

Case Study of Publishing and Using Open Courseware: Perspectives of Instructors, Students, and an Evaluation Group*

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Knowledge can be more meaningful when it is shaped and personalized through interaction with others. Implementation of open learning environments such as open courseware or shared knowledge communities has gradually become more common. A case study which investigated instructors' experiences and perceptions of publishing and using open courseware in the classroom was conducted at a university in Korea. Responses from participating students and an evaluation group regarding how they perceived open learning environments were also examined. Based on the inductive analysis of the data, this study discusses advantages and challenges of publishing open courseware and collaborative learning environments. Also, practical guidelines for developing reusable learning materials are suggested.

Keywords : open courseware, e-learning, collaborative learning, reusable learning material

* This research was supported by the Kyungwon University Research Fund in 2010

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Introduction

Rapid ICT (Information and Communication Technology) development influences and leads many changes in societies. The educational field is not an exception. Many universities have implemented LMS (Learning Management System) and offered a variety of e-learning courses. E-learning enhances accessibility and convenience to instructors and students. However, most LMS currently used at universities and companies in Korea take a traditional e-learning approach. For example, traditional e-learning systems only focus on administrating courses, managing contents, and monitoring students' learning processes whether or not they utilized the curricular content of the site. Providing pre-formatted contents and managing learning processes systematically used to be considered an efficient way of learning, but this approach had a limitation for learners to attain evolving knowledge and competence needed in 21st century (O'Hear, 2006).

Recently web 2.0 technology, which enables users to share and disseminate information easily and quickly gets attention. In Korea, there have been attempts to employ web 2.0 technology in traditional LMS so that learners can share and build knowledge collaboratively. Furthermore, open courseware movement in higher education in Korea (<http://www.kocw.net>) has been initiated for sharing valuable knowledge. Open courseware is a certain way of opening educational resources, and using open courseware can improve pedagogy and learning materials (Malloy, Jensen, Regan, & Reddick, 2002).

The successful implementation of e-learning cannot be assured from availability of materials and cutting edge technologies; rather it depends on how instructors and learners construct learning environments together by incorporating e-learning technology to enhance learners' learning experiences and to build knowledge. In specific, to publish and use open courseware, it presumes that instructors allow peer instructors to review the works developed and let the materials be shared with others for academic purposes. Therefore, instructors' active involvement is critical

for the success of open courseware implementation. It is good to expand the use of collaborative e-learning environments with open courseware; instructors need to be aware of the advantages of the open courseware, and they need to develop instructional strategies for implementing open courseware in their classrooms effectively. Also, it is important that students have opportunities for mutual interaction rather than receiving learning contents, so that they can actively engage in extending their learning.

For this article, a case study which investigated experience and perceptions of publishing and using open courseware in the classroom was conducted. Responses were collected and discussed in terms of instructors', students', and an evaluation group's perspective. Some research (Malloy et al., 2002; MIT, 2006, 2009) has discussed benefits of using open courseware, but it is rare to investigate experiences of the authors who published their courseware. The study aimed to focus authors' experiences and difficulties of publishing courseware. In addition, using open courseware in the classroom is relatively new to students, so it is valuable to see how students perceived the open learning environment. Opinions from the evaluation group who are representatives of industrial fields, the education field, and academic experts are considered as having more global perspectives. Based on the responses, the related issues of publishing and using open courseware are discussed and practical guidelines for developing reusable learning materials are suggested. The present study is expected to help higher educational institutions and e-learning companies seek future directions of new learning environments.

Theoretical Framework

Emergence and Impact of Web 2.0

Web 2.0 is considered one of the significant factors which impact on web-based

development (Brown & Adler, 2008). Web 2.0 is “read-write web” (Lessig, 2005), which promotes the active participation and collaboration among its users. Web 2.0 tools, such as blogs and wikis, make people publish their own contents and interact with others through social networking, so the boundary between information producers and consumers becomes blurry.

Since Web 2.0 enables users to participate in a content producing process, it reveals the potential of networked knowledge. Having opportunities of creating and publishing users’ own contents make them externalize their thinking, and even the ideas can be elaborated by other users (Kang & You, 2008; Lehtinen, 2003). More educational practitioners consider that web 2.0 technology enables learners to create new knowledge while they are sharing and expanding knowledge collaboratively, so educational practitioners are interested in utilizing web 2.0 technology to foster constructive learning (Im, 2008; Kang, 2007). According to Brown and Adler (2008), “the Web 2.0 is creating a new kind of participatory medium that is ideal for supporting multiple modes of learning” (p.19).

O’Hear (2006) emphasized the new direction of e-learning systems to reflect web 2.0 characteristics into e-learning systems. He stated, “[E-learning 2.0] takes a ‘small pieces, loosely joined’ approach that combines the use of discrete but complementary tools and web services-such as blogs, wikis, and other social software-to support the creation of ad-hoc learning communities” (p. 19). Rogers, Liddle, Chan, Doxey, and Isom (2007) also suggested that the ultimate goal of future e-learning and educational environments was developing the flexible model that strengthened participation and collaboration, and which also promoted an easy creation and reuse of learning contents.

It is clear that web 2.0 technology impacts on learning, but most of all, the successful implementation of e-learning 2.0 depends on the degree of openness and collaboration among knowledge users. Instructors and students need to consider that sharing knowledge can revitalize the teaching and learning process in terms of rapid enhancement of pedagogy, technique, and contents (Malloy et al., 2002). It

leads instructors and students to have a new perception about learning.

Connectivism

There is a new perspective on learning which is achieved by emphasizing the networking of distributed knowledge. Siemens (2005) named it as 'connectivism'. Connectivism refers to learning as the networking process of knowledge nodes, which belongs to networked people. He argued that learning theories including behaviorism, cognitivism, and constructivism, which focused on how an individual learns were not sufficient to explain learning within organizations. Individuals learn and process knowledge within organizations either from people or database, and learning starts from an individual, but it occurs within organizations by integrating and synthesizing distributed and networked knowledge. The assumptions of connectivism are the following: (a) learning and knowledge can exist outside of an individual, even in non-human appliances, (b) learning can be extended by diverse opinions, (c) capacity to learn is more vital than what is currently known, (d) the sustaining and managing of networks are crucial to foster continual learning, (e) abilities to recognize patterns and links between ideas and concepts, and to build connections are critical, and (f) reconstructing understanding or altering decisions is considered to be a process of learning, especially under circumstances of rapid increase of information (Siemens, 2005).

Learning can be effective when distributed knowledge is dynamically connected and the learning environment fosters emerging new knowledge. When social technology is integrated with learning, it provides tools that facilitate building and strengthening of learning communities as well as searching, distributing, and manipulating the knowledge. Therefore, social technology becomes a part of learning technology, which supports learners to create, externalize, share, and reflect their knowledge. Furthermore, networked learning communities can be developed among instructors and experts, and the materials including courseware and knowledge that they are sharing will influence their teaching practice.

Open Educational Resources (OER) and Open Courseware

Open Educational Resources (OER) refers to opening a wide range of academic resources to anyone for free and allowing users to use and reuse them. The OERs include text, images, audio, video, simulation, game and many other free academic resources. One well-known OER implementation is MIT OpenCourseWare (OCW). In 2002, Massachusetts Institute of Technology (MIT) has started to publish all of the educational materials from undergraduate and graduate courses on the web so anyone can access and use the learning materials. The number of uploaded MIT OCW reaches 2,000 courses in 2010, and many other universities and institutions in U.S.A. as well as universities in other countries have joined the OCW consortium. OCW includes a course syllabus, lecture notes, course calendar, readings, assignment and other course materials. According to the MIT OCW evaluation report (2006), the number of educators, students and self-learners who used OCW for their teaching and learning had increased. 46% of educators who visited OCW site had adapted OCW contents, and 62% of users integrated OCW materials with other contents. Users of OCW preferred lecture notes, readings, and video lectures respectively. Findings from the report indicated that people in the world widely used and adapted OCW materials.

Research (MIT, 2006; Sumner, Dawe, & Devaul, 2002) showed that sharing high quality learning materials could improve teachers' instruction and students' learning. Sumner et al. (2002) implemented a digital library project in the earth sciences area, and the project involved many teachers from the community in developing reusable learning materials. Developed learning materials included maps, lesson plans, experiment examples, virtual field trip resource and so on. The researchers emphasized that sharing high quality learning materials could support teachers to improve their instruction and enhance learning in their classes.

However, to accelerate the efficiency and effectiveness of OER, the reusability of resources becomes important. To improve the reusability of OER, not only resources are developed in a standardized format, but also they are recommended

to be developed as learning objects. Reusable learning objects are the small chunks of digital resources that can be reused independently to aid learning (Wiley, 2000). Reusable learning objects are small, easily tagged, disseminated, and derived, so they facilitate remixing and improve the accuracy of searching target resource. In e-learning 2.0 environment, sharing and reusing learning objects foster learners to have more opportunities to build and modify their knowledge (Sandars & Haythornthwaite, 2007). Therefore, for easy disseminating and adapting learning content, developing reusable learning materials as learning objects becomes essential to the e-learning 2.0 environment.

Although much research discusses the advantages of OER or adopting e-learning 2.0 technologies (Malloy et al., 2002; MIT, 2006, 2009; Sumner et al., 2002), little research has been done to investigate experiences and perceptions of instructors and students in publishing learning resources in Korea. Therefore, this study examined how instructors, students, and an evaluation group perceive advantages and challenges of publishing reusable learning objects and their employment in the classroom.

Method

Setting

The study was conducted at K University, a mid-size private institution located near Seoul, Korea. K University had proposed and implemented a university 2.0 project aiming to construct open, shared, and collaborative learning environments. The whole project was carried out for 2 years, and a university 2.0 learning system and open courseware had been developed to support students' learning as a part of the project. The university 2.0 system was designed for instructors and students in a convergence program of biology and nanotechnology, and it supported them in

sharing their knowledge and artifacts. In fall 2008, instructors for four undergraduate courses opted to use the university 2.0 system during these classes. The four courses were an introduction of bio-nano engineering, biochip technology, introduction of bio-MEMS (Micro Electro Mechanical Systems) & NEMS (Nano Electro Mechanical Systems), and nanotechnology engineering. Each class regularly met face-to-face for one or two times a week. Four instructors published their courseware in the university 2.0 system, and students used the system to promote their learning.

Participants

All four instructors who used the university 2.0 system, seventy-two students who enrolled in the four courses and a panel were participated in the study. Firstly, one female and three male instructors are from bio-nano department, and their ages were ranged from late 30's to early 40's. They had about two years of teaching experience. Secondly, the students had different backgrounds such as chemistry, biology, electrical engineering, and environmental engineering from sophomore to senior. At last, a panel was consisted with five experts for evaluating the project and the system. Three content experts among the panel were from outside of the university, and the other experts were professors in education and IT from the university. The panel regularly reviewed the project and conducted evaluation.

The university 2.0 system

The university 2.0 learning system was specifically designed and developed for easy sharing, distributing, and reusing knowledge. The learning system consists of three main components: *Media Library*, *Courseware*, and *Wiki*. *Media Library* allows users to search and access shared learning objects, and users can also upload their own artifact to *Media Library* for knowledge sharing. Twenty faculty members of bio-nano and chemical engineering departments at this university were involved in

developing learning objects which were shared in the *Media Library*. Each learning object is provided with author's information, a description of the content, tags, text comments, the numbers of views, downloads, and recommends. *Courseware* includes a course syllabus, lecture notes, other multimedia learning objects related to a specific weekly topic, information of team-based learning activities, and assignments for the class. *Wiki* allows users to create and edit contents collaboratively regarding specific topics.

Two distinctive features of the university 2.0 system are following. Firstly, when instructors create their own open courseware with multiple learning objects, instructors can use either their own learning objects or colleagues' shared learning objects from the *Media Library*. Secondly, since each learning object has tags and all courseware are open to all users, students can search related learning contents regardless of their registered courses.

Procedure

To gather experiences and perceptions regarding publishing and employing open courseware in the classes, multiple data sources were used to triangulate the data. A structured interview questionnaire for instructors, a web survey for students, a structured evaluation for the evaluation group were used. Altrichter, Posch, and Somekh (1993) stated that triangulation "gives more detailed and balanced picture of the situation" (p.117), so that triangulation data analysis improves credibility and validity of the study.

In this study, the evaluation group data were collected twice; one was before the university 2.0 system was fully developed and another one was at the end of the project. Regarding the first data, the evaluation group members reviewed the design plan of the learning system, sample courseware, and an instructional implementation plan. Then, they rated the evaluation form items and responded to the open-end questions.

At the beginning of fall 2008, four instructors from four courses developed courseware for their own classes either by using their own learning objects or by importing other colleagues' works from the *Media Library*. The ways of organizing the classes were determined by course instructors. During the first 2 weeks, an orientation was given to each class explaining how to use the learning system, what kinds of learning activities could be organized, and what the potential benefits could be. During the classes, learning activities varied from class to class. For example, students in the introduction of bio-MEMS & NEMS course participated in team projects, and while each team presented their work, the presentations were digitally recorded. After completion of the presentation, all teams uploaded video files of their presentations to *Wiki*, and other teams and the instructor wrote feedback to the presentations on *Wiki*. The final team products were uploaded in the *Media Library* for sharing. Students from other courses were also given individual or team projects, and students uploaded their learning outcomes to the system for sharing and getting feedback.

At the end of the semester, four instructors were asked to respond to a structured interview questionnaire via e-mail, which asked for their experience and perceptions of publishing and using open courseware in the classroom. In addition, a web survey with 10 items was conducted with students regarding their satisfaction with the classes. This web survey was administered through the university web. Lastly, the evaluation group's second data was collected just before the university 2.0 project period was ended. The evaluation group members reviewed and evaluated the overall achievement of the university 2.0 system and courseware implementation. The method of evaluation of group data collection was same as the first one.

Data analysis

In order to analyze structured interview questionnaire responses from the

instructors and evaluation data from the students and the evaluation group, inductive analysis was employed. The purpose of an inductive analysis is to understand the meaning in extensive and complicated data by data reduction (Thomas, 2004). So as inductive analysis involves meaning condensation, meaning categorization, and meaning interpretation (Coffey & Atkinson, 1996; Han, 2008), identifying main themes by reading and re-reading of data, categorizing, and interpreting process occurred concurrently.

Findings

The numbers of learning objects used in each courseware are as shown in Table 1. The data are organized in terms of the authorship of the learning objects. That is, the learning objects were counted based on how many instructors used their own materials and adopted colleagues' works in each courseware. Among four instructors, the instructor in the course D used the highest number of his own learning materials; otherwise the instructor in the course A used the highest number of other colleagues' learning materials. The instructors in the course C and D used the learning objects derived from other institutions.

Table 1. The Numbers and Rates of Learning Objects Included in Courseware by the Authorship

Instructor	Authorship (unit: item)			The rate of reusing others' learning objects
	Own works	Others' works		
		Colleagues	External	
Course-A	26	17	0	40%
Course-B	20	0	0	0%
Course-C	30	0	5	14%
Course-D	39	0	6	13%

The responses from the instructors, students, and the evaluation group were analyzed. After many repetitions, revisions, and refinement of category systems, four themes and 23 categories were identified. The four themes were (a) perceived advantages of publishing courseware and sharing learning objects, (b) perception of implementing collaborative learning, (c) challenges of publishing learning objects, and (d) suggestions for improvement. The detailed findings for each theme are following.

Theme 1: Perceived advantages of publishing courseware and sharing learning objects

Instructors especially perceived the significant benefits from sharing courseware among colleagues. The identified benefits are (a) instructors can easily recognize the level of students' prior knowledge by reviewing prerequisite courseware, (b) instructors determine scope of knowledge to teach by considering other related courseware, (c) instructors can save time for creating learning contents, (d) social networks among faculty can be strengthened through the sharing activity, and (e) teaching plans or strategies can be improved by adopting colleagues' courseware. By reviewing colleagues' classes, instructors could share teaching ideas and reflect upon their own class organization and teaching strategies. Therefore, they can refine their instructional strategies, materials, and learning activities. One instructor stated that he would like to use various instructional strategies and learning activities for future classes.

All participants including instructors, students, and the evaluation group recognized the high accessibility of valuable learning materials. One member from the evaluation group stated "*the quality and contemporary learning materials updated by instructors and students will ensure students to equip concurrent social and industry demand*".

Further, members of the evaluation group and students recognized the impact of learning effectiveness as students can preview and review the learning materials at their own pace. Overall, the instructors recognized the value of sharing courseware, and students appreciated its learning support aspect. Members of the evaluation group highly valued this accomplishment as one attempt to innovate in higher education.

Theme 2: Perception of implementing interactive and constructive learning environment

When classes were using the university 2.0 system, all participants clearly recognized students' active learning engagement. All instructors reported that students were actively participating in their discussions, sharing ideas, and giving feedback to each other since there were many channels to share their knowledge. This interactive learning environment provided the classes to diverse perspectives about what they were learning, and they learned a lot from each other. Students made more inquiries about their learning, and the classes were more student-driven. The instructors articulated the assurance of students' learning, and instructors had positive perceptions of constructing collaborative and participatory learning environments. Instructors were satisfied with students' learning process and their cognitive artifacts as learning outcome. Students who participated in the study evaluated courses via university web. The scores of course evaluation ranged from 42.1 to 47.0 ($M = 46.3$) out of 50, and this result indicated that students were generally or highly satisfied with classes. Similarly, the evaluation group valued the engaged learning environment. One member of the evaluation group stated,

Having collaborative and productive learning environment enables learners to create and share learning objects, and it transforms passive learners into active learners who build

knowledge. This kind of learning effort will direct university education as more vivid and practical thus invigorate student's enthusiasm toward learning.

Theme 3: The challenges of developing and opening learning objects

From the collected data, instructors expressed negative attitudes towards opening *all* learning materials to the public. First of all, instructors were not comfortable with the evaluation by public, and they were also concerned about critique of the materials. Furthermore, they were concerned about intellectual property issues and the boundaries of Fair Use for academic purposes. Also they did not want to take on the burden of responsibility for the legal questions. Due to the subject characteristics, some courses may have many learning materials like pictures and video clips. In addition, sometimes instructors want to use valuable but confidential materials during the class. Some instructors expressed concerns that heavy emphasizing being open to the public may lead to leaving out critical information in learning objects. Other challenges identified dealt with the sustainability for maintaining and expanding this implementation.

Although challenged initially, due to lack of prior experience with developing multimedia learning objects, instructors' confidence was increased. Instructor –A stated,

At the beginning, it was not easy to develop multimedia learning objects because I do not have experience, and there were none to compare. However, as resource were added and shared in the Media Library, I am more confident to create and evaluate mine comparing with other colleagues' in terms of the format, length or scope of learning objects. In addition, if necessary, I can reuse other colleagues' works so it becomes valuable and convenient.

Theme 4: Suggestions for improvement

As the instructors suggested, all four of them wanted to have a flexibility to publish course materials. They all preferred to share them within the university, and they liked to have options to choose open or not, depending on the item, due to either intellectual property issues or materials' confidentiality. To stimulate the diffusion of publishing and sharing learning objects, some instructors emphasized the need for institution level support, and students suggested more active advertisement to the public for more involvement and collaboration with other experts and learners. Another important suggestion came from the evaluation group. They emphasized having an objective evaluation process for ensuring learning results. One member of the evaluation group commented:

While the advancement of university 2.0 system is undoubtedly recognized, three point are suggested as considerable: (a) its objective evaluation system for individual learning as well as group learning, (b) balancing contemporary education with the highest intention of college education, and (c) defining clear role and responsibility of faculty and students.

In short, the identified four themes and 23 categorized are outlined in Table 2.

Table 2. Analysis of Structured Interview Questionnaire and Evaluation Data

Themes	Category
Perceived advantages of publishing courseware and sharing learning objects	<ul style="list-style-type: none"> - Convenient to use and prepare for the class - Valuable resource to understand learners' prior knowledge - Valuable resource to understand expertise of other colleagues - Helpful to develop instructional ideas and improve teaching strategies - Improving learning effectiveness - Improving accessibility of up-to-date learning resource - Being a driving force to innovate higher education - Changing perception about publishing and sharing learning materials
Perception of implementing collaborative learning	<ul style="list-style-type: none"> - Active engagement of learning process - Promoting inquiry of learning - Improving collaborative team effort - Peer learning - Providing feedback each other - Adopting/exposing to diverse perspectives - Promoting students' motivation towards learning
The challenges of publishing learning objects	<ul style="list-style-type: none"> - Lack of prior experience - Anxiety or burden for being evaluated - Dealing with intellectual property issues - Attaining sustainability
Suggestions for improvement	<ul style="list-style-type: none"> - Providing organizational support - Allowing flexibility for opening learning materials - Being equipped with objective evaluation systems for individual learning and team learning - Defining clear roles and responsibilities of instructors and students.

Discussion and Implications

Among the identified advantages of publishing courseware and sharing learning materials, some points are worth discussing. First of all, instructors compare and reflect their courseware by reviewing other courseware in terms of the quality of materials and instructional strategies, so it seems to provide self-evaluation opportunities for instructors. This also makes instructors reduce their anxiety of generating courseware because they can have ideas from others' works while they are creating it.

Another interesting finding is that the instructors value the chance to figure out other colleagues' special interests. Even though instructors are in a related field, they do all have different special expertise. Especially since the instructors from the study were relatively new to the department, and they were busy with their research, they did not know what other colleagues were exactly teaching. Sharing learning objectives among colleagues helps instructors build more academic relationships among themselves, and this would lead instructors to easily extend their discussion about classes.

Furthermore, instructors from the study value the chance for having information about their students' background knowledge. Opening a courseware allows instructors to refer to other related courses, and they are able to presume their students' prior knowledge before the course begins. Therefore, determining where to start and what to teach becomes more concrete and it would help instructors develop lesson plans.

In this case study, not only instructors are sharing and creating their knowledge, but also students can access rich learning resources linked with tags, and students do produce their own learning outcome collectively and collaboratively. This is an example of connectivism, which emphasizes that learning occurs when distributed knowledge is integrated to pursue their learning goals as Siemens (2005) emphasized. All participants including instructors, students, and the evaluation

group were strongly satisfied with active learning engagement, constructive and personalized learning opportunities foster learning motivation and enthusiasm.

Contrary to its many advantages, one of the major identified barriers to publishing and reusing learning objects is the many intellectual property issues. Although open copyright licenses such as Creative Commons License are available for OER, when instructors develop learning objects, often times they need to use images and other resources from published materials that are not under open copyright license. Due to the subject content characteristics, the instructional materials from the study also needed a large amount of photos and videos. The instructors were first responsible for clearing the intellectual property issue, and the instructors individually responded to solve this problem. Since the OER movement is a growing phenomenon, universities should be aware of the open paradigm and endeavor to deal with intellectual property issues. A guideline for OER is now available from Korea Open Courseware website (www.kocw.net), but more organizational supports are needed, such as operating a specialized team to process the requests of instructors for clearing and discussing authorship issues, so that an individual's burden can be reduced. Also organizations endeavor to find strategies to develop knowledge consortiums and to attract contributors to get involved, so open learning culture will be enriched

Another barrier is that instructors are burdened because they have not enough competence to develop multimedia learning objects and they are anxious about being evaluated by others. Usually instructors are good at using computers, but what matters is that they do not have experience to develop multimedia resources in a good quality. Today there are many easy and affordable tools available to make multimedia, so once instructors have a few trials with the right guidance, this problem will be resolved very easily. This competence is required for instructors not only developing learning objects, but also understanding and adapting to 21st learners' learning styles. According to Dede (2005), he used the term "napsterization of education" for describing the influence of digital media on

student's learning. He argued that digital learners create a "*personally tailored* learning path, picking and choosing from multiple resources of media, resource, projects or other curriculum content which they can then bundle together to meet their individual needs and learning styles" (Baird & Fisher, 2005, p. 14). As use of digital media is increasing in 21st society, so utilizing and adapting technologies in the learning process becomes critical. Therefore, universities should provide infrastructure and services including educational programs for instructors and students to utilize technology and enlighten instructors for embracing digital learners' learning styles. Furthermore, public attention can encourage instructors and learners to create high quality of learning objects.

Most importantly, a strong need for having flexibility to publish courseware and share learning objects was identified from the study. As one instructor pointed, if openness is emphasized too much, then the critical and sensitive information can be excluded. Therefore, instructors need to be eligible to determine whether materials are opened to public or not, and a learning system should support this feature. On the other hand, academic potentials of sharing knowledge should be acknowledged to faculty. Organizations should prepare schemes for the implementation of open learning environment and lead the faculty. As instructors from the study recognized the advantages and potential of sharing and collaborative learning, presenting by much evidence, especially from colleagues who had the experiences, will be more persuasive for other faculty to be motivated, and this will help to form a community of practice.

However, sharing learning materials are not sufficient by itself for learners to participate or interact. Therefore, instructors should facilitate learners' participation by initiating structured learning activities or projects. When learning products are presented and shared not only face-to-face but also on a learning system, students can easily evaluate and reflect their works by comparing others' and students may more actively provide feedback. Instructors need to design learning activities and use instructional strategies, which can elicit learners' higher order learning

objectives. These collaborative learning activities shape students to practice and learn within learning networks or learning communities, and they can be trained as knowledge “prosumers” (Lin, Bonk, & Sajjapanroj, 2008). In these learning environments, facilitating and guiding learning processes are more important roles of instructors, rather than simply delivering knowledge. In addition, instructors need to be good models by being part of knowledge networks and collaborating with other experts.

There are a couple of implications for enhancing reusability of learning materials in terms of development. First, learning contents should be developed in the form of small objects, which are easily reused without further editing; Bulkier files, such as lengthy Podcasts, can be inconvenient to use or derivate for use in other classes. In this study, when courseware are developed, all the materials are in small learning object form so that instructors can easily reuse other colleagues’ learning materials or to mix and mesh them with other resources. Since the instructors strongly expressed the satisfaction with its flexibility and convenience, and reusability is probably one of the influential factors in instructors’ recognition of advantages to open courseware. Moreover, developing learning objects in a universal file format is also critical for reuse for downloading to personalized handheld devices. Second, since intellectual property issues are sensitive and important in digital publication, providing accurate and explicit information regarding sharing and reusing the materials must be done in order for users to reuse them appropriately. When authors upload the files, a system provides prompts requesting detailed information including an author’s name, affiliation, date of creation, contact information, and the scope of limitations of permissions for reusing the materials so that authors notify the level of sharing and derivation. Third, since the management of meta-data is critical for users to search the contents, recommending related resources by rating the relevance of materials will increase chances for users to navigate the content. Especially for video resources, choosing thumbnails of uploading files manually is better than extracting the first screen automatically.

For the future, researchers should investigate the positive and negative variables that influence learners in sharing knowledge and collaborating in e-learning 2.0 environments, and research needs to investigate the feasible solutions of eliminating barriers of opening and sharing learning objects. Developing appropriate research methodology and instruments to evaluate students' learning in the perspective of e-learning 2.0 are also required to evaluate the effectiveness of e-learning 2.0.

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Received 2010.08.25/ Peer Review Completed 10.15./ Accepted 10.26.