PROMOTING HYBRID LEARNING THROUGH A SHARABLE ELEARNING APPROACH

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ABSTRACT

Educational technology is developing rapidly, making education more accessible, affordable, adaptable, and equitable. Students now have the option to choose a campus that can provide an excellent blended learning curriculum with minimal geographical restraints. We explored ways to maximize the power of educational technologies to improve teaching efficiency and cut costs without sacrificing high quality or placing an extra burden on faculty. This mission was accomplished through adaptable e-learning content design and development.

We developed scalable, shareable, and sustainable e-learning modules as textbook chapters that can be distributed platform independently. The resulting e-learning building blocks can automate the assessment processes, provide just-in-time feedback, and adjust the teaching material dynamically based upon each student's strengths and weaknesses. Once built, these self-contained learning modules can be easily maintained, shared, and re-purposed, thus cutting costs in the long run. This encouraged faculty to share their best teaching practices online. The end result of the project is a sustainable knowledge base that can grow over time, benefiting all the disciplines through knowledge reuse and sharing.

KEY WORDS

Elearning, Instructional Design, Hybrid learning, SCORM, Computer-Assisted Instruction, Just-in-time Feedback

I. INTRODUCTION

The cost of textbooks has been increasing over the years. Advances of emerging technologies, such as Web 2.0, expedite the growth of collective intelligence and the process of offering knowledge in digital formats. Domain experts can now contribute to the ever-growing knowledge base over the Internet without help from programmers. Further research is needed to enable students to access digital textbooks based upon open access materials through emerging technologies.

EBooks are gaining popularity as an alternative to traditional books. EBooks are electronic versions of

printed books readable on a personal computer or hand-held device. Adopting eBooks not only saves trees, it also allows learners to search contents, share notes, and collaborate with others. The International Digital Publishing Forum (IDPF) reported (http://www.huffingtonpost.com/mark-coker/ebook-market-exploding-co_b_507107.html) that U.S. wholesale eBook sales for the month of January 2010 rose 261 percent to $31.9 million from the same period a year ago (Figure 1). Also in July of 2010, Amazon announced that their eBooks sales outnumbered their hardcover books (i.e., 143/110) for the first time in the past three months (http://www.nytimes.com/2010/07/20/technology/20kindle.html?_r=1). Based upon the 2010 Horizon Report (http://wp.nmc.org/horizon2010/), eBooks are gaining a competitive edge over traditional textbooks on campus – the time-to-adopt horizon is expected to be two to three years.

Figure 1. The trend of eBook sales

However, there are currently no standard eBook formats and no standard eBook Readers that allow any student to access to any eBook on any subject domain through any digital device. For instance, some eBooks are in PDF or image formats (i.e., JPEG, GIF, PNG, or BMP); while others (e.g., Kindle (AZW), MP3, MOBI, EPUB, eReader, BBeB, PRC, AAC, etc.) are supported by independent and open-source programmers. As a result, the practice of multiple eBooks following multiple formats fragments the eBook market. A standard for packaging and selling eBooks is lacking, thus it keeps authors from distributing their books to all eBook devices.

In our study, we developed web-based scalable, shareable, and sustainable e-learning modules that could be assembled as chapters and distributed through any web-enabled device. The e-learning modules combine both content and assessment and are presented in an ordered fashion that allows a student to practice and drill as they gain knowledge. The result is an electronic textbook alternative unlike the current trend for e-textbooks, which are simply digital copies of traditional textbooks.

The study was lead by faculty from the Department of Academic Computing and Educational Technology at York College of The City University of New York. Three instructors participated in the study, offering six computer literacy courses in Spring, 2010. One instructor, also the author of this paper, collaborated with the other two instructors who had never taught hybrid courses. The use of the proposed elearning modules

and Web 2.0 technologies was exploited to enhance hybrid learning.

Once built, our self-contained learning modules can be easily maintained, shared, and re-purposed, thus cutting costs in the long run. This encourages faculty to share their best teaching practices online. The end result of the project is a sustainable elearning module knowledge base that could grow over time, benefiting all the disciplines at our college. We hope our work will also help nontechnical teachers build confidence and competency to leverage the emerging technologies in the classroom and to better prepare students for their future professions.

We asked the following research questions to progress towards an effective elearning solution.

- Is such a system easy to scale up?
- What tools do teachers need to develop reusable eLearning modules?
- How to encourage informal learning through a sharable and reusable framework?

Our goals were to make the best use of emerging technologies and existing collective intelligence from the Internet to build elearning modules that could improve teaching efficiency and cut costs. The objectives listed below illustrate what we wanted to achieve through the development of elearning modules.

- Promote collaboration: 1) The sharing of elearning modules or their collections as chapters would invite active and meaningful discussions and collaboration among faculty regarding domain content and pedagogical strategies. 2) We would establish and maintain collaborative working relationships with other campuses interested in management and development of sharable elearning module knowledge base.

- Design effective assessments tools: adaptive instruction could only be achieved through a better understanding of the students through effective assessments. We would develop effective tools to automate the assessment processes that were not possible with traditional textbooks. The assessment result would also reflect the needs and strengths of a student in terms of learning objectives instead of final scores.

- Promote standardization of elearning modules for compatibility, scalability, reusability, and portability.

- Adapt to future efforts: explore, develop, and evaluate an effective and generic electronic textbook alternative model that could be easily adapted to fit other learning enhancement efforts.

- Inform future research: innovative pedagogical strategies and instructional design practices could be derived from this project.

II. REUSABLE AND SHARABLE ELEARNING MODULE DESIGN

A. Instructional Design Goals and Model

Our design of elearning modules was informed by the extensive research on Computer-Aided Instruction (CAI) for individualized learning. Learning with a personalized tutor has proved to be one of the most effective ways of learning. There is overwhelming research to support the benefits of one-on-one tutoring in improving students' grades, problem solving skills, and motivations [1, 2, 3, 4, 5, 6, 7, 8, 9,10] Using computers to provide personalized instruction as an alternative to human tutors has drawn the attention of researchers in the fields of computer science, education, psychology and cognitive science. Our elearning modules are remotely accessible, allowing students to: (1) gain essential knowledge in the subject domain,

(2) practice and drill, (3) receive just-in-time feedback, and (4) track performance assessment results for reflection and learning transfer. In addition, elearning modules, in the role of "computer–as-tutor," were able to: (1) observe students' performances, (2) identify misconceptions and missed concepts, (3) provide immediate feedback, and 4) inform instructors of potential problems with the class's understanding of the material.

Rapid prototyping based upon the ADDIE [11] instructional design model was applied, which include the following system design phases: Analyze, Design, Develop, Implement, and Evaluate. This instructional device helped us analyze our students' learning needs, review existing resources, design and develop elearning module materials, implement modules into chapters, and evaluate usability. It was a re-iterative process during which we met with instructors for suggestions or questions, checked with students informally for feedback, and redesigned/reassembled some elearning components to improve learning experiences. We conducted post-instructional summative evaluation. Through anonymous surveys, we asked questions related to the usability of the modules and users' learning experiences.

B. SCORM-based Elearning Module Design

The basic unit of a page in an elearning module is a Shareable Content Object (SCO) (Figure 2). Each SCO represents a very specific piece of course content. An SCO can be a single web page or a collection of web pages. As each SCO is self-contained, altering one SCO will not affect the functionality and performance of the entire elearning module. Each SCO can communicate with a Learning Management System (LMS) through an adapter written in Javascript. This adapter is platform and web-browser independent. It functions as a messenger (i.e., sharing information, such as interactions and user preferences) between SCOs and LMSs.
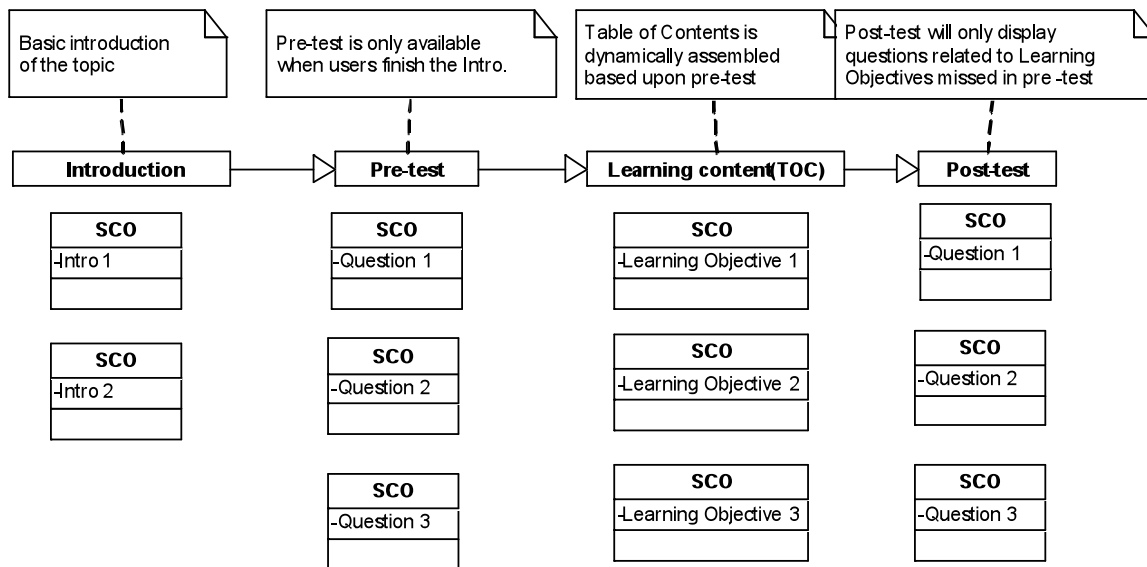

Figure 2: Each SCO acts as a building block that can be delivered to students based upon their performance.

SCO is part of the Shareable Content Object Reference Model (SCORM) elearning standard sponsored by the US Department of Defense [12], which mandates that all its e-learning purchases should be SCORM-compliant. Among SCORM goals are the ability to enable interoperability, accessibility and reusability of web-based learning content for industry, government, and academia. It aims to achieve the ideal of learning anytime anywhere through enabling any SCORM-conformant elearning content, developed with any au-

thoring tool, to be distributed to any learner, from any platform, by any SCORM-conformant LMS. Today, most major LMSs and educational software vendors comply with this standard for creating and deploying elearning.

The SCORM-compliant elearning module can track, among other things, the time each student spends in the module, where he or she is having trouble and, with that information, dictate what comes next. This individualized approach allows for optimal self-paced learning. Also, elearning modules will have the potential to be utilized across a variety of curricula. For example, the college's research librarian could create a chapter built from elearning modules that teaches and evaluates students' abilities to critically examine web resources. This information literacy chapter could be used in a variety of courses ensuring students are prepared for online research.

The SCORM standardization allows each piece of course content or SCO to be developed once and then reused with any other SCO in any other course or courses. Figure 3 is a mock-up map showing what a sharable knowledge base will be like when faculty across disciplines are involved in the development of elearning SCOs. An SCO can be transported to any other LMS that complies with the SCORM standard. It also separates the content development from the instructional strategy design. Such process of resource aggregation is done through content packaging. For example, an instructor can group a set of SCOs developed by others and define his or her own sequencing rules. Or an instructor can apply the same set of instructional rules to different groups of SCOs in different subject domains. Most major elearning tool vendors (Adobe, Microsoft, SoftChalk) provide user-friendly authoring tools that allow users to specify SCOs they want to include, a description of those SCOs, and what data they'd like to be saved to LMS (Figure 4). The resulting specification is an XML file with a structure like a table of contents (Figure 5). The XML files, called manifest files, are saved in the root folder of the learning package. The package is usually wrapped in a zip file. The zip file as a single unit can be uploaded to any SCORM-LMS. When a learning package is requested by a user, a SCORM player will parse the manifest file first to understand how the SCOs are structured and where to find them before displaying them.
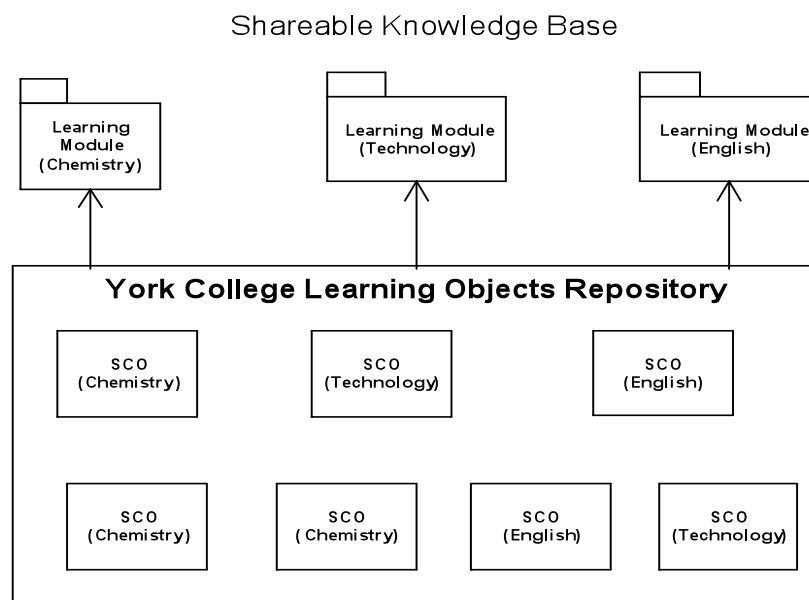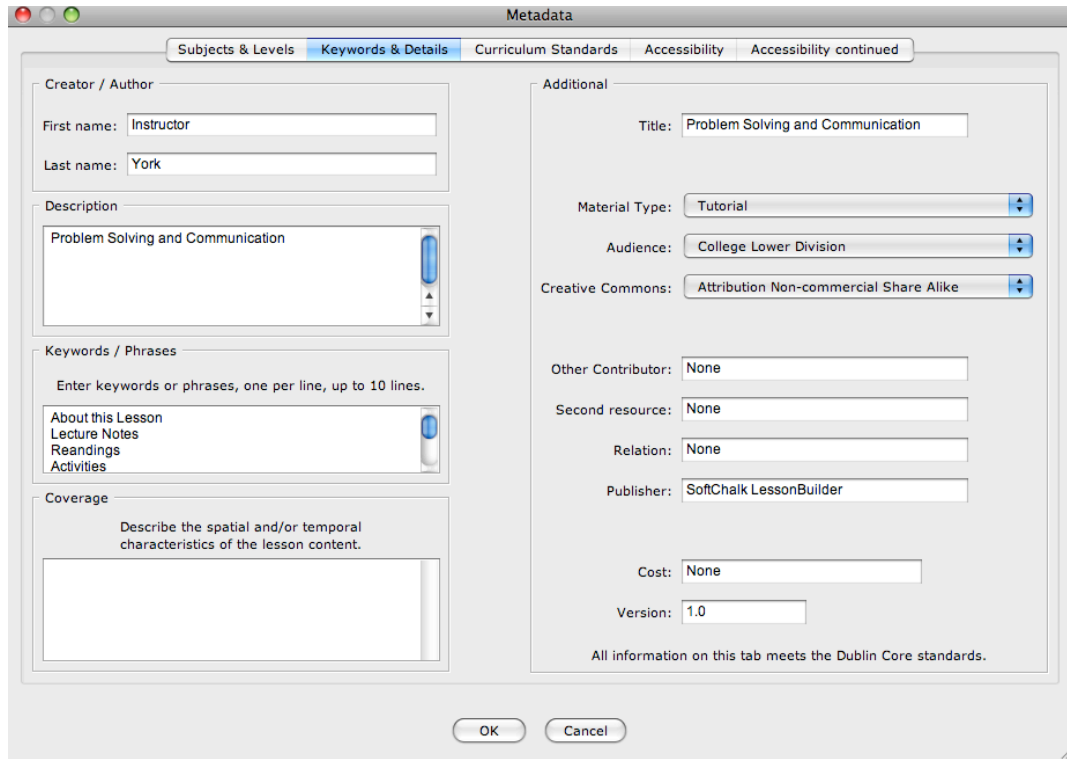

Figure 3: The knowledge-sharing repository

Figure 4: The Interface of an Authoring Tool from Lessonbuilder (Http://Softchalk.Com)
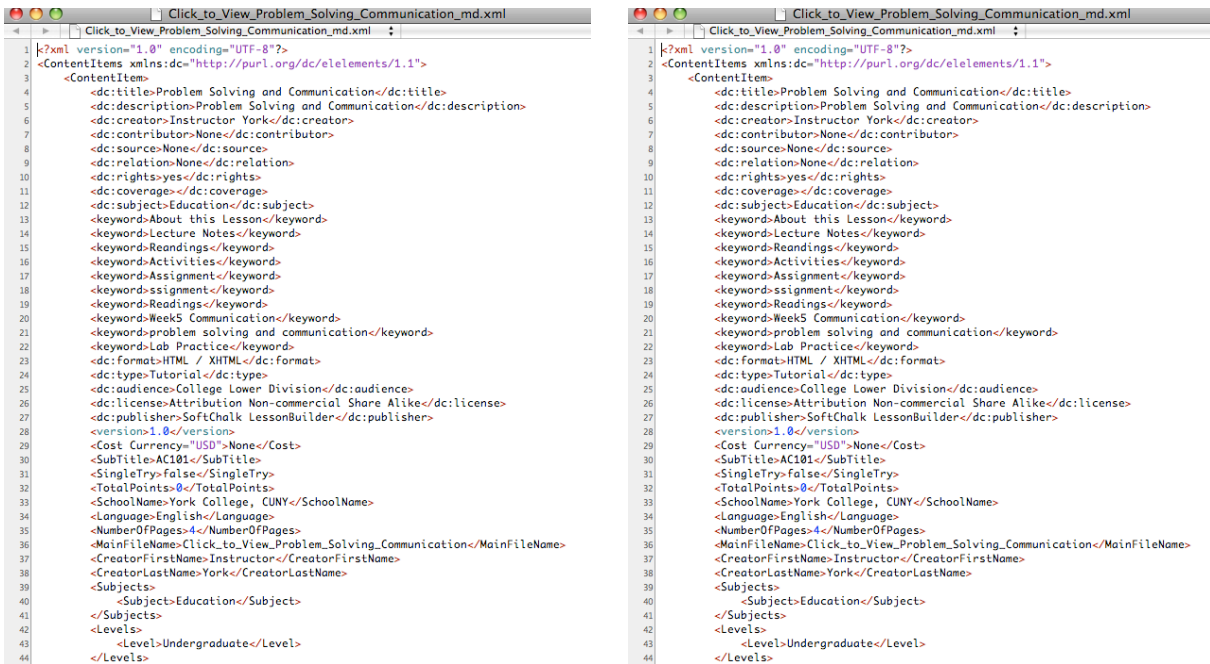

Figure 5: Left: a sample XML file with metadata describing a learning content that can be interpreted by SCORM-compliant LMSs; Right: a sample manifest file describing a learning package with three SCOs and the corresponding files for each SCO

C. Elearning Module Development and Implementation

Two college assistants helped design and develop elearning modules with a total workload of about 15 hours a week. They were both from the Teacher Education department with limited technical background. They used Dreamweaver and LessonBuilder as authoring tools to assemble modules into chapters – one for each week. Instructional strategies were considered throughout the design process. SCORM does not regulate which instructional strategies should be used and how. We implemented instructional strategies through designing interactive components (e.g., flash card games, cross-word puzzles), providing just-in-time feedback (e.g., quizzes), promoting collaboration (e.g., online discussion through LMS), or encouraging social networking (e.g., peer support through blogging).

We did an initial training with the two instructors who taught the course in hybrid format for the first time. They had taught the same course in face-to-face format in earlier semesters. They felt the flow of the course structure was clear and the design of each elearning module was well thought-out and reasonable. They were trained on how to manage the content in our LMS (Blackboard). For instance, they learned how to view user test, interactivities, number of learning attempts, and duration of learning. They were solicited for feedback on how to improve the navigation of the learning structure so that students could experience a less steep learning curve.

III. STUDY METHOD

We conducted our pilot study in spring 2010 in six of our computer literacy courses taught by three instructors at a 4-year college. Two instructors had never taught online/hybrid courses before; the third instructor, also one of the authors of this paper, developed the elearning modules. It saved each student about $100 over buying a textbook that was required from the previous semester. The elearning modules were split to chapters posted to BlackBoard each week. We embedded lecture notes, readings, activities (e.g., games, puzzles, etc), assessment, and assignments in each chapter. We found it encouraged collaboration among faculty and was easy to use by students. We have been able to easily reassemble some chapters from the elearning modules to fit our instructional needs throughout the semester (Figure 6).

Figure 6: A SCORM-based prototype for CPE workshop and a computer literacy course. The basic components (SCOs) were packaged together to make an elearning chapter.

IV. RESULTS OF THE STUDY

We conducted student surveys and interviews, soliciting their feedback regarding the usability of the elearning modules (Figure 7). Lessons learned from the process will be the basis for the next round of elearning module design and development. Table 1 below depicts students' answers for each question (N=51).

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I was able to control the pace of my own learning.	49%	41%	8%	2%	0%
The online course materials were difficult to follow.	10%	14%	16%	25%	35%
Online assignments were helpful in understanding the course content.	33%	47%	18%	2%	0%
The time I spent online would better have been spent in class.	11%	6%	18%	18%	47%
The connection between what I did online and in class was clear.	37%	37%	20%	6%	0%
Participating in the online discussion board could be useless for my learning.	12%	20%	20%	12%	37%
I wouldn't have any difficulty managing my time for the online part of the course.	43%	28%	18%	4%	8%
I was unable to share ideas with other students on a regular basis.	12%	14%	31%	24%	20%
I would recommend taking hybrid courses to a friend.	55%	35%	8%	2%	0%

Table 1: Questions answers from the anonymous survey

After the end of the semester, both instructors, although teaching the hybrid course for the first time, initiated feedback through emails below:

Email feedback from one instructor:

"… this hybrid course, offered for the first time in Spring 2010, was a success. The syllabus of this newly revised hybrid course was well thought out and well designed covering the basic computer concepts, terminologies, and hands-on skills normally associated with a computer literacy course. You are to be complimented for the success of the course. I benefited from your work of re-designing the course and was indebted to you. I wanted to acknowledge your contributions."

Email feedback from another instructor:

"Thanks so much for your help and knowledge during this semester. I appreciate it very much. All is going well with the end of semester classes. Looking forward to the fall semester and working with you."

V. POSSIBLE ISSUES AND THE SOLUTIONS

Currently, we are building the elearning modules on top of an existing LMS, BlackBoard, which may be down for system upgrades or maintenance. As our SCORM-compliant elearning modules are self-contained, each learning module can be burned to CD or downloaded from the web and run from a user's computer as an application. The only feature not available is the recording of the student performances as well as the dynamic assembling of the adaptive learning content. But as a temporary solution, it will provide an uninterrupted learning experience for students if issues like this do occur. For the future delivery of the learning modules, we plan to have elearning modules hosted in the cloud, on remote servers, just as web-based email is maintained by host servers. Therefore, instructors do not need to maintain a server, database, or hardware, which is offered and maintained by commercial companies as utility services (e.g., we plan to adopt Rustici's SCORM Engine service and Winhost's web server and database facility in our study). This eliminates another system administration layer, making the constructing of learning content a simple and straightforward process.

We would like to have our future participating faculty members to have an opportunity to share their learning modules beyond their specific knowledge domain. For instance, an instructor building Geology elearning modules could adopt SCOs on Chemistry foundations. Students will benefit the most by receiving instruction from experts across disciplines using the shared and reassembled elearning modules. The authoring tool, LessonBuilder, allows us to load lessons from the local computer to make a new learning package. We can achieve learning module sharing through hosting packaged lessons from a network drive.

Ownership and intellectual property issues could prove to be an impediment to adoption broadly by professors. The creator of each SCO would be its owner and would have the option of not including it in the knowledge base. Also, instructors could decide to create SCOs and make them available only in limited circumstances. We hope to encourage an OpenCourseWare model that will be under some form of a Creative Commons License. We believe instructors will see advantages to having their SCOs adopted in a variety of elearning modules as they receive recognition. This recognition can lead to publication in discipline specific publications or Scholarship of Teaching and Learning publication.

VI. DISCUSSION AND CONCLUSION

Although the SCORM standard has been required in government and industry for elearning content interoperability, academia has been slow to follow their lead. This is partially due to the lack of resources, expertise, and technical support to promote the elearning standardization effort. For instance, Blackboard is a big LMS player in K-16, but its current support of SCORM is still limited. One of the biggest promises of the latest version of SCORM standard, SCORM 2004, is its sequencing feature that tailors instructions to individual needs. But our institution's current Blackboard license, Version 8, which we used, did not support SCORM 2004 as they claimed. There are occasional system glitches running the older version of SCORM 1.2 as well.

We have been in direct contact with the Blackboard's developers of their SCORM plug-in. They communicated that there is a lack of motivation to make Blackboard fully SCORM-conformant, as few universities have allocated resources to develop SCORM-based elearning contents. Blackboard's stance seems emblematic of academia's current level of interest in SCORM.

But this may change over time given SCORM's penetration in other markets. Fletcher [13] estimated that

more than 6 million SCORM learning objects were available globally. It's important to help educators secure the benefits being realized in business by enabling them to locate and access ADL objects already available in industry and government repositories [14]. This is the area that needs much research in the near future. As Collier said, "[elearning standard] support adds considerable cost and time to the testing of product releases. Even though most of these content providers may support a version of SCORM, the technology has not proven to be plug-and-play due to different implementation assumptions made by each content provider" [15].

Based upon the results of this study, we next propose to answer the following questions:

 • Is such a system readily scalable?

New technologies emerge on daily basis. We should try to avoid developing a prototype that may soon become obsolete. Web 2.0 provides web-based applications and services through cloud computing. These applications can interface with each other. A SCORM-based elearning approach allows non-programmer to assemble re-usable elearning modules and embed them in Web2.0 environments for collaboration and knowledge sharing. For instance, a chapter on the Internet for Education can also be adopted in a Teacher Education course, providing opportunities for students to read the materials, practice, and communicate with others. Such systems can expand as the scope of the knowledge repository increases. As contents and instructional strategies are separated, such a system can scale up to fit to different instructional and learning needs.

 • What tools do teachers need to develop open access elearning modules?

The elearning content developed should be interoperable across platforms through flexible delivery options. We created a generic elearning development process based upon widely adopted web authoring tools such as Dreamweaver, MS. Word, FrontPage, MS Visio Studio, and SoftChalk. For starters, we developed some elearning module templates for faculty. These include the basic components in a chapter – quizzes, readings, lecture notes, interactive games. It's the first step to help teachers rapidly develop contents that could generate more thoughtful insights on such issues as human-computer interaction and adaptive elearning.

 • How can informal learning be encouraged through an open access framework?

As students spend more time online socializing, exploring web pages, educators need to find a more effective way to interact online as a learning facilitator. Through the affordance of Web 2.0 technologies, teachers can promote informal learning by authoring SCORM-based elearning contents, designing activities, and facilitating social interactions in a pervasive way. Based upon the positive summative survey from students and informal feedback from instructors, we are encouraged to continue our effort towards promoting learning anytime anywhere through such an open access framework.

Currently the authors have been funded to invite participants and extend the study to other disciplines. We are presently inviting content specialists to develop elearning modules for their respective domains. Participants will then pilot modules in their respective courses. Also, as modules are created and with the agreement of the creator, modules can be added to a repository which will be locally hosted and available to the college community. There is concern that in order to create a true textbook alternative a large number of collaborators will be needed and an editorial review process for elearning modules will need to be defined. If the study in other disciplines proves successful, we will seek resources to develop a broad-based adoption strategy.

We believe our project helped build a practical electronic textbook alternative using SCORM compliant elearning modules. The approach encourages collaboration among instructors in an effort to promote

knowledge sharing. The effect additionally has the potential to reduce textbook costs. This is especially important for students from under-resourced communities who are first generation college students and who, pedagogically speaking, come to the table with a disadvantage academically and financially. Finally, these elearning modules provide adaptive instruction possibilities that are sensitive to our students' needs and strengths.

VII. ABOUT THE AUTHORS

Xin Bai is Assistant Professor of Educational Technology in Department of Teacher Education at York College, City University of New York. She earned her doctorate in Instructional Technology & Media from Teachers College at Columbia University. Xin taught several graduate core courses at Teachers College at Columbia, including Cognition and Computers and Intelligent Computer-Assisted Instruction. She was a Project Director of the REAL (REflective Agent Learning environment) Project at the Institute for Learning Technologies at Columbia University. She also worked as Chief Learning Architect at a company in charge of facilitating adult e-learning and designing Learning Management Systems. Xin's research focuses on educational games, simulations, intelligent tutoring systems, e-learning, and ubiquitous learning. Her work is built on the research done on cognitive science, artificial intelligence, and educational technologies.

Michael B. Smith is Assistant Professor of Communications Technology and the Director of Academic Computing and Educational Technology at York College of The City University of New York. More information about him is available at his website, http://www.york.cuny.edu/~mbsmith.

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