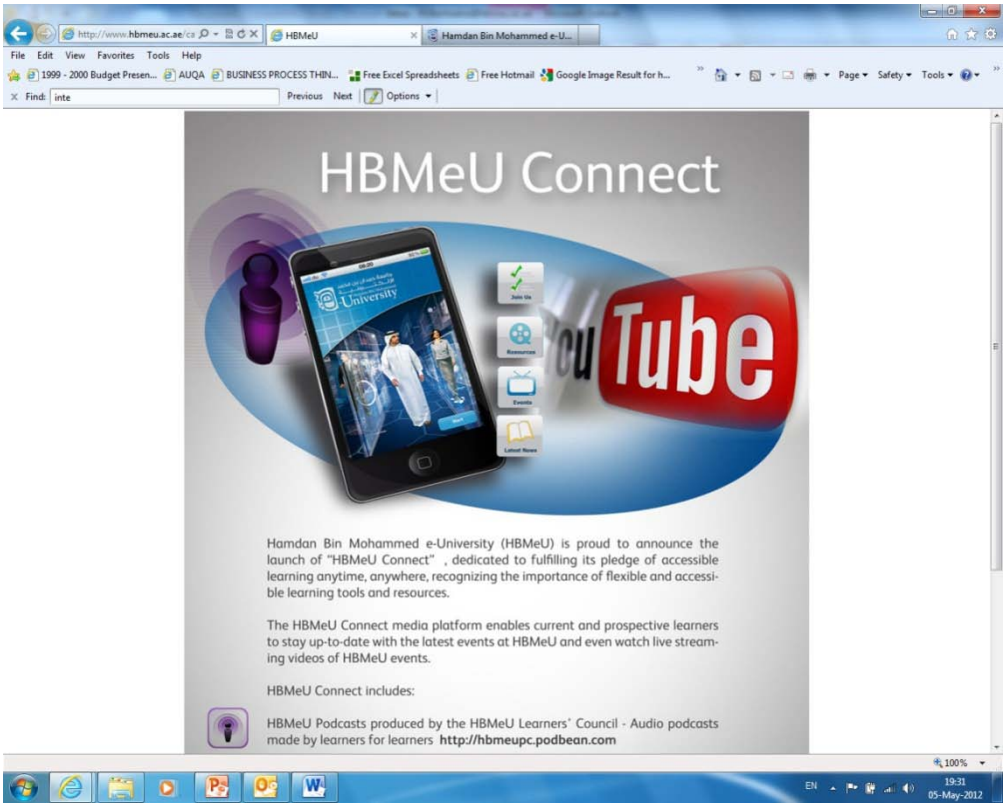

Figure 6

Snapshot of HBMeU Connect

Use of ICT to Support Blended Learning Delivery

Blended learning delivery using the ICT is challenging in terms of integrating the support of face-to-face and e-learning in a cohesive way and to have a smooth learning experience. At HBMeU, the Knowledge and Technologies Department division provides infrastructure to support online learning by using the university's Virtual Learning Environment also composed of related software applications running internally and externally from the university campus. In this way, such provisions provide an accessible e-learning platform also supported by a number of learning resources including e-Library and other knowledge repositories that the university has created.

Therefore, at HBMeU, the VLE works as a suite of software applications running in an integrated way to support smooth learning experience. These applications provide

communication channels between faculty and the learners and also provide access to online digitised courses.

The core components of the VLE are described below.

Learning Management System (LMS)

This is the platform used for asynchronous collaboration between the learners and the faculty members and facilitates self-paced online learning. The software platform Moodle is an open-source used as an LMS as it is one of the leading learning management systems supported by a large community of developers and e-Learning practitioners.

Virtual Classroom

Live lectures are conducted through the Virtual Classroom application and are integrated within the LMS platform where faculty members deliver their presentations and learners attend and participate actively in discussions throughout the lectures. The Virtual Classroom service is supported by the Wimba Classroom platform. The Virtual Classroom allows engagement with learners in synchronous, live and interactive tutorials in real time where learners and faculty members can meet online to engage and unpack the constructs presented in the learning materials on the LMS. Learners and faculty can utilise a range of communication tools allowing chat functionalities, exchange of files, sharing texts, discussing ideas using voice and video boards as well as access to e-mail. Interestingly, all the synchronous sessions can be archived for future reference.

E-Library

E-Library (Figure 7) allows the faculty and learners to gain access to databases of articles and resources using a single search box. E-Library is integrated into the LMS for effective utilization and allowing faculty and learners to search within the course site when engaged in self-study.

Figure 7

e-Library portal

E-Store

The university has created an e-Store (Figure 8) to distribute and sell e-books published by it in areas of strategic relevance to the Arab Middle East. Learners, scholars and practitioners in any part of the world can gain access to the e-Store and place orders for e-books, Arabized articles and other publications.

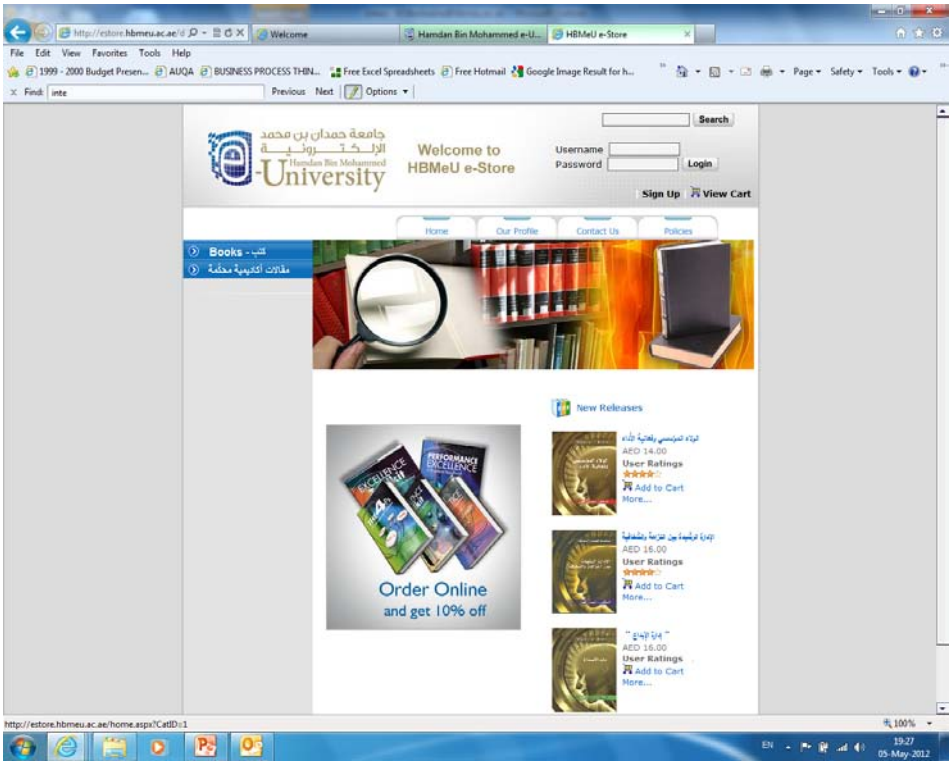

Figure 8

Snapshot of e-Store

HBMeU plays an important role in spanning the boundaries between different generations of the educational system allowing for the development of appropriate online course design and development. By implementing technology-enhanced learning through blended mode of delivery, it provides a flexible solution for learners in the UAE and the region at large. It allows the learners to continue their professional development within a life-long learning framework while pursuing their professional careers. In addition, a strong component of university courses allows for a strong integration between theory and practice. The outcome leads to the development of graduates equipped to make a meaningful and effective contribution to their workplace.

Survey on e-Learning with e-Book and e-Devices

In the emerging paradigm of e-learning, e-books and e-reader devices have come to play an important role. In order to test the importance and relevance of these devices, we

conducted a modest survey exercise in the UAE. For the purpose of this survey, we convened a focus group. The purpose of the focus group was to gather issues and questions related to e-books and e-reader devices that arose in the context of the UAE and the Arab region at large. The focus group meeting was convened in February 2012. It included two professors and three practitioners who came to Dubai to give keynote addresses at the conference organized by HBMEU in January-February 2012. A senior professor at the HBMEU chaired the meeting and explained the purpose of the focus group. He facilitated the discussion at the meeting that lasted nearly 3 hours. Several interesting issues related to e-education and training in the Middle East cropped up at the meeting. The guidelines developed by Morgan (1988) were used during the focus group discussion. A list of constructs related to e-learning, based on a review of literature was revealed to the participants in the focus group. They were asked to select and assess the variables they felt were important when assessing the importance and relevance of the e-books and e-reader devices in e-learning. The findings from focus group research were used to develop the survey instrument design.

Survey Instrument

During the second phase of the research exercise, a survey instrument was developed to (a) assess the relevance and importance of e-books and e-reader devices for the respondents and (b) find out from the respondents what kind of e-Learning device would appear to meet their needs. The focus group acted as a basis for the development of the questionnaire. The survey instrument had two parts. The first part sought information from the respondents on each of the nine questions identified. A five-point Likert scale, with 1 representing “Strongly Disagree”, and 5 “Strongly Agree” was used to measure the responses.

The second part of the questionnaire was designed to know what the respondents thought about e-books and e-reader devices in the light of their educational needs. A five-

point Likert-type scale was used with 1 indicating "of utmost importance" and 5 indicating "of no importance" to measure the responses.

Sample Selection and Administration of Survey

The target population for the study included all the learners including in-career personnel who were studying at HBMeU. To ensure a fairly representative sample, respondents were selected from the data base available at the Learner Relationship Management (LRM) unit of HBMeU. Survey questionnaires were administered in two ways. First, two staff members of the LRM unit were requested to deliver the questionnaires to the learners. A second set of questionnaire was completed on site by the learners who came to HBMeU for the academic orientation function at the outset of the Spring 2012 semester. Here also, the staff members of the LRM unit personally delivered the questionnaires to the respondents. The sample was thus a convenience sample of students participating in e-Learning programmes. Of the 100 questionnaires were given to the target respondents, 76 valid questionnaires were returned to the authors. It is an acceptable response rate in social science research. The results are presented in Table 4.

Table 4

Responses from learners

#	Items	Mean	Std.deviation
	Section 1		
Q1	My country has developed a robust ICT architecture.	4.25	0.94
Q2	I have access to the Internet.	4.16	0.87
Q3	My organization provides official information through iPad and smart phones.	3.92	1.04
Q4	My country has initiated reforms in education to	4.01	0.88

	integrate e-learning technology.		
Q5	E-learning is gaining ground in my country.	4.48	0.97
Q6	I believe that I can do better in my life with the IT-related skills.	3.59	1.03
Q7	My country has accredited e-learning programmes.	4.03	0.96
Q8	I believe in learning on my own.	4.33	1.20
Q9	I like to use e-books and other e-reader devices.	4.01	0.88
	Section 2		
Q1	E-books and e-reader devices such as iPad and smart phones in the area of e-learning	4.25	0.94
Q2	E-books and e-reader devices complementing the traditional learning resources and formats	3.52	1.02
Q3	M-learning for in-career personnel	3.47	0.89
Q4	Digitized material as an effective e-learning resource	3.89	1.10
Q5	Open Educational Resources (OERs) available through e-learning devices	3.71	0.90

Interestingly, the mean scores of all variables in section 1 are greater than 3 indicating that each of the statements is agreed to by the respondents. Similarly, robust mean scores in section 2 lend support to the notion that e-books and e-reader devices are of great importance, particularly for in-career personnel.

During the qualitative interviews, some learners explicitly mentioned that e-books would be cost-effective for them. However, access to learning materials available on iPad and

smart phones would be limited to those who could afford to buy those devices, some respondents observed.

At the second level of analysis, we conducted ANOVA and Chi-square tests to examine any differences in responses to the 14 Likert-scale type questions used to analyse responses. These tests were conducted within two demographic items: gender and age. These tests can be used to analyse responses in a situation where the number of respondents is rather small (Davis and Pecar, 2010). Of the 14 ANOVA tests, just 2 significant differences were discovered. First, male and female respondents differed in their agreement with item 2: "I have access to the Internet". Second, significant differences were also found within age groups for survey item 8: "I believe in learning on my own". During the qualitative interviews, it emerged that some female learners did not have access to the Internet in their homes. With reference to item 8, it emerged that the younger respondents preferred to be taught by an instructor. Those in higher age groups (30 and above) indicated that they would prefer to learn on their own. Hence, e-books and other e-learning devices were of greater interest to them. We also used a Chi-square analysis to test for significant differences in responses for section 2. None of the $\chi 2$ tests yielded statistical significance. Therefore, the survey findings suggest that students perceive e-books and other e-learning devices in almost similar manner.

Policy Options

Admittedly, one size of policy won't fit all the Arab states. Lessons of experience from HBMeU suggest that e-learning requires substantial investment in technology including computers, servers, learning-specific hardware, learning systems, delivery tools and platforms. It also requires highly-trained specialists such as multimedia instructional designers, Web designers, technologists, and e-faculty to develop and deliver modules. These are actually fixed casts that must be incurred. Moreover, instructional materials are digitized,

thereby reducing variable costs. The GCC countries and some other countries such as Jordan and Libya are in a position to incur these costs to promote e-learning and address the problem of illiteracy. However, policy reforms granting e-learning full validation and accreditation would be helpful in accelerating the pace of literacy programmes.

The second cluster of Arab states includes Maghreb countries as well as countries such as Syria and Lebanon with modest resources. These countries might use affordable asynchronous forms of communication only to deliver programs of study. These programs could be useful in producing technical and vocational labour force.

The third group includes relatively poorer countries with large populations and geographical areas such as Sudan, Yemen, Egypt, Mauritania and Morocco. The main policy challenges for these countries lie in the provision of higher education to women and girls, particularly in rural areas and remote communities, creating awareness of the importance of education, and removing wide gaps between urban and rural literacy for both genders because of lack of infrastructure to reach out to the illiterate sections of society.

A common thread running through these three groups of Arab countries is the proliferation of technology. The pace of technology proliferation may be different in different Arab countries, but this kind of proliferation across all Arab states cannot be reversed. Many programs can be conveniently offered online. Policy makers in a large number of Arab states can take advantage of this opportunity to save resources by developing e-books and offering courses on the Internet. However, the challenge here is to question what has been done for centuries and search for new ways to offer educational programs. For instance, can virtual faculty replace full-time faculty? Can private sector organizations be partners in e-learning? Can an institution of higher learning such as HBMeU (with considerable innovations and expertise at its command) franchise its digitized books and programs throughout the Arab states? Can an e-learning institution run as a private enterprise listed on a stock exchange?

Can an e-Learning institution open up branches at several locations worldwide? Can markets be allowed to take control of higher education? Can a consortium of institutions be formed to design and deliver online programs in a globalized world? And, what are the pros and cons of each option in the Arab states?

If traditions are faithfully upheld and if it is not possible in a cultural sense to find a substitute for traditional education, can a two-tier system evolve? If yes, what courses would be the ideal candidates for online delivery, and what others could be taught in a traditional face-to-face environment? These are all interesting questions for future research.

HBMeU's experience with e-learning suggests that policymakers in the Arab states also face the following challenges.

1. Lack of recognition by policy makers

This is indeed a great challenge. E-learning institutions and even online degrees obtained from eminent institutions Europe and America are generally not recognized by the education ministries in the Arab world.

2. Social and cultural resistance

The Arab region includes tradition-bound conservative societies. Quite often, they put up resistance for new ideas and new ways of imparting education.

3. Skills and competencies / changing mindsets

It is popularly perceived that skills and competencies can only be acquired in a traditional manner. Therefore, it is a challenge for decision makers to change the mindset of the potential learners.

4. Paradigm shift/ reengineering of educational system

Admittedly, e-learning calls for a paradigm shift from ethno-centric approach to a learner-centric approach. Proliferation of e-learning programmes would pose a challenge for policymakers to actually re-engineer education

5. Quality assurance

E-learning brings in its wake a challenge relating to quality assurance. Explicit standards of quality assurance ought to be introduced to uphold quality of e-learning.

6. ICT maturity level disparities

The disparities in terms of ICT maturity in the Arab countries pose a challenge for e-learning institutions that seek to extend their reach in the Arab region.

In order to move forward in a meaningful manner, policymakers should consider the following:

- Educational reforms aimed at decentralization of education
- Development of national systems for quality assurance at all levels of education
- Adopting new forms of learning (from teaching to learning and from instructor-centric to learners-centric approach)
- Incorporating e-books and other e-reader devices in education and training
- Embracing a philosophy of lifelong learning to support continuous learning for all through multiple pathways
- Enhancing collaboration among Arab countries to share knowledge, preferably through OERs
- Promoting international networking and well-thought-out partnerships.

Conclusion and Directions for Future Research

This exploratory study was limited in terms of constructs. Future research studies may want to investigate other constructs, variables and demographic factors. For instance, constructs such as perceived risk related to shifting paradigms in education, students' skills in emerging technologies, e-reader devices and policy regimes might be worth studying. Another limitation of this study is that it was limited to one university. It was assumed that perceptions of a sample of students (chosen for this exploratory study) would typify, to a

great extent, students' perceptions of e-books and e-reader devices in other Arab countries. Samples from other Arab countries would help arrive at more robust findings. Determining the antecedents for e-books and e-reader devices in e-learning success in each discipline would be of value to all stakeholders in education.

While academics and practitioners have argued with passion and emphasis that e-books and other e-Learning devices have the potential to benefit a broader base of learners in the Arab states, the fact remains that they are still evolving. It would require conceptual and empirical research studies to scientifically test the effectiveness of e-learning devices in removing illiteracy in the Arab states. An important extension of this study would be to examine and analyze how the evolution of e-Learning in several Arab countries is bringing about a change in mindsets of students, faculty, academic administrators, policy makers and members of the society at large. This kind of experiential knowledge may be a more important determinant of subsequent policy direction.

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Utilization of Digital Textbooks in Korea

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Abstract

The Korean government has begun a big innovation: the Digital Textbook Generalization Plan, revised and refined as the SMART Education Plan in 2011, which has been propelled as an innovation of instructional methods since 2007. According to the plan, every student in every class of elementary and secondary schools will use digital textbooks by 2015. It is expected that the Korean government's bold plan will help isolated groups of students, including handicapped students, by grafting education onto state-of-the-art technology, and that Korea's education industry will be revitalized, while also creating jobs in the IT industry.

However, Korea's initial plan meets some resistance. Although Korea's digital textbooks have the strength of rapid and stable internet and telecommunication environment, they have some critical problems such as high initial establishment costs, a lack of instructional models for digital textbooks, and parents' and teachers' anxiety regarding college entrance examinations. Accordingly, systemic strategies in the course of development, delivery, quality control, evaluation, and institutionalization of digital textbooks should be taken into account for successful diffusion of the innovation of 'digital textbooks.'

This chapter aims to introduce the educational utilization of digital textbooks in Korea. It focuses on the present status of digital textbooks, development process of digital textbooks, evidence of effectiveness for digital textbooks, and their prospects and caveats.

Keywords: Korea's innovation, digital textbook, smart education

State of Affairs in Korea

The Korean government has made efforts to apply a form of electronic textbooks in public education since 2007, to overcome limitations of printed textbooks, to help realize personalized and engaged learning through flexible educational systems, and to utilize various learning resources made by the public and private sectors. Korean students have been considered sufficiently 'digitally native' to utilize such electronic textbooks. For example, at the PISA 2009 Digital Reading Assessment, Korea ranked first among 19 countries. This showed that Korean students had excellent ICT utilization abilities.

In Korea, terms such as e-book, e-textbook, and digital textbook have been used in order to draw a contrast with printed books. The meaning of e-book is broader than merely e-textbooks and digital textbooks, because e-books include other books besides textbooks. e-Textbooks and digital textbooks are mainly associated with textbooks in elementary and secondary education. Although 'e-textbooks' are limited to the digitalization of existing printed textbooks, Korea's educational administration has developed and delivered 61 kinds of e-textbooks to students for 'schoolbag weight loss' and for students as digital natives since 2011, at an estimated cost of 33 million USD (See Table 1). PC-based e-textbooks for Korean, English, and mathematics are provided with printed textbooks in the form of compact discs to elementary and middle school students for free. For increased ease and usability, e-textbooks reorganize and integrate the contents of textbooks and related workbooks. They have the basic functions of magnifying and reducing the screen and bookmarking. The government provides e-textbooks and PCs for 18 percent of high school students from low-income families.

Table 1

Distribution plan of e-textbooks

	Subject	No. of CDs	No. of Orders
Elementary School	Korean	12	6,748,964
	Mathematics	12	6,750,776
	English	4	2,351,347
	Subtotal	28	15,851,474
Middle School	Korean	6	4,137,456
	Mathematics	3	2,073,408
	English	3	2,075,303
	Subtotal	12	8,286,167
High School	Korean	7	2,448,063
	Mathematics	7	2,059,733
	English	7	1,702,706
	Subtotal	21	6,210,502
	Total	61	30,343,143

Source: MEST, 2010a, p. 6

The term 'digital textbook' has been in use since 2007. The digital textbook (See Figure 1) is "a textbook for students that includes the contents of the existing textbooks, supplementary books, workbooks, glossaries, etc.; integrates such contents with multimedia, such as video clips, animation, virtual reality, etc.; and formulates them with various interactive functions for students to study according to their characteristics and academic

levels" (KERIS, 2010, p.24).

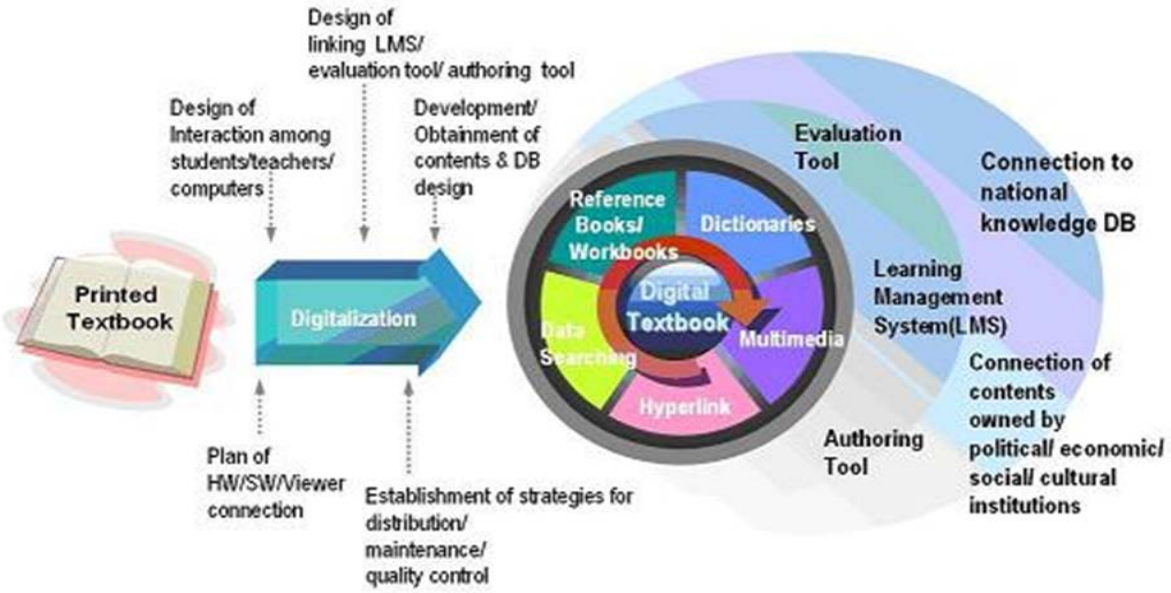


Figure 1

Concept of digital textbooks

Source: KERIS, 2010, p. 88

The digital textbooks consist of three parts: digital textbook contents, digital textbook platform, and learning device, as described in Figure 2. Digital textbooks are connected with EDUNET, the National Teaching & Learning Centre, by SSO (Single Sign On)[1]. EDUNET is a comprehensive education information service in Korea with public access, but designed specifically for teachers and students. Through linkage to the central government, local governments, and schools, EDUNET provides a range of instructional and learning support material and other education-related information. The digital textbook platform provides

tools for functions such as writing, memo, note, etc. Learning devices include tablet PCs and desktop PCs using Linux and Windows operating systems.

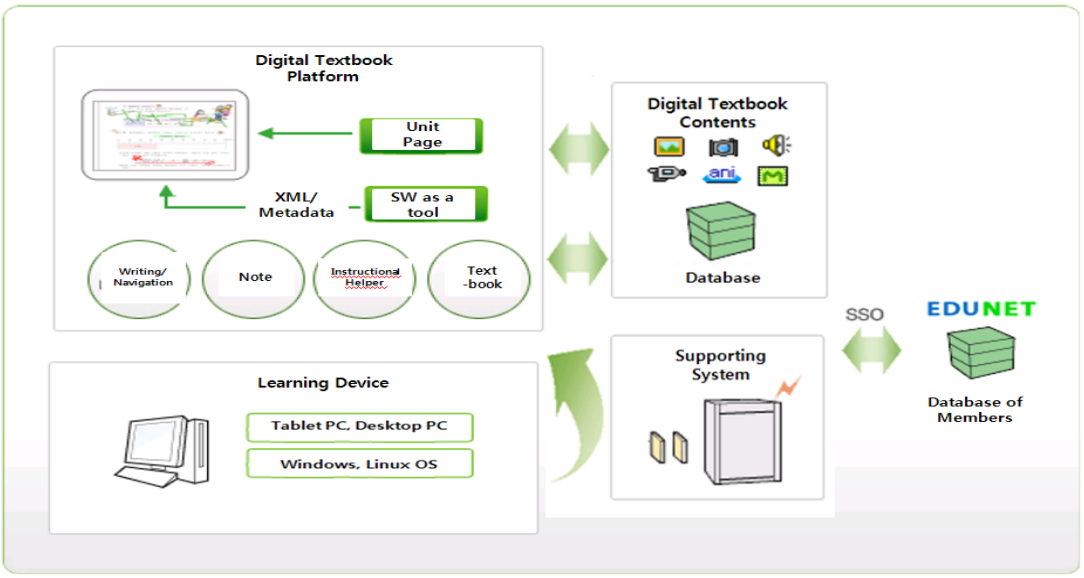


Figure 2

Structure of digital textbooks

Source: Kim, 2011, p. 30

Digital textbooks may have several educational advantages compared to printed textbooks. They enable learner-centred and self-directed instruction, multi-directional exchange, learning by students' achievements level, and prompt conversion of contents (See Table 2).

While digital textbooks are the main governmental policy, the Korean government has kept pace with utilizing e-textbooks. This is in part because the present method of operating pilot digital textbooks has a critical difficulty in downloading various learning

resources from the server.

Table 2

Comparison between digital textbooks and printed textbooks

Description	Digital Textbooks	Printed Textbooks
Concept	Digitalized textbooks Data searching Workbooks/References Multimedia/Hypermedia Evaluation tool LMS Authoring tool	Paper-based textbooks
Type of Data	Multimedia data Linked among subjects	Linear data Difficult to link related data among subjects
Learning Method	Learner-centred / self- directed study	Teacher-centred teaching activities
Instruction Design	Multi-directional exchanges Accomplishment of learning by study level customized to learner	Single-directional teaching-learning activities Difficult to customize to learner's level or to implement one-to-many learning
Data Management	Prompt conversion	Conversion impossible

Related to digital textbooks, which have been seen as an innovation of instructional methods, there have been two big innovations led by the Korean government: the Digital Textbook Generalization Plan (MEST, 2007) and the SMART Education Plan (MEST, 2011a) as shown in Table 3.

Table 3

Korean plans for developing digital textbooks

	Digital Textbook Generalization Plan (2007)					SMART Education Plan (2011)			
	2007	2008	2009	2010	2011	2012	2013	2014	2015
Development of prototype Research of viewer development & pilot testing schools									
Development of pilot digital textbooks (10 subjects) & viewer based on Windows & Linux Operating 20 pilot testing schools									
Development of pilot digital textbooks (8 subjects) Operating 112 pilot testing schools									
Development of integrated viewer & revised pilot digital textbooks (4 subjects) Operating 132 pilot testing schools									
Development of revised pilot digital textbooks (4 subjects) Operating 63 pilot testing schools									
Establishment of the focus for developing digital textbooks					2011 (Oct.) - 2012				

The 'Digital Textbook Generalization Plan' was established in 2007 by the Korean Ministry of Education, Science and Technology (MEST). It was estimated to cost 3.68 million USD. The first stage (2007-2009) involved developing examples of digital textbook content, introducing them into pilot testing schools, and establishing the functions of digital textbooks. Digital textbooks require a platform, supporting systems, and application programs. In 2007 and 2008, a platform based on Windows and a platform based on open source software (e.g. Linux) and support systems were developed (KERIS, 2010). After the development of digital textbook prototypes in 2007, digital textbooks were developed for 10 subjects in 2008, and for eight additional subjects in 2009 (Table 4).

In the next stage, law and institutionalization related to copyright was improved, and information infrastructure and teacher training plans were been established. In addition, guides for the standard form of e-textbooks, along with an inspection guide, were developed. In 2010, an integrated platform utilizing both Windows and Linux was developed and distributed in order to support desktop PCs, notebooks, and netbooks, as well as tablet PCs. Also digital textbooks for social studies and science were revised. In 2011, digital textbooks for Korean and mathematics were revised.

Table 4

Development of pilot digital textbooks

Year (pilot testing schools)	School	Grade	Subject	No. of subjects
2008 (20)	Elementary	5	Korean, Social studies, Science, Mathematics, Music, English	6
		6	Korean, Mathematics, Social studies, Science	4
2009 (112)	Elementary	3-6	English	4
		4	Social studies, Science	2
	Middle	1	English, Science	2
2010 (132)	Elementary	5-6	Revision of Social studies & Science	(4)
2011 (63)	Elementary	5-6	Revision of Korean & Mathematics	(4)
		Total		18

Source: MEST, 2011b, p. 19

As a newly revised innovation, the Korean government announced the 'SMART Education Plan'[2] (MEST, 2011a), which is supposed to develop digital textbooks for elementary and secondary education from 2014 to 2015. The digital textbook project in the Plan will be advanced in parallel with printed textbooks, and will focus on utilization of all

kinds of smart devices via the web, whereas the 'Digital Textbook Generalization Plan' focused on replacing printed textbooks and distributing devices such as e-book readers based on specific operating systems. The degree of usability was not considered in initial digital textbooks. It was not easy for users to utilize them because their functions were very complex. Korea's educational ministry will set up a 'cloud system,' which allows learners to access digitalized learning materials at any time and from anywhere; this system will be called N-Screen (See Figure 3). N-Screen, a kind of service available in cloud computing[3], is an environment where anyone can use the same contents and services through various devices such as smart phones, tablet PCs, TVs, desktop PCs, etc. To build a cloud-based digital textbook service, the method of service supply (e.g. appbook, browser, content plus viewer) and the method of content delivery (e.g. downloading, web connection) should be considered together.

To utilize digital textbooks, hardware and software are required, and huge amounts of financial support should be available for managing and maintaining them. A study (Kim, Kim, Lee, Ha, Lee, & Jeong, 2008) estimated that for the first five years (2012-2016), digital textbooks would have a net cost of 6.2 billion USD, meaning that each student should pay 13.53 USD per month. Compared with the relatively low cost of printed textbooks, the high initial cost for e-devices of digital textbooks may be an obstacle to the diffusion of their utilization. Developing one kind of textbook is estimated to cost between 44,000 and 60,000 USD, and developing the 232 kinds of digital textbooks required for elementary, secondary, and special schools will cost about 10 million to 14 million USD (Kim, Kim, Lee, Ha, Lee, & Jeong, 2008).

In addition to Korea, many countries, including Australia, the USA, Finland, Japan, and Singapore, have driven classroom innovations related with digital textbooks. These

nations have strengthened teachers' competency and established ICT environments (instructional content, instructional method, instructional environment) as representative agenda (Kim, 2011).

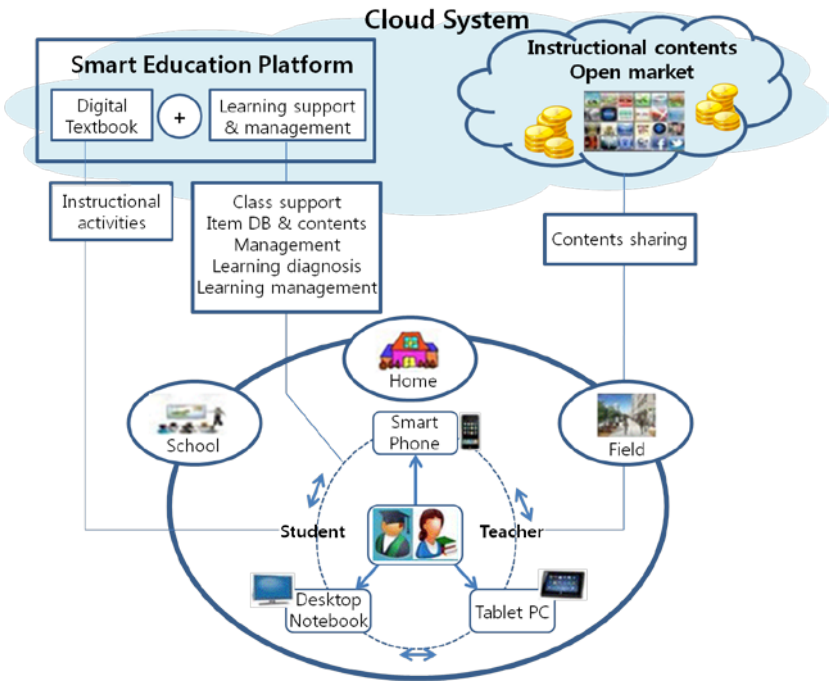


Figure 3

Cloud system for digital textbooks

Source: Jeong, 2012, p. 14

Korea's initial plan of using digital textbooks in classrooms at every level by 2015 is now meeting with some resistance. Educational leaders have become concerned that young students are too dependent on technological devices such as tablet PCs, desktop PCs, and smart phones. One in 12 Korean students between the ages of 5 and 9 are addicted to the Internet (The Washington Post, March 25, 2012). There is another concern that wireless

education may not mean better quality. Change agents of digital textbooks, including government officials, have exaggerated trust in smart education. There will be some changes in the digital textbook plan due to those concerns (e.g. students in first and second grade are likely to use only printed books). That is, printed and digital textbooks will be used together in some ways.

Table 5

Comparison of Korea with other countries by task

Area	Korean MEST's tasks	Australia	USA	Finland	Japan	Singapore
Instructional contents	Development and application of digital textbook	●	●	◐	★	●
Instructional method	Activation of online class	★	●	●	●	★
	Establishment of online evaluation system	◐	★	X	◐	★
Instructional environment	Creating content - sharing culture	●	●	◐	●	●
Teachers' competency	Strengthening teachers' smart learning skills	★	★	◐	◐	◐
Building infrastructure	Creating a cloud education service	★	●	◐	●	◐

★: nation's priority area ●: entire application ◐: partial application, X: not applied

Source: Kim, 2011, p. 26

Although Korea's digital textbooks benefit from a rapid and stable internet and telecommunication environment, they have critical problems such as their high initial establishment cost, the lack of instructional models for digital textbooks, parents' and teachers' anxiety regarding college entrance examinations, and health side effects.

Development of Digital Textbooks

Digital textbooks, as defined earlier, are digitalized books into which multimedia components plus interaction mechanisms are integrated. Such being the case, the pilot digital textbooks are supposed to be developed up to 2012 and complete digital textbooks will be developed to the fullest until 2014 as being authorized by official organizations like the Ministry of Education, Science and Technology of Korea and/or regional Office of Education.

The development of pilot digital textbooks basically focused on four components from the outset: prototype textbooks, multimedia materials, evaluation materials, and other learning aids as in Figure 4. Prototype textbooks here mean digital textbooks which are digitalized from the contents of existing printed textbooks. Since there were no officially authorized digital textbooks during the pilot test period at least until 2012, digital textbooks of this period were developed by digitalizing the original contents of printed textbooks. Although prototype textbooks include literally the same contents as the printed textbooks, they may feature reorganized screens, based on the digital contents and the learning devices used by pupils and teachers.

Multimedia materials are learning content in digital textbooks such as videos, animations, flash-operated modules, etc., used by pupils or teachers in order to make learning or instruction easier or more effective. These may be used linked directly from the contents of digital textbooks or linked to separate sites.

Figure 4

Components of digital textbooks

Evaluation materials such as diagnosis tests, formative tests, unit tests, and summative tests are also included within the digital textbooks, and developed according to the subject matters of lessons. Varieties of test items are scored automatically or manually, and contain commentaries.

Other contents of pilot digital textbooks here mean learning aids or tools which cannot be contained within printed textbooks due to size restrictions; for example, dictionaries for language classes, chronological tables for social studies, etc.

Complete digital textbooks, including the four components mentioned above, are developed through a systems approach (TFT on Digital Textbooks of KERIS, 2011), such as traditional instructional systems development models (Gustafson & Branch, 2002). That is, the development of digital textbooks goes through four phases, as in Figure 5: Analysis,

Design, Development, and Inspection.

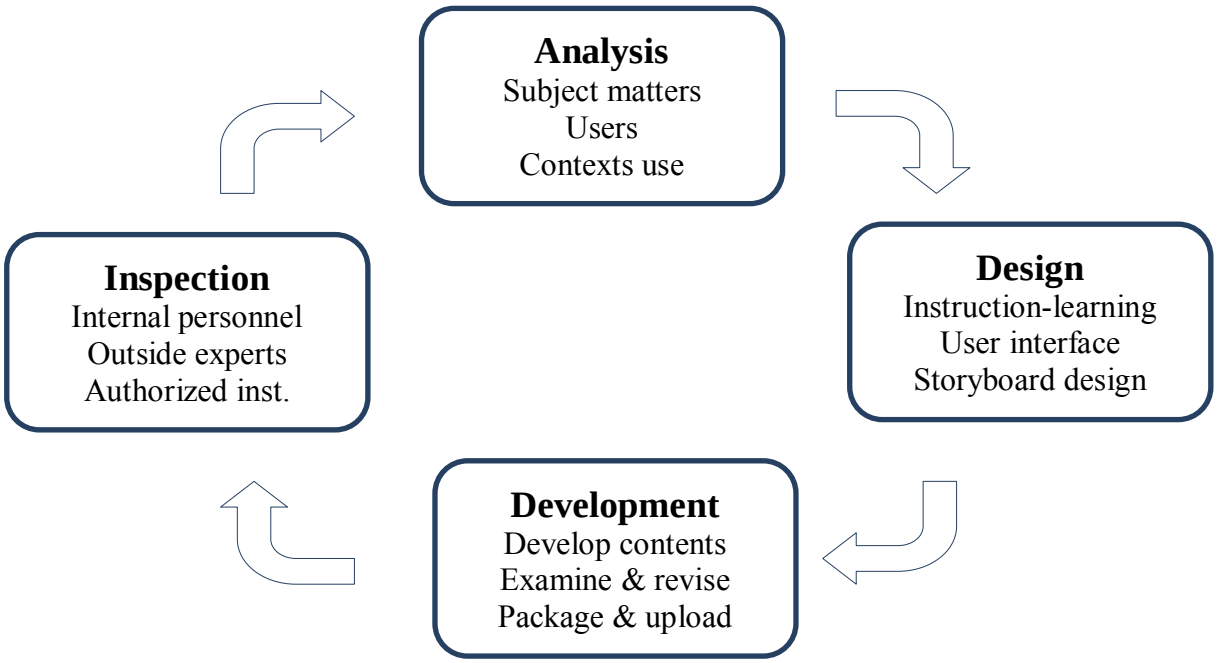


Figure 5

Development phases of digital textbooks

Analysis

In the first phase, Analysis, subject matters of school curricula are analyzed and users, contexts of use, and the existing contents are examined. Analysis of subject matters of school curricula is conducted by subject matter experts focusing on curricula and textbooks, features of the recent national curriculum, accomplishment levels and learning topics for each grade, and organization of the contents of semester-unit-lesson. Through this analysis, featured contents of digital textbooks are identified and instruction-learning models and design strategies to be applied are found.

With regard to analysis of users and contexts of use, pupils and teachers who will use digital textbooks, the place where they will use them, and the Internet environment, etc., are

examined. What is important here is to grasp real needs from the field based on responses from teachers as well as pupils who have experience with digital textbooks in pilot test schools. In other words, necessary functions for end users of digital textbooks are figured out through the analysis of users and contexts of use.

Existing digital contents from various contexts, such as nation-wide learning support systems (Edunet, Cyber Home Learning System 2.0), are analyzed next. Specifically, in analyzing the contents of units or lessons of the systems, proper contents very relevant to the subject matters of digital textbooks being developed are identified, and some contents are also revised in order to be included as contents of digital textbooks later. It is very useful because these may be able to expose functional problems and possible errors within the contents and design of digital textbooks. Furthermore, other internet sites relevant to the subject matters of the digital textbooks being developed are analyzed in order to be later used as reference sites. Thus, improvements in contents as well as functions are carried out in advance through the analysis and included in development.

Design

In the second phase, Design, overall development strategies are established based on the previous analysis of subject matters, users and contexts of use, and existing contents. Strategies include instruction-learning strategies, UI design, storyboard writings, and development guides.

With regard to instruction-learning strategies for digital textbooks, there are basically two aspects to be considered: one is the contents that teachers are supposed to use in lessons, and the other is the contents and functions to be used by pupils for individual learning. Instruction-learning strategies, thus, are determined first by considering users and contexts of use, and specific scenarios for instruction and learning are prepared accordingly. The

scenarios generally consist of learning set and attention to objectives, implementation of learning activities, and wrap-up.

After instruction-learning strategies are established, screen layouts and user interfaces are designed; these are supposed to be as important as the contents of digital textbooks. At the moment, the criteria for user interface design in Korea are learning convenience, usability, and ease of remembrance. Based on these design strategies, storyboards are written for the development of each digital textbook. The storyboards are completed according to each lesson as a basic unit of instruction, in which the most subordinate learning objects are regarded as minute learning modules.

Once specific design strategies are completed, these are applied to a prototype of one lesson to figure out possible problems with contents, strategies, usability, etc. Then, overall development guides are established and the workflow progresses into the whole development process.

Development

In the third phase, Development, prototypes, multimedia contents, user manuals, etc. are first authored, then examined, revised, and packaged according to curricular units, and uploaded onto a server.

Prototypes of digital textbooks in Korea are now being developed in HTML, in conformity to web standards, in order that they can be operated on various devices. HTML5 in particular is being used now in Korea because the present platform, which is based on by current provisional digital textbooks, supports it. With regard to screen layout, CSS[4] styles are applied for more convenient maintenance as well as consistency of all the contents. Configuration issues regarding screen pages of digital textbooks, however, are not determined at the moment because there are such trade-offs between horizontal and vertical

configuration. That is, horizontal configuration of screen pages is generally legible on computer monitors, but it is not easy to grasp overall contents at a glance, as with vertically unfolded pages of printed textbooks due to segmented contents. With vertical configuration, on the other hand, it is easy to grasp overall contents at a glance because of the same configuration as the printed textbooks while it is not legible when seen on computer monitors.

All file formats are made of HTML, CSS, JS, etc., and frequently used functions are modularized after being made in jQuery[5]. Browsers, while the present platform for digital textbooks being loaded with WebKit 0.0[6], are supposed to use the scripts that are driven on this version and be optimized for at least IE 6.0 or higher, Chrome, Firefox 1.5, Safari 3 or higher and so on.

The user interface of digital textbooks varies depending on contexts, in which the user interface is flexibly connected to additional learning contents. Examples of these flexible user interfaces are typically 'textbook-study guides-notes' as in Figure 6.

Multimedia contents for digital textbooks include images, sounds, videos, animations, and other learning tools, etc. Specifications and examples of the multimedia contents which are now being developed are in Table 6.

One point that is being maintained throughout the development process is that reusability and interoperability are considered for digital textbooks. That is, the digital textbook should be usable with any digital devices and on any platforms. It is known that several foreign countries experienced failures with digital textbooks because of the expensive devices required for their use. Much emphasis, thus, is being placed on the idea that standardization of digital textbooks in delivery as well as in development will solve this problem.

Finally, the contents of developed digital textbooks are packaged according to units

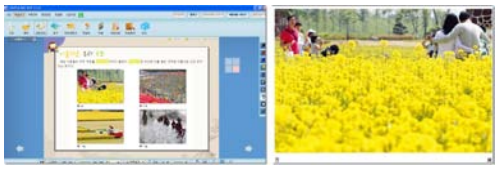
after combining the pages of contents. Resource management and page ordering are then set up using the packaging tool KEM 2.0[7], and metadata are entered. And two kinds of users' manuals are prepared: pupils' manuals and teachers' manuals. They mainly explain major screens of contents and various functions, with screen captures of them, in order for pupils and teachers to easily use them.

Figure 6

User interfaces of digital textbooks

Table 6

Multimedia contents of digital textbooks

Contents	Specifications	Examples
Image	Formats: JPG, PNG, GIF Resolution: DPI 72 or higher	

Sound	Formats: MP3, WAV Conditions: 96kbps or higher consistency in volume control bar	
Video	Formats: AVI Conditions: DTP_API-driven or FLV-based Flash driven; Video XVID, X264, OGG recommended) control bar	
Animation	Formats: gif, swf or HTML5, AVI Conditions: control bar	
Learning Modules	Formats: HTML, swf or exe Conditions: feedbacks or responses possible via Drag & Drop, Click	
Other Aids	Formats: (various) Conditions: linked to 'lesson activity' buttons of platform	

Inspection

In the final phase (Inspection), internal personnel, as well as experts from outside and authorized institutions, examine the final products in terms of quality and copyright. What is

considered important at this point in time is paying attention to copyright infringement especially when developing contents, images, and multimedia materials other than the ones in existing textbooks. In Korea, all products from the development of digital textbooks are ascribed to the Korea Ministry of Education, Science and Technology and/or regional Offices of Education in terms of their copyrights.

With regard to quality control, in particular, there have been efforts to monitor the quality of e-learning contents[8] and learning management systems at individual and national levels (Kim, 2004; Kim & Lee, 2008). The standards of e-learning contents and learning management systems can also be used for evaluating digital textbooks. The quality of digital textbooks is mainly determined by the textbooks' content and platform (e.g. e-devices). Accordingly, change agents, including educational officials, teachers, instructional designers, etc., should have an eye for selecting good content and platforms.

The standard for selecting good digital textbooks can be divided into two categories: instructional content and platform (Jeong, 2008; Lim, Song, Lee, & Lee, 2009; Kim, 2004; Kim & Lee, 2008). 'Instructional content' incorporates a set of criteria such as compatibility, validity, accuracy, and usability. 'Platform' includes four subcategories: interchangeability, accessibility, stability, and suitability.

Table 7

Standards of digital textbook selection

Category		Sub-category
Instructional Content	Compatibility	Conformity with curricula, law, copyright, ethics, & standards

	Validity	Selection & structure of content
		Presentation of materials
		Agreement between goals, content, & evaluation
	Accuracy	Content (e.g. words, theory, data)
		Expression
	Usability	Easiness of course procedure
		Flexibility of interaction & evaluation
Platform	Interchangeability	Compliance with standardized spec.
		System interoperability
	Accessibility	Usability of functions
		Control of user
		Searchability of information
	Stability	No system error
		Easiness of uploading & downloading
	Suitability	Harmony & consistency of screens
		Look & feel
		Technical support

Instructional content should be designed to conform with existing educational curricula, law, copyright, ethics, and standards, validity of selection and structure of content, presentation of materials, agreement of goals, content, and evaluation, accuracy of contents (e.g. words, sentences, concepts, theory, data) and expression (e.g. logic, punctuation). The content of digital textbooks should feature easy course procedures and provide a variety of

interaction and evaluation. All contents of digital textbooks must be developed according to the standards so that any parts of the digital textbooks can be seen by any e-devices, and be interchangeable with other contents.

The platform of digital textbooks plays an important role in connecting and loading main components of the digital textbooks such as contents, teacher-student interaction tools, individual learning, and learning management systems (Lim, Song, Lee, & Lee, 2009). The area of 'platform' to be considered for digital textbook evaluation is mainly related to technology. Platforms should be developed to have system interchangeability by complying with standardized specifications of digital textbooks, such as SCORM (Sharable Content Object Reference Model) and IMS Common Cartridge, increased accessibility by improving usability of functions, easiness of user control, and searchability of information. System stability should ensure no errors and easy uploading and downloading. The platform screen should be designed to have harmony and consistency and look and feel. Also, technical support can be a critical factor affecting platform selection.

The four phases of the whole development process so far, of course, are not implemented in linear order as in the figure image. Going back and forth between the phases in the process of carrying them out is always possible, depending on the circumstances. In this sense, the whole development process is likely to be described as a reflexive, recursive development model (Willis, 1995). It is expected that more appropriate and effective digital textbooks will be produced through this method in Korea.

Effectiveness of digital textbooks in Korea

Digital textbooks have merits in the aspects of instruction and economy, when compared with printed textbooks. Since 2008, MEST has measured the effectiveness of digital textbooks developed by the government. A 2008 digital textbook evaluation with 18

pilot testing schools utilizing digital textbooks was carried out to assess the effectiveness of six digital textbooks (Korean, English, mathematics, music, social studies, and science) over seven months (Byun, Seo, Ryu, Yang, Jeong, & Bang, 2008). A total of 4,284 students participated in this study. The research[9] found that in urban communities, students using digital textbooks had higher learning achievement than students using printed textbooks in science, social studies, and mathematics. In rural districts, students' learning achievements in all subjects including Korean, English, science, social studies, and mathematics were higher in schools using digital textbooks than in schools using printed textbooks. Furthermore, in terms of self-regulated learning ability, the students using digital textbooks achieved higher scores than the group using printed textbooks[10]. And there was no significant difference in learning attitude and problem-solving ability between the two groups. This research has the limitation of the short period of study. The study recommended that the improvement of teachers' skill and perception in using digital textbooks, enough teacher training and application of such training, establishment of appropriate hardware and software, technical and administrational support, and leadership of related persons and institutes should be facilitated for effective digital textbook use in classes.

In addition, according to a 2009 digital textbook evaluation[11] with 72 pilot testing schools utilizing digital textbooks (Byun, Kim, Song, & Lee, 2010), learning achievements in science and social studies of 5th grade students using digital textbooks were higher than those of students utilizing printed textbooks. The 5th grade students using digital textbooks also achieved higher scores in self-regulated learning ability than the group using printed textbooks[12], except in the subarea of 'ownership' of self-directed learning ability. There was no statistical difference in the effects of digital textbooks by length of usage; there was no difference between two groups using digital textbooks for two years and less than one year,

respectively, in learning achievement, learning attitude, and self-directed learning.

A 2010 digital textbook evaluation with 132 pilot testing schools utilizing digital textbooks (6,052 students, 357 teachers) was carried out (Noh, Kim, & Lee, 2011). According to the results, learning achievements of the experimental group using digital textbooks were higher than those of the control group using printed textbooks. In the aspects of self-regulated learning ability, problem-solving ability, and learning flow, the group of students using digital textbooks also attained higher scores than the students utilizing printed textbooks. Students and teachers were satisfied with the usability of digital textbooks; in particular, students living in urban areas with lower grades, and with strong ICT skills felt more satisfaction with digital textbooks.

In addition to the macro approach of those policy researches, there have been several micro approach researches. Ryu, Han, and Kim (2008) investigated the differences between printed textbooks and digital textbooks from the perspective of classroom interaction. Three teachers participated in the research. There were 44 observations of classes from June 2008 to November 2008. The school was located in middle-sized city and students were at the middle level of socioeconomic status. This study demonstrated the effectiveness of classes utilizing digital textbooks in terms of 'interaction in class': digital textbooks made students organize their learning, feel motivated, and participate in a variety of learning activities. This reduced the time spent on instruction preparation by the teacher, expanded the opportunity of utilizing instructional materials, and realized monitoring and management of students' learning at any time. Choi and Seo (2009) reported that using digital textbooks had positive effects on scientific problem-solving by elementary school students. In particular, low achievers' problem-solving skills were much more improved than high and mid achievers' skills. According to a study (Kang, Song, Lee, & Koo, 2010) identifying variables affecting learning

achievements with 87 5th grade students, information literacy was a significant variable. Cognitive presence and emotional presence were the variables that predicted satisfaction. The study's results indicated that when designing digital textbooks, instructional designers should consider those variables for effective learning.

Song (2011) examined the effects of using digital textbooks on mathematic achievements according to family background, especially for socioeconomic variables (e.g. father's school years, father's occupational status, perceived income level, size of city). 197 elementary students participated in the study. The results showed that there were significant differences in mathematics achievements for two variables of fathers' school years (college, community college, high school) and size of city (large, medium & small). In medium and small cities, groups using digital textbooks got higher scores on a mathematics test than groups using printed textbooks.

To summarize the effectiveness of digital textbooks briefly, it seems to be difficult to jump to the conclusion that they can play an important role in learning achievements themselves. Although the present impact of new media 'digital textbooks' should not be overlooked, more time is needed to ensure their effectiveness. "In light of the history of media its impact on instructional practices, … it is reasonable to expect changes both in schools and other instructional settings are likely to come about more slowly and be less extensive than most media enthusiasts currently predict" (Reiser & Dempsey, 2002, p. 37).

The digital textbook project is also estimated to set off industrial ripple effects (Table 8). From 2012 to 2016, the minimum induction of production, added value, and job creation will amount to almost 27.3 billion USD, 16.9 billion USD, and 240 million USD, respectively (Kim et al., 2008). In addition, while the production and delivery of printed books is estimated to cost almost 177 million USD per year, the transition to digital textbooks

will reduce these costs (Table 9).

Table 8

Minimum industrial ripple effects of digital textbooks

	Induction of Production	Added Value (Unit: USD)	Job Creation
2012	14.9 billion	9.2 billion	131 million
2013	2.9 billion	1.8 billion	25 million
2014	3 billion	1.9 billion	27 million
2015	3.2 billion	2 billion	28 million
2016	3.3 billion	2 billion	29 million
Total	27.3 billion	16.9 billion	240 million

Source: Kim et al., 2008, p. 308

Table 9

Cumulative cost of printed textbooks and digital textbooks (USD millions) [13]

	Printed Textbooks	Digital Textbooks
2012	177	59
2013	354	115
2014	532	169
2015	709	221
2016	887	269
2017	1064	315

2018	1242	359
2019	1419	401
2020	1597	440
2021	1774	478
2022	1952	513

Source: Kim et al., 2008, p. 264

Concerns about excessive use of digital textbooks have recently increased. Utilization of digital textbooks might cause physical and psychological health problems to both teachers and students. Physical problems result from VDT (Video Display Terminal) syndrome, including dry eye syndrome, headaches, chronic fatigue, and musculoskeletal pain. Psychological problems include learning stress resulting from being unfamiliar with digital devices. A study (Seomun, Chun, Lee, Yang, Kim, & Park, 2009) analyzing the effect of digital textbooks on students' and teachers' health, reported that the level of electromagnetic waves was not serious, and there were no significant differences in dry eye syndrome and musculoskeletal pain between two groups using digital textbooks and printed textbooks. However, this research was carried out for one and half years, which is not long enough for deep observations. Accordingly, continuous experiments related with side effects of digital textbooks should be performed for sufficient periods of time.

Prospects and Caveats

It has been almost 120 years since the publication of Korea's first modern textbooks was ordered by King Gojong of the Chosun Dynasty in 1895. Now the new age of textbooks, beyond printed textbooks, has arrived, in which the Ministry of Education, Science and

Technology will invest 2.2 trillion won (2 billion USD) in a 'SMART Education' project, which is to deliver all curriculum materials in a digital form. It is expected that the Korean government's bold plan, starting in 2015, will help isolated groups of students, including handicapped students, by grafting education onto state-of-the-art technology, and that Korea's education industry will be revitalized, while also creating jobs in the IT industry. As of now, digital textbooks, as a core of the smart education plan, are being developed on a large scale, to be applied to the entire school system. In these innovation-driven times, however, some caveats are in order.

First of all, while the new digital textbooks are being developed on a large scale, consensus on the exact model to be used has not yet been reached. For example, multimedia components and other learning aids which are supposed to be added onto 'the book' contents of digital textbooks are very different depending on the subject matter. Moreover, the more networking with external resources on the current plans is emphasized, the more vague the line between digital textbooks and e-learning and even LMS becomes. Obviously, digital textbooks are not a 'panacea,' but simply 'book-style' textbooks which will be routinely used as texts in the classroom. A clear model of digital textbooks, among other things, needs to be agreed upon among stakeholders, especially before related regulations are instituted.

Second, the prototypes of digital textbooks being currently developed need to be recursively and reflexively reviewed by teachers in the field. This review will not only determine the limitations of current digital textbooks but will also ascertain the actual requirements of these textbooks. If there are plausible features emerging from the reviews, these should be included in developing final prototypes. For instance, the Meso level approach, which considers inter- and intra-class collaboration, is required in designing digital textbooks. That is, digital textbooks should be designed to be used with a teacher's classroom

activities, as well as with feedback provided by the teacher and sometimes by his or her colleagues (Jo, 2009; 2011). In addition, state-of-the-art technologies like Web 2.0 should be taken into account in order for limitations to be overcome so that a sort of digital textbook 2.0 model may be identified (Lim, Noh, Song, Choi, Nam, & Lee, 2011).

Third, systemic strategies in the course of development, delivery, quality control, evaluation, and institutionalization of digital textbooks should be taken into account for successful diffusion of the innovation of 'digital textbooks.' The resistance to innovation, if any, can be especially frustrating when it comes from the innovation's intended adopters. This being the case, careful examination of the causes of this resistance can be a useful tool for the change agent. This, of course, should be focused on 'instruction' rather than 'technology.' In this vein, various models of educational change will be helpful for practitioners of change: Ely's change environment (1990), Havelock and Zlotolow's change process (1995), Fullan's change agent (1991), and Zaltman and Duncan's resistance to change (1977).

Finally, in addition to the major caveats above, attention should be directed in advance to some other problems that might occur in the utilization phase. Efforts, for instance, should be made to minimize side effects such as health problems with VDT syndrome caused by long-term use of devices for digital textbooks. VDT equipment has diversified with the spread of the notebook computer, portable devices, and input equipment, along with the spread of various types of software, etc. Health effects might be more serious for young pupils if they are exposed to VDT-related tools almost constantly each day, including at school.

Endnotes

1. Single sign on is a property of access control of multiple related. With this property a user logs in once and gains access to all systems without being prompted to log in again at each of them.
2. Foreign countries' cases similar to Korea's 'SMART (Self-directed Motivated Adaptive Resource Free Technology Embedded) Education Plan' are as follows: Japan's 'Future School Promotion Project (2010-2020)', Singapore's 'FutureSchools @Singapore' (2006-2015), Finland's 'InnoSchool' (2007-2010), America's 'The National Education Technology Plan 2010'(2010-2015), Australia's Smart Classroom Project' (2002-2014). Those projects have been propelled by the governments and have the common goal of 'building digitalized classroom'. Especially Singapore started digital textbook project (eduPAD project) in 1999 and it developed and applied learning device as a middle form of notebook and PDA. However, the project failed mainly due to lack of support for collaborative learning. USA developed a digital textbook called as 'GoReader'. Parents' economical burden (e.g. buying notebook & GoReader) brought about its failure.
3. The delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility over a network (typically the Internet) (Wikipedia, 2012, http://en.wikipedia.org/wiki/Cloud_computing)
4. CSS (Cascading Style Sheets) is a style sheet language used for describing the presentation semantics (the look and formatting) of a document written in a markup language. Its most common application is to style web pages written in HTML and XHTML, but the language can also be applied to any kind of XML document, including plain XML, SVG and XUL.

5. jQuery is a cross-browser JavaScript library designed to simplify the client-side scripting of HTML.
6. WebKit is a layout engine designed to allow web browsers to render web pages. WebKit powers the Apple Safari and Google Chrome browsers. It is also used as the basis for the experimental browser included with the Amazon Kindle ebook reader, as well as the default browser in the iOS, Android, BlackBerry Tablet OS and webOS mobile operating systems.
7. KEM (Korea Educational Metadata) version 2.0 is the metadata standardization format which was developed at KERIS (the Korea Educational Research and Information Service) in 2003 in order to promote the sharing and distribution of educational and research information.
8. Present Korean organizations for assessing educational contents are as follows: National IT Industry Foundations Agency (www.nipa.kr), Korea Educational Research and Information Service (www.keris.or.kr), Korea Research Institute for Vocational Educational Training (www.kriver.re.kr), and Korea University of Technology and Education (Human Resources Development Institute: hrdi.kut.ac.kr).
9. No significant difference is between experimental group using digital textbooks and control group using printed textbooks.
10. There was no significant difference in the scores for treatment group and control group statistically ($p>0.05$).
11. This research was carried from October, 2009 to April 2010 with 16,736 elementary students.
12. There was a significant difference in the scores for treatment group and control group statistically ($p<0.05$).

13. It is assumed that the cost of digital textbooks per subject will be 0.15 million USD, and three companies will develop 166 kinds of subjects (Kim et al., 2008).

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From Perspectives to Requirements of E-Learning Ecosystems in University Context: Interlinking Actors, E-Resources, and Technologies

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Abstract

E-learning in university context usually includes a quite large network of actors, resources and technologies. The main actor in learning ecosystem is the student. Other key members are teachers, information about the courses (syllabus, schedule) and information resources about the study topic (books, lecture slides and notes, web-resources). In university context teachers are responsible for selecting the information resources but libraries usually administer them. As a consequence the library is also a central actor in e-learning ecosystem.

E-learning happens through interactions in the network. Different members of the network have different roles, e.g. teacher guides the students to the information sources and helps them to understand and interpret the information. This kind of dynamic network of actors and resources can be seen as an ecosystem.

This chapter has two objectives. The first is to explore three perspectives to the e-learning ecosystem: those of students, teachers and the library. Each has a different view on the benefits, challenges and restrictions of e-books, e-readers and other e-devices and each experiences and effects the e-learning ecosystem in different ways. The viewpoints are connected but differ dramatically in their scale and context. In order to enable an effective and flourishing e-learning ecosystem, one needs to connect these to form a single united

service. Thus, the second objective of this chapter is to combine the three perspectives to e-learning ecosystems and produce high-level requirements for technologies and solutions related to e-learning in universities and envision future scenarios of flourishing e-learning ecosystems.

Keywords: E-learning ecosystems, students, teachers, library, e-books, e-readers

Introduction

Digitization of information and communication has had an impact on almost all aspects of our lives. In universities especially the amount of information as well as practices of accessing it have changed dramatically. New books and articles are published every day and the article databases have grown to vast information portals. Digitization's impact on communication practices in universities is twofold. On the research side the communication practices have remained quite the same. New research information is still disseminated through officially published journals, conference proceedings and books. Some journals and conferences have changed to open access, i.e. have put their articles freely available to their web sites. However, the traditional publishers and subscription fees still play a major role in academic publishing. Although, open and free information portals such as Wikipedia have become important information sources, their role in publishing new and original information is not very big. In teaching and learning the impact of digitization has been bigger. The visible results of this are the plethora of existing and emerging e-environments for teaching and learning. The topic of e-learning has been approached from different perspectives such as distance education (Walker, 2001) and naming of the e-environments and e-tools somewhat reflects these approaches. For example there exists learning management systems (LMS), managed learning environments (MLE), online learning centres (OLC), and learning support

systems (LSS). The amount of e-learning systems is vast, e.g. Wikipedia (March 2012) lists almost 40 different available e-learning systems.

In addition to information and access to it, digitization has had impact also on the most central activities of university studies, reading and writing. The digitization of writing happened already during the 20th century and computers and word processors are nowadays an integral part of our lives. However, in reading the change is happening at the moment. E-book readers as commercial products emerged during early 00s (e.g. Sony Librié, 2004) and became successful during 2007 and 2008 (Amazon Kindle was introduced 2007 and Sony Reader 2008). E-book readers are mobile devices that are designed mainly for reading digital texts. Often e-book readers utilize electronic paper technologies in order to provide better readability in varying light conditions and better battery life than computers with LCD or LED displays. The emergence of touch screen tablet computers such as iPad has challenged the dominance of e-book readers and electronic paper.

Although information portals and e-learning systems as well as e-reading devices are technically separated systems, their usage links them deeply together. Interconnectedness is a feature of ICT in general (Castells, 2000). Recently for example mobile industry has recognized this and companies are shifting from product business to building ecosystems of devices, content and users. Similarly e-learning especially in universities and other educational organizations includes quite a large network of actors, resources and technologies, i.e. an ecosystem. A single course or other activity of educational organization usually includes at least teachers (professors and lecturers in universities), students, and managerial actors for keeping track on passed courses and completed degrees. In addition to these actors, information sources (usually provided by the library of the university) and devices and systems (owned either by the university or the students) for accessing the information play an important role.

This chapter focuses on the learning activities and omits the administration and other external activities. Learning in universities is a process, which includes studying the topic and proving one's skills in exams. As mentioned above, the digitization relating to writing is in a more stabilized phase than relating to reading. Thus we are focusing on the usage of digital texts and information resources in learning in universities. The objective of this chapter is to 1) explore the impacts and potential of digitization of learning in universities from the perspective of the most important stakeholders, i.e. students, teachers and the library, and 2) combine the different perspectives towards digitization of learning in order to produce high-level requirements for flourishing e-learning ecosystems.

The first objective means studying the viewpoints and experiences of students and teachers as users of electronic texts and information resources and analyzing the ways in which the library could and should support them. The second objective is approached by envisioning a high-level future scenario of e-learning in university context based on understanding of students', teachers' and library's objectives and needs, and extracting requirements for e-learning systems from that.

The research applies the user-centred design approach with an additional strategic analysis viewpoint. User-centred design is a design and research approach that emphasizes the importance and centrality of the users of information and communication systems. User-centred design emerged during the 1980s as a counter force for what was seen as system centric engineering principles (Mao, Vredenburg, Smith, & Carey, 2005). There exist many different sub-themes and approaches inside user-centred design. However, the basic principles of active user involvement throughout the design and development of new technologies, iterative design process, and empirical measurement of the quality of the designs are generally agreed on (Mao et al., 2005). The strategic viewpoint emphasizes the different simultaneous contexts in which the activities take place, the scale differences

relating to the contexts, and interaction between them. Context is seen as the holistic socio-physical environment in which the activities take place. The physical environment can be relatively simple even in mobile and distributed situations. However, the social environment is messy at the minimum. Even when looked at from an individual's viewpoint, an activity can take place in multiple different social contexts. For example, when reading a book for a course, a student might also be trying out a new note taking technique and fulfilling his or her dream of becoming a master of science. Acknowledging the different contexts and their different scales as well as understanding how change in one reflects on the others is a key task of the analysis.

The methods of the research reflect the methods of user-centred design. The students and their viewpoint was studied with interviews and an experiment during which five different e-reader devices were given to a group of six students to use during one study period (ca. two and a half months). The teacher's opinions and viewpoints were gathered in a pair interview and individual interviews. Since the library is not a single entity that can be observed or interviewed, the library's viewpoint was mapped by analyzing the core technologies, publishers' information portals, and different mobile devices that can be and are utilized by the students to access the portals. The Aalto University Library is a research focused open library. Its goal is to provide best possible service to its customers (researchers, teachers, students and other interested citizens). Thus the library is interested in the fit between electronic information resources and the devices used to access them. In addition the library needs to prepare for helping its customers to access e-resources with a large selection of different mobile devices.

E-Books and E-Readers in Academic Setting

E-books and e-readers have been studied quite extensively. However, the complex context in which e-books and e-readers are used in academic settings as well as the

connections between electronic texts and different kinds of devices capable of showing them is still not very well understood.

E-books in Learning and Academic Settings

Several studies of e-books have concluded that their usage is growing steadily although not very fast. For example in the Ebrary Global e-book surveys conducted in 2008 and 2011 (McKiel, 2012) the percentage of respondents who never use e-books has decreased only slightly from 49% in 2008 to 47% in 2011. The main reasons for not using e-books were not knowing where to find them and preferring printed books. In the same time period there was only a 2% gain, from 52% to 54%, in the use of library provided e-books by the students for class assignments even though the percentage of students aware that their library offered them increased from 57% to 65% according to the survey. This all points to the conclusion, that e-books have not become more popular among students during this time. However, the usage statistics of e-books tell a different story: Ebrary usage statistics show an average of 30% increase per year. McKiel contributes this difference to the students becoming more accustomed to e-books and seeing more clearly their limitations in use for a given scholarly assignment.

A benchmarking survey of the UK National E-books observatory study (Nicholas et al., 2008; JISC Collections, 2009) collected over 22,000 responses and showed that 62% of student were already using e-books for their scholarly work, but only 47% were using library provided e-books. When asked about the last time they used an e-book, half of the students described their reading as “dipping in and out of several chapters”, while under 20% said they read several chapters. This quick reading was usually done from the screen (63%), seldom fully in printed form (6%), while 30% of the student did a bit of both. The results showed that the most important resources for completing academic assignments from the student’s point

of view were their own books or notes closely followed by free Internet resources; library resources, printed or electronic, or online course materials were not considered as important.

In a study about e-book awareness and use (Abdullah & Gibb, 2008a) it was found that a majority (57%) of the almost 1400 students who replied were not aware that the library offered e-books and 60% had not used e-books in general. Of those who knew of the library's e-books, about half had found out about them from the library's website and 24% had gotten the information from a lecturer. Most (67%) of the users read the material on screen while only 25% printed it out. In the second part of the study (Abdullah & Gibb 2008b) a smaller group was interviewed and asked to interact with an e-book platform to perform certain tasks. It was shown that the different navigation tools for different formats caused difficulties for the users. E-books were found to be useful for searching for specific information and for reference purposes, but printed books were preferred for extensive reading.

In the Rowlands, Nicholas, Jamali, and Huntington study (2007) about the views of faculty and students at University College London about e-books, 44% of the over 1800 respondents were e-book users and only 35% of them used e-books provided by the library, even though the material was mostly used for work or study. The users preferred to read the books on screen instead of printing them out, while still stating that printed books are much better as to the ease of reading. E-book discovery behaviour was found to be a key issue for the increased uptake of e-books; for example undergraduates wished to have e-books included and clearly marked on reading lists. In a follow up study (Rowlands & Nicholas, 2008) it was found that self-reported book discovery is greatly affected by demographic factors, especially gender, with males stating much higher independence from the library.

A University of Illinois survey (Shelburne, 2009) revealed that e-books had not previously been used by 43% of the respondents and the most common reason was that they were not aware that e-book were available to them. The greatest advantages of e-books were

found to be instant access from anywhere, searching within the text and portability. The common issues of reading from the screen, navigation, locating the resource, DRM and access problems were listed as the disadvantages of e-books.

In a study by Woody (2010) previous experience with e-books was not found to increase the preference for e-books and printed textbooks were preferred over e-books overall. Thus low e-book usage is not only a question of students finding the material; even those who find and use it consider print a better medium for textbooks.

In addition to usage times and amounts, also the challenges of using e-books and the opportunities e-books provide have been studied. For example Joint (2010) describes the various pitfalls of the e-book platforms for the user: proprietorial e-reader platforms with different functionalities and restrictions, DRM, inadequate tools, barred access or even access terminated in the middle of a session for turning pages too fast (a problem also noticed at Aalto University). However, Dewan (2012) warns that new e-book technologies, the new EPUB3 format and the increase in online learning and mobile device use will make e-books more and more important in academic libraries. As a result, the libraries must be ready for this shift from print to electronic. Libraries also feel the need to move towards electronic resources as ever-expanding shelf-space becomes unbearably expensive, but the transition is likely to be slower and more difficult than with journals (Medeiros, 2010).

In the two-year study of JISC National E-Books Observatory project (www.jiscebooksproject.org/) about use and attitudes towards e-books, online access, searchability and cost were found to be the three biggest advantages of e-books. Portability was also mentioned as an advantage by 5.3% of the respondents (Jamali, Nicholas, & Rowlands, 2009). In a previous study (Aaltonen, Mannonen, Nieminen, & Nieminen, 2011) the authors of this article have tested the portability of e-books on dedicated e-book readers. It was found that most of the library's e-books could not be downloaded to the readers, which

did not have an Internet connection. However, as more and more students carry around a laptop, tablet computer or another device with Internet connection, the e-books also become more mobile. In a study by Lai (2011) it was found that convenience, compatibility, and media richness are all important factors in adopting dedicated e-readers to use. Compatibility with the old print book reading habits had the greatest influence on accepting e-readers by affecting the perceived ease of use. However, the advantages of online access were also important; the freedom to download material anywhere combined with the possibility of dynamic, rich media sets the reading experience apart from traditional print.

E-readers in learning and academic settings.

Several studies have been made about using e-readers in an academic environment. The Sony Reader has been tested in Penn State University (Behler, 2009), The Lloyd Sealy Library (Kiriakova, Okamoto, Zubarev, & Gross, 2010) and the Open University in collaboration with Cranfield University (Mallett, 2010). The Amazon Kindle readers have been tested in Texas A&M University Libraries (Clark, Goodwin, Samuelson, & Coker, 2008; Clark, 2009), Princeton University (2010), the Darden School of Business at the University of Virginia (2010) and the Pratt Institute (Pattuelli & Rabina, 2010). They were also tested in three clinical settings in Texas and North Carolina for use in medical education (Shurtz & Von Isenburg, 2011). Both the Kindle and the Sony Reader were tested by The North West Missouri State University (Rickmann, Von Holzen, Klute, & Tobin, 2009) and a testing of five different readers, including these, was conducted at the Helsinki University of Technology (Aaltonen et al., 2011).

The general finding from all these studies was that the e-readers are well suited for linear, recreational reading, but are ill-suited for use in an academic context as is corroborated by the literature review by Tees (2010). The lack of easy navigation, annotation tools and proper graphic displays as well as the slowness of browsing and searching were common

problems found in these studies. Some of these problems are solved by the arrival of tablet computers with better navigation, colour and graphics abilities. In a further study at Texas A&M University Libraries (Goodwin, Shurtz, Gonzalez, & Clark, 2012) Kindles loaned by the library were in great demand and received very positive feedback from the customers towards the project. It was found in analysis that the e-readers were used for popular reading instead for research, but even with this type of reading negative comments were collected about graphic support, note taking and delays in changing pages.

The libraries faced issues of licensing and copyright, as these devices are made and marketed for private use. Questions of policy, licensing, availability, and technical issues were raised by Dougherty (2010) while Drinkwater (2010) warned of the difficulties with DRM (Digital Rights Management) and incompatibility issues caused by the many different formats. All these restrictions made the dedicated e-readers unattractive for the academia.

The students themselves have not yet been a great driving force on the uptake of e-readers in academia. A survey done by Foasberg (2011) asked college students if they owned e-book readers as if so, how they were being used. Only 23.5% of the respondents said they read e-books in the first place and of these only 15.7% used dedicated e-book readers to do so. The ones who had e-readers used them for leisure reading; it was noted that once again that many of the college's academic materials were not compatible with the e-readers.

The iPad and other tablet computers as well as smartphones and other mobile devices are going to change the scene of e-reading. They will allow for new functionality, but also new obstacles are bound to arise. Lippincott (2010) noted that already smartphones had similar capabilities to laptops, allowing for accessing course management systems, searching databases, reading books and articles and organizing of citations. Many publishers already have apps for using their resources on smartphones and the number of apps for scholarly purposes is bound to increase.

Ecosystems of e-books and e-readers.

Appelton et al. (2005) showed that embedding e-books into a course's virtual learning environment helped to increase students' use of e-books. Adding direct links to e-books on the reading lists makes them easy to find and use. Introducing relevant e-book collections at the beginning of the course and setting assignments to be done based on given, and linked-to, resources familiarized the students with the e-book platform. Importance of easy access has been noticed also in other studies. For example Carlock and Perry (2008) and Letchumanan and Tarmizi (2011) list access problems as one of the biggest reasons for not using e-books. In addition Lin et al. (2010) found that word-of-mouth communication, such as comments from other students, and expert recommendations, such as from lecturers and professors, are more important in influencing the students' perceptions about using e-books than are all the library's efforts to promote this material. Naturally also the physical design of e-readers can affect on the usage of the devices and the e-books on them. Letchumanan and Tarmizi (2011) found the physical design and insufficient collections to cause resistance to e-book use in addition to the unreliability of access.

These studies of success and failure of e-books and the use of e-readers link together a large number of different actors and technologies, e.g. e-books, e-readers, students, teachers and libraries' collections. This kind of large and dynamic network can be seen as an ecosystem. An ecosystem analogy is not a new one in the field of ICT. For example Nachira (2007) uses ecosystems to describe the dynamics of digital business. The power of the ecosystem metaphor is in how it explains diversity, complexity and change (Briscoe & Sadedin, 2007).

Ecosystems are difficult to define in a general yet useful way. Thus Holling and Gunderson (2002) have instead defined four key features of ecosystems. According to them ecosystems change, include members and subsystems of different scales, do not have a single

equilibrium, and have a tendency to break if fixed policy and management are introduced. The change in ecosystems is neither continuous and gradual nor consistently chaotic. The key features of ecosystems are also interesting when compared with e-learning.

Three Perspectives to E-Learning Ecosystems in a University

The first objective of this chapter is to explore three perspectives to the e-learning ecosystem: those of the student, the teacher and the library**.** Each has a different view on the benefits, challenges and restrictions of e-books, e-readers and other e-devices and each experiences and impacts the e-learning ecosystem in different ways. The students and teachers are the main users of the products and services. The library is an organizational actor that sees the situation from a different perspective.

Students

From the student's perspective the aim of studies is learning and eventually graduating from the school. In the case of an individual course or teaching/learning event the goal is usually to learn the topic well enough to pass the course and to be able to utilize the new knowledge in following courses or tasks. Learning happens in multiple different places and contexts, e.g. in classrooms and other premises provided by the university, at home, on a bus, at cafeterias etc. The possibilities of utilizing for example electronic information resources differ between different learning contexts. Also students' goals and study practices differ between contexts. For example participating in a lecture is very different from doing group work in a cafeteria. E-books and e-readers are making study resources available in a new way; easier to carry around and access anytime, anyplace.

Aalto University has different web-based portals for course enrolment and study planning, course communication, and assignments and exercises. The course enrolment and study planning portal is designed to be the core part and the other portals for example get the basic information of the courses from there. However, the students utilize mainly the course

communication portal, since it includes all the necessary information about the individual courses (schedule, study materials, assignment information, etc.) (Mannonen, 2009).

The study material differs between the courses. Usually it includes either books or articles and additional documents created by the teachers. Additional documents can include lecture slides, commentaries of articles, and other unpublished texts. Only the unpublished materials are distributed through the portal. Documents are usually in PDF format. From the books and articles only basic information needed to find them from the library or other information sources is usually given. Although, most of the published study material can be found in the University Library's collections, the students usually search for the materials through Google and other web search engines. Generally students only seldom have problems on getting access to the selected materials.

In the spring of 2010, a two and a half month evaluation period with five different e-book readers was conducted. During the evaluation, the devices were given to five students to use during one study period. The students were given a short introduction and guidance for using the devices and help on converting course materials to formats suitable for each device. During the research, the e-book readers were not yet very common among the students. None of the students that participated in the research had used e-book readers or seen electronic ink based screens beforehand. Students expected the e-book readers to behave like mobile computers and as a result the user experience of the devices was judged to be slow and cumbersome (Aaltonen et al., 2011).

Interestingly, many of the students had a habit of reading almost all of the electronic materials from computer screens. The e-book readers are usually marketed by claiming that it is easier and less tiring for the eyes to read on them instead of a computer screen. However, the students' reading habits included a lot of fast browsing and jumping between documents and the e-book readers were very cumbersome on these tasks. The electronic ink technology

uses less energy and tolerates better changing lighting conditions but is very slow in page changes compared with traditional LCD displays (Aaltonen et al., 2011).

In addition to slowness in page turning, the e-book readers also lacked good note taking features. The students saw the devices as small and lightweight replacements for somewhat heavy and bulky laptop computers but missed good and usable ways to annotate the materials and even take notes during classes. Also the study material presented problems for the devices. The devices were normal consumer devices with 5” or 6” displays. Most of the electronic study material is in quite large format (A4 or letter) and in order to read the text the students needed to zoom in with the devices. The zooming was clearly not the core functionality of the devices and it resulted in many difficulties in navigating the documents (Aaltonen et al., 2011).

An additional analysis of the e-book reader usage contexts of the students revealed that the devices did not fit very well into the larger ecosystems of different information resources, devices and environments the students were in while studying. Studying almost always included contacts to other students taking the same course as well as multiple information sources. This was probably the reason for many of the students to prefer laptop computers to books and printed materials when studying. However, the currently popular tablet computers seem to be a much better fit for students’ needs and working habits (Mannonen, 2011).

Teachers

Teachers aim to guide the students to the best information resources and to help them to interpret the information correctly. This happens through selecting and creating study material for courses, designing lectures and assignments so that they support the students in understanding and learning the key aspects of the topic and planning the exams so that they

measure what the students have learned. E-books and e-readers are becoming platforms the teacher has to take into consideration in disseminating the study materials.

The teachers' views on e-books, e-readers and e-learning were collected in a pair interview and two individual interviews. All of the teachers worked in the department of computer science but the topics of their courses varied quite a lot. Two of the teachers were responsible for bachelor level programming courses and two for master level courses on software engineering. The teachers' opinions and viewpoints towards potential information sources for courses (and students) differed a lot. The teachers of programming courses were open to the idea of students finding the needed information from whatever resources were available to them, while the software engineering teachers were more strict on that the students should first read the official course material and then check other information sources if they wanted. As a result the strategies of distributing study materials differed greatly. The teachers of programming courses published lecture slides and texts they had written for the courses themselves in the course portal. The software engineering teachers usually designed the course reading list based on books and academic articles and published the list on the portal. In addition, the lecture slides were usually added to the portal.

In general teachers were interested in supporting the students on learning, not on using certain devices or finding out how the library's services work. As a result, the teachers usually do not consider too much how to minimize the students' work of obtaining the study material. For example, if the course book was available in some format at the library and at a reasonable price in the campus bookstore or Amazon.com, the teachers considered it a good enough situation and did not usually for example check if the selected book or a similar one would be available in electronic format at the library. The teachers were aware that the access to and the format of the material can affect on how well the students perform at the courses and some of them were interested in how many of the students bought the course book or

how much the electronic book was used. However, none of the teachers had consulted the library about the topic.

Libraries

University libraries aim to ensure that the students and teachers have easy access to high-quality resources that are relevant to the learning process. E-books and other e-resources bring a great benefit to the library: resources can be used by multiple persons at the same time, accessed in any hour of the day, require no shelf space and do not deteriorate from use. Often e-resources are also a financially valid option and e-books, for example, are already used successfully on many Aalto University courses. The challenge for the Library with the e-learning ecosystem is to find material the users will want, which can be delivered the way the users choose and utilized as it suits them. There are as many e-book platforms as there are e-book publishers and aggregators, and each platform has different functionality and restrictions of use. Mobile devices, such as e-book readers, tablets and smartphones, set new requirements for these platforms and services. It is essential for the librarians in acquisition to know that the e-book they purchase can also be used on these devices. The compatibility of dedicated e-readers with the library's e-book services (eg. Myilibrary, DawsonEra, Knovel, Elsevier and Springer) has previously been tested (Aaltonen et al., 2011) and now the testing was expanded to include tablet computers and smartphones to see if they can circumvent the DRM problems experienced with some resources on the dedicated e-readers.

The Aalto University Library provides the students with access to bibliographic and full text databases, academic journals, as well as electronic books and reference works. The full text materials can be divided into two groups: those protected by DRM and those that are not. Material that is available in unprotected PDF-form is easily usable and transferable to various devices. The students can save this material on their own computers, read it on their mobiles and use it on tablets or dedicated e-readers (Aaltonen et al., 2011). This material

mostly consists of journal articles, but also some of the electronic books available in the library are in this form. The library's e-book packages in this form include collections from Elsevier, Springer, Wiley, Emerald, OECD, Sage, SPIE and Morgan & Claypool. Usually books subscribed to or purchased from the publisher directly are free of DRM and available to use on most platforms. The DRM protected materials are usually e-books; the services in use at Aalto University are Ebrary, DawsonEra, Myilibrary, Ellibs and Safari.

In the previous study, only the Ellibs service allowed downloading of a DRM protected book to the user's computer. This required the use of Adobe Digital Editions software. This service allows a book to be loaned to a user and the PDF stops working after the set loan period. These books could in theory be moved also to the dedicated e-readers, but in fact this proved to be too complicated to consider promoting it to the library's users. Now also Ebrary, DawsonEra and Myilibrary are offering an option to download the material for a limited period of time. Some services allow the downloading of the whole book and some just a limited part of a book. However, the downloading of an entire book always requires registration procedures and the installation of software.

Also the scene of e-readers has totally changed from the last round of testing: the iPad and other tablet computers have emerged with great popularity and smartphones allow access to the electronic resources. These new devices were tested for compatibility with each of the above-mentioned e-book services as well as with the ordinary unprotected PDF.

The devices tested were the iPad, iPod Touch, Galaxy Tab, Nokia N8 smart phone, a Nokia Lumia smartphone and Asus Eee tablet in addition to a PC. Most resources could be used with these devices in a browser, but new problems did arise. The small displays are not optimized for viewing e-books in a browser and using the buttons for e.g. turning the page became challenging on the small touch screens of the smart phones. Some of the phones didn't support Adobe Digital Editions or Adobe Reader, which are required for the

downloading of e-books from several of the platforms. On the tablets the situation was better as the bigger screen made for pleasant viewing and enabled the easier use of the touch navigation. The Bluefire app enabled the use of the Ebrary and Ellibs books on the iPad, which greatly improved their usability compared with reading them from the browser. In general the usability was better once the material could be downloaded away from the browser application; e.g. scrolling from page to page became possible. However, epub or another format more flexible than PDF would have yielded even better results.

Another important issue for the library is how the material can be shared or linked to by both teachers and students. Optimally, the students would have immediate, one click access to the materials from the course's information pages. This would require either materials which could be uploaded to the pages, or easy linking directly to the material which also allows for remote use. Many e-resource licenses do not allow for the material to be uploaded even to a closed study environment and as discussed previously for most e-books this isn't technically possible. Whether the licenses allow or restrict the use of the material on teaching platforms has not been a key issue at Aalto University when selecting resources. Maybe this should be taken more into consideration in future subscriptions.

But as most e-books still would not be available and as several larger publishers and distributors only allow linking to the material in a teaching package, easier and better linking options have to be considered. Links copied directly from the publisher's web pages usually include a lot of unnecessary and session dependant information and often will not work as such at a later date. Permanent links and DOI addresses offered by some publishers can help with this issue, but general guidelines on good linking still need to be established. The links will also not work if the student tries to use them from home or elsewhere outside the university network if they have been copied within the network. At Aalto University, remote access requires for the linking to first lead to a proxy server and only after authentication to

the material in question. The proxy can of course be added to each address, but undoubtedly the teachers would find this cumbersome. The portals where the students find the course information should be configured to direct all links to the proxy first. As the students already login to this system they would not even notice the proxy in accessing the materials. Currently, the users at Aalto University have to separately login to the library portal in order to remotely access the materials unless each link has already been enhanced with the proxy address. This also requires searching for the material again through the portal, unless using a browser that can use the authentication across several tabs (like Firefox). Each university naturally has their own ways of remote use, and many will surely have already resolved this issue. But as the remote use and teaching portal solutions are often designed separately from the library systems and at different times, the interoperability of these systems is not to be taken for granted.

Effective e-Learning Ecosystem: Combining the Separate Perspectives and Contexts of Students, Teachers and Library

A viable e-learning ecosystem can only emerge if all key members benefit from participating in it. All new technologies and solutions should take into account the whole e-learning ecosystem instead of just parts of it. The second objective of this chapter is to combine the three perspectives of students, teachers and library and produce high-level requirements for technologies and solutions related to the flourishing e-learning ecosystems in universities**.**

Since the viewpoints of students, teachers and the library differ from each other quite a lot (see above), we start with a vision of an effective e-learning ecosystem and based on the vision, we will analyze the changes and requirements needed for each stakeholder. Lastly we will discuss the steps needed to fulfil the vision.

Vision: Effective e-Learning Ecosystem 2015

The library's services are integrated into the university's study portal. On the other hand, the course structures and activities are visible in the library's online services. As a result, the library can for example follow the usage of different resources and change its offerings based on usage or even predicted usage. For example if a large course is scheduled for the spring term, the library can add the simultaneous usage licenses for the books and other electronic material required by the course then change the licenses to other resources after the course has finished. Since the library is aware of the e-material usage of the courses, it can ensure that the links to different materials continue to work even in situations where the distributor of the material changes by updating the links automatically to the study portal. Similarly, the library can provide direct links to different formats of the same course material (e.g. physical book, online book, epub book). In addition to these aids to collection management, the library also gains interesting insights to its collections. It can utilize course reading lists and other groupings made by the teachers and students in providing different kinds of recommendation services to its customers.

The teacher can utilize the library's effective search services when planning his or her courses and selecting the course's study materials. The selection can then be imported to the study portal as a link collection. The teacher can also annotate and comment on the material and be sure that the students see the comments side by side with the material. The teacher does not need to worry about the amount of licenses for the materials since the study portal provides that information for the library automatically. The teachers can also provide informal guidance to for example thesis workers by writing recommendations and reviews of the library's books and articles.

The student sees the course material in the study portal and can access the material through the provided links. He or she can highlight the most interesting and important parts as well as comment on them. In addition the students can share notes and comments relating

to the materials and even ask the teachers about difficult topics. When doing individual work, e.g. writing a thesis, students can utilize the course reading lists and comments through the library's search service. The library's search services show the courses that utilize each book or article and list also what other books and articles those courses use. In addition the students can create and share their own book and article lists.

Fulfilling the Vision of Effective e-Learning Ecosystem

The above scenario of an effective e-learning ecosystem depicts a situation in which the separate organizational functions, the library and teachers and research units, provide a shared service for their customers, the students. Naturally also the teachers are customers of the library. However, from the students' perspective a course, its teachers and study materials are one entity. In order to build and maintain the service, the teachers and library need to collaborate actively. Both the library's and teachers' skills and knowledge are needed for the service and they both benefit from each other's activities. The library gets insights from the teachers relating to the library's books, journal subscriptions etc. The teachers, although experts on subject matters, do not have the resources needed for managing the vast amounts of new publications. In addition the teachers can benefit from more active collaboration with each other through the library's services. For example a teacher can utilize the recommendations and comments of other teachers when recommending additional readings relating to his or her courses.

However, collaboration amongst the service providers is not necessarily enough. Gupta and Vajic (2000) have stated that in order to provide a successful service experience, one needs to build the experience in collaboration with one's customers. In the case of e-learning in universities, this means that the students should not be left outside the loop. As large organizations, universities have a tendency to collect huge amounts of anonymous and quite abstract feedback. Questionnaires and surveys can provide good information about the

current state of the affairs but service and ecosystem design requires active collaboration and mutual communication. The role and skills of the students' should be acknowledged. For example testing the myriads of e-book readers, not to mention creating guidelines on how they can be used to access different kinds of e-resources is an endless task where the students can make a difference. A flourishing e-learning ecosystem needs also flourishing discussions and sharing of experiences relating to constantly developing tools and technologies. While the teachers might be best to evaluate how well the tools and services support learning and the library to how the different parts of its collections and new devices interoperate, the students are the one that will use the tools and services the most. Thus, the students will also have more experiences and insights on how the tools and services really work.

Conclusion

E-learning in universities happens as the interplay of members of quite a complex network. The network includes actors such as students and teachers, organizational units such as the library and university administration, information resources such as books, the World Wide Web and journal and conference article databases, and place such as the lecture halls, cafeterias, offices and homes of teachers and students. The network resembles an ecosystem. It is under constant change and its members have different roles. In addition to this, the success of the whole network is the prerequisite for the success of its members.

The most important members of the e-learning ecosystems are students, teachers and libraries and other information providers. Each of these members sees the ecosystem and its activities from a different viewpoint. For the student, the individual learning process is the core through which he or she sees the whole ecosystem. The teachers think about groups of students and the balance between teaching and managing courses. The library is concerned about the access and usage of its collections. The viewpoints are connected but differ dramatically in their scale and context. In order to enable an effective and flourishing e-

learning ecosystem, one needs to connect these to form a single united service. The library's service needs to support both personal learning and teaching activities. Respectively, the library's collection management activities have to be integrated with course portals and other technical solutions used for teaching and learning.

From the technology development perspective the situation is as complex. University has quite independent units and for example the library acquires its own solutions. Even if the university would change its practices and started to build or buy integrated solutions, the students and thus the devices that are used to access the university's services would be independent of the development. Instead of very large all-inclusive solutions a better option might be smaller and more open services. Technology development is fast and uneven. Open solutions could allow the changing of small parts easier than large monoliths. For example new versions of e-book readers and other mobile devices are introduced at the very least annually.

Currently it seems that general-purpose mobile devices such as smartphones and tablet computers are favoured in e-learning ecosystems. The digital rights management solutions as well as document formats do not fit very well to the teaching and learning context and thus a lot is required from the device that is used to access the e-resources. For example when a document format does not support the scaling of text, the device needs to have easy and natural zooming options.

Universities' rapidly evolving e-learning ecosystems also present opportunities and challenges for research. This chapter has presented a general overview of three important perspectives towards the e-learning ecosystems. Important themes for future research are: the dynamics of development and technology acquisition and development processes of large e-learning ecosystems as well as good collaboration practices inside them.

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Trends, Issues and Solutions in e-Book Pedagogy

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Abstract

This chapter presents the main issues, state of the art and solutions in e-book pedagogy. Born or reanimated digitally, e-books complete modern traditional and digital libraries and allow users to read (online/ offline), to construct their own learning through personalization, to preview or to hear the content. In all cases the e-book pedagogy proves Dale's Cone of Experience for complex global environments. E-book pedagogy for portable devices aims to achieve a metasystems model of thinking. The aim of metasystems thinking is to achieve learning outcomes with reference to environment that is real and virtual, local and global, dynamic and adaptive. The literature on components of metasystems learning theory is reviewed. The main focus is to provide an overview and details on how e-book pedagogy is to be constructed to meet five different scenarios: static e-books, multimedia e-books, hypermedia e-books, customized e-books and personalized e-books. It is concluded that integrated pedagogy is the current trends concept of metasystems learning design.

Keywords: metasystems approach, e-learning, m-learning, e-book, digital book

Introduction

Information and communication technologies change our vision about the principles, strategies, resources, tools, methods, procedures and techniques used for learning. The Digital Age has allowed rapid communications, networking and socialization. Education occurs in a variety of formal, informal and non-formal learning environments. Feedback is coming from

“local and real, global and virtual learner - centred environments” (Midoro, 2005, p. 32). Learning is guided by motivation, both intrinsic and extrinsic (Elliot & Dweck, 2005, p. 17). Many institutions and learners have been experimenting with alternatives to designed pedagogical strategies to enhance successful learning, such as flexible learning, blended learning, and online access to programs and/or to e-books, digital or electronic textbooks.

The e-book digital format started the Gutenberg Project. There are over 38,000 free ebooks and 600 of the “best” e-books online and for Kindle, Android, iPad, iPhone etc. Stored in digital libraries, e-books are available in plain text, HTML, PDF, EPUB, MOBI, and Plucker. There are many libraries with free access: LibriVox, Runivers and Aozora Bunko. Usually, e-books are stored online, for example: NOOK Kids Store, Children’s E-Books, and TumbleBooks. Many publishers have begun distributing e-books, such as Cambridge University Press, Oxford University Press, Springer, Elsevier, RSC Publishing, Wolters Kluwer/Ovid, Taylor and Francis etc.

The user reads e-books in online libraries or builds his/her own e-library, using desktop computers, laptops, e-readers, e-devices or some mobile phones. The most commonly used e-devices are Kindle, iPhone, iPad, Android devices, BlackBerry, Windows Phone7, Mac etc. The rationale for the diversity of e-devices used for education is in the different formats – EPUB, PDF, DOC, TXT, HTML, RTF, JPEG, GIF, PNG, BMP, and MP3 – that e-book technology adopts. Different formats give rise to broad e-book categories: free e-books; e-books for purchase and licensing; plain text; audiobooks, multimedia books, FlexBook, Flip Books, and Wiki Books etc. Each time a new format of e-books emerges, it is expected to be a new opportunity to gain new readers and a new audience.

E-book structure and functionality have much in common with the same features for e-textbooks, educational software and academic textbooks. The similarity between such technologies was reported by Porter (2011, p. 28): “The electronic textbooks, also known as

digital texts, e-texts, ebooks, e-books, electronic books, and hypertext books, represent a marriage of a hardcopy book within an electronic environment with software, such as Adobe Acrobat PDF, XML, SGML, HTML files, or hardware, such as a Palm Reader, E-Reader, Sony Reader, and Amazon's Kindle among others". E-books are expected to be more and more used in universities, colleges, non-formal learning environments or/and workplaces (Connaway & Wicht, 2012; Sedig, 2005). As was noted by Sachoff (2012) more than 18 percent of new textbook revenue in the higher education and career education markets will come from digital textbooks by 2014. As was noted by Nicholas et al. (2008) over 60 percent of students were using e-books for academic work, but preferred to read short sections from e-books, rather than the complete text (less than 6 percent of students had read the entire text) and almost 60 percent estimated that they read for less than 20 minutes in a session.

McFall, Dershem and Davis (2006) observed that e-textbooks have the potential to address some of the paper textbook's shortcomings, taking advantage of the digital context and new learning techniques. The technology allows sharing annotations with textual notes, building diagrams and engaging students with interactive online lectures. Coloured highlighters and shared bookmarks are an interesting way to create bookmarks in the text, share bookmarks with the class, point them to specific passages, or to other outside resources.

E-textbooks facilitate learning. Luika and Mikk (2008) note that the low-achieving students profited from clear instructions, familiar icons, examples, and answering from the keyboard. The high-achieving students benefited from key-combinations, menus with different levels, the Internet, analogies and lower density of terms in the content of the material. In electronic textbooks, not only the content, but also the design of the software, should be different for learners with a different achievement level.

E-book pedagogy generally refers to strategies of instruction rely to teaching and assessment both in online and blended learning. The definition can be analyzed as follows:

the word “pedagogy” comes from the ancient Greek *paidagogeo*, literally ‘to lead the child’. The word “electronic” concerned with or using devices that operates on principles governing the behaviour of electrons. The main example of using electronic in educational technology is electronic books/electronic textbooks/digital book. In some cases the electronic textbooks are viewed as digital textbooks. Digital textbooks refer to the way that an electronic item or some new technology has been made, for example special coding called “discrete signals”, e-ink or e-paper technology. Usually, digital textbooks are defined as core textbooks with which students can learn contents that are tailored to their abilities and interests. The pedagogical functions, incorporated in digital textbooks, provide the learner with a combination of textbooks, reference books, workbooks, dictionaries and multimedia content.

These and other sources concede that e-book pedagogy moved slowly to e-learning and m-learning. Murray and Perres (2011) demonstrate that the era of e-textbooks is coming. Are we ready for these radical challenges in e-book pedagogy? The problem is that e-book pedagogy cannot be view only as pedagogy. This domain needs to be analyzed with complex problems that arise from e-learning and m-learning. These domains are: philosophy of learning, educational psychology, cybernetics of open systems and knowledge management. E-learning aims to enrich learning by blending models, conceptualizing multimedia; standardizing interoperable content representation; personalizing learning experiences to custom learning devices; integrating administrative functionalities with other academic units; and not the least, ensuring expected quality of learning. On the other hand, m-Learning refers to the use of handheld devices such as PDAs, mobile phones, laptops and any other handheld information technology device that many be used in teaching and learning.

As argued by Cassagnol (2011), e-textbooks are the most complex type of e-book, with everything from pagination, notation, searching and indexing, copy/paste, the ability to post to social media, and also multimedia such as video, audio, pictures, and slideshow. Up

until now, e-books have not been much more than PDF versions of books, used by students for highlighting and making notes in the margins. However, with the change from hypertext to Web 2.0 technologies there is a need to re-conceptualise the pedagogy of learning. The new learner-centred environment consists of wikis, weblogs, social bookmarking services and RSS feeds. M-Learning adds new technologies like SMS, MMS, WAP, GPRS, Bluetooth, PDAs, 3G and 4G phones, MP3s and CAMs. So, is concluded that e-book pedagogy integrated two main trends in educational technology: e-learning and m-learning. The pedagogical tools for e-pedagogy are: electronic books, electronic and/or digital textbooks.

The aim of this chapter is to identify and describe trends and issues in e-book pedagogy for the learner-centred environment, as well as strategies, procedures and methods for new learning. Such strategies include the provision of metasystems thinking capable to change our vision about linear and systems thinking. The research problems are: What are the cybernetic principles for the e-book pedagogy? What are the similarities and differences between cybernetic, philosophical, psychological and management principles? Could e-book pedagogy provide an environment for development the self –regulated learning capacity?

Beyond studying good practices to substantiate the e-book pedagogy, the objective of the chapter is to investigate the metasystems approach in order to develop a deeper understanding of how a knowledge graph increases intrinsic motivation to read and learn with e-books. The following section provides a review of the recent literature in order to explain good practices to substantiate the e-book pedagogy. The section after that outlines the approach of Instructional System Design. The subsequent section describes trends and issues in modern e-book pedagogy. Then the portable e-reader content and pedagogy is described, followed by the integrated pedagogy of competence in contrast with portable e-readers. The next section describes the approach of metasystems design of e-books. The final section concludes and offers insights for e-books pedagogy and future research.

Good Practices to Substantiate the e-Book Pedagogy

Good practices to substantiate the e-book pedagogy have their roots in philosophical, pedagogical, psychological, cybernetic and knowledge management theories. The pedagogical roots for e-books are traced from behavioural learning theory and stochastic learning. Berg (2003) emphasizes two main techniques for the use of media in the classroom: one concentrating on behaviour, and another focusing on process and holistic, experiential-based learning. These technologies use different principles and pedagogical strategies for learning design, but have common roots.

The first root, dated from the beginning of the last century, is called the *Visual Instruction Movement* (Reiser, 2001). This root aims to combat "verbalism" in the classroom, however, the books are focused on memorization and drill and practice techniques. The making of films for educational use in the early years was not explicitly guided by pedagogical theories. The studies of that time show that the instructional value of any media product is determined largely by how it is used and less by how well the films were designed. With all this, the strength of a new movement consists in successful efforts at thinking about learning design.

The second root, named *Audiovisual Instruction*, was famously predicted by Edison: books would be replaced by motion pictures (Cuban, 1986). So, for 20 years teachers used trigger films (short, problem-centred films) in order to engage students in learning through new methods, including silent films that added some scope for customization. Nonetheless, Reiser (2001) notes that practices were not greatly affected by research programmes as people either ignored, or were not made aware of, many of the research findings. During the early 1950s, leaders in the audiovisual instruction movement had become interested in theories of communication focused on process, involving a sender and a receiver of a message, and a channel, or medium, through which that message is sent. Moreover, during

the 1920s audiovisual instruction was completed by educational radio. New programmes were available for foreign languages, health, social studies, economics, science, music, art and assessment.

During World War II the audiovisual and educational radio tested hypotheses about various filmic techniques and their instructional effectiveness. As was noted by Molenda (2012) they tended to show procedural tasks from the performer's viewpoint rather than the viewer's and to use a first-person stream of consciousness narration to model the thought process of the performer. In the post-war period research was conducted on visual and auditory perception. The most relevant strand was Gestalt psychology, pioneered by Wertheimer and elaborated by Koffka and Köhle. The strength of Gestalt psychology, as a type of humanistic-existentialist psychology, is in the concept that perception of a whole differs from that of the individual stimuli that make up the whole.

Later, Dale's Cone of Experience was proposed (Lalley & Miller, 2007). The principles for learning, as well as for audio and visual media, could be arrayed in a spectrum from concrete to abstract. So, it was demonstrated that people generally remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say and write and 90% of what they do. The proposed principles were completed by educational television tending to emulate lectures, demonstrations, voice-over visualizations, interviews, panel discussions, dramatizations, field trips, or documentaries.

After Shannon and Weaver's information theory and Wiener's cybernetics, specialists in educational technology were viewing teaching/learning problems as a communication problem. The theory of operant conditioning was proposed by Skinner (1954). The programmed instruction, as *third root*, came with a new arrangement of stimuli, responses, and reinforcements and the teaching machines with programmed instruction lessons were expected to change the vision of learning. This methodology allows students to progress

through a unit of study at their own rate, to check answers immediately and to advance only after the answer is correct. The Skinner stimulus-response model was based on the principles that learning takes place through a series of small steps in which the learner must actively participate and with success in learning, the student is immediately rewarded. The realization of such plans depends on a number of factors, the priorities being feedback and reinforcement, which is indisputable, and the main strength of the programmed learning. The weakness is the teacher-centred environment. It is preferable, therefore, to focus on controlling through interaction with the instructional environment, where students were unable to ask questions and to develop self-regulated skills.

The alternative to programmed instruction was *Personalized System of Instruction.* This is a teaching–learning strategy, which was proposed by Keller (1968), who defined the concept as: "This is a course through which you may move, from start to finish, at your own pace. You will not be held back by other students or forced to go ahead until you are ready. At best, you may meet all the course requirements in less than one semester; at worst, you may not complete the job within that time. How fast you go is up to you. The work of this course will be divided into 30 units of content, which correspond roughly to a series of home-work assignments and laboratory exercises. These units will come in a definite numerical order, and you must show your mastery of each unit (by passing a "readiness" test or carrying out an experiment) before moving on to the next" (Keller, 1968, p. 81).

The methods of delivering the information (class, lecture or demonstration in traditional classroom) and the main actors include the teaching staff, which includes proctors, assistants, instructor and a graduate laboratory assistant. A proctor is an undergraduate who has been chosen for his mastery of the course content and orientation, maturity of judgment, understanding of the special problems that confront a beginner, and for his willingness to assist. The role of proctor is to provide students with all study materials except textbooks.

The work in the laboratory will be carried out under the direct supervision of a graduate laboratory assistant. The role of graduate classroom assistant is to provide the course materials and to keep up all progress. The role of instructor is to select the material, organize and to present the material, construct tests/examinations, provide lectures, demonstrations, act as a clearing-house for requests and complaints and to arbitrate in any case of disagreement between students and proctors or assistants.

The outcomes of personalized system of instruction are analyzed by final examination, in which the entire term's work will be represented. "With certain exceptions, this examination will come at the same time for all students, at the end of the term. The examination will consist of questions which, in large part, you have already answered on your readiness tests. Twenty-five percent of your course grade will be based on this examination; the remaining 75% will be based on the number of units of reading and laboratory work that you have successfully completed during the term" (Keller, 1968, p. 81).

Fourth is *Computer Aided Instruction (CAI)*. The principles of CAI are aimed at establishing more effective communication methods, both verbal and audiovisual. These methods use interactive questioning and appropriate feedback in order to improve retention. E-books, designed according to CAI principles, were mostly designed as interactive and intelligent tutors, known as *computer tutors*. Anderson and Krathwohl identify the following principles: use the production system model of the student, communicate the goal structure of the problem space, provide instruction on the problem-solving context, promote an abstract understanding of the problem-solving knowledge, minimize working memory load, provide immediate feedback on errors and adjust the grain size of instruction according to learning principles and enable the student to approach the target skills by successful approximation.

Computer aided instruction programme modes were drill-and-practice and tutorials with a strong control of author or instructor, rather than learner control. The strength of CAI

pedagogy is the strategy which allows designing interactive learning environments with immediate feedback, hypertext, simulations and animation. Moreover, the learning models incorporated in such instructional programs could provide consistency in presentation and adjust the difficulty of the context to the learning styles. CAI methods can improves instruction for students with disabilities. However, the weakness of this pedagogy is the minimal role of reality and social interconnections.

Instructional Design

One of the most interesting movements in educational technology is *Instructional Design* (Hakkinen, 2002; Kahle, 2007). This term is used in cases when "technology incorporates known and verified learning strategies into instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing" (Merrill et al., 1966, p. 2). Instructional design technology is based on System Approach to Training (SAT). As was noted by Molenda (2012) the essence of the systems approach is to subdivide the instructional planning process into steps, to arrange those steps in logical order, then to use the output of each step as the input of the next. "The systems approach represent a closed – loop, self – correcting process for proceeding from identified needs to predicable outcomes" (Lipsitz, 1973, p. 38).

While the systems approach was defined in 1956, as was noted by Fry, Bryan and Rigney (1958), it was recognized mostly after the ADDIE model, which means that the instructional programme can be developed in five phases: *analyze*, *design*, *develop*, *implement* and e*valuate*. Gustafson and Branch (2002, p. 19) explain that analysis often includes conducting a needs assessment and starting a goal. Design includes writing objectives in measurable terms, classifying learning as to type, specified learning activities and media. Development includes preparing student and instructional materials (both print

and non-print) as specified during design. Implementation includes delivering the instruction in the settings(s) as specified during design. Evaluation includes both formative and summative assessment as well as revision. Formative evaluation involves collecting data to identify needed revisions to the instruction; summative evaluation involves collection data to access the overall worth of the instruction, in either absolute or relative terms.

In 1990, after the hypermedia revolution (Barker & Tucker, 1990), the e-pedagogy received a new tool: the *Learning Content Management System*. The e-book became a component of such a system, but the content can be divided into information and assessment. The learning content management system allows personalization, editing, and modifying content as well as site maintenance and teacher management from a central page. It provides a collection of procedures used to manage workflow in an individual and collaborative environment. The student can choose the format, read and distribute e-books as discrete units of text, items and a sequence of images etc. The good practice to substantiate the e-book pedagogy can be considered as the following: "separation of structure, content and presentation, an exactly defined workflow management and the management of content in the form of small units, so called assets. This leads to quality, better reusability and reduced costs", as was noted by Bergstedt *et al*. (2003, p. 155).

After 2000, the learning design principles were changed again (Koulopoulos & Frappaolo, 2000; Bolhus, 2003; Kramarski & Gutman, 2006). With the digital wave the focus of learning is based on three main conditions: learning is a lifelong process, learning design is always evolving, and natural resources are limited. The new learning ideal was established as involving professionalism, planetary thinking and culture pluralism. The learning environments became as real as virtual. The learning design is focused on technology enhanced learning. The learning activities are placed in formal schooling and in centres for lifelong learning and provide learning for health, safety, security and new competence.

Moreover, the behaviourism principles were definitively changed to cognitivism multimedia and constructivism learner centred environments. From a cognitivist perspective learners use memory and thought to generate their own strategies as well as store and manipulate mental representations and ideas. The classic paradigm of constructivism, as it was to become, was examined, criticized and added to by specialists in knowledge management, cybernetic pedagogy, and quantum psychology. According to Huang (2002) the instructional principles, driven from constructivism, can guide the practice of teaching and design to interactive, collaborative, authentic and learner-centred learning. In order to do this, information needs to be well structured, rely to authentic learning objects, dynamic and flexible cognitive processes describing actions, events, and changes in the cognitive system.

Arguments furnished by science have reignited the debate about objectivist and constructivist design approaches. Objectivist design (Jonassen, 1991) revealed the learner's processing of information, and emphasized controlling the nature, sequence and frequency of learning activities in order to replicate the knowledge of an expert performer in the most efficient manner possible. Instead of this, a constructivist approach is based on the belief that people create their own understanding based upon their perceptions of stimuli in an environment. Objectivist conceptions of learning assume that knowledge can be transferred from teachers or by technologies and acquired by learners. This approach has put forward two main issues: 1) How to structure the information in e-books? and 2) what type of structure is the most appropriate for e-books and how the structure should be designed?

The most appropriate theory, which provides the answer of how to design structure and content in e-books pedagogy, seems to be Elaboration Theory (ET), proposed by Reigeluth (1983). The basic strategies of ET are: *organizing structure* (conceptual, procedural or theoretical); *simple-to-complex sequence* (the most important and the most representative remaining versions of the task first); *constructivist learning* (cognitive

flexibility theory and situated cognition theory) and *guidelines for designing constructivism learning* according to five principles proposed by Jacobson (1994). There are: multiple conceptual representations of knowledge, link and tailor abstract concepts to different case examples, reduce domain complexity early, stress the interrelated and web-like nature of knowledge and encourage knowledge assembly.

What was described by Vygotsky in 1978 seem to be widely implemented in e-book pedagogy. But, as was noted by Eun, Knotek and Heining-Boynton (2008) the concept of zones of proximal development needs to be conceptualized. The student's understanding is influenced by guidance, conceptual tools, socio-cultural norms, standards and curricula. Learning is an activity which involves both social and material resources. For these reasons the zone of proximal development could be extended, if e-book pedagogy will provide methods for learning that will take into account the student' cognitive structure (*a priori* knowledge) and prospective (the cognitive potential).

However, e-books pedagogy rely on acquiring new knowledge, skills and competence in complex, realistic, and relevant learner-centred environments. For this approach, the social negotiation constitutes an integral part of learning, supports multiple perspectives and use of multiple representations and nurtures self-awareness of the knowledge construction process. On the other hand, in a high globalized world requires that students will rapidly process information, will learn new knowledge and will demonstrate new skills. One of the most suitable theories is Merrill's first principles of learning that describe learning as activation of *a priori* experience, demonstration of skills, application of skills, and integration of these skills into real-world activities.

All these facts constitute the premise for e-book pedagogy. However the weakness of all the described premises is in principles of learning for e-book pedagogy. Could these principles be fully integrated in e-book structure and content? Yet in 1972, Landa wrote that

effective learning is possible only in those instances where special devices and equipment are designed and used. These devices will allow a flexible adaptation of teaching to the dynamics of assimilation of knowledge, skills, and habits by each student. They will assist and regulate automatically or semi-automatically the complex processes of teaching, learning and control.

Recently the *iPad* paradigm has been recognized. Instructional design paradigm has been change to learning design. Moreover, the e-learning and m-earning pedagogy paradigm was shifted again in order to address more ambitious goals. Its aim is to support the cognitive, affective and psychomotor mechanisms for adaptation and accommodation to rapidly changing conditions in the real learning environment (Mayer, 2005; Midoro, 2006; Kalantzi & Cope, 2008; Railean, 2010a). In order to make this idea a reality the educational technology is viewed like a *product* (pedagogical resource) and a *process* (authoring tools for constructivist learning). The first technology, in addition to high resolution text, images and animation, allows discover of new methods for understanding. Instead of this, the second technology is an intention to write collaboratively or to personalize e-book content, using, for example, FlexBook or Wiki, add a chapter, link pages, uploads files or provide feedback.

What are the trends and issues in modern e-book pedagogy? Are there any differences in pedagogy of e-books written for networking computers and e-books written for portable e-readers or mobile devices with e-readers?

Trends and Issues in Modern e-Book Pedagogy

The scientific literature has increasingly articulated the links between “new learning as element of a science of education” (Kalantzis & Cope, 2008); “digital natives” (Prensky, 2001), a “learner-centered environment” (Midoro, 2005) and a “more open educational system” (Frick, 1996). As was defined by The New Londin Group in 1997 the pedagogy is a teaching and learning relationship that creates the potential for building learning conditions

leading to full and equitable social participation. However, in many cases the pedagogy is concerned about the transmission of knowledge, which could be translated as *linear, systems and metasystems thinking*. The linear thinking is usually associated with the works of Skinner (1954), while the systems thinking are based on the works of Gagne (1985). Metasystems thinking relies on constructivism. This approach can be proved by the theory of optimized directed graph (or knowledge graph), theory of probabilities and statistics. The first results, noted by Railean and Cataranciuc (2012), refer to a case study in teaching informatics and statistical analysis of two independent variables: values gained from oral self-assessment and values gained from computerized assessment, with high values of correlation.

In the context of portable e-reader pedagogy the major discussions rely on m-learning theory, which needs to be focused on meta-philosophy, metasystem, meta-theory, meta-language, meta-variables, metacognition, metadata, etc. Theoretically, the linear mathematical learning theories described research in statistical theory and probability, cellular automata, neural networks etc. The systems mathematical learning theories rejects the linear cause-effect, rely on cognitivism and, instead of it, try to explain the behaviour of the learning objects through producer-product relations, connectionism, dynamic stochastic systems, social media and multimedia in learning.

Starting from a meta-philosophic point of view, the linear thinking is a process of thought following known cycles or a step-by-step progression where a response to a step must be elicited before another step is taken. In other words, linear thinking represent rational thinking, when if a =b, and b=c, then a=c. The early programmed textbooks are the best example. So, in programmed learning, the student is forced firstly to answer and then to reinforce the answer before moving on to the next. Instead of this, e-book pedagogy aimed to develop linear thinking treats a student's brain as an empty vessel to be filled with knowledge. The most used pedagogical strategy is step-by-step sequencing common to

cognitive tutors. Moreover, the new methods of learning with technology are designed to introduce new concepts in step-by-step fashion and practice it under well-defined conditions (computer aided instruction).

Systems thinking is a process of understanding how things influence one another within a whole and refers to an orderly, logical method of identifying, developing and evaluating a set of strategies aimed at attaining a particular instructional goal. As was noted by Mora et al. (2003) the systems approach is a scientific paradigm that emerged in the early 1940s as an alternative to the classic positivist scientific paradigm dominant in the natural sciences research and what was developed in biology, psychology, sociology, politics, economics, operational research, management science and information systems. The strategy comes in two varieties with procedural or conceptual models. The procedural models apply cognitive taxonomy aimed to teach a rule, to form a skill or an attitude. Conversely, the conceptual models incorporate specific strategies to teach well-defined logical content. The idea claims that sequences should progress from simple to complex. Searching and browsing are the more common interaction styles with information. Objectivism and constructivism are the most used pedagogical strategies. The weakness of this approach consists in the idea that truth is absolute and cannot be investigated rather than being reinforced.

Metasystems thinking is like "human thought characterized by expansion in multiple directions, rather than in one direction, and based on the concept that there are multiple starting points from which one can apply logic to problem" (Hauge, 2012). The expression "meta *X*" denotes that *X* is more than a system or "a system of systems" (Baranova, 2000; 2006) and *X* results in meta-system transition. As was noted by Klir (1990) the term meta *X* is used as a name for things or systems, which are bigger than *X* in the sense of more organized, having higher logical structure or analyzed in a more general sense. In contrast to the previous model, the new model is one of dynamism, flexibility and self-regulation. Current

advances are associated with metasystems, which are not unified, and not totalities, but a environment that a system needs in order to exist either inside or outside the system. In other words, the metasystem mediates between a system and its parts just as well as it mediate between the super-system (system of systems) and its subsystems. The metasystem is the glue that holds the various systems together, but its nature is not like the system (Palmer, 2002). The metasystems represent an "integration of systems which is carried out by a parameter set regardless of whether these systems have one set of variables or not" (Kapra, 2004).

The e-book pedagogy, according to the metasystems approach, aimed to develop meta- competence with new knowledge architecture characterized by dynamic functionality and more interconnected logical content deposited in long-term memory. It must be admitted that e-books, unlike other pedagogical resources and/or instructional tools, are not merely e-text representations of objectives, but are also processing systems. E-books are like generators of knowledge, skills and competence that provide sources for a metacognition mechanism. Furthermore, through the iPod and iPhone paradigm, teachers sought to harmonize the interdependences between cognitive, affective and psychomotor objectives (in order to engage students in active learning and to improve learning outcomes). Only in extreme cases do they use cognitive objectives.

As was noted by Kazak et al. (2010) the key components of the metasystem for children with emotional or behavioural needs include families, cultural norms, values and services. This is important because improving outcomes for children and adolescents with mental health needs demands a broad meta-systemic orientation to overcome persistent problems in current service systems. Improving outcomes necessitates the inclusion of current and emerging evidence about effective practices for the diverse population of youth and their families. In the case of widely used e-book pedagogical design, the core theory can be Bronfenbrenner's ecological system theory. The rationale of this choice is learning, which,

like a complex metasystem, is designed for formal schooling, but in reality is affected by increasing influences of distance non-formal and informal education. Dib (1987) notes that non-formal education is when educative processes are endowed with flexible curricula and methodology, capable of adapting to the needs and interests of students, for which time is not a pre-established factor but is contingent upon the student's work pace, and certainly do not correspond to those of formal education. Informal education is quite different from non-formal education and comprises the following activities: visits to museums or to scientific and other fairs and exhibits, etc.; listening to radio broadcasting or watching TV programs on educational or scientific themes; reading texts on sciences, education, technology, etc. in journals and magazines; participating in scientific contests, etc.; and attending lectures and conferences. The reality emphasizes that stimulus-response-reinforcement is not a unique learning method and that is not any way to ignore the impact of global events. "The effects of larger principles defined by the macrosystem have a cascading influence throughout the interactions of all other layers" (Paquette & Ryan, 2001). But, what are the principles of e-books elaboration? Can classical principles of didactics be used in e-books learning design?

The e-book is the core concept for e-learning and m-learning. E-learning is just-in-time education which is delivered as individualized, comprehensive, dynamic learning content in real time, aiding the development of communities of knowledge, and linking learners and practitioners with experts. M-learning relies on a device with anywhere, anytime wireless access. Rosen (2010) has emphasized the key concepts:

- information is available anywhere there is Internet access
- information is available anytime
- information is available through devices that are becoming commonplace and will soon be affordable for most people

- information can be pushed from the environment to the learners and pulled by the learners from the environment
- the learning environment is fluid and adapts as the learner learns.

M-learning is not normally part of formal schooling and its aim is not to develop new knowledge, behaviours, skills, values or competences. Clark (2011) notes that m-learning is more about performance support and complementing learning and is conducted asynchronously. The students can read materials, complete and submit exercises or quizzes, participate in online discussion forums, and complete the project or end-of-course evaluation. The communication model is more learner-context than learner-learner or learner-expert. Due to the small screen it is more common to listen to an audio device or to interact for 3-10 minutes with animated content, and view digital photos or videos or disseminate them. The strength of this pedagogy is in audiovisual content. In order to achieve this aim, teachers need to teach knowledge, skills and competences. Is it possible to do this using the current state of the art in educational technology?

The open architecture of e-readers and e-devices provides access to nonlinear digital content, allowing open access to data, information and knowledge. The learning is more continuous than discrete, unlike the content representing a digital version of printed books or academic monographs. These are the weaknesses of m-learning pedagogy, but if the content is commensurate with the user's needs and preferences one can see that e-books have done more good than harm to modern education.

The strength of e-book pedagogy is in interactive frameworks. The affordances of these technologies include reduced storage demands, ease of back-up and the ability to construct meaning with graphic communication. If interactive frameworks are included in the electronic portfolio, the student obtains a powerful didactical tool for hypothesizing, designing and constructing the meaning of real learning objects and to form their own

coherent whole in order to reorganize elements into a new functional cognitive structure. Moreover, as Wang and Turner (2008) mention, the process of creating electronic portfolios provides students with the responsibility of reflecting on their learning. The assemblage of an electronic portfolio is a classic example of a constructivist activity because the students can construct and revise their knowledge, skills and competences. The most important benefit of an e-portfolio is retaining the intrinsic motivation.

One of the possible educational technologies is an "electronic textbook in an electronic portfolio" (Railean, 2009). The key factor that affects this technology is that the instructional context cannot be pre-specified, the student cannot construct his/her own understanding based only on his/her real-life experience, *a priori* structure is strongly individual and the key concepts are the most important figures. The basic premise of learning with e-books is that performance is reflexively aware of adaptation and accommodation to real life and not a reproductive activity based on similarity between presented and required knowledge. The second premise is e-reader and e-device tools, which allow intrinsic motivation to be maintained through global socialization. The power of e-devices strengthens socio-constructivist pedagogy.

On the other hand, the knowledge management requirements emphasize the role of the core structure of competence. As was noted by Gerard and Rogiers (2009) the structure of competence is a complex construct formed by *savoir-reproduire*, *savoir-faire* and *savoir-être.* The savoir- reproduire (which is equivalent to savoir or savoir -dire) represents theoretical and verbal knowledge; savoir-faire represents methods, techniques, procedures, and learning strategies; and savoir-être represents wishes, affectivity, emotions, and motivations (Railean, 2012a). Such a structure of e-book pedagogy integrates cognitive, psychomotor and socio-emotional domains into integrated pedagogy. In spite of this, e-book pedagogies are very different. While a highly effective alternative learning environment with interactive

strategies, the lack of essential online qualities creates problems for the designer in of offline and online instruction, who must have knowledge of online and offline methodologies and the skills to manage digital dialogue.

The lack of physical presence of a teacher and classmates and the lack of support from classmates is replaced by a two-way interactive model of transmitting the data (information, knowledge) with relevant pedagogical scenarios and suitable didactical schemes. However, although a teacher would be able to create pedagogical scenarios for e-readers or for e-devices, usually school administrators ignore this. Nonetheless, well-designed scenarios create a high synergy between author and learners as proved by hermeneutic dialogue.

E-book pedagogy can be viewed as an interdisciplinary science which provides new principles for cognitive activities through new methods of teaching, learning and assessment that affect knowledge, skills and competence development instead of a scholastic view of learning. What should be taught and what should not be taught through e-book pedagogy when portable e-readers or mobile devices are used? Are there any differences between methods of learning for portable or/and mobile devices? The first idea is that learning objects need to reflect the specific nature of the digital dialogue: a new form of sharing information on the Internet through Skype, Twitter, iTunes, Facebook, Wiki Books etc. Yet e-book pedagogy of the highest quality can and will occur in a programme provided beyond the traditional curricula, developed or converted in order to educate the digitally competent.

E-book pedagogy provides a learner-centred environment and new opportunities for lifelong learning. The global culture with its variety of methodologies, forms, formats and modalities of knowledge delivering; the special needs and psycho-pedagogical characteristics of digital learners; the controversies between digital natives and digital immigrants; and the interest in studying new technologies place e-book pedagogy ahead of the fact to accept a metasystems approach for learning design. To be successful the curricula, the network, the

context, the learning environment, the technology, the teacher and the students must be carefully balanced in order to take full advantage of the strengths of the new era and avoid pitfalls that could result from its weaknesses.

However, many domains cannot be taught with e-books alone. This means that new pedagogy cannot ignore traditional face-to-face learning or hybrid learning methods. Just because it may be technologically possible to simulate a real learning object, it is not necessarily best to teach through e-learning or m-learning. Before going on, we should draw attention to the differences between reading online and reading offline, and between their two respective sciences of design: instructional system design and learning design. Instructional systems design specialists do not like to be confused with learning design specialists.

While learning design specialists are concerned with learning theories and models, e-book pedagogy provides pedagogical strategies which improve memory and increase thinking speed through fun and interactive didactical activities. Young children apply and disseminate interactive didactical games, step-by-step animations or animated shops, digital videos and audio files in order to develop their own network, both real and virtual. In some cases professional storytellers teach children the joys of reading in a format they will love and native speakers “redirect” children to think in a foreign language. The didactical activities are like a goldmine of new methods and models for new learning. Such activities focus traditional curricula to follow more contemporary practices and perspectives: hermeneutic dialogue, group conversation, peer, group and cooperative assessment. The digital content can be adapted to “slow”, “unorganized” or “smart” and struggle to teach and assist with active engagement in learning.

The hermeneutic dialogue initiates intrinsic motivation. The aim of dialogue, for Gadamer, is to reach an understanding that centres less on asserting one’s point of view and more on individual transformation. In the case of e-books this aim can be reached more

easily. Many technologies allow annotating the text, bookmarking the pages, saving notes, listening to audio files and setting up a wireless connection. Their affordance is proved by hypermedia, interactive visuals, hypertext and/or backing up the personal online or offline library. Therefore, the author of personalized digital content has neither the intention to reproduce provided content nor does he/she want to purely capture what someone has said in order to find the meaning, but instead, seeks to explore opportunities for the production of new meaning generated in dialogue with the initial author.

Another definition was proposed by Lau (2011, p. 1): "e-textbooks can also be in CD-ROM, DVD-ROM, or portable document format (PDF) file. They can also be downloaded from websites". Moreover, textbooks that offer the instructor assistance in the form of a CD-ROM, test bank, lecture outlines, PowerPoint slides, or Website material give added support in creating an online course. Some textbooks offer these licensed resources free of charge should the instructor adopt the text. Other textbooks offer course cartridges of content that import directly into courseware management systems like Blackboard or WebCT.

The Portable e-Reader Content and Pedagogy

According to the *Oxford Dictionary*, an e-book is an electronic version of a printed book which can be read on a computer or a specifically designed handheld device. The main advantages of portable e-book readers are better readability of their screens (especially in bright sunlight) and longer battery life. This is achieved by using electronic paper technology to display content to readers. The best and the most expensive of the portable e-book readers are the first category. These products have big screens, wireless or 3G connectivity and ample storage space. The additional functionalities include colours, touch screens, visually stunning works, web browsing capability, fast interface, easy navigation etc.

Mid-range e-readers are versatile enough to suit a wide range of users' needs. They are smaller, easier to carry, with longer battery life, usually with a high contrast e-ink screen and wireless connectivity. In contrast, a cheaper e-reader is a portable e-device, usually without wireless connectivity, but with the features to play music and/or to store files in an extensive storage capacity. While it has no wireless connectivity or audio player, as an e-book reader it works fine.

The portable e-book readers use e-paper technology and e-ink on their screens. Despite the fact that the more compact display may not make for a great e-book reader, what these devices lack in screen measurement they make up for in portability and value. With e-paper technology the user can easily insert or delete new pages, fill pages with drawings and hand-written notes and turn the pages like a book. It offers interactive features: hyperlinks, keyword search, and annotations that provide tool for an effective learning.

Usually, e-paper technology relies on e-ink technology. E-paper is a display technology designed to mimic the appearance of real ink on paper. Basically, light is reflected on the display, and no power is used to display a page since the electronic ink is bi-stable. The latest innovation is E-Ink Triton Imaging Film, which enables thousands of colours e-paper displays, high contrast, sunlight readable and low power performance. This innovation closes the digital divide between paper and electronic displays. Triton's crisp text and detailed colour graphics are fully viewable in direct sunlight. This technology is 20% faster than previous equivalents and allows users to turn a page, select a menu, take notes, or view animation or dynamic content for signage, advertising, or browsing the Internet.

The portable e-readers for education are more sophisticated. Trachtenberg (2012) notes that Inkling-based e-books make full use of the iPad's colour, video and touch screen. A biology text, for example, offers 3-D views of molecules such as DNA, as well as video lectures and interactive quizzes. Users can highlight text, take notes and share them in real

time with other users, such as fellow students. Along the way, students can jump outside the text to Google or Wikipedia. Litton (2008) observed that students indicate note they are leaving, which could be included in social networking, creating groups, sales etc.

One interesting example is iBook (a line of laptop computers targeting the consumer and education markets with lower specifications and prices than the PowerBook). Users can receive ePub from the iBookstore, add their own ePub and PDF files via data synchronization with iTunes, display e-books with multimedia and use VoiceOver. At the beginning of 2012, Apple announced the free release of iBooks 2, which can operate in landscape mode and allows for interactive reading. In addition, a new application, iBooks Author, was announced for the App Store, allowing anyone to create interactive e-textbooks for reading and reinforcing learning, and the iBookstore was expanded to include a textbook category.

Many schools around the world have deployed iPads and iPad devices in education, including iPads, iPod Touches, Android Tablets, netbooks, laptops and even specialized devices for students with special needs. One of the main problems is mobile device management (how to effectively deploy and manage mobile devices on a network while providing flexibility for teachers to update content). This problem can be solved through identifying the processes which rely on real didactical processes. In our point of view the main processes can be considered: “information/communication, cognitive and assessment” (Railean, 2010b). Each of the processes can be defined based on procedural implementations for future structuring actions and tools. The portable e-readers need to be able to set authentication policies, to filter browsing on devices, to install apps, to lock down in some special cases, and to configure settings.

On the other hand, the pedagogy is the art or science of teaching, education and instructional methods. The pedagogy relies on educational ideals; but learning involves thinking, writing, communicating, metacognition, learning objectives, assessment, knowledge gaps

etc. and is guided by intrinsic and extrinsic motivation. Self-regulated learners are the most productive because they can set goals for themselves and plan actions to achieve them. In order to be effective for learning, e-books pedagogy should provide methods that will allow user to create concept maps or structured drawings, summarize a page with a drawing linked to that page and provide a space for making conclusions about what was read or constructed cognitively. The processes should be witnessed in collaboration through sharing the annotations, content, or learning objects observed in nature and stored in digital forms. Such processes need to be supported by affordance of e-content, e-ink and e-paper technologies. The incorporated assessment model should provide immediate and/or delayed feedback, but more intelligent and adaptive than ever before.

Many educators agree that digital texts and mobile reading platforms have vast potential both for students and schools. Scientists have reported that portable e-readers improve the reading experience for students, if students have “anytime, anywhere” access to their course content; ensure that teachers have the ability to provide diverse resources quickly and economically; and that the reading and annotation experience is the equivalent of or an improvement over traditional books and textbooks. However, if students are required to find a learning object in a real non-formal environment, to take digital pictures or a short video and store it in a digital portfolio, the instructional objectives are more likely to be achieved. For example, if the K-12 students are going to learn about redox processes, they need to investigate the learning objects like malachite, baking soda etc.

E-books can be designed according to different educational models and scenarios. In the case of the open educational resources model the CK12 FlexBook can be used. The teacher will select or write chapters, customize the content or put his or her course pack of supplemental readings into a digital format readable by many portable e-readers. Many tools are available to encourage students to draft, edit, and then publish their works digitally, and to

put them up for sale in one of many bookshops for independent, self-published authors. This programme would be most effective with a creative writing class or club; a group of interested student-writers could form a group with a teacher-mentor to explore this burgeoning form of self-publishing. The programme explores the advantages of hypertext by enabling students to publish work in a way not previously available.

There are some academic problems which need to be taken into consideration for the portable e-reader paradigm. How does the portable e-reader align with the curriculum? Who will be responsible for its management? How do we hold teachers accountable for using the devices? Are there planning/collaboration times to share best practices in using mobile devices? Is there a curriculum vision for the iPods and iPads? Does it align with the school's mission? How will parents and/or the community be involved if students are bringing the devices home? Are the educational apps sufficiently available to support the curriculum? Are there enough content creation tools to replace the traditional computer desktop/laptop? There are some concerns about privacy and copyright issues. Teachers and students can create their own content, compose their own textbook using relevant tools, or teach students how to publish work in a public format.

The Integrative Pedagogy of Competence and Portable e-Readers

The idea of integrative pedagogy was provided by Gerard and Roegiers (2009). Such a structure represents the base of a dynamic and flexible strategy that can be used in the metasystem to manage knowledge through: *theoretical methods* (obtained through the integration of psycho-pedagogical principles into the functional structure of the competency) and *practical methods* (used by complying with the stages of the elaboration theory development process). The dynamic and flexible educational strategy for enabling competence employs:

- communication/discovery strategies – the learner plays a central role in personalizing the content from the educational environment, guided by the teacher as the manager;
- cognitive activity strategies – the learner gains theoretical applicable knowledge and learns methods, procedures, and techniques for individual, group, collaborative, and co-operative work;
- assessment strategies – the learner is involved in different forms and can use different methods and techniques of assessment and self-assessment.

The integrated pedagogy of competence aims to meet five different scenarios in order to incorporate static, multimedia, hypermedia, customized and personalized e-books (textbooks).

Static e-books are the electronic version of printed monographs. Brusilovsky, Schwarz and Weber (1997) note that for many designers, the ideal form of educational WWW material seems to be a static electronic copy of a traditional textbook: chapter by chapter, page by page, picture by picture. Such "static electronic textbooks" have two major shortcomings: they are not interactive enough, i.e., students can only passively read the educational materials, and secondly, they are non-adaptive, i.e., students with different abilities, knowledge, and background get the same educational material in the same forms. Such e-books use HTML or PDF. Because portable e-readers support these formats it is very easy to add e-books to a portable e-library or to read them online. Content can be added through purchasing, downloading from online libraries, or scanning/ photoscanning the printed books.

Multimedia e-books are the multimedia representation of book content, usually through video files. The benefits of multimedia for learning were described by Uden (2002): a parallel between multimedia and the natural way people learn (Information Processing theory!); an emphasis on dual coding (using more than one code in the learning process); non-linear hypermedia format (users can choose information freely); more interactivity than

traditional classroom lectures; and flexibility (may be used in the classrooms, by individuals or small groups). The multimedia e-books are more effective when it is important to use dual coding of information, when the media support one another and when the media are presented to learners with low prior knowledge or aptitude in the domain being taught.

Hypermedia e-books allow information to be created, stored, accessed, transmitted and manipulated in a variety of ways. Anyone consulting e-books on portable e-readers nowadays will be surprised at the simplicity of the tools for the knowledge, skills or competence representation, and at the ways in which these tools used to be applied so readily to data, information and knowledge transfer with the learning environment and user and vice versa. The contextual navigation aids enable users to navigate but, also, to get lost in hyperspace. In such situations, e-book pedagogy is indispensable because of their specific capabilities. Omnipresent in open learning environments, formal and non-formal schooling, hypermedia e-books are an integral part of teaching, learning and assessment processes.

Customized e-books are a type of book which can be tailored for teachers or teachers' needs. The main example is FlexBook. Anyone can use the provided content and build their own. The strength of FlexBook seems to be in open access to knowledge and in the equality of opportunities provided both for teachers and students from around the world. This technology is empowering. Hence on the one hand it provides a tool to construct their own understanding, on the other they call for active searching and browsing with existing content.

Personalized e-books are a kind of e-book which is constructed by the learner based on a teacher e-book. The term "personalized e-books" differs from the term "web personalization", which means "segmentation of user groups in order to create and aim effective messages at customers" (Rozanski, Bollmann, & Lipman, 2001) and by Keller's Personalized System of Instruction. Individual changes are found in modifications to learning actors' decisions though strategic mechanisms and cognitive styles. The individual now

possesses hermeneutic dialogue which facilitates the understanding of learning objects and effective tools for self-assessment. Though the goals are different, the methods are quite similar. Both use collection and interpretation of observable data and the user inference. The user plays a fundamental role in learning and, therefore, in design of his/her own textbook. At this juncture it is relevant to mention a user model, which can be constructed using a variety of methods, including Bayesian networks, machine learning, overlay methods, and stereotype methods, with rules initially declared by scientists and subsequently controlled by programmers. In these circumstances the distinction between the initial conceptual optimized structure (teacher e-book) and the obtained structure (student e-textbook integrated in an e-portfolio) becomes important.

Metasystems Design of e-Books

The most innovative approach in e-book pedagogy can be considered Metasystems Design (MD). According to the metasystem transition theory (Joslyn, Heylighen, & Turchin, 1997), there is a way to make some number of copies from one initial system, that result in a new system S' which has the systems of the S type as its subsystems, and also includes an additional mechanism which controls the behaviour and production of the S-subsystems. In the case of metasystems design, S' can be considered a metasystem with respect to S. As a result of consecutive metasystem transitions a multilevel structure of control arises. In our case the epistemology of globalisation (S') is a metasystem with respect to educative ideal (S). The epistemology of education has the following subsystems: pedagogy (S1), psychology (S2), cybernetics (S3) and management (S4) and, probably, other domains (Sn).

Metasystems learning are guided by other laws and principles. All the processes are multi-level, dynamic and self-regulated, managed by an open, dynamic, flexible, extensive and complex metasystem. The communication is done through synchronic/asynchronic

transmissions. Two ways of transmission distinguish the teaching and learning. Nevertheless, the forms of transmission differ online and offline, respectively, into real (formal school) and virtual (distance learning). In the powerful learning environments the learners need to be knowledge workers with their own aim to develop competence of adaptation and accommodation to the highly globalized world (Railean, 2010b).

The learning process is grounded on an optimized knowledge graph structure based on hermeneutic dialogue as the result of a dynamic and flexible instructional strategy. This theory led to the constructivist philosophy of learning, cybernetic pedagogy, quantum psychology and knowledge management. Learning takes place both in a global education continuum (GAE paradigm) and in the real learning environment (Bronfenbrenner's Ecological Systems Theory). This gives all students the opportunity to be engaged in active learning processes. The complete comprehensive metasystems design plan includes planning, elaboration and validation (Figure 1).

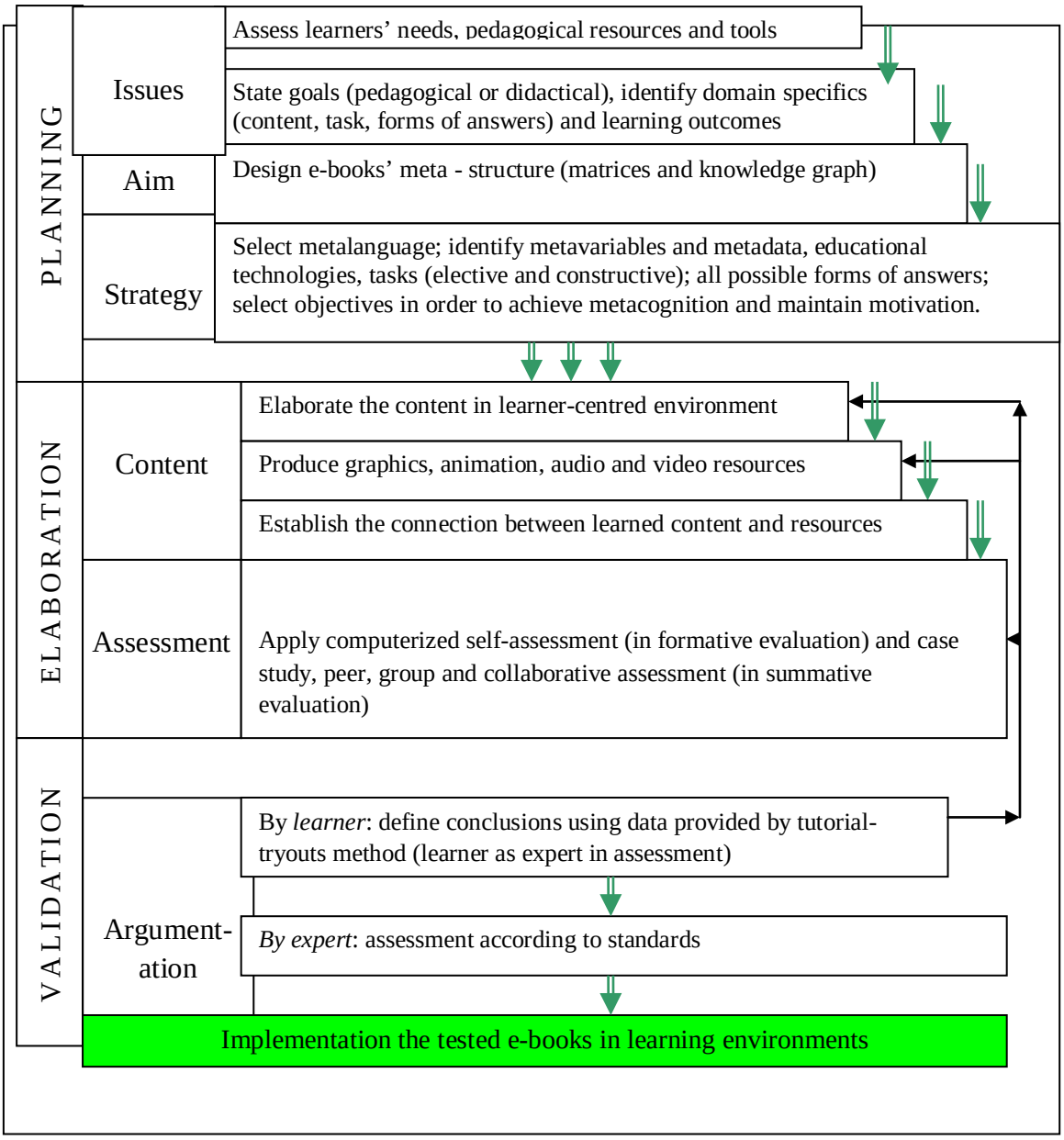

Figure 1

Metasystems design plan

In the above diagram, the phases and stages are connected with arrows and indicate a sequential, but nonlinear order. Our intent was to convey dynamism and flexibility in the manner of a "dynamic and flexible instructional strategy" (Railean, 2008). Such processes are guided by "the principle of self-regulation, the principle of personalization, the principle of clarity, the principle of dynamicity and flexibility, the principle of feedback diversity and the principle of ergonomics" (Railean, 2012b, p. 342). Out of the principles identified in the

quoted statement above, *four* are fundamental in metasystems design: 1) Are the elements of e-book structure strongly interconnected (e-learning context methodology, knowledge graph)?; 2) Will the learner be motivated enough to learn with e-books (intrinsic and/or extrinsic motivation)?; 3) How is the performance obtained (educational ideal, strategy, methods, procedures, objectives, action verbs etc.)?; and 4) How will the outcomes of learning (methods and forms of assessment) be determined? These four fundamental elements – e-learning context methodology, motivation, education ideal to action verbs, and assessment – form the framework for metasystems design. These elements are interrelated with the principles and psychopedagogical functions of e-books and e-textbooks. In our point of view the e-book learning mechanism depends on at least one of the following functions: cognition, systematization, self-regulation, information, formation and integration. The first three functions rely on teacher centred environments and can be achieved if e-books are structured as pedagogical resources. The second relies on a learner centred environment and views e-books as an instructional tool which allows students to construct their own understanding. These activities can be done individually or collaboratively, using for example the Wiki Books tool.

The metasystems design approach is highlighted by the following statement: “In the era of excessive information, the skill of choosing and evaluating information is very important. Clearly this skill cannot be developed in an environment where the “right information” is selected (by others: the teacher, the book, the curriculum) and presented (for the student to accept, to digest, to memorise, to “learn”). This is not to say that there is “no information that should be digested, however being taught the right things to learn does not help in learning to choose the right things to learn – and certainly not in selecting and evaluating information” (Yildirim et al., 2002, p. 153).

The metasystems design describes learning through e-books at teachers' and students' levels. The integrated structure of competence is obtained at the cognitive, affective, and psychomotor levels. Such a structure is dynamic and flexible for all cases when synergic effect is achieved. Similarly with the instruction system design, writing objectives is one of the essential elements in the metasystems design process. The difference is in semantic representation of the action verbs. One of the possible methods is to identify metadata and then integrate it in meta-language. These methods can be achieved using the model proposed by Elliot and Dweck (2005). The action verbs aim to develop metacognition (planning and evaluation) and knowledge (declarative and procedural) through thinking (critical, creative) and learning (explicit, implicit) in order to maintain motivation (intrinsic and extrinsic). The action verbs are extracted from the Bloom, Simpson and Krathwohl taxonomies.

One of the main problems seems to be meta-design of concepts and prototypes. Different methods and standards have been developed based on user and graphical interface interactivity. Graphical interfaces help users to receive cues that might help them to understand concepts. The learning scenarios are an example of where the e-context acts as a generator of data. So, the metadata are completed using *a priori* knowledge in a Wiki or knowledge management system. To solve the tasks the students can choose to visit virtual museums, laboratories or to ask a friend from another part of the world. The personalized content of e-books is very different. Finally, the pedagogy of portable e-books has the potential to develop qualitative cognitive structures.

Conclusions and Future Work

It is evident that e-book pedagogy is increasingly becoming popular amongst all science of education. We have reviewed the concepts of the e-book and e-textbook and showed that these should be the trends and issues, roots and suitable technologies. Initially

were analyzed the good practices to substantiate the e-book pedagogy and their philosophical, pedagogical, psychological, cybernetic and knowledge management roots. These roots are: *visual instructional movement*, *audiovisual instruction*, *programmed instruction* and *computer aided instruction*. After reviewing the main ideas, the definition and properties of the metasystems approach (metasystems thinking) and metasystems design were analyzed.

Then, the concept of instructional system design was compared with the evolution of theory and technology of learning. Next, it was observed that metasystems design principles allow us to explain learning in correlation with the transition to knowledge society. In this case, the metasystems glue together the pedagogy of competence, quantum and environmental psychology, cybernetics pedagogy and knowledge management. The interdependence between these domains was analyzed. In turn, it was identified that actions are equivalent to the functions of e-books and are determined by self-regulated learning processes, stabilized through immediate and delayed feedback.

Finally, we described the communication/information processes, cognitive activity processes, and computerized assessment processes. Hypothesizing that metasystems design in the near future will replace linear and systemic approaches, it was concluded that the portable e-readers can be useful to engage students in global collaborative learning classrooms in studying Science, Technology and Math. Self-regulation is developed through the maintenance of student motivation which will determine the active participation in the learning process. Looking at the future possibilities of the most popular trends, it was concluded that the future of e-books pedagogy is metasystems learning design approach.

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Audio-Visual Emotion Recognition System with E-Reader for Enhancing E-Learning

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Abstract

Today's revolution of technology provides many possible ways of conducting e-learning. In order to provide high quality and efficient tools, practitioners are normally required to occasionally revise the content of teaching based on the feedback from students. However, that feedback may not be sufficiently accurate to point out precisely the unsatisfactory portions of the pedagogy techniques or delivered materials during the learning process. Thus, to present the possibilities for improving the efficiency of problem identification by practitioners, this chapter describes the development of e-learning with the capability of performing audio and visual based emotion recognition. In the proposed system for e-learning tool development, the detection of facial expression and emotions in speech are designed to be done by the e-reader's front-camera and built-in microphone. Theories behind the system such as visual and audio data processing are also explained in this chapter to show how the pattern of each emotion can be clustered and classified. The classification of emotions is based on the feelings of the learners such as happy and angry. Simulations were conducted on PCs based on databases: TFEID (visual) and eNTERFACE (audio), and random test samples taken from e-reader devices. The experimental results show a high recognition rate of users' affective state for positive and negative emotions of at least 86.7% and the possibility of adoption in e-readers for e-learning applications.

Keywords: E-Learning; Emotion Recognition; Audio-Visual; Principal Component Analysis; Linear Discriminant Analysis; Mel-Frequency Cepstral Coefficient.

Introduction

E-learning can be defined as the use of online technologies in the learning process or support at a distance. To be specific, instructions are delivered remotely to learners via electronic devices and usually learners and practitioners are separated by distance and time (Roberts, 2010). John Dewey (1994) who promoted "progressive education", claimed that education should be a continuous reconstruction of living experience based on the learners. With the trend of research aiming to improving pedagogy styles based on the latest technology, e-learning has become another area of education which provides distance learning (Pozgaj & Knezevic, 2007). E-learning systems have been adopted in various applications, such as educational videoconferencing (Montgomerie & King, 2012) and assessment (Baumann, Early, & Swanson, 2010). Based on recent research from Shank (2012), e-learning modes can be divided into four types with different levels of usability: two major types are synchronous e-learning and asynchronous e-learning. Synchronous e-learning such as online conferencing and webinars, is a mode with the requirement to wait for both practitioners and students to begin. Conversely, asynchronous e-learning can begin anytime once the materials are available. Today's e-learning systems do provide a number of benefits to both students and practitioners; however, the typical systems are not human-centred enough and not able to adjust themselves to meet student needs based on their emotions (Lou & Hu, 2010). The phenomenon of emotion deficiency can occur if the practitioners do not sufficiently consider learners' situations. Emotion deficiency (Zhang, Wang, Wang, & Wang, 2007) refers to the separation between students and teachers, and students and students, which means they cannot communicate face to face and immediately as in conventional

education. Thus, some problems learners have with the learning process cannot be solved, such as if students gaze at unresponsive computer screens for a long time, they do not experience interactive pleasure and emotion stimulation, and they may have negative emotions.

Emotion recognition is an automated way to determine a person's affective state with the help of affective computing (Picard, 1997). Affective computing is defined as "computing that relates to, arises from, or deliberately influences emotion or other affective phenomena", according to the inventor of this term – Picard (1997, p.4). It covers the processing of humans' emotional speech, facial expression, physiological signals or body gestures/movements. There are many kinds of affective states of humans that occur in daily life. Six of the "universal emotions" – happiness, sadness, anger, fear, surprise and disgust (Ekman, 1970) – are commonly used in emotion recognition systems because most of the other emotions are still not able to be universally distinguished (Wang & Guan, 2008). Moreover, positive emotions in learners indicate the motivations of the students to solve problems, while negative emotions hinder the thinking process (Eyharabide et al., 2011). According to the research by Kaiser and Oertel (2006), negative emotions that may affect the e-learning process can be divided into two parts based on regions on Russell's circumplex model: the region of frustration and anger, and also the region of boredom and sleepiness. One of the limitations of emotion recognition is that the accuracy of audio based recognition is much lower than that of visual based recognition systems due to the complexity of extracting the important emotional features from signal form (Alepis, Stathopoulou, Virvou, Tsihrintzis, & Kabassi, 2010; Wang & Guan, 2008). Moreover, facial expression recognition also has some problems that may affect accuracy when the recognition system is applied in random circumstances. For example during a video conferencing session, the system may

encounter problems with illumination, and the angle of the facing camera (Wang & Guan, 2008), which can significantly reduce recognition performance.

To enhance efficiency in designing e-learning systems, recently there has been a trend of utilizing emotion recognition systems (Tian et al., 2011; Nosu & Kurokawa, 2006; Li, Cheng, & Qian, 2008). For instance, the architecture of an interactive text-oriented affect compensation mechanism in e-learning was developed by Tian et al. (2011) to predict learners' emotions from the text of online conversations. According to that paper, positive and negative emotions can be classified to deal with different situations during the e-learning process such as learners changing the conversation topic, listening to music, recommending encouraging stories etc. Another effort to recognize emotion in order to support e-learning was carried out by Nosu and Kurokawa (2006) to diagnose learners' emotions from facial expressions and biometric signals. The system is able to diagnose eight emotions of users by using facial feature points (for facial expression), and pulse rate, breathing rate and finger temperature (for biometrical signals). They were able to achieve 74% accuracy based on their own criteria of eight emotions: easy/difficult, boring/interesting, confused/comprehending and tired/concentrating. An affective computing model for e-learning systems is also proposed by Li et al. (2008) to recognize learners' emotions from their facial expressions and posture, and process the affective information statistically. Their proposed system models (Learner model and Teacher model) can then react based on the recognition results to change the teaching contents or teaching strategies. These efforts at adopting emotion recognition in e-learning show the innovative possibilities in improving the efficiency of the teaching practitioners' teaching strategy or material.

In this chapter, an audio-visual emotion recognition system is proposed to be applied in the process of e-learning with an e-reader device (i.e. iPad 2 in our case). By utilizing the capabilities of e-readers in recording voice with a built-in microphone and capturing facial

expression with a front-camera, the proposed audio-visual emotion recognition system is able to process audio and visual data, perform emotional feature extraction and classification, and simulate the results based on the test samples from databases and captured by the e-reader device. The organization of this chapter is as follows. The next section provides a review of e-learning systems, the applications of emotion recognition to e-learning and detailed reviews of emotion recognition systems. The following section explains the processing techniques for audio and visual data in this emotion recognition system with a focus on feature extraction methods. Subsequently the integration of audio visual emotion recognition with an e-learning application is presented and explained. In the section after that, simulation results which classified the positive and negative emotions from the extracted emotional features are presented to determine the performance of the emotion recognition system. The final section provides conclusions.

Audio-Visual Emotion Recognition

This section discusses the theory behind the audio-visual emotion recognition system based on the process flowchart in Figure 1. The techniques for extracting emotional features in visual and audio data have been a popular topic in related fields. However, the emotion features are found differently in visual data (in pixel value) from audio data (in signal form). The remainder of this section explains the visual and audio extraction process from input pre-processing to classification.

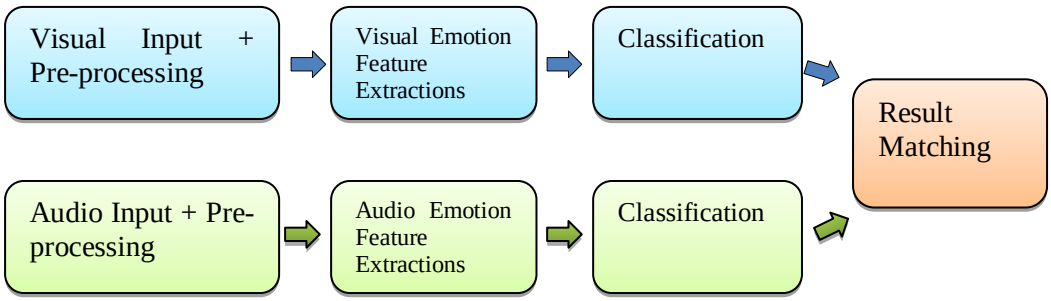

Figure 1

Overview of the audio-visual emotion recognition system

Reviewing in-depth the previous research related to emotion recognition, some great efforts have been made to improve its performance with different system models or techniques. Wang and Guan's (2008) research was based on the six universal emotions and extracted the prosodic features, Mel-Frequency Cepstral Coefficient (MFCC), and formant frequency features from emotional audio information. For visual data, they performed feature extractions on the Gabor wavelet features. A multi-classifier scheme was used and performed a feature selections technique – the Mahalanobis distance based stepwise method – to recognize the correct emotion. The recognition rate was claimed to reach 82.14%. In another effort, unlike most emotion recognition research, Zeng, Tu, Pianfetti, and Huang (2008) developed an audio-visual based system which not only recognized the basic emotions, but four other cognitive states: boredom, puzzlement, interest and frustration. The facial expression features were extracted by using a Piecewise Bezier Volume Deformation tracking algorithm (Tao & Huang, 1999), while the audio features were extracted by using a software package which is able to perform normalized cross correlation and dynamic programming. For classification, a Multi-stream Fused Hidden Markov Model technique was developed and considered better than other versions of the Hidden Markov Model (HMM) classifier such as face-only HMM, pitch-only HMM, energy-only HMM and independent-HMM. Alepis et al. (2010) also worked on this type of emotion recognition system (as reported in one of their recent papers). The feature extraction method for facial expressions used the measurement of changes on different specific landmarks of the face (such as forehead, chin, right/left cheek, etc.) by comparing six other affect states with the neutral state. On the other hand, the features of emotional speech were extracted by using an Audio-Lingual Mode subsystem which adapted a technique called Simple Additive Weighting (Yingming, 1999). By using their own database and a Euclidean distance classification

technique, the recognition rates were higher for visual based results than audio based for the states of neutrality, happiness, disgust and surprise, while sadness and anger rates were higher in audio based. By extracting features such as pitch frequency, energy, Mel-frequency Cepstral Coefficient, harmonics-to-noise ratio and zero crossing rate from audio data, and creating a subspace for visual data, another audio-visual emotion recognition system was developed by Gajšek *et al.* (2010). The Support Vector Machine classifier was used in this research and the accuracy of the recognition for the six universal emotions was claimed as 71.3%. The study proved that fusion (audio-visual) based recognition is higher than audio based (62.9%) or video based (54.7%) with their affect recognition system.

Visual Emotion Feature Extraction

The visual emotion features can be extracted after the facial region is detected. According to Weng, Zhang, and Hwang (2003), affective states can be recognized from facial expressions in two ways: extracting features from the whole face or from different parts of the face. The method of extracting features from the geometric regions of facial expressions emphasizes detecting each area of the face such as lips, eyebrows, eyes and chin separately before the recognition process begins (Paleari, Chellali, & Huet, 2010). For example, 14 different features are defined from the distances between the two mouth corners, chin and mouth, nose and mouth, nose to chin etc. according to the research from Valenti, Sebe, and Gevers (2007). The method of treating the face as a whole unit is popular in visual based emotion recognition because of its low computational cost and high efficiency in feature extraction (Chakraborty, Konar, Chakraborty, & Chatterjee, 2009; Weng et al., 2003). In this chapter, we focus on the methods of treating the entire face at once not only because of those advantages, but because of the potential for developing a feature extraction algorithm and improving the results from emotion recognition systems (Turk & Pentland, 1991; Choi, Tokumoto, Lee, & Ozawa, 2011; Zuo, Zhang, Yang, & Wang, 2006).

The visual feature extraction method in this chapter first uses Principal Component Analysis (PCA) (Turk & Pentland, 1991) to reduce the dimensionality of the data input. By using this technique, the most important components of the data will be preserved and projected into a subspace. These components are then discriminated according to their respective emotions by using Linear Discriminant Analysis (LDA) (Fisher, 1936) to provide a better recognition result.

Principal Component Analysis (PCA).

PCA was originally called "eigenfaces" and was developed by Turk and Pentland (1991) to improve the performance of facial recognition. This method avoids the loss of important information when reducing the dimensions of input data, and it can be applied to several pattern recognition related areas. This is because the algorithm is based on the weighted sum of the principal components and suitable for handling large amounts of data. A few researchers further developed this method to improve its performance. One of the popular versions is called Two-Dimensional Principal Component Analysis (Chen & Yangzhou, n.d.) which not only saves time spent reconstructing the pixels into 1-D vectors, but can improve performance by using a different calculation method on the matrixes.

Assuming image data to be a two-dimensional array, each array is re-constructed to a one-dimensional column vector. The training image set is then constructed by concatenating N numbers of column vectors, where each column of the training set represents an image. Then, the centre image is obtained by subtracting the mean of the image from each of the data dimensions. This produces a normalized data set, $\bar{X}$, defined in (1), whose mean is zero. The covariance, Ω of the centre image can be then obtained by multiplying the centre image with its transpose values as shown in (2).

$$\bar{X} = X - \frac{1}{N}\sum_{i=1}^{N} X_i \tag{1}$$

$$\Omega = \overline{XX^T} \tag{2}$$

Eigenvalues and eigenvectors are calculated and re-arranged to select the eigenvectors with the largest eigenvalues which represent the most important components. Finally, the subspace is ready to be projected. The principal components, U can be obtained by multiplying the original training image, X_i into the transposed subspace, V^T, as shown in (3).

$$U = V^T X_i \tag{3}$$

Linear Discriminant Analysis.

Linear Discriminant Analysis or Fisher Linear Discriminant was invented by Fisher (1936) to solve taxonomic problems. The main aim is to discriminate between two species of flowers by maximizing the ratio of difference between the means of within-species and means of between-species measurements from a linear function. Since then, this method has been used in many different research areas, such as mathematical statistics and pattern recognition. In our case, LDA is performed once the projected image features from (3) are obtained. This method is used because there are six emotion classes of training data, and after PCA, most of the features are overlapping. It may cause poor performance from the classifier if the components are not well discriminated. Thus, LDA is able to discriminate them to their respective classes and construct another subspace based on the previous data. This can be done by computing the maximum between-class distance and the minimum within-class distance is maximized (Sharkas & Elenien, 2008).

By calculating the mean, m_j of the image for each class, the within-class scatter matrix, S_W and between-class scatter matrix, S_B can be calculated according to (4) and (5) respectively.

$$S_W = \sum_{j=1}^{C} \sum_{i=1}^{N} (x_i^j - m_j)(x_i^j - m_j)^T \tag{4}$$

$$S_B = \sum_{j=1}^{C} (m_j - m)(m_j - m)^T \tag{5}$$

where C is the number of classes, N is the number of training images for each class, and m is the mean for overall training input from PCA.

The largest eigenvalues, L and its eigenvector, λ are then computed from both S_B and S_W matrix, as defined in (6):

$$S_B L = \lambda S_W L \tag{6}$$

The Best Projection Matrix, W_{BPM} is then computed to find the best separated space with (7)

$$W_{BPM} = argmax \frac{|W^T S_B W|}{|W^T S_W W|} \tag{7}$$

where $W^T S_B W$ and $W^T S_W W$ is the scatter of the transformed feature vectors of S_B and S_W respectively. The feature vector from PCA can then be projected into the LDA space, and the discriminated trained data can be obtained:

$$P = W_{BPM}{}^T U \tag{8}$$

Audio Feature Extraction

Compared to visual emotional features, for audio emotional features we cannot distinguish clearly which emotion state is represented by the most powerful features (Wang & Guan, 2008). Thus, it is necessary to investigate acoustic features with different methods to efficiently characterize the correct emotions (Ayadi, Kamel, & Karray, 2011). The main streams of the research on audio features for determining emotional states can be divided into two categories: prosodic features and spectral-based features.

Before performing any feature extraction on audio signals, a pre-processing method such as Voice Activity Detection (VAD) is used to detect the presence of speech. With this method, the signals are segmented into frames which carry the emotional information to be extracted. Mel-Frequency Cepstral Coefficients techniques are then used for extracting the audio emotion features. Another option for extracting audio emotion features is computing the prosodic features from the signal. Then the results of MFCC have their dimensionality reduced by the PCA technique and discriminated to their respective emotion classes by the LDA technique.

Voice Activity Detection.

Speech is a signal that varies in the time-domain. Thus, it should be noted whether there is a non-speech period of time within a particular time of a signal when performing speech processing in emotion recognition. A Voice Activity Detector divides the time series of a speech signal into several frames, then applies computations to the signal to identify its attributes. A shortcoming of the algorithm in VAD is that it assumes the background noise is stationary (Cho & Kim, 2011). Thus, normally a low-pass filter is used beforehand to filter out the unwanted signal frequency (noise). A voice activity detector which uses short-time energy and a short-time zero-crossing rate (Yang, Tan, Ding, Zhang, & Gong, 2010) is used in this chapter.

Extractions for Prosodic Features.

Prosodic features are mainly related to the rhythmic aspects of speech, and are normally represented by the statistics and variations of fundamental frequency, energy, intensity, speaking rate, etc. (Wang & Guan, 2008). According to Busso, Lee, and Narayanan (2009), the global properties of fundamental frequency (f0) or pitch contour are the most emotionally salient among the audio features. Pitch can be estimated based on the Fourier analysis of the logarithmic amplitude spectrum of the signal (Paleari et al., 2010), while the range of pitch can be calculated from the differences between maximum and minimum amplitude. Another major prosodic feature is the speaking rate (Wang & Guan, 2008) which is the result of computing the speech signals between pauses, as defined in (9).

$$Speaking\ Rate = \frac{N}{\sum_i^N T_i} \tag{9}$$

where N is the number of voice segments and T_i is the length of each segment.

Jitter and Shimmer (Mireia Farrús, 2007) which measure the cycle-to-cycle variations of fundamental frequency and amplitude respectively are also prosodic features that can be used in identifying the characteristics of voice.

Extractions for Spectral Features.

Spectral based features represent a short time-windowed segment of speech. According to Ayadi et al. (2011), the distribution of the spectral energy across the speech range of frequency can provide the emotional information within it. In this chapter, the cepstral coefficients derived from a mel-scale frequency filter-bank, also known as mel-frequency cepstral coefficients, will be used to represent the speech spectrum. MFCC is widely used in recognition systems related to speech. It extracts the significant components from the speech audio data and represents them according to a Mel-Frequency scale which is identical to the behaviour of the human ear (Wang & Guan, 2008).

Firstly, the speech signal is divided into a few frames of equal duration, which is called Frame Blocking or Framing (Bala, Kumar, & Birla, 2010). The frames overlap each other to preserve the continuity of the speech signal. That step is followed by multiplying each frame with a Hamming Window so that the continuity of the left and right side of the frame can be increased or maintained. The Hamming Window used in this chapter is defined with the equation:

$$w(n) = 0.54 - 0.46\ \cos\left(2\pi \frac{n}{N}\right), 0 \leq n \leq N \qquad (10)$$

After multiplying with the Hamming Window, it is necessary to convert to the frequency domain because the signal features are difficult to observe in the time domain. Thus the frames are then converted into the frequency domain by using Fast Fourier Transform. The result is then scaled by Mel scaling using the equation (11):

$$Mel(f) = 2595\ \times \log_{10}\left[1 + \left(\frac{f}{700}\right)\right] \qquad (11)$$

After scaling, it can now be observed in vector form as MFC coefficients (Hossan, Memon, & Gregory, 2010) after applying Discrete Cosine Transform. The cosine transform results in the most signal energy being compacted in the first 15 coefficients.

Classification

As part of the intelligent computing field, classification techniques help affective computing with categorizing or deciding the most relevant emotions the input belongs to. The popular techniques for classification include Nearest Neighbours (Zhan, Chen, & Zhang, 2006), Neural Network (Lu & Wei, 2004; Chen, Cowan, & Grant, 1991; Wei & Guanglai, 2009) and the Hidden Markov Model (HMM) (Moni & Ali, 2009).

Nearest Neighbours is a classification method using statistical theory (Zhan et al., 2006). The nearest neighbour of a test sample is found by referring to the trained samples. Euclidean Distance is normally used for measuring the distance. This way of classifying is widely used in various pattern recognition applications especially face recognition because of its straightforwardness in performing classification. Firstly, the projected training data are obtained from the previous stage. By identifying the number of classes, the distance of each training data is computed based on the Euclidean Distance equation (12):

$$d(C, C_k) = \|C - C_k\| = \sqrt{\sum_{i=1}^{m}\sum_{j=1}^{d}\left(C^{(i,j)} - C_k^{(i,j)}\right)^2} \quad (12)$$

where C_k is the training data from the previous stage and C is the testing data.

The neural network technique can be divided into three categories: Multi-Layer Perception (MLP) Neural Network (Lu & Wei, 2004), Radial Basis Function Neural Network (RBFNN) (Chen et al., 1991), and Recurrent Neural Network (Wei & Guanglai, 2009). The MLP Neural Network (Lu & Wei, 2004) is able to learn complex decision boundaries and is one of the most popular classification methods used for emotion recognition. It has the advantage of being easy to implement once the structure of the neural networks is fully specified. However, the drawback is that generally neural networks used for classification are too complex to be specified completely. On the other hand, RBFNN (Chen et al., 1991) can be regarded as a two-layer neural network which initially measures the input data with the cosine method and then conducts the network weights determination. The determination is

normally based on the Orthogonal Least Square method. The data is considered the network centre when the minimum cosine value is reached. Neural network and HMM each have their own advantages and disadvantages. For instance, neural network performs better when the numbers of training data are low, while HMM is based on a probability algorithm to model sequential data, and has the advantages of statistical grounding, modularity and transparency of the model (Moni & Ali, 2009). However, HMM has a shortcoming of poorer performance in discriminating the input samples compared to neural network.

Integration of Proposed Audio-Visual Emotion Recognition System on E-Reader

Figure 2

Scenario of emotion recognition during e-learning

E-learning can be carried out in different applications, thus the emotion recognition system we propose aims to be flexible enough to perform well in different scenarios. For example, when the process of e-learning is approached with the learners' needs to talk (e.g. foreign language speaking exercises, oral speaking assessment, phonetics learning and so on), their emotions can be determined from their facial expression and speech. However, this is only applicable if the learners are facing the screen (or front camera) during the e-learning process. Thus, the proposed system was developed to be able to perform audio-only emotion

recognition when facial detection fails. There are also many scenarios that only require learners to learn from the displayed content (e.g. reading materials, answering quiz questions, watching the recorded video tutorial, and so on). The emotion recognition system also has the ability to identify emotions from the facial expression only in such cases.

Figure 2 shows an example of a scenario for recognizing the learner's emotion states from an e-reader during the process of e-learning. Normally, to perform e-learning on an e-reader, the learners require application software or apps which are designed by practitioners. Once the app is opened from the e-reader, the camera and built-in microphone are activated simultaneously. Thus during the process of learning, facial expression and emotional speech are able to be detected. The capturing and recording process continue until the app is closed by the learner. The results of positive and negative emotion states will be then classified by the system and submitted back to the practitioners for analysis. To ensure the efficiency of the recognition system, there are some factors to be considered in order to provide good practice for practitioners when designing or adopting the system into their e-learning application, as listed in Table 1

Table 1

Summary of good practice in application design

Factors	Descriptions
Illumination	The lighting of the learner's environment during the learning process may cause inaccuracy of emotion recognition from the captured facial expressions. Thus, ensure the learner's environment has good illumination or enhance the pre-processing technique to compensate for bad lighting.
Noise	Noise or unwanted audio signals that occur when learning in a noisy

	environment can also weaken the performance of the recognition. Noise filtering techniques should be considered in the software design.
Connectivity	Internet connectivity as a feature of applications should be considered by practitioners to enhance the speed of obtaining the results of recognition.
Memory	From the stage of detection to classification, e-reader devices are required to spare some memory space to prevent disturbance of the learning process. Thus, develop systems with less computational requirements.

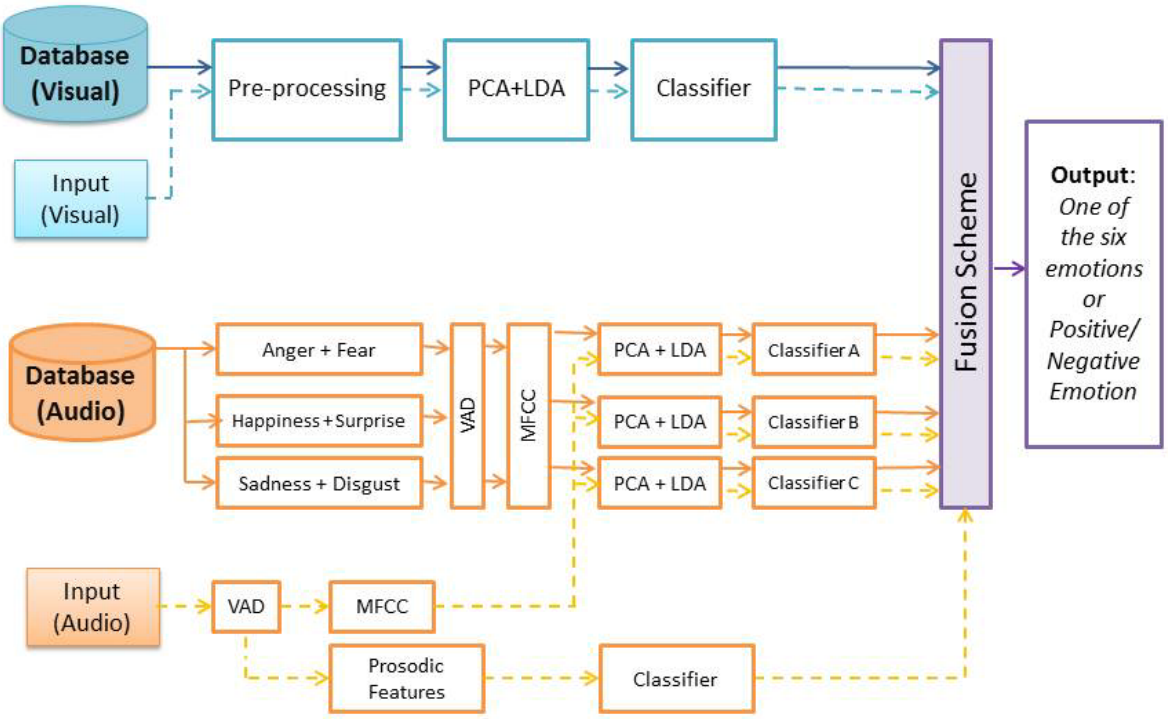

Figure 3

The proposed audio-visual emotion recognition system model

Figure 3 shows the proposed emotion recognition system model that was used in the e-learning interface. It is divided into two modalities: visual path and audio path. Each path

requires a training process before it can be tested by the detected input data. There is also a proposed fusion scheme which outputs the results of positive and negative emotions.

For the visual path, the visual data from the training database are firstly pre-processed to normalize the image size and quality. Then, the feature extraction techniques – PCA and LDA – are used for reducing the dimensionality and discriminating the preserved important emotion features. The outcome of the feature extraction methods is a subspace which reduces the computational cost of the testing process. Once the test data are pre-processed, they can be directly multiplied into the subspace and hence the classifier – Nearest Neighbour – calculates the distance between the trained emotion features with the input data's emotion features in the projected subspace. The result of this path is passed into the fusion scheme to compare with the audio path's results.

The audio path has two sub-paths. Since the audio emotion features are unlikely to be distinguished clearly (Wang & Guan, 2008), the first sub-path initially divides the data from the training database based on three groups of emotions: "Anger and Fear", "Happiness and Surprise", and "Sadness and Disgust". Voice Activity Detection is then applied to detect the speech signals, as well as MFCC to extract the speech coefficients from each signal. Next, with the feature extraction techniques of PCA and LDA, three different subspaces for each emotion group are computed. Similar to the visual path, the first sub-path tests the input audio data by inserting into the trained subspace after pre-processing with VAD and MFCC techniques. Three classifiers are used for different groups of emotions to classify the closest emotion of each group. The selection of the results from group is determined in the fusion scheme. The second sub-path is based on the prosodic features. The input audio data are also tested on this sub-path to extract different type of features to help in decision-making of emotion selection in the fusion scheme.

In the proposed fusion scheme, there are two levels of weight selection. Firstly, based on the weights from the visual path, V_P and second audio sub-path, A_{P2}, a group from the first audio sub-path, A_{P1} is selected if the group carries the highest weight from the two paths. Once the group is selected, one of the two emotions of the group which carries the highest weights will be selected. For example, the emotion of the tested input is recognized as anger if A_{P2} and V_P shows the group of "*Anger and Fear*" has the highest weights, and the test image's extracted feature has a shorter Euclidean distance to the anger features compared to fear features. The final level of the fusion scheme will then decide whether the emotion is considered a positive or negative emotion. This is to provide feedback to the particular teaching parties to enhance their e-teaching process in the future.

Experimental Results and Analysis

In this section, the proposed audio-visual emotion recognition system for e-learning was trialled on databases – eNTERFACE (Martin, Kotsia, Macq, & Pitas, 2006) and Taiwanese Facial Expression Image Database (TFEID) (Chen & Yen, 2007) – using MATLAB software on PCs. The eNTERFACE corpus is constructed by 1170 utterances which contain 42 subjects (34 male and 8 female) from 14 different nations. The emotions included in this English spoken database are happiness, anger, disgust, sadness, surprise and fear. The emotions are the reactions of the subjects after listening to six different short stories. Each subject was required to read five phrases based on their reactions to each situation. One of the example phrases for happiness is "I'm so excited!" TFEID is a facial expression database that consists of 7200 images captured from 20 females and 20 males. The emotion types available for this database are anger, disgust, fear, happiness, sadness, surprise, neutral and contempt. Although there are two different angles (0 and 45 degree) captured for every subject, we only selected frontal images since most of the time during e-learning the learners are facing the screen.

The purpose of the simulation was to assess the performance of the proposed audio-visual emotion recognition system. The simulation was carried out on PCs to test each modality of audio and visual, as well as the fusion of both for the system. Visual and audio samples taken from e-reader devices were also used together with the database for training and testing.

For the audio part, 100 training samples which consist of 5 sentences from 20 different subjects were randomly selected for each emotion, of which five samples were taken from the e-reader device – iPad 2 – and the remaining samples were from the eNTERFACE database. Then, another audio testing set was formed with 18 samples which included 16 samples that were randomly chosen from the database and two samples recorded by the iPad 2 in a quiet environment. On the other hand, the visual part used 180 total training samples or 30 sample images for each emotion (of which 28 samples were randomly chosen from the TFEID database and two samples were taken from the front camera of the iPad 2 under a good lighting condition.

All images used for the training and testing stages were scaled to 72×72 resolution. By referring to the proposed emotion recognition system, the results of both audio and visual modalities were simulated and shown in Tables 2 and 3 below. The results based on six universal emotions (Happiness, Sadness, Anger, Disgust, Fear, Surprise) were compared to the results based on positive (Happiness) and negative emotions (Sadness, Anger, Disgust, Fear). For the audio-only simulation, the weights from the visual path were not taken account in the classifier. For the visual-only simulation, the weights from both audio sub-paths were not taken into consideration. The simulation for the fusion path is shown in Figure 3 where the weights from both audio and visual paths were used to determine the emotion features.

Table 2

Simulation results for six emotions (sadness, anger, disgust, fear, happiness, and surprise)

	Audio	Visual	Fusion (Audio + Visual)
Accuracy of emotion recognition	66.7%	73.3%	83.3%

Table 3

Simulation result for positive and negative emotions

	Audio	Visual	Fusion (Audio + Visual)
Accuracy of positive emotion	86.7%	100%	100%
Accuracy of negative emotion	91. 7%	95.0%	100%

The results showed that the fusion accuracy is better than either the audio-only or the visual-only emotion recognition rate. The recognition rate of positive and negative emotions is also higher than the recognition rate of the six universal emotions. This is because the emotions are easier to distinguish with fewer emotion classes. Since the e-learning process is more concerned with positive and negative emotions, compared to other non-related emotions, the high accuracy indicates that the audio-visual emotion recognition is applicable and efficient for assisting the design and development of e-learning applications.

Conclusion

The adoption of audio-visual emotion recognition systems on e-reader devices is a huge step towards improving the quality and efficiency of e-learning applications. This chapter has attempted to review the efforts regarding e-learning applications and previously proposed emotion recognition systems to improve the currently available e-learning applications. Moreover, we have demonstrated a proposed architecture for emotion recognition in e-learning systems based on audio-visual data. A fusion scheme was also proposed to match the scores of visual and audio based classification and other scores from the different emotion sub-groups by using a weighted sum rule. With help of the max rule in the fusion scheme, the final recognized emotion output of the system was obtained with high accuracy. The merit of the proposed audio-visual emotion recognition system is that it helps to recognize learners' positive and negative emotions when performing e-learning with high accuracy, and can assist practitioners to design e-learning tools which are able to be revised based on the learners' emotional responses. This conclusion reinforces our commitment to these methods and has encouraged us to continue the work of improving the efficiency of delivering e-learning.

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Usability and the Acceptance of E-Books and E-Reading Devices

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Abstract

E-books and e-book readers have potential to provide capabilities beyond the traditional printed book. The acceptance of e-books is dependent on the acceptance of the e-book reader. The Technology Acceptance Model (TAM) states the perceived usability affects system use (Pai & Huang, 2011; Venkatesh & Morris, 2000). Understanding the usability barriers that exist for small-screen mobile devices and how they impact perceived usability improves the devices' acceptance into the e-learning environment. This chapter discusses studies of usability using the Amazon Kindle, Barnes and Noble Nook, Apple iPad, and Windows 8 tablet. The usability barriers to e-book readers are identified from the literature. The resolution of these barriers by current e-book reader design is shown to be incomplete, and all barriers are not of equal importance to the user. The results of the study are used to select devices to implement in a university classroom. The lessons learned from two years of a paper-free classroom reveal usability issues related to Internet availability and configuration can also impact technology acceptance of e-book readers by both staff and students.

Keywords: iPad usability, e-books, e-book readers, tablet, HCI, usability, Windows tablet, cloud, mobile devices, interoperability

Introduction

E-books are not a recent phenomenon (Johnson & Brodia, 2000). Consumer-ready portable e-book readers have been available since the late 1990s (Henke, 2001). The recent generation of e-book readers has addressed several key issues related to acceptance by a more general public (Horcher & Cohen, 2011). Understanding the key factors that lead to a sufficient level of usability to gain general acceptance is critical to successfully integrate e-book devices into e-learning.

In February of 2012, the US Department of Education issued a challenge to the nation's elementary schools to move from paper media to digital textbooks in the next five years (Klein, 2012). Citing the advantages of a textbook that can be easily updated and transported, as well as provide a media-enriched learning experience, Secretary of Education Arne Duncan stated the switch to digital is an obvious and simple choice. E-book readers that are usable are the key to making these materials accessible to the widest possible audience.

Extending the e-book reader to the elementary and middle school community provides a different challenge than individuals. Switching to an electronic library of resources rather than a print library demands skills not currently in the core competencies of these school systems (Nov & Ye, 2009). Elementary schools are traditionally not early adopters of technology, due to funding issues and their user community. Early adopters typically tolerate a higher level of instability in the technology in return for the satisfaction of being the first to have the experience (Park & Yoon, 2005) and a sense of personal innovation (Chang, 2010).

As suggested in a study of web-based information service adoption (Luo, Chea, & Chen, 2011) satisfying the utilitarian requirements of the technology adopter is as much a factor as making the use of technology pleasant. The Motivation Model and the Uses and Gratifications theories of technology adoption consider both these perspectives, and have proven of value in studies of mobile phone adoption , which, similar to e-book readers, are

mobile devices used by a general population of varying technology proficiency (Tojib & Tsarenko, 2012).

The usability studies in this chapter also approach technology acceptance from both the utilitarian perspective and user gratification. The e-book readers are examined for the usability of key functionalities. In many cases of technology diffusion, such as security awareness (Horcher & Tejay, 2009; Shaw, Chen, Harris, & Huang, 2009), user training compensates for a lack of usability. Instead of the processes being moulded to the user, rules and consequences are instituted to force a tolerance of less usable technology (Stanton, Stam, Mastrangelo, & Jolton, 2005). In the resource-constrained technology support environment typical of the academic organization, lack of usability in e-book readers cannot be alleviated by the involvement of trained technical support. Similar to the home and small business environments without formal information technology support departments (Poole, Chetty, Morgan, Grinter, & Edwards, 2009), high usability of e-book readers should improve effective adoption by reducing the need for technical support. Knowing what characteristics determine usability will improve an educator's ability to choose how to integrate such devices into the classroom.

Determining Usability and Functionality

To determine how to deploy e-book readers it is necessary to identify the key usability factors affecting e-readers. The usability factors relevant to small screen devices have been previously identified in other similar devices such as mobile phones and PDAs (Churchill & Hedberg, 2008; Kang, Wang, & Lin, 2009). Understanding how these contexts relate to both the current and future generations of e-readers improves the design of e-learning.

The usability barriers, as seen in Table 1, fall into four major areas. To achieve the highest level of usability, the e-book reader design should address most of, or all, the barriers.

Screen Readability

At the top of the list is the readability of the screen (Kang et al., 2009). As screens have evolved from the single font green-on-black (Mills & Weldon, 1987) to the high resolution retina display of the iPad 3, the readability of print on screen has begun to equal and even excel the quality of the printed page (Nebeling, Matulic, & Norrie, 2011). As the screens improve, the willingness of the general public, especially those readers under 30 years of age, to read exclusively on the screen increases (Huang, Liang, Su, & Chen, 2012). The eye fatigue that prevented extended reading of large quantities of text on a computer screen (Kang et al., 2009) is reduced by new approaches to the display such as e-ink and high resolution.

The e-ink display applies a technology that displays from microcapsules of positively charged white particles and negatively charged black particles suspended in a clear fluid (Siegenthaler, Wurtz, Bergamin, & Groner, 2011). Changing the amount of charge on the particles changes the shapes, or letters, the particles form on the screen. In contrast to the constant refresh of the Liquid Crystal Display (LCD) particles suspended before a backlight, the e-ink display consumes less power (Golovchinsky, 2008), and projects less light back into the face of the viewer.

Table 1

E-book usability barriers

Usability Barrier	**Literature Reference**
Screen Readability	**Usability evaluation of e-books.** (Kang et al., 2009) A comparison was made between conventional books and electronic books. The results determined eye fatigue from the inferior screen display was a major factor

	in readability. Testing was done on early e-book reader models similar to the Rocket e-book.
Navigation	**Navigation techniques for dual-display e-book readers.** (Chen, Guimbretiere, Dixon, Lewis, & Agrawala, 2008) Print materials are often manipulated to allow access to multiple sections of the book through flipping back and forth, or simultaneously looking at two sections. The use of thumbnails, or small windows to other sections of the electronic book, is tested as a solution to make navigation on an e-book reader as functional as the conventional reader. A custom prototype of a two screen device similar to the Toshiba Libretto W100 was the platform.
Portability/ Physical	**Learning object design considerations for small-screen handheld devices.** **(**Churchill & Hedberg, 2008) The form factors of small screen devices make them highly portable. The reduced size can also make the screen hard to read, and the resolution less clear. As mobile devices shrink in size, the design of the device must continue to achieve key functionalities in power consumption efficiency and screen manipulation. Testing was done on a Pocket PC Windows 2002.
Network Connection	**From telephones to iPhones: Applying systems thinking to networked, interoperable products** **(**Walker, Stanton, Jenkins, & Salmon, 2009). Mobile devices are not isolated technology. Similar to the networks of computer workstations, mobile devices like iPhones need to be aware of a user's interaction with other devices and automatically bring information about that user to the device, such as content and preferences. Testing was done on the

Apple iPhone.

Mobile information access in the real world: A story of three wireless devices (Serif & Ghinea, 2008)

The flow of information between a laptop, PDA and a remote head-mounted camera was studied to understand how a user interacts with multiple devices in a mobile environment.

Navigation

In the printed book, the table of contents serves as the navigation. The digital book has the ability to access the material via the traditional table of contents (Marinai, Marino, & Soda, 2010), and in non-traditional ways (Beer & Wagner, 2011). When reading for entertainment the reader typically consumes a book from the beginning to the end. The academic reader will read portions of the text and also refer back to previously read sections (Rabina & Pattuelli, 2009). The ability to move quickly and accurately through the content is a major factor in the usability of the ebook reading device.

Portability/Physical

The form factors of small screen devices are a critical factor in e-book acceptance, particularly for the commuting reader. Just as the airlines are looking for ways to reduce the amount of paper in the cockpit (Nomura, Hutchins, & Holder, 2006), students as well as people in business are looking to reduce the weight and size of the information they carry. Going from a fully loaded backpack weighing pounds (Golshani, 2008) to a portable device that weighs ounces improves usability through portability.

Network Connection

Mobile e-book readers have been around since the Pocket PC of early 2000 (Myers, 2005), but Amazon cut the cord to the computer companion previously needed to load books and consequently simplified the process and the interface (Bartholomew, 2008). Network connectivity not only simplifies moving content to the device at the start, but also provides the opportunity to interact with the content with multiple devices (Walker et al., 2009). The user connects to the content with whatever e-reader device is most convenient for the situation, and still retains any notations, bookmarks or other personal markup which is connected to the content. For the casual reader perusing a novel, it means the content is always open to the right page to continue reading. For the academic reader, it means having a textbook, plus a wealth of supplementary material available (Marshall & Ruotolo, 2002).

Assessing Functionality of E-book Readers

To assess the extent to which the barriers to usability have been overcome, the typical functionality expected of an e-reader, plus the additional functionalities possible based on the mobile platform needs to be defined (Ashbrook & Lyons, 2010). These two sets of parameters are used to validate the usability and functionality of several current devices in usability studies.

The usability testing in the current study focused on three major task workflows commonly performed by a reader interacting with text material regardless of the storage medium. These major areas are shown in Figure 1. The user must progress through the previous capabilities to succeed at the tasks at the higher levels. The first two sections have close equivalents in the physical book. The enhanced capabilities address areas where the e-book has a design advantage over the printed counterpart.

The participants performed a list of tasks with each e-book reader. Each task tested an aspect of e-book reader usability as described by the usability barriers in Table 1. The

study compared the Barnes & Noble Nook and the Amazon Kindle 3, also known as the Kindle Keyboard.

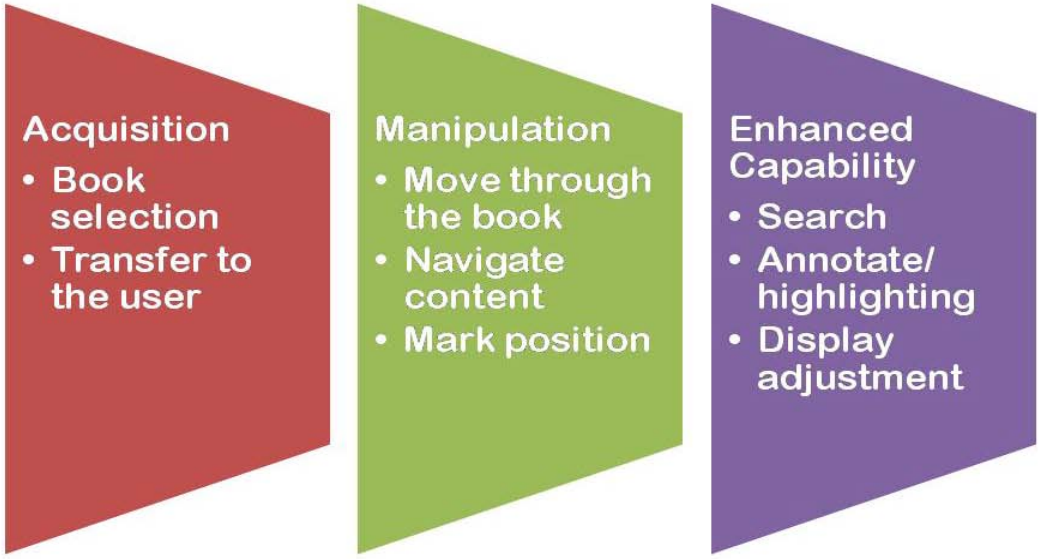

Figure 1

Task flow for an e-book interaction

As part of the entry questionnaire the subject was asked to assess their attitude toward e-book readers on a three-point Likert scale. The same question was asked at the conclusion in an exit questionnaire. The overall time to complete all tasks was recorded, as well as the number of times the user requested assistance. The observer noted the comments made by the user while thinking aloud for later analysis. The tasks for which the subject requested assistance were also noted. The time and date of each session was recorded.

At the conclusion of the session, the observer interviewed the subject to get a usability rating for every task, and for each e-book reader. In addition to giving a rating on a five-point Likert scale for 16 tasks on each e-reader, the subject was also asked for an overall preference between the Barnes &Noble e-reader and Amazon Kindle e-reader.

The reportedly preferred software was not consistent with the software receiving the higher composite score of usability, as was predicted in the hypotheses of the study. In cases where it was inconsistent, the subjects stated that one usability characteristic was so overwhelming that it outweighed the other considerations. In some cases this overwhelming reason resulted in the selection of the Amazon Kindle. In the others, it resulted in the selection of Barnes & Noble Nook. The subjects mentioned they liked how the e-book looked on the screen, and used that criterion alone to make their choice. This is an indication that screen usability may have greater weight than the other usability barriers.

Of the four usability barriers, the tasks related to navigation received the lowest scores. No subject felt navigation deserved the highest score. In contrast, the portability and screen readability tasks received the highest ratings for both e-book readers. This suggests that the use of e-ink and improved displays have resolved the readability problem, even where the layout of the screens might create accessibility issues. The ability of users to move around the book and manipulate the information needs further refinement to achieve the level of usability desired by the typical subject.

In addition to the results from the questionnaires, observations of each subject also yielded some interesting points. Neither age nor computer expertise was a predictor of how the subjects perceived usability. Across the board, though, women reacted differently to the technology. There was greater anxiety among the female subjects about whether they were performing the test correctly. Furthermore, due to the design of the e-book readers, female subjects did not obtain a successful experience when using the device correctly. The buttons were too stiff to respond to the typical feminine pressure, while touch screens did not perceive the stroke of the women's fingers. This suggests the devices are not calibrated to a norm that includes both genders.

The impact of the device not responding is two-fold. The usability becomes suspect, and the subject loses confidence in their ability to control the device (Hurtienne et al., 2010). When linked to research that notes the impact of social-cultural issues on early adoption (Park & Yoon, 2005), this lack of usability for one gender points to a bias in design. Since men dominate the technology fields (Todd, Mardis, & Wyatt, 2005), and the early adopters (Chau & Lung Hui, 1998), it would follow that the first generations of device design reflect a male aesthetic.

Women also reacted differently to the size and shape of the device. In each case before beginning the task list, the female subjects examined the size, shape and texture of the device. Though not measured specifically in the results, this reaction to texture and colour suggests there may be some usability issues related to whether the subject feels they can hold the device comfortably.

Predicting Usability of E-Book readers

The results of the usability study described above confirm the validity of the barriers, even though the impact of the barriers is not uniform. A user population that is diverse in both technology literacy and age, like the potential e-reader readers, makes usability design more challenging (Fischer, 2011; Norman, 2009). Gender, age and capability differences drive how humans interact with devices, including mobile and wearable devices (Kimchi, Amishav, & Sulitzeanu-Kenan, 2009; Schwanen, Kwan, & Ren, 2008). Based on age and gender, some functionalities are more important to some users than others (Karahasanovic et al., 2009). Certain usability factors are also more critical to “get right” regardless of age and gender (Kurniawan, 2008).

Next generation of devices

Looking forward, e-book readers keep evolving into configurations that satisfy the needs of a reading population. Even before putting the devices into the hands of the users, the

usability of the devices might be predicted by scoring them based on the extent to which the device surmounts the identified usability barriers for e-book readers. To illustrate this, a comparison of the iPad 3 (also known as the latest generation iPad), the Amazon Kindle Fire (1st generation), and an Acer w500 tablet running the consumer preview edition of Windows 8 was made.

These devices represent the next generation that combines e-book reader functionality with other desirable functionalities of mobile devices and smartphones such as playing video, accessing the Internet, and creating limited content such as email (Barkhuus & Polichar, 2011). Though it is becoming common for the general public to manipulate multiple mobile computing devices (Oulasvirta & Sumari, 2007), there is an opposing need to reduce the amount of maintenance and learnability by consolidating functionality into a smaller number of devices (Leung, Findlater, McGrenere, Graf, & Yang, 2010).

The Apple iPad and Amazon Fire run on dedicated hardware devices. The Windows tablet used for the comparison was an Acer W500 tablet with an active touchscreen. The usability was predicted using the Analytic Hierarchy Process (AHP) for decision-making (Saaty, 1994). AHP consists of a series of sub-processes to combine unstructured criteria into a single ranking to select an alternative (Saaty & Shang, 2011). The use of the AHP model is described by IsIklar and Büyüközkan (2007) as a method for selecting mobile phone alternatives. For this exercise the usability barriers were substituted as the criteria in the model, as seen in Figure 2.

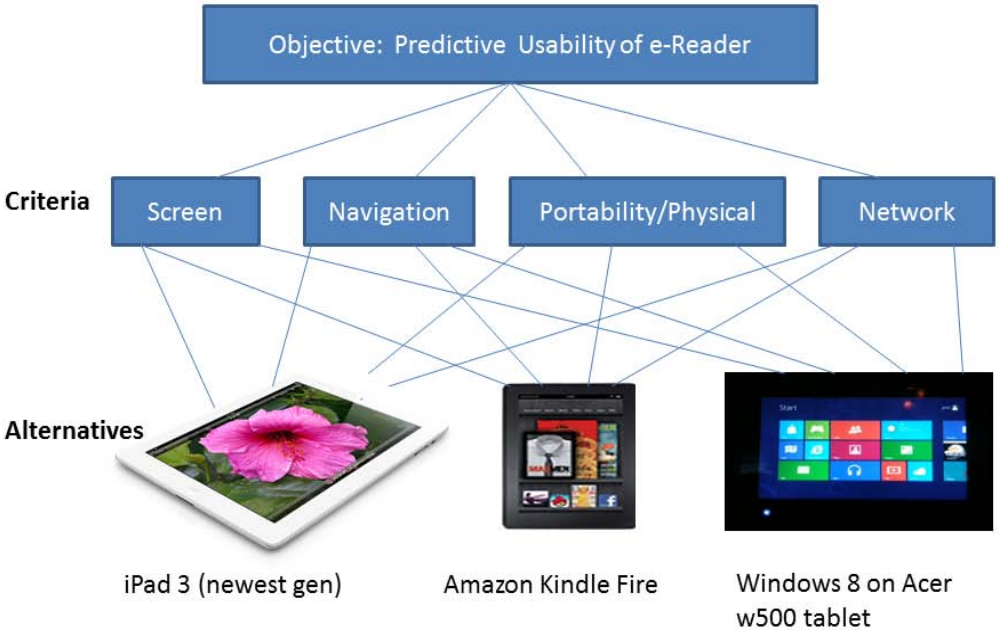

Figure 2

AHP diagram of the usability barriers applied to e-reader selection

The pairwise comparisons of the usability barriers were used to assign a weight to the score for each barrier's resolution. The priority was based on the usability study described earlier in the chapter comparing the Amazon Kindle Keyboard and the Barnes & Noble Nook. Since the subjects indicated screen as the only factor in their usability preference, this was given a higher priority than any other criterion. Portability was mentioned most frequently as the second most important factor in usability, and was rated as half as important as the screen. The last two usability barriers, network and navigation, were considered equal in their importance in relation to each other. The weights for prioritization for each barrier appear in Figure 3.

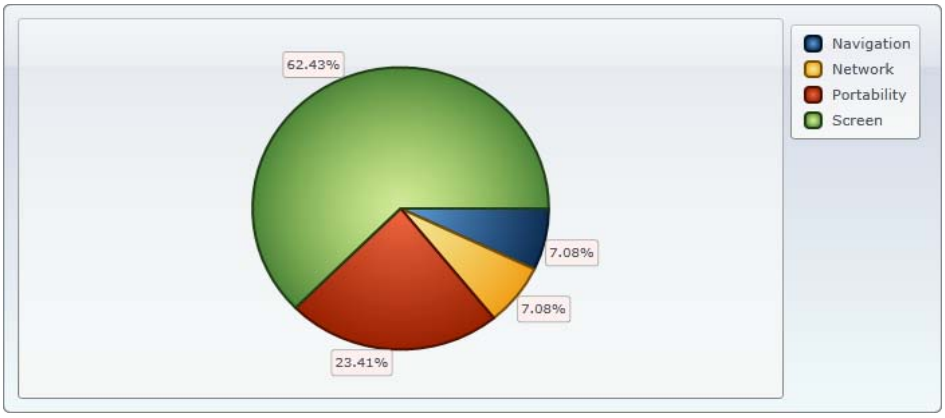

Figure 3

Weights of the importance of resolving the usability barriers

Scoring the Alternatives

The criteria, or usability barriers, were broken down into sub-categories for scoring the alternatives as seen in Table 2. For some of the criteria there was a score given of 1-3, with the highest score given to that alternative that achieves the resolution of the barrier to the highest extent. If two alternatives were equal in their resolution of the usability barrier, the score given was “2”.

Other features do not have a scale to which the score can be linked. These features, as indicated in Table 2, were given a Boolean value of 0 or 1. The alternative either has the capability which resolves the usability barrier or not. These are modifications of Saaty’s 1-9 verbal scale (1994) as suggested by Finan and Hurley (1999) to reduce inconsistency. The geometric scale suggested by the study was further reduced to a simple existence or non-existence of a sub-feature in an alternative.

Table 2

Usability barriers and sub-components with descriptions and scoring

Usability	Sub-component	Description
Screen	Readability	How the screen looks in resolution and clarity
		Ranking 1-3, highest rating for the highest clarity possible
	Adjustability	Whether the text size can be adjusted
		Ranking 1-3, highest for the greatest range of text sizes
Navigation	Table of Contents	Entry from table of contents into body of book possible
		Rating given on a Boolean scale (1-yes, 0-no)
	Search	Look for something in the contents of the book
		Rating given on a Boolean scale (1-yes, 0-no)
	Alternate options	Other options for moving through the text non-sequentially
		Ranking 1-3, highest given for the most options, such as bookmarks
	Notes	Ability to add personal notes to text
		Rating given on a Boolean scale (1-yes, 0-no)
Portability/ Physical	Screen size	Diagonal measure of screen size
		Ranking 1-3, highest rating given for most portable size
	Weight	Weight in pounds or ounces
		Ranking 1-3, highest rating given for lightest
	Thickness	Thickness in inches
		Ranking 1-3, highest rating given for thinnest
Network	3G/4G	Ability to connect to network through wireless
		Rating given on a Boolean scale (1-yes, 0-no)
	Wifi	Ability to connect to a wi-fi network
		Rating given on a Boolean scale (1-yes, 0-no)

For example, as seen in Table 3, the iPad 3 was given a score of 3 for its readability because the screen technology for the retina HD display was the most advanced. In the area of navigation the iPad lagged behind the Kindle Fire for functionality. The Kindle app was used as the measure of functionality because it was the only e-reader software available on all three platforms at that time. The Kindle dedicated device subsequently had the most feature-rich and high-scoring navigation. The scoring was done based on direct observation of the technical capabilities of each device by five experienced e-book users. The weight was taken from the values calculated in the AHP analysis pictured in Figure 3.

Table 3

Scoring the alternatives to predict usability of next generation

Usability	Feature	iPad	Score	Amazon Fire	Score	Windows tablet	Score
			Screen				
	Readability	High definition Retina display	3	In-Plane Switching (IPS) LCD	2	Thin film transistor(TFT) LCD	1
	Adjustability	6 levels of text	2	8 levels of text	2	Slider with non-discrete levels	1
	Subtotal		5		4		2
	Weight	*.6243*					
			Navigation				
		Kindle app for iOS		Kindle native		Kindle app for PC	
	Table of	On-screen	1	On-screen	1	On-screen	1

Contents						
Search	On-screen	1	On-screen	1	On-screen	1
Alternate options	Page numbers, locations	2	Page numbers, locations, social, access to notes	3	Page numbers, locations	2
Notes	Not available	0	Notes on pages	3	Not available	0
Subtotal		4		8		4
Weight	*.2341*					
Portability/Physical						
Screen size	10 inches	2	7 inches	1	10 inches	2
Weight	1.44 pounds	2	14.6 ounces	3	3.48 pounds	1
Thickness	.37 inch	3	.45 inch	2	.63 inch	1
Subtotal		7		6		4
Weight	*.0708*					
Network						
3G/4G	Optional	1	Not available	0	Not available	0
Wifi		1		1		1
Subtotal		2		1		1
Weight	*.0708*					

Note: All values in the table were recorded from direct observation of the three devices.

Combining the usability scores, as seen in the graph shown in Figure 4, reveals that the Amazon Kindle Fire narrowly edges out the iPad 3 as the predicted most usable e-reading device of the next generation. Particularly for the academic user, the resolution of the navigation barrier should possibly be prioritized higher (Rabina & Pattuelli, 2009). The leisure reader normally moves in a linear fashion through content. The academic reader has a greater need for the ability to annotate as well as navigate the content, due to the nature of the content consumption (Thayer et al., 2011).

The Windows 8 tablet, which is not on dedicated software, is significantly behind in usability due to form factors such as weight, and screen clarity. On the other hand, this platform offers the ability to swap between the tablet interface and the traditional desktop, and to use Microsoft Visual Studio to create “metro”, or tablet-styled apps (Fulton, 2012). As a multi-purpose device the Windows 8 tablet has the potential to surmount the usability barriers through the familiarity of the apps that are available on the platform.

Though not a usability issue, the relative cost of devices is another factor in the selection of e-book readers by academic users (Loebbecke, Soehnel, Weniger, & Weiss, 2010). E-book reader vendors have noted the tremendous growth possible in the academic market, and are beginning to weigh the needs of this market in the design of e-reader hardware and software. Five months after its introduction, the Amazon Kindle Fire was the top-selling Android tablet, which is an indicator of the level of adoption (Sarno, 2012).

This method of prediction can be repeated to continue to identify the most usable devices at any point in time for the academic user. At this time there has been no e-book reader that scores at the highest level of resolution for all the usability barriers, making it the obvious choice. The AHP process allows the assessment of the best alternative at a particular point.

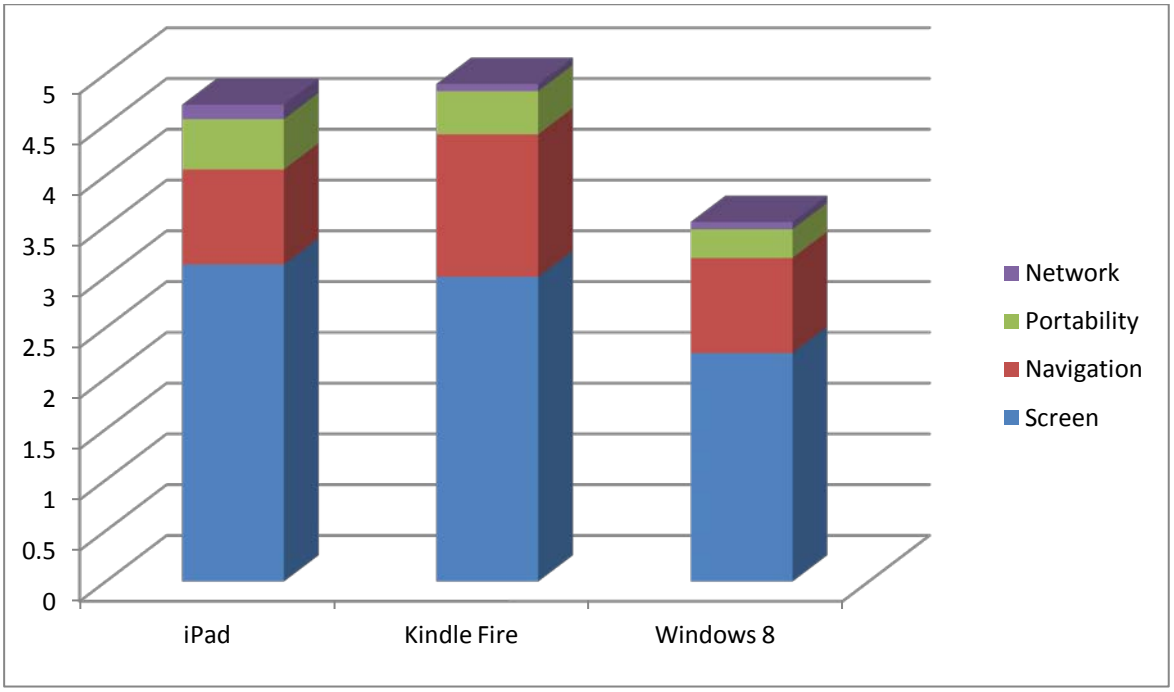

Figure 4

Comparison of latest generation of e-book devices by usability barriers with ranking

The AHP process can be adjusted by adjusting the weighting of the criteria. For example, the academic user might feel the functionality for navigation was equally important as the screen. Another possibility is that additional functionality for supplementary materials such as video, the usage of Microsoft Office, and the ability to program on the device are added to usability criteria. Another set of academic users might prioritize a larger screen over a lightweight device. By adjusting the weighting and scoring of each new criterion against the same or even a new set of alternatives, the usability of e-book reader devices can continue to be predicted.

Evolution of e-Readers to the Cloud: A Security and Usability Perspective

The movement of digital content for e-readers to the cloud follows naturally from the resolution of the usability barrier described above as Network. Even before the recent renaissance of the e-reader, the movement to digital libraries and digital repositories to the cloud (Tsakonas & Papatheodorou, 2008) had begun.

Digital libraries were not the exclusive province of research institutions. Online retailer Amazon began its online empire as a bookseller, wooing customers with low prices, convenient shipping, and book reviews (Mahajan, Srinivasan, & Wind, 2002). In the wake of the dot.com bust in 2002-2003, Amazon expanded its stable profit base into other goods such as electronic devices, when other companies exited the market (Javalgi, Cutler, & Todd, 2004). Amazon's business model involved using its stable profit base as a stepping-stone to new markets (Loebbecke, Soehnel, Weniger, & Weiss, 2010).

Amazon returned to its roots as a bookseller with the introduction of the Kindle e-book reader in 2007 (Norman, 2009). Amazon's e-reader product shows the same end-to-end systems thinking that lead to the success of the iPad. The device addressed the usability issues previously hampering widespread e-book adoption. The Kindle was not the first e-book reader on the market, nor does it have overwhelming superior features. The dedicated device Kindle e-reader addresses key usability concerns, and works instantly, allowing the user to buy books wirelessly. Amazon cut the cord to the computer companion previously needed to load books and consequently simplified the process and the interface (Bartholomew, 2008).

Continuing Evolution

Similar to iTunes' strategy of using a proprietary format that can most easily be obtained from the Apple store (Bhattacharjee, Gopal, Marsden, Sankaranarayanan, & Telang, 2009), the Amazon Kindle uses a proprietary format by default (Bartholomew, 2008). Though there are sources for e-books that can be read on the Kindle other than Amazon, these sources require the customer to tether the Kindle to a PC to load the device. Also like iTunes, Amazon provides a well-designed website as a continuing source of information about the device, and products available. Consumer familiarity with a website, and its

perceived usability, generates greater consumer loyalty in Internet interactions (Flavián, Guinalíu, & Gurrea, 2006).

When institutions build digital libraries, they must consider the long-term implications of print resources versus online resources (Chan & Lai, 2005). These include pricing concerns, storage of the media, and recovery from loss. A consumer building a private digital library has similar concerns. Some digital services, such as Audible.com (Coyle, 2006) and Amazon, give customers the ability to download any purchases made previously. This is another example of anticipating the usability needs of the non-technologically-savvy consumer. In addition, the commitment to the Amazon brand increases because of the usability, and the consumer is less likely to switch to a new device and lose access to their library.

Public and university libraries are starting to expand their collections to include digital versions of books. Instead of putting content on reserve, the academic users can share access to a digital version. Getting more copies of material is a matter of licensing, rather than physical acquisition of the content. The ability to cache content on a device, and share information, calls for additional capabilities (Smith, 2011). Modelling design on the paper processes of traditional libraries reveals needs for security and privacy (Lindoo, 2009). Even within a personal library of digital content all content is not equal in risk, value and importance (Patel, 2009).

Enhancing Usability through Cloud Storage

As the ready availability of cloud-based content becomes trusted by the users of e-readers, the pattern of how they use their device changes. The e-reader device becomes so entwined into patterns of daily living that it is literally the first thing the user grabs in the morning to start their day (Bohmer, Hecht, Schoning, Kruger, & Bauer, 2011) with news and weather and the last thing at night to unwind with games or leisure reading. Instead of

downloading content and continually managing the storage of a device, it has become possible to stream content from a cloud location and never truly store it on the device (Islam & Grégoire, 2012). Downloaded content is reserved for times when the e-book device is off the grid, such as a poor signal area or an airline flight.

Just as cloud computing services extend the computing power available to an individual or organization (Zhai, Liu, Zhai, Ma, & Chen, 2011), cloud storage of publicly available audio and video extends the storage available to the user on their e-book. This is particularly significant for large video files and large collections of audio files, since these formats typically consume more space and processing (Naor, 2011). On a resource-constrained platform like the e-book reader this ability to view the content in place on the cloud drive is a major contribution to the usability of the device. It eliminates the need for content management on a platform where there are limited tools for content management.

The cloud allows the content to follow the user across various devices and mobile apps (Lakshman & Thuijs, 2011). For example, in the scoring done to assess the next generation of e-book devices, the same content was downloaded to three different devices simultaneously from the cloud. As the assessment proceeded, each device was synchronized with the cloud to get the latest bookmarks, notes, and position settings for the content.

Security and Access Concerns

Digital libraries of publicly available material present different issues than the personal information contained in tax and health records (Bays & Kaelin, 2010). The security is not so much about protecting the information of the individual, as the Health Insurance Portability and Accountability Act (HIPAA) does for medical records (Martino & Ahuja, 2010) as it is about monetization. The owners of the intellectual property stored in digital repositories implement security protocols that allow access to only the individuals who have paid for the content.

Cloud storage also facilitates time-based content access. The most common implementation of time-based security access is the technique of password expiration (Zhang, Monrose, & Reiter, 2010). The window of access is limited to a window of 60, 90, or even 120 days to protect the digital resources from unauthorized access. If the authorization has been compromised without the legitimate user noticing, expiration limits the exposure (Horcher & Tejay, 2009).

Instead of a physical object in the user's possession, the digital version of a resource is temporarily cached on the e-reading device. Whenever the content consumer connects to cloud resources, the digital repository software can examine the content on the device. There is the opportunity to grant and revoke access to various materials in the cloud and on the device. Currently the cloud-based security does not actually remove or download content on the device, leaving that task to the user. A significant departure from this norm occurred when Amazon tried to withdraw content from Kindle e-book readers (Sage, 2009).

One of the most famous fictional examples of information control, *1984*, describes how governments changed history and reality by changing the information in repositories (Orwell, 1949). Though in the actual year 1984, information repositories had not evolved to the level predicted in the book, 92% of business information in 2010 is created in electronic form and most not reduced to hardcopy (Ruhnka & Bagby, 2010). The electronic version of *1984* itself was the centre of an information control controversy in 2009, when Amazon erased copies of *1984* from the Kindle e-book reader. The action revealed a level of control over the content on the devices not covered by the Amazon terms of service, and prompted a lawsuit (Sage, 2009).

The secondary backlash against Amazon for demonstrating this control over its consumers' devices was costly in terms of reputation, over and above the $150,000 judgment against Amazon in the lawsuit. The terms of the settlement direct Amazon to handle similar

issues in the future in a manner that involves customer interaction rather than unilateral control. The capabilities of content vendors to withdraw and/or alter content represent a significant shift in content control for the educator. While an electronic textbook may update itself automatically to remain current, materials the educator had previously referenced might also disappear. This is of particular concern for controversial content, and could result in de facto censorship.

The privacy of library circulation records has traditionally been sacrosanct (Bowers, 2006). Government and other authorities have attempted to retrieve patron library records, and had been denied access by diligent library professionals protecting the privacy of their patrons. This defence was significantly eroded by the provisions of the USA Patriot Act passed in 2001. As a result, US libraries have been encouraged to keep the least amount of information possible about their patrons (Stielow, 1992). Movement of the patron information to a cloud-based repository removes it from the stewardship of its traditional guardians.

Once the information moves off-site, or even never moves on-site, there are concerns about who owns the data (Newman, 2011). The private information is controlled by cloud repository owners, who can link that to the wealth of information about buying habits in the case of Amazon.

Cloud-based repositories also present issues for information banned in particular countries due to historical or cultural issues. The cloud-based commercial repositories, such as Amazon and Barnes & Noble, deliver content worldwide. Both of these cloud repositories contain copies of Adolf Hitler's works such as *Mein Kampf*. Written while Hitler was imprisoned after his first attempt to acquire political power, *Mein Kampf* presents an alternative picture of Europe formed in the image of an extended German empire (Hitler, 1925). Though his later regime became notorious for anti-Semitic persecution, these ideals

are only indirectly expressed in *Mein Kampf*. What later became one of the most destructive ideologies of modern times was disseminated as an innocuous, rather florid political treatise. In the original German the prose is even less alarming.

His opus, *Mein Kampf*, is still banned in Germany, and publishing an excerpt on a German website is illegal (Anderson, 2002). The Kindle section of www.amazon.de, the German Amazon website, does not offer the original edition. Similar issues will continue to challenge the distribution of materials in the cloud to academic readers. US-based companies with a global presence that deal with technological information restricted from distribution outside national borders often implement "Chinese wall" security models (Jun et al., 2012) within the company. Educators may run into similar issues with banned and restricted information based on political boundaries when deploying e-books in e-learning environments in an international context.

Going Paper-Free: Usability Experiences in the E-Book Classroom

The evolution of the paper-free classroom resembles the trend towards the paper-free office proposed in the 1980s (Horcher, 1985). At that time although electronic versions of information were available, most workers preferred to use the digital information in print format. This preference for print is attributed to the screen usability issues detailed earlier. Shifting to e-book and e-reading devices requires re-thinking, but not necessarily more work (Lindoo, 2009).

The growing popularity of online and hybrid courses at the university level (Olapiriyakul & Scher, 2006) dovetails well with the e-book phenomenon. The students are already interacting with the syllabus and other course materials through a screen. Extending the mobile learning experience to the textbook for the course frees the student to experience

learning at any location and increases their sense of empowerment and satisfaction with the learning experience (Liaw, Hatala, & Huang, 2010).

The use of e-books in the classroom conserves more resources than just the paper comprising the textbook. It frees both the instructor and student from the confines of having the information only in one physical location. The weight of the heaviest dedicated e-book reader is less than that of one textbook (Golshani, 2008), lightening the load of the academic user who walks to class from a dormitory or from an office. In addition, the extended capabilities of e-book readers, documented in the first section of this chapter, allow the material to be accessed and manipulated in a more efficient manner.

The digital nature of the textbook also creates opportunities for easy short-term ownership of material, similar to the textbook rental programmes at some universities (Varughese, 2005). At the end of the semester, the rental period expires, and the student loses access to the material. The end of semester buyback and reselling of textbooks through a university bookstore is disappearing. The student can also choose to permanently purchase the material and retain any individual digital markup or notes they made to the content.

Best Practices for Deploying E-Books in the Classroom

The techniques described in this section are based on two years of using exclusively electronic materials to teach computer science classes at a four year university. In the first semester, the only paper used in the context of the class was the teacher evaluation form at the end of the semester. By the second semester this form was available online, and all classroom processes took place online.

The first step is to find the textbook, or textbooks, in digital form that contain the bulk of the material to be presented in the class. The textbook publishers are happy to provide close to immediate access to electronic versions of text. Some publishers allow sections of

the textbook to be rented or purchased in digital form. The cost of digital textbooks is one-third to one-half the cost of the print equivalent. For more specialized courses, such as a computer forensics course, the materials were less available at the beginning of the two year period. By the second year both the books used in the computer forensics course were in digital format.

The next step is selecting an e-reader, or e-readers, that match the material. A text-only e-reader such as the Kindle keyboard or Kindle Touch may provide sufficient functionality for textbooks that are principally or even exclusively text. For example, an English literature course which features the works of Jane Austen, or other authors with materials in the public domain, would be a good candidate for text-only e-readers. On the other hand a computer science textbook might be better suited to the devices evaluated in the second section of the chapter, with audio-video capability and the ability to browse and access supplementary materials on the Internet.

Prior to beginning class, send your students links to the materials and how to acquire them in print and electronic form. The textbook publishers are eager to expand this market, and provide pre-formatted messages with links to the content for you to send to your students.

Once class begins, use the electronic version of the textbook as part of the lecture. For example, in a Visual Basic class, the pages showing illustrations of concepts can be put up on an overhead projector by bringing them up on the teacher's podium computer screen. The major textbook publishers have apps that provide access to digital copies of the material through a standard PC. Also, when assigning labs and programming problems from the material, the actual pages can be viewed by the class as a whole while the instructor highlights specific points.

Lessons Learned

Like any new technology, digital textbooks do not solve every problem. Here are some of the situations that arose during the two year trial of the totally digital classroom.

Wireless and wi-fi coverage.

If the students and instructor are pulling the content and/or supplementary materials from the cloud, access to a network needs to exist and be dependable. For classes scheduled in a lab with computers on every desk, this is not a concern. In this professor's experience, some of the buildings at the university had excellent coverage, and others lacked both wi-fi and cellular coverage. Prior to the beginning of the class it is advisable to check the network available in the main classroom. The Information Technologygroup at the school may be able to assist by installing additional wi-fi routers to provide a network signal. An alternate location for the class may need to be requested. Encourage your students to download the material to the local cache of their e-reading device before class.

In some cases professors welcome the lack of cell phone and wi-fi coverage because it makes texting and Internet usage impossible. The students cannot multi-task and miss material because of their distraction caused by electronic interaction outside the classroom (Williams et al., 2011). To isolate the classroom it is also possible to use cellphone jammers, or turn the wi-fi router off.

Resistance to change.

Even though the students were all 18-25 years old, and used to reading on-screen, the group did not uniformly adopt the e-book option. Similar to other groups experiencing change (Hultman, 2003) a percentage of the students enthusiastically embraces the change, another portion tolerates, and another group clings to paper. Some students used both paper and digital versions of the book. The paper version was left at home, and the digital version was brought to class. Other students willingly embraced the digital version because of cost savings accrued by renting the book. Others resisted acquiring either version. Over the two

years the percentage of willing adopters in the class rose from a couple of students per class to one-third of the class.

One student experienced expiration of the digital content before the class ended. The student had rented the book in a previous semester and dropped the course. A bookstore would have refunded the purchase, but the digital rental would not. The digital processes for security and temporary access to e-books will need to more closely match the physical equivalents in the bookstore to satisfy the students' needs.

Not Handing in Work.

The all-digital nature of the class meant that assignments were never collected in class. Some of the students used this as an opportunity to not turn in work. Without the work being physically collected it was less obvious who was on track and who was not. This can be remedied by tracking assignments, even if the grading is not complete, to identify the students at risk.

Conclusion

Introducing e-books into the classroom is not as simple as replacing paper with pixels on a screen. The flow of information from educator to student can be enhanced by the new electronic format due to the improved ability to track distribution. The interoperability of a network-attached e-book reader makes a textbook available to the student at multiple locations. It reduces the need for students to manage the contents of their backpacks based on the weight of the books. Educators also can shift time from producing paper to distribute information to more satisfying classroom enrichment.

To deploy e-book readers into the classroom the educator must understand the key functionalities described in this chapter, and how to predict which devices will give students the best e-book reading experience. Understanding key usability factors makes it possible to design curriculum materials that suit the new platform and take advantage of the new

capabilities. Sharing annotations of material, or collaborating on commentary on published material takes advantage of the e-book functionality beyond the printed version.

The lessons learned from these studies are being used to plan the introduction of e-book readers in a small private middle school and elementary school. The responses of the students and staff to the e-book readers will be studied to further understand the connection between usability and acceptance.

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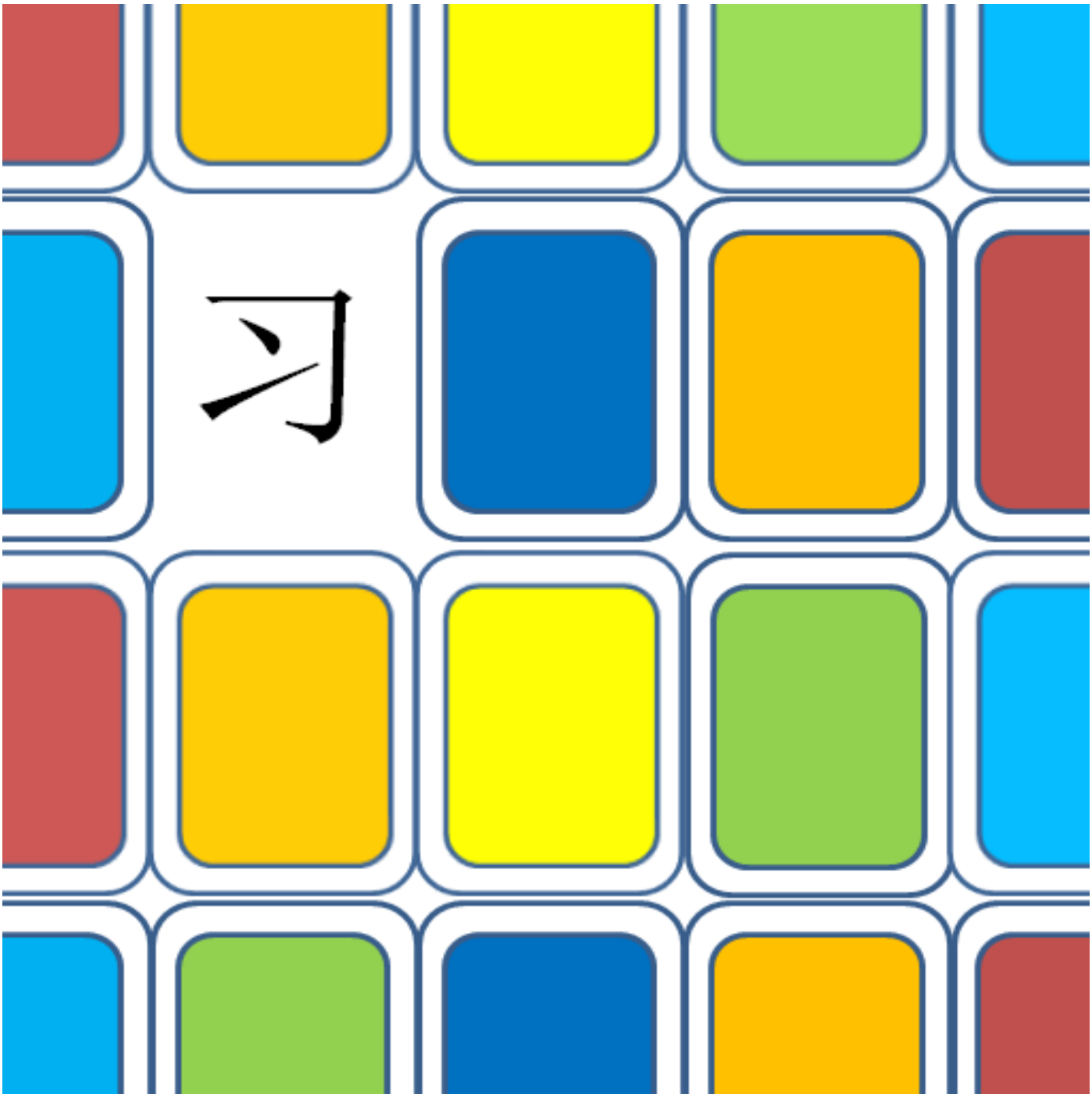

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