Foundations for an e-Textbook: A Textbook Metaphor for Educational Content Aggregation

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Abstract. The concept of the textbook has been changing over the last two decades since the World Wide Web was introduced. The word "textbook" has become a metaphor when new dynamic, personal, open, reusable digital learning resources have appeared. The concrete name of this concept is still missing. We can meet words like "personal textbooks", "open textbooks", "flexbooks", "personal digital library". But what stays behind the concept of the future textbook? There are several main components: facilitator (teacher), who combines the first version of the textbook, consisting of learning objectives and outcomes, links to resources relevant to students' general background, abilities and competencies; learner, his thorough profile information and personal learning objectives; and technology, that helps learner to achieve those goals and competencies that are relevant personally to student.

Keywords: e-textbook, open learning resources, adaptive hypermedia, competencies, user modeling

1 Introduction

Textbook is shifting away from traditional book concept, where the main activity is reading and passive memorizing of information. It certainly started its own way of development, but potential output is not quite clear - what would we call textbook in the future? The word "textbook" itself is becoming a metaphor.

The main purpose of this research is to find out how concept of the textbook has changed and will change in near future: what is the role of Information and Communication Technologies (ICT) in changing the textbooks' concept? How can it make learning process more effective and become personal to every student?

Personally, my goal is to start with my research activities and to contribute to the field of education technology not only as a practitioner, but as a researcher and creator of new ideas.

2 Rationale

2.1 Research Problem

21-st century society needs better and more effective learning resources, just making them digital is not good enough. Textbooks of 21-st century are most likely digital, interactive, dynamic, containing multimedia, personal, based on active constructivist learning models. And they should have common technical and physical specifications and formats, so they could easily be exchanged and dynamically used.

2.2 Research topic

The main topic of the PhD project is reshaping textbook, its' future development and possible perspectives. For better understanding the research topic a concept map of textbook in higher education has been compiled (see Figure 1 below), which is the main keyword of given project. The map describes current states of art of textbook concept starting from common understandings and components that distinguish text-books from ordinary books, continuing with the forms (printed, electronic) and moving to the concept of e-textbook and open textbook.
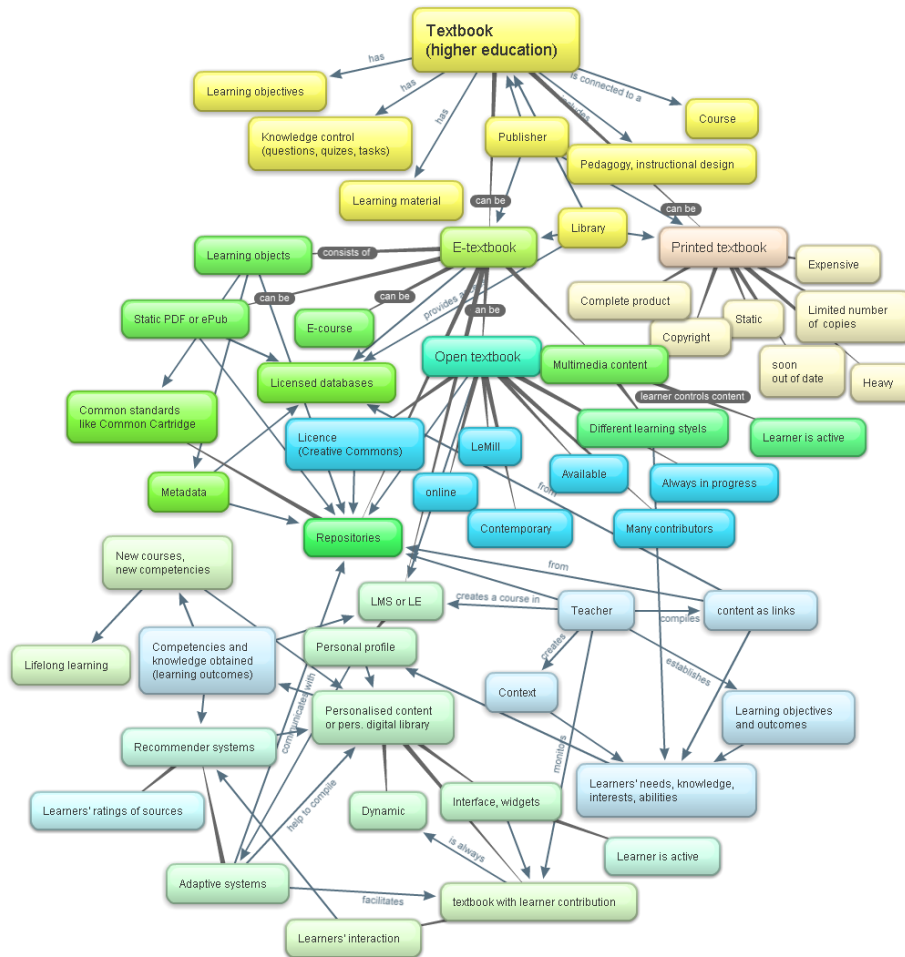
Fig. 1. The concept map of term "textbook" (compiled in bubbl.us)

The concept map brings out the possible future scenario of compiling a dynamic textbook to the students taking into account their previous competencies, knowledge and skills, also personal learning goals and affordances.

2.3 Research Context

The concept of textbook has been clear and unchangeable for hundreds of years. Texts were used for educational purposes already in ancient Greece. Then they were shaped in a form of printed book after invention of printing press in 1450-s by J.Gutenberg [1]. The development of textbooks has been thus closely connected to books' one, the differences between books and textbooks are minimal: they have always had the same medium (paper), format, publishing and delivery models. The only

difference was the content or genre of the publication and its target groups. Remarkable changes happened after the wide spread internet services and World Wide Web in the beginning of 90-th of last century.

Advances in information and communication technologies (ICT) change the way people interact with textbooks [1]. Online and digital materials are making it increasingly easy for students to access materials other than the traditional print textbook. Students have now access to different kinds of electronic resources (e-books, scientific articles, learning materials in repositories and learning management systems, tutorials, educational videos and podcasts etc.) [16]. Students are given more freedom and control; learning process becomes flexible, personal and thus more effective.

Printed textbooks have many limitations: expensive, heavy, static, outdated, narrow - being a sole source of information, hard to get, since the number of copies is limited [2]. Diana Laurillard finds that new technologies and interactive computational model provides a form of knowledge representation radically different from traditional reading/writing activities according to static textbooks and passive listening to the teacher [3].

Digital textbooks are shaping the future of textbook development and whole educational process. But digital textbooks can also be static (scanned or digitized copies of printed editions) or PDF or ePub e-books that are simply large amounts of text in a digital form. And they are usually still published and distributed by publishers through information vendors, making them expensive and hard to get.

Students should not only have a wider choice of resources and modalities of study materials from which to choose, but also share the responsibility of identifying appropriate additional resources for the course and even contributing to the learning resources in a course [4].

The main objective of the learning process should be giving the student the possibilities to obtain competencies and knowledge he needs for completing his personal tasks and goals, taking into account his previous experience, interests and skills. So every student should have their own personal textbook that is tailored according to his needs learning goals, skills and previous experience [5]. Such kinds of textbooks can be compiled by using ICT tools (web applications and developments (e.g. semantic web), databases and repositories, links' aggregators, adaptive and recommender systems etc.).

It means that user profiles should be created, continuously updated and stored in server. User modeling should be applied to more effectively answer learner learning needs. [6]. The other part of adaptive systems concerns learning materials, that should be available to adaptive mechanisms and provided with metadata.

Those materials are usually stored in open repositories or databases, which brings us the concept of "open textbook", which is an openly-licensed textbook offered online by its author(s) or through a non-profit or commercial open-licensed publisher [7].

Open textbook is strongly connected to the concepts of open content and open educational resources (OER). Open content initiatives and projects are focused on creating collections of sharable resources and on devising licenses and metadata schemata [8] .

David Wiley brings out several OER attributes that distinguish them from other open resources on the web (like for instance e-newspapers and e-magazines). He calls them "4R Permissions" (Reuse, Revise, Remix, Redistribute). All of these permissions are easily used in Creative Commons' licensing policy [9]. There are many projects and initiatives created for sharing open content on the web using licenses like Creative Commons, for instance OER Commons, MIT Open Coursware, Carnegie Mellon Open Learning Initiative, Flat World Knowledge, CK-12, Curriki, Khan Academy and also Estonian famous initiative LeMill. European Union's Structural Funds support creation of good quality freely available digital learning resources under frame of different projects. One of such project called BeST[1] was implemented in 2009 – 2013 for Estonian higher education institutions. Nearly 2400 learning objects and 1800 e-courses were created during the project. All the materials are licensed under Creative Common license and uploaded to public repository1[2] and can be used in textbook compilation through content aggregation for local educational institutions.

There also has been done a lot of research work about using a common format for describing, referencing and sharing learning outcomes information definitions across different systems, domains and sectors in the frame of iCooper project [10]. This kind of information could also be included in personal profile of the students and be exchangeable between different systems.

So teacher becomes the first guide or facilitator, initial textbook compiler, establisher of learning goals and outcomes relevant to specific course. Students then take the lead of their learning process and create their own textbook adding there resources that are relevant to their personal learning objectives, desirable competencies and outcomes. Those new resources can be added with the help of technology, called adaptive systems or adaptive hypermedia that work on data mining principles, getting information from students' personal profile and from different databases or repositories of learning objects, that are provided with metadata and creating patterns from their learning behavior.

Adaptive hypermedia systems build a model of the goals, preferences and knowledge of each individual user, and use this model throughout the interaction with the user, in order to adapt to the needs of that user [11]. Implementation of adaptive hypermedia in education domain is called adaptive educational hypermedia. For example, a student in an adaptive educational hypermedia system will be given a presentation that is adapted specifically to his or her knowledge of the subject [12], and a suggested set of most relevant links to proceed further [13].

The field of adaptive educational hypermedia attracted attention of a larger community of researchers after 1996, when the first research experience was accumulated and the number of information resources on the web tremendously grew [14]. In educational context users with learning goals and knowledge on the subjects require essentially different treatment [15].

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[1] BeST programm official web-site (in Estonian) http://www.e-ope.ee/best (04.09.2013)

[2] Repository of Digital Learning Resources http://www.e-ope.ee/en/repository/ (04.09.2013)

2.4   Research goal

The main goal of the research work is to facilitate the emergence of textbook as a metaphor and to design the architecture and concept of future textbook in the context of Estonian higher education sector based on the models of open educational resources, competencies' based learning, adaptive systems and user modeling in order to improve quality of educational process.

2.5   Research Questions

Following research questions have been established to reach the main goal of given research work:

    1) What are the current trends in e-content development for higher education?

    2) What are the current trends in e-textbook, aggregation and recommendation technologies?

    3) To what extent can these technologies be combined to deliver a dynamic and personalized e-textbook that would facilitate the reuse of existing higher education e-content?

    4) What should be afforded by a dynamic and personalized e-textbook targeting higher education?

3   Methodology

Fulfilling the main goals and providing sound answers to the above stated research questions will be achieved through:

- **Literature review :** to find out and analyze state of the art of e-textbook: existing concepts, technical specifications and developments, publishing models, conceptual changes and trends in Estonia and worldwide; to develop understanding of different technical concepts like adaptive systems, user modeling, recommender systems, semantic web and content aggregation in TEL domain; to get familiar and analyze previous research that has been done in this area.

- **Technology survey**: An extensive, annotated and comparable collection of related artifacts, such as: systems, applications, prototypes and other software products; Goal: to get to know current 5 technical and pedagogical possibilities of available ICT tools for creating e-textbooks. Methods: information search from different scientific papers and web sources; unstructured interviews with different focus groups: educational technologists, university teachers, IT-specialists, researchers and experts in this field. Interviews can be done through e-mail, via skype and face-to-face. Data will be analyzed using mixed methods.

- Analyzing of available open digital learning resources and e-courses created in frame of European Social Foundation e-content production program BeST (implemented in Estonia in 2009-2013) according to certain criteria. Goals: to define possible elements and matured concept of e-textbook (can produced digital content be perceived as e-textbook or part of it). To find out if the existing e-course' quality guidelines and prize models that were developed during BeST program are affecting digital content quantity and quality. Methods: interviews with different focus groups, university teachers and educational technologists in Estonian higher education institutions; discovering (from repository of DLR and open web) e-courses, e-textbooks and learning objects; setting up analyzing criteria and qualitative analyze of digital learning resources.
- Students' survey: to find out students' expectations towards e-textbooks, their technical readiness to use different digital learning resources. Methods: structured interview with Tallinn University students of bachelor and master level; and quantitative data analyses in software like Excel.
- Designing the foundations of an architecture supporting enable the use of a textbook metaphor for educational content aggregation (based on previous research steps); Goal: to provide technical solution for finding and aggregating e-textbook content from different parts and sources (i.e. recommender systems inside repositories or adding some elements of adaptivity to certain learners in e-learning environment,).
- Developing a concept demonstration prototype;
- Contextual validating of the proposed architecture: structured questionnaire with quantitative analyses in Excel, interviews, visual observation of students.

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