

E-Textbook with Lecturer-Created Quiz Capabilities

Jongmyung Choi¹ and Iksu Kim^{2*}

¹*Department of Computer Engineering, Mokpo National University, Muangun,
Jeonnam, South Korea*

²*School of Computer Science and Engineering, Soongsil University, Sangdodong,
Dongjakgu, Seoul, South Korea
jmchoi@mokpo.ac.kr, iksuplicer@ssu.ac.kr*

Abstract

The e-book industry has been growing very fast for the last several years, and the e-book sales at Amazon.com already surpassed the printed books at the end of 2010. In the near future, the printed textbooks in K-12 and in higher education will be replaced by the e-textbooks that support multimedia and user interaction. Furthermore, the future e-textbooks will support user interactive quizzes and instant feedbacks on the quizzes for students' better learning and lecturers' better teaching. Quizzes and feedback in classes are very common and helpful to check students' understanding and to correct their misunderstanding. However, the current e-textbooks support only limited capabilities for quizzes and feedback. For example, they do not support interactive quizzes, instant feedbacks, statistics for students' understanding, or methods for lecturers to make their quizzes in the e-textbooks. In this paper, we propose an e-textbook system that supports interactive quizzes, instant feedback, and quiz-maker, which allows lecturers to make their own quizzes at schools after deploying e-textbooks. Using this e-textbook system, lecturers can make quizzes at any pages in the e-textbooks, and students are able to check their understanding efficiently with instant feedback while reading the books. We also introduce our prototype system, which is implemented utilizing HTML5. The prototype system has advantages such as device independence, ease to implement and low cost.

Keywords: *E-textbook, Quiz, Lecturer Created Quiz, HTML5*

1. Introduction

The book market is about \$151 billion, and it is much bigger than those for music or movies [2]. In the whole book market, e-books have become very popular and common with the popularity of smart phones and tablet devices. Even though the e-book market is still small portion in the whole book market (about 15% in U.S. [2]), its growth rate is very high, about 34% increase from 2012 to 2013 [1]. Furthermore, at Amazon.com, e-book sales already surpassed the traditional paper book sales in 2010 [14]. In the near future, e-books will be the major portion of the book market, and take the place of the printed books.

Textbooks are books used in K-12 schools and universities. Until now, textbooks have been the printed books, but there have been some tries to convert the textbooks into the e-textbooks. In U.S. e-textbook market is about \$14 billion [3], and they expect that e-textbooks will reduce costs, improve education, and allow new enhanced textbooks which include multimedia and user interaction. Similarly, Korean government also announced her plans to distribute the e-textbooks to K-12 schools until 2015.

E-textbooks are a kind of e-books, and they adopt the same technologies used in the general e-books. However, the e-textbooks require extra technologies that help students to

* Corresponding Author

understand what they read and what they learn in their classes. According to some research [7], multimedia helps students to understand what they learn, so that some e-textbook such as iBooks [4] from Apple support rich media and user interaction. In education, another important things which improve learning are quizzes and instant feedback. The quizzes and instant feedback are very important in the e-textbooks because they check whether students understand what they learned or read. However, the existing e-textbook systems do not provide interactive quizzes, or allow the lecturers to make their own quizzes in the e-textbooks.

In this paper, we propose an e-textbook system which supports interactive quizzes, instant feedback, correct/wrong answers statistics, and lecturer-created quizzes. The quizzes in the e-textbooks can help students to check what they understand and what are important in their learning. The quiz test is evaluated instantly, and it allows the student instantly to check his/her understanding. For efficient education, lecturers should know about students' status: what they understand and the parts where they feel difficulties in understanding. That information can be drawn from the statistics of quiz testing result. The lecturers need to make their own quizzes in their classes, and add them to the e-textbooks for the students to check their learning while reading the books. Author(s) and lecturers are able to add quizzes while writing e-textbooks or after deploying the books. In the system, a quiz consists of a question, multiple examples, correct answer(s), and a page number. The page number is used to specify the location where the quiz is popped up. In our system, students' e-textbooks are grouped according to school or classroom, and the books in a group are identified with a group number. Therefore, a teacher can add quizzes to e-textbooks in a group, and the quizzes are spread out the e-textbooks in the group automatically. Therefore, lecturers can customize quizzes in their classes.

Our work has three contributions in e-textbook technologies. First, we propose the concept of quiz-enabled e-textbooks, and interactive quizzes and feedback will help students and lecturers for better education. Second, we introduce the concepts of group-segmented e-textbook, in which we group e-textbook users according to school or classroom. This concept makes it possible for the lecturers to create their own quizzes, register them to their classes, and appear the quizzes in the class students' e-textbooks. Third, we introduce our prototype system in MVC (Model-View-Control) architecture, which allows lecturers to add quizzes after deploying e-textbooks. This architecture allows authors and lecturers to add extra information or services after deploying e-books.

This paper consists of four sections. In Section 2, we will summarize the related works and compare them to our work. After then, we describe the requirements and design issues for the e-book system in Section 3. In Section 4, we specify our prototype system and its evaluation, and finally we reveal our conclusions in Section 5.

2. Related Work

There has been research on e-books or e-textbooks. The existing research is categorized into two groups: user studies on e-textbooks. The work in the first group is about experimental studies to find the effectiveness of quizzes and feedback in the e-textbooks. Sally Maynard and Emily Cheyne [7] conducted an experiment to verify if the e-textbook could improve students' learning. In their study, 60 students participated in the experiment, and they were grouped into two: one group used the printed textbook, and the other group used an e-textbook in CD-ROM. After the study, they found that the e-textbook was widely accepted by students, and it improved group participation. Furthermore, the e-textbook users got higher test score in the group test and in the individual tests compared to the printed textbook users.

David Pundak, *et al.* [13] studied student attitudes towards their Web-based Online Assignment Checker (OAC) in the school classes. The OAC system checked students' assignment and gave them feedback. Their study revealed that the students believed that

OAC assisted lecturers to relate to their difficulties, contributed to their success in the course, and did not encourage cheating such as copying.

Law E. and Sze Dai Pang [11] utilized online assessments for students and instructors to monitor the learning process. Their research questions were whether the assessments might improve the learning outcomes of students, and whether there were links between the result of the online assessments and final grades. According to their study, the online assessments were effective in improving students' learning and achieving their goal outcome. Furthermore, there were clear correlation between the achievement in online assessments and the final grade. Their study showed the effectiveness of online assessments and the importance of students' self-monitoring of their process and the level of achievement in their learning.

The research in the first group was about user studies on e-textbook and online quizzes. And the studies revealed that e-textbooks were accepted by students, and quizzes and feedback helped students and staff in education. Therefore e-textbook should support quizzes and instant feedback for better education.

The work in the second group is about e-textbook systems. Those systems have some similar features compared to our system. Ben Freasier [9] introduced a web-based homework quiz system, which was designed to help undergraduate chemistry students in learning. Students were able to access the system via the Web at any time at any place only if their computer were connected to the Internet. It supported interactive quizzes, external links to helpful chemistry sites, and animated 3D chemical structure visualization. The system got positive feedback from students and staff.

Sawaki M. *et al.* [10] introduced a quiz dialog system and its users' evaluation results. According to their work, its quiz style information was helpful to students in their learning. An interesting feature of the quiz system is that it was able to automatically generate quiz questions from Wikipedia articles.

Yoshimichi Oikawa, *et al.* [12] introduced a similar question generator, which was designed for and applied to peer teachings in university chemistry classes. Compared to other systems such as Ben Freasier [9]'s, it was able to generate similar quiz questions dynamically at client side utilizing Javascript. On generating questions, the system used a pre-defined question, but it changed the examples in the question at runtime. Compared to the existing peer teaching, in case of peer teaching with similar questions, students participated more actively in their learning.

The studies in the second group were related to the e-textbook systems, and the systems had similar features, *i.e.* quizzes and instant feedback compared to our prototype system. However, our concept and proposal have at least three uniqueness contrasts to the existing systems. First, the existing systems kept the content and the quizzes together, not separated. However, we separate the quizzes from the content, so that we can apply the quizzes to other e-textbooks without modifying the books. Second, the existing systems cannot add quizzes after deploying the systems, but our system is able to add quizzes after deployment. Third, the existing systems did not support lecturer-created quizzes, but our concept and prototype systems allow lecturers to add quizzes at schools.

3. E-Textbook with Quizzes

3.1. Evolution of E-textbook

The concept of "electronic book", known as ebook or e-book started at the late 1960s [6]. Similarly, electronic textbooks (e-textbooks) are a kind of e-book, but they are textbooks used at school for educational purpose.

According to the e-book formats and the devices, the development phase of e-textbooks can be divided into two stages: the initial stage and the second stage. In the initial stage, the e-textbooks were used in desktop computers, and they were carried with

CDs. In this stage, the use of e-textbooks has been expanded rapidly since the 1990s with the popularity of personal computers. Those e-textbooks included multimedia data and provided students with interactive form to help them to study with fun and less efforts. Unfortunately, the e-textbooks were built on companies' own proprietary format, so that they were not able to be widely used by users, nor developed by content providers. As the result, the e-textbooks were not as popular as the printed textbooks, so that the e-textbooks in this stage were used only as the auxiliary material for education.

The second stage, in which we are now, has started since around 2007 with the advent of Amazon Kindle and Apple iPhone. Those devices allowed users to move around with their own computing devices, and the e-books were delivered to the devices via wireless network or WiFi. Furthermore, the e-book contents were in the standard format such as ePub2. However, e-textbooks in ePub2 have some drawbacks to overcome: lack of rich media or user interaction. In the future, the e-textbooks in this stage will take the position of the existing printed textbooks, and they will become the primary material in schools. The U.S., Korea, and other countries have plans to replace the printed textbook with e-textbooks.

Table 1 shows the similarities and differences of e-textbooks in two boom periods. The biggest difference is the e-textbook software. The e-textbook in the initial stage is an application integrated with content. However, the e-textbook in the second stage consists of a viewer software and the e-textbook content. Therefore, authors only need to create e-textbook content not software.

Table 1. Comparison of E-textbook Development Stages

	Initial Stage	Second Stage
Device	Desktop computer	Smart device
Boom Period	1990s	2010s
Viewer SW	One viewer for one e-textbook	Shared viewer for e-textbooks
Content Format	Proprietary format	Standard format (ePub, HTML5)
Delivery	CD	Wireless network
Multimedia	Support	Not support (ePub2) Support (ePub3)
User Interaction	Support	Not support (ePub2) Support (ePub3)
Quizzes	Support	Not support
Costs for an e-textbook	Very high	Low
Time to develop an e-textbook	Very long	Short

3.2. E-Textbook System Design

The traditional e-book system consists of a hardware device, e-book viewer software, and the e-book contents. The contents are downloaded from e-book marketplaces such as Amazon.com or e-book servers. Some e-book viewer software utilizes cloud computing services for managing e-book contents, bookmarks, comments, and other information. The traditional e-books in ePub2 do not support the feature of interactive quizzes. They support only text-style, non-interactive quizzes. The quizzes are a part of e-textbook content. Therefore, students have difficulties in checking their understanding. Figure 1 shows the architecture of the traditional e-textbook systems.

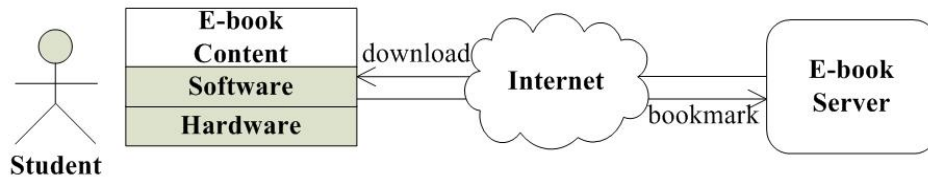


Figure 1. E-textbook System

There is another media that has been used as e-textbooks, the Web page. It is still used as e-textbooks in schools. The Web-based textbooks are open to the public, but most of them are used by small group of students when they are used as the e-textbooks in schools. In the most cases, the publishers, authors and class lecturers are the same person. Therefore, the lecturers can freely access to the contents, and modify them. Sometimes, they can add some quizzes in the e-textbook to help their students understand what they learn.

In contrast to the Web-based e-textbooks, the traditional e-textbooks, whether in CD or in ePub format, are connected to the publishing companies, and they are used in mass schools and classes. In the traditional e-textbook, publishers, authors, and lecturers are all separated. As the result, the lecturers cannot modify the contents nor add their own quizzes questions. The traditional e-textbooks in ePub format are still not yet widely used as the primary textbook in school, but they are considered as the future e-textbooks.

To overcome the limits of the traditional e-textbooks, which do not allow the lecturers to modify the contents or add quizzes, we propose an e-textbook system with small group partitions. It follows the traditional e-book's publishing and delivery system, but it allows lecturers to add their own quizzes to the e-books for their class groups. Figure 2 shows the relation between e-textbooks and readers. In Web-based e-textbooks, the web pages are used as e-textbooks, and the students who use the web pages as their e-textbooks are small number. However, e-textbooks in ePub2 are published and delivered by large publishing company, and their readers are massive. Figure 2-c shows a new e-textbook, which follows mass publishing and delivery system, but its readers are partitioned into small groups like classes. Therefore, group leader, *i.e.* lecturer, can have some privilege to add quizzes and information.

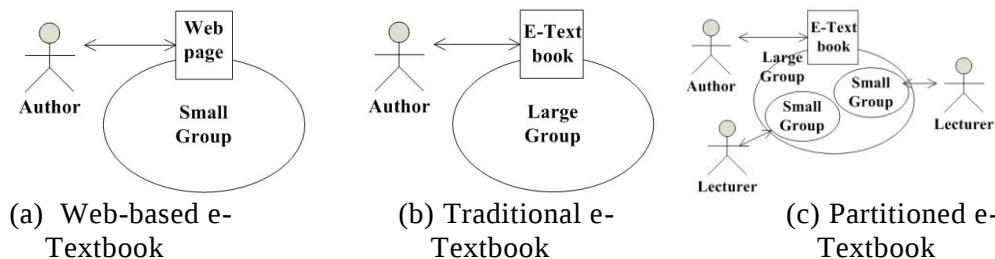


Figure 2. E-textbook and Readers' Group

For the “partitioned e-textbook system” in Figure 2-c, we have two strategies: giving IDs to users, and separation of e-book content and quizzes. The lecturers can make groups with unique ID (group ID) and students participate in the group. Then we have a Quiz Server to manage quizzes separated with e-textbook content. The quizzes are stored in the Quiz Server with group ID. While students read the e-textbook, the quizzes pop up in the e-textbook. The quizzes are interactive, and students' answers are evaluated instantly and give them feedback. Figure 3 shows the architecture of quizzes enabled e-textbook. The Quiz Server is separated from the E-book Server. The E-textbook content is downloaded once at install time, but the quizzes are downloaded at runtime from the Quiz Server.

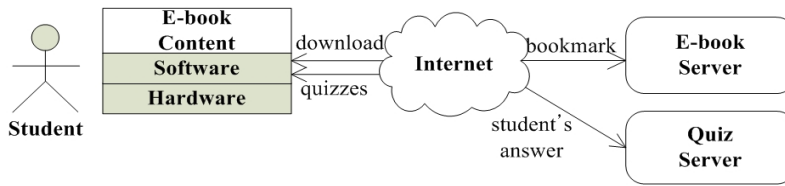


Figure 3. Quizzes-Enabled E-textbook

4. Prototype System and Its Evaluation

4.1. Implementation and Testing

We have implemented the e-textbook system utilizing our HTML5 e-book platform, which was developed in our previous research [5]. The e-textbook viewer is a hybrid app., and it utilizes WebView component and the Web technologies such as HTML5, CSS, and JavaScript. We added interactive quiz features to the existing platform. Fig. 4 shows the architecture of e-textbook viewer that supports quizzes. The architecture follows the MVC (Model-View-Controller) pattern. The DOM plays the role of Model in the architecture, and it contains all the data for e-textbook content and quizzes. It receives e-textbook content from e-book server and quiz information from Quiz Server, and combines them into one DOM (Document Object Model) tree at runtime. E-textbook Viewer plays the role of View and Controller in MVC pattern.

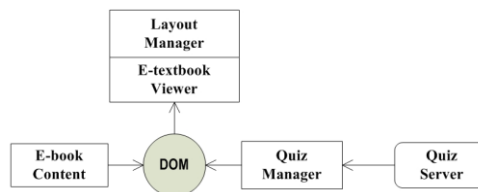


Figure 4. MVC Architecture

Figure 5 shows the lecturer's view of an e-textbook. When lecturers use the e-textbook, it shows the menus for manipulating quizzes as shown at top left in the figure. Each lecture should have a unique ID to distinguish himself/herself from students, and he/she is able to create group IDs for his/her classes at school.



Figure 5. Lecturer's Page

Figure 6 shows how to create a quiz. A quiz consists of a question, a number of examples, the correct answer, and the page number in which the quiz pops up. A question can be a single choice or multiple choices from multiple examples. Furthermore, a question may have a picture in its question.

Figure 6. Creating a Quiz

Figure 7 shows a quiz popup in the e-textbook. Students read a page in the e-textbook, and on the moment of leaving the page, the quiz pops up. They check what they read or what they understand by answering the quiz. The quiz is evaluated instantly and shows the result to the students. Therefore, students get feedback through the quiz and its evaluation about their understanding of what they read and what they learn. Furthermore, the results of the quizzes are sent to the Quiz Server, stored at the server, and the data are used to get statistics on students' understanding and difficulties in their learning.

Figure 7. Quiz Popup in E-Textbook

4.2. Quiz-Enabled E-textbook Evaluation and Future Work

Our prototype system supports interactive quizzes, instant feedback, quiz statistics, and lecturer-created quizzes after deployment. However its implementation has some limits: it does not support quizzes with rich media. For example, it cannot include videos in its question or in its examples. It does not support automatic quiz generation which was introduced in Yoshimichi Oikawa's research [12]. In spite of its limits, it has unique features compared to the existing systems. Table 2 shows our prototype system's uniqueness and the similarities with other existing systems.

Table 2. Evaluation of Our Prototype System

Category	Features	Applications	Web Pages	ePub2	Our Prototype
Platform	Device	PCs	PCs	Smart Devices	Smart Devices
	Content Format	Proprietary Format	Web Standards	ePub2 Standard	Web Standards
	Viewer SW	Proprietary Applications	Web browser	Standard Viewer	HTML5 Web browser
	Delivery	CD	Network	Wireless network	Wireless network
	Style	Full Screen Game	Scroll	Book	Book
Capability	Multimedia	Yes	Yes	No	Yes
	User Interaction	Yes	Yes	No	Yes
	Script	No	Yes	No	Yes
	Quiz	Yes	Yes	No	Yes
	Statistics	No	Possible	No	Yes
	Lecturer-Created Quizzes	No	No	No	Yes
	Lecturer-Created Information	No	No	No	Yes
E-textbook Development	Viewer and Content	Integrated	Separated	Separated	Separated
	Content and Quizzes	Integrated	Integrated	Integrated	Separated
	E-textbook Development Cost/Time	High / Long	Low / Short	Low / Short	Low / Short
Quiz Development	Quizzes Development Cost/Time	High / Long	Medium / Medium	Medium / Medium	Low / Short
	Quiz Creator	Authors	Authors	Authors	Authors / Lecturers
	Quiz Creation Time	While Writing Books	While Writing Books	While Writing Books	Any Time
	Multimedia Quiz	Possible	Possible	No	Possible
	Group Support	No	No	No	Yes

5. Conclusions

Similar to the popularity of e-books in the publishing market, e-textbooks will replace the printed textbook at schools in the near future. The most of e-textbooks are in ePub format, and they do not support quizzes or instant feedback to the students. Quizzes and feedback in education have been known to be very helpful for students to understand what they learn, and to correct misunderstanding. Therefore, quizzes and instant feedback in the e-textbook are very important features.

In this paper, we proposed an e-textbook system in which the lecturers can add their quizzes to the e-textbook. A lecturer has his/her own identifier and sign in the sever system to get privilege to make quizzes. Lecturers can make quizzes by writing questions, examples, correct answers, and page numbers. The quizzes in the e-textbook will help students to check whether they understand classes, and to correct what they misunderstand with instant feedback. The cumulated data from the quizzes and students'

answers will help the lectures to understand which parts are difficult for their students to understand. Our quiz-enabled e-textbook will enhance efficiency in education.

Acknowledgements

This research was supported by Research Funds of Mokpo National University in 2014.

References

- [1] J. Lee, "E-book Market Trend and Future Prediction and the Structural Changes in the Value Chain of the Publishing Market", Information and Communication Broadcasting Policy, KSIDI Pub., vol. 26, no. 8, (2014), pp. 1-21.
- [2] R. Wischenbart, C. Carrenho, J. Celaya, V. Licher, M. Kovac, and V. Mallya, "Global eBook: A report on market trends and developments. Update spring 2014", (2014) April,
- [3] J. Band, "The Changing Textbook Industry", DISCO, (2013) November.
- [4] iBooks, available at <https://www.apple.com/ibooks/>
- [5] J. Choi, Y. Lee and K. Kim, "An HTML5-based Interactive E-book Reader, International Journal of Software Engineering and Its Applications", vol. 8, no. 2, (2014), pp. 67-74.
- [6] H. Henke, "Electronic Books and E-Publishing", Springer Verlag, London, (2001).
- [7] S. Maynard and E. Cheyne, "Can electronic textbooks help children to learn?", The Electronic Library, vol. 23, no. 1, (2005), pp. 103-115.
- [8] D. P. Brunet, M. L. Bates, J. R. Gallo 3rd, and E. A. Strother, "Incoming Dental Students' Expectations and Acceptance of an Electronic Textbook Program", Journal of Dental Education, vol. 75, no. 5, (2011) May, pp. 646-652.
- [9] B. Freasier, G. Collins, and P. Newitt, "A Web-Based Interactive Homework Quiz and Tutorial Package To Motivate Undergraduate Chemistry Students and Improve Learning", Journal of Chemical Education, vol. 80, no. 11, (2003) November, pp. 1344-1347.
- [10] M. Sawaki, Y. Minami, R. Higashinaka, K. Dohsaka, and E. Maeda, 'Who is this' quiz dialogue system and users' evaluation, Spoken Language Technology Workshop, IEEE, December, (2008), pp. 149-152.
- [11] E. Law and S. D. Pang, "Use of online assessments to monitor learning outcomes in higher level engineering courses", Proc. of Interdisciplinary Engineering Design Education Conference (IEDEC), IEEE, March, (2014) pp. 18-23.
- [12] Y. Oikawa, R. Matsuba, T. Kita, K. Suzuki, and H. Nakano, "Development of a Similar Question Generator to Support Peer Teaching", Proc. of International Conference for Media in Education 2012, (2012) August.
- [13] D. Pundak, M. Shacham, and O. Herscovitz, "Integrating Online Assignments Checking in Introductory Courses", Journal of Information Technology Education: Research, vol. 12, (2013), pp. 191-202.
- [14] Bloomberg, "Amazon.com Says Kindle E-Book Sales Surpass Printed Books for First Time", available at <http://www.bloomberg.com/news/2011-05-19/amazon-com-says-kindle-electronic-book-sales-surpassprinted-format.html>, May (2011).

Authors



Jongmyung Choi, He received the Bachelor's degree, Master's degree, and Ph. D. in Computer Science from Soongsil University, South Korea, in 1992, 1996, and 2003 respectively. He is currently an associate professor in the Department of Computer Engineering, Mokpo National University, South Korea, since 2004. He did research as a visiting scholar at Georgia Institute of Technology, USA, from September, 2010 to December, 2011. His research interests are human computer interaction, context-aware systems, social computing, and healthcare.



Iksu Kim, He received the B.S., M.S., and Ph.D. in Computer Science from Soongsil University, South Korea, in 2000, 2002, and 2008, respectively. He worked at SKYCOM as a manager until January 2009. He is currently an assistant professor in the School of Computer Science and Engineering at Soongsil University since September 2009. His research interests include system security and network security.