A Conceptual Framework of Web 2.0-based Interactive Portal for Improving Learning and Teaching in Construction Curricula

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ABSTRACT
This paper presents a conceptual framework of a web 2.0-based Portal, which will be a repository of thousands of construction project digital images accessible with an interactive interface. This paper also discusses the advantages, design schema and contribution to knowledge base of using this Portal for teaching staff and students. This repository conceived from educational literatures aims to provide full access to construction-related digital materials. The Portal will be adopted in the real educational environments, in particular, construction technology courses and its effects will be evaluated through interviews and surveys via a pre-test-post-test methodology.

KEYWORDS
construction education, construction technology, digital image, Web 2.0, learning portal

INTRODUCTION
A good deal of investigation and development is underway in the Australian universities into the possibilities for effective and efficient online learning and online assessment, which is a natural outcome of the increased use of information and communication technologies (ICT) to improve learning and teaching. There are many reasons why online learning and online assessment have been being adopted by the Australian universities. As more and more students seek flexibility in their courses, it is unavoidable that there will be growing expectations for flexible learning and assessment. Further, many teaching staff are seeking to diversify assessment tasks to cover more assessable skills and giving more timely and informative feedback to students along their progress. However, they are experiencing a large number of technical and pedagogical issues.

During the past decade, digital images, by replacing analogue images, have become a major element in the rapidly evolving educational landscape, but how does the use of these new digital formats contribute to the changing practices in teaching and learning in construction higher education? How to develop a database that is dynamic, editable and searchable by students? The main purpose of the conceptual framework presented in this
paper is to build both a knowledge base of such practices and an active online community (a Portal) for teaching staff and students using digital learning materials that includes images, text, video clips, animations etc. Generally, the extents and sizes of individual collections of digital images and digital texts are usually large. Most teaching staff would save images on their own computers, in the format of picture files or in PowerPoint, and unfortunately they do not have enough time, resources, knowledge and expertise to organise and manage these images. This fact raises technical support issue. The University of California, Berkeley study (Harley 2006) noted the need for an effective tool that could create and manage personal digital libraries, aggregating and integrating heterogeneous resources for re-use. The authors believe that most teaching staff could be adrift until these technical promises can be fulfilled. There is a clear connection between inadequate technical support and underuse of digital learning materials such as images provided by both teaching staff and students. A review of the relevant studies of the use of digital images for teaching and learning yields the following three particular projects: Pennsylvania State University’s “Visual Image User Study” (VIUS) (2003) examined the needs of digital image users across its campuses in order to design an effective image delivery system; The UC at Berkeley’s “Digital Resource Study” (Harley 2006) focused on how to produce better and more well-used digital resources; RLG’s smaller study, “Out of the Database, Into the Classroom,” reported on its efforts at improving the usability of its own Cultural Materials image database. However, there are no noted research efforts in using digital images to enhance the learning and teaching in construction higher education.

THE NATURE OF CONSTRUCTION TECHNOLOGY COURSES
To improve learning and teaching of construction technology courses, firstly we have to understand the features of construction technology courses and argue why digital images are particularly important for students’ learning and understanding. The learning aims and learning outcomes should be the main focuses. The typical courses in construction technology knowledge domain aim to help students develop knowledge in relation to the technologies and processes used for building construction, including foundations, structure skeletons, cladding (enclosure), interior fitouts, material handling strategies and formwork selection. They also aim to develop students’ critical, creative and analytical skills, with particular application to the decision-making or problem-solving processes involved in the construction of buildings (Zou 2007a). The major learning outcomes in a construction technology course include demonstrating an in-depth understanding of construction processes and technologies, evaluating such processes and technologies and develop and apply solutions to practical problems, and demonstrating the ability to
specify and manage the construction processes and applications of various construction technologies and selection of construction materials (Zou 2007a). The major challenges of teaching construction technology courses are related to the course’s practical emphasis, including comprehending the complexity of buildings and the interactions between different elements and components of buildings, understanding and making wise decisions about and choices from many alternatives (including materials, technologies and processes) for a particular practical scenario, and solving technical problems during the process of construction (Zou 2007a). The course also presents the teachers with practical challenges, particularly in relation to helping students apply their theoretical understanding of detailed construction processes to enhance their practical understanding and skill development. The practical nature of the course has therefore driven the introduction of visual aids teaching strategies.

PERCEIVED AVANTAGES OF USING DIGITAL IMAGES PORTAL IN TEACHING AND LEARNING

The proposed Digital Image Portal could be an open access free interactive online space for teaching staff, tutors and students to have access to construction-related digital images for the following purposes: preparation of lecturing notes, texts and quizzes, students’ assignments and projects, interactions with students, class presentations, student review, after-class discussion, or for any other purpose. There will be a number of advantages for teaching staff to use digital images portal in teaching. The Portal particularly could enable teachers to develop more engaging visual aids to support more straightforward explanations of teaching materials, especially for abstract concept and process in construction technologies. The portal could also allow students to contribute to the learning experience, and provide them the best possible support for ongoing and future studies. Each digital image could be tagged with a number of pre-defined keywords that categorize them into different subjects based on the nature and contents of the digital images. A powerful database could be used to store and categorise the images. Users can search the desired pictures through entering different keywords, or combination of keywords. More interestingly, users can edit, upload and add images to the database as well as an author, which makes the Portal more like a Wikipedia, an authoring tool, not only acquiring information but also authoring and contributing information that can be shared and used by others.

Digital images could help make subject areas understandable for students. In construction, good images can greatly improve the accessibility of most construction methods concepts. Digital images could also provide ease of use in assignments and quick availability after field trips or labs. In addition, students will be able to sharing their
own project images they took on their own or during class visits to construction sites. They will be able to upload and share the photos of a construction site and construction progresses they have taken in their project-based learning/case study.

With the help of the Portal, more images will be accessible. The portal could provide a large variety and volume of images that teaching staff can use and retrieve. For instance, teaching staff are able to involve students’ firsthand observations for construction curriculum. Moreover, the Portal could make the teaching process more efficient. It also provides greater interactivity as a result of greater variety of material and images.

THE PROPOSED CONCEPTUAL FRAMEWORK

The conceptual framework proposed in this paper aims at the following three main aspects: improving students’ understanding and learning, pedagogical innovation, and online assessment. Before the framework was conceived, the authors investigated the graduate attributes defined at University of New South Wales (UNSW 2003) in order to best align the spirit of the framework with the graduate attributes. Graduate attributes are the qualities, skills, and knowledge a university community agrees that its students should develop during their time with the institution (UNSW 2003). Two graduate attributes were identified, which, by adopting the Portal, they can be enhanced, which were also emphasized by Zou (2008) in his article “Working together to achieve graduate attributes of our students”:

1. **Analytical and problem-solving skills:** To demonstrate these qualities to an employer, the students emphasised the importance of effective decision-making, particularly in challenging situations. They thought that assignments with real-life relevance and applications would be most helpful as a means for developing these qualities during their studies. The project-based learning approach is identified to be an appropriate method for students to gain analytical and problem-solving skills.

2. **Knowledge of contents:** To demonstrate content knowledge, students could discuss relevant examples from their experience and studies as well as provide accurate solutions to problems faced by the employer. They also thought that hands-on, practical examples of industry problems in class, as well as workplace visits and guest lecturers from industry would help them develop these skills. Participants also emphasised “in-depth information about particular theories in the discipline”. The project-based photo repository in the Portal provides the appropriate, concrete and touchable resources of creating such real and practical context for students to better understand and learn the knowledge behind a specific abstract concept or process.
The framework was conceived to improve the above two students’ skills. The Portal can improve students’ learning outcomes and experiences, especially “project-based learning” and online assessment, which will be used to drive and motivate students with self-learning. The online resources developed from this project will be used to help student learning such that to take the online assessment tasks and conduct online discussions.

Information and communication technology (ICT) has been widely used in education in recent years in terms of online resources, interaction and communication (Alexander, 2006; Kolo & Breiter, 2009). The use of digital portal can significantly improve students’ learning outcomes and experiences as shown in the conceptual framework depicted in Figure 1. It aims at improving students’ learning experience and outcomes via the online learning platform, which stores and shares online resources among students. Furthermore, the platform also collects data from students’ learning style, learning behaviour and learning outcomes and therefore builds a student database, which can provide a personalised database to each individual student.

Figure 1 – Proposed framework of the interactive online learning portal

The Portal will be an open access free interactive online space for teaching staff, tutors, and students, to have access to construction project-related digital images for the following purposes: preparation of lecturing notes, students’ assignments and projects, interactions with students, class presentations, student review or study, texts and quizzes, after-class online discussion or for any other purpose. As mentioned in previous section, there will be a number of advantages for teaching staff to use digital images portal in teaching. In particular, the Portal particularly could enable teachers to develop more engaging visual aids to support more straightforward explanations of teaching materials, especially for abstract concept and process in construction technologies. The portal also
could allow students to contribute to the learning process, and provide them the best possible support for ongoing and future studies.

The fundamental feature of the conceptual framework is its user-centred (i.e. student centred). For example, at the very bottom layer of the portal, it captures and stores “student database which is personalised data of each student); it also allows students to share resources among themselves. At the top layer, the portal aims at student learning experience and outcomes by encapsulate the principles of “user-centred” and “multi-cultural-oriented” as well as life-long user modelling.

The Portal can also be an effective communication and collaboration platform for teachers to be a facilitator rather than an instructor to guide the student learning. The teaching staff can also use the Portal to frame questions of worth exploring, to structure meaningful tasks, to monitor students’ learning progress, and to give timely and informational feedbacks.

This portal, apart from providing technical learning materials and resources, could also become a “fun” tool for students because they have the ability to add, edit and customise the learning contents. This means students interests and engagement to learning will be increased. Further, visual images can hold students better, as an old says goes “an image is equivalent to a thousand of words” and digital images are more accessible. According to the UNSW Guidelines on Learning that Inform Teaching (UNSW 2003b), effective learning is supported when students are actively engaged in the learning process, while activities that are interesting and challenging, but which also create opportunities for students to have fun, can enhance the learning experience; and students learning can be better supported by the use of multiple teaching methods and modes of instruction.

Application and implications

As mentioned in previous section, one of the learning objectives in construction technology courses is to demonstrate an in-depth understanding of construction processes and technologies. In order to facilitate the development of students’ practical understanding and skills, it was found that site visits, and real life case studies are very important. Site visit gives students direct experience of the professional and disciplinary context of the contents they are studying in construction technology courses. However, due to the increasing number of class size, and the site-safety requirements, site visits has become not feasible and realistic. Spicer and Stratford (2001) studied the student perceptions of a virtual field trip to replace a real field trip. They concluded that students were extremely positive about the potential of the virtual field trip to provide valuable learning experiences. Under the circumstances where real site visits are not accessible
and realistic, virtual site visits through a series of digital images in the Portal to form ‘virtual site visits’ is very promising which is much better than words/texts. The Portal could include and integrate e-text, illustrations, images, computer animations, video clips and online quizzes. For example, a serial presentation/slide show of pictures could allow students to view and understand the process of erecting the formwork needed in building construction. Students can pause, stop or re-play the demonstration as many times as they like. E-text descriptions could also be provided within the demonstration to help students understand the contents better. Because the demonstration in the Portal is a visual medium for hands-on interactive experience, it encourages active engagement and a practical rather than a theoretical perspective.

However, adopting the proposed Portal means a shift of the focus of the course. Particularly, teachers have to reconsider their pedagogy while transiting the course to digital images-oriented. For instance, teachers might have to spend more time redesigning and even revamping their classes to make them digital in both course materials and teaching and learning process.

**Development of online assessment tasks and submissions**

The Digital Image Portal could be used to develop online assessment tasks. It is commonly agreed that assessment is the single most powerful driver on learning in higher education. Assessment plays a central role in student learning whatever the mode of learning is. It is widely accepted that well-designed learning activities aligned with learning objectives are useful strategies contributing to successful learning and teaching in construction technology and management studies. Assessment focusing on lower-level cognitive skills such as true/false or multiple choice responses is prevalent used in online assessment but is questionable in a higher education environment. As mentioned before, the “real” project-based experience is much emphasized in construction technology courses which can be well communicated via digital media (the Portal). Therefore adopting the Portal as students’ rich resources for project-based learning is envisaged to be effective in enhancing students learning and assessment. The Portal can help to devise richer online assessment tool to develop higher order cognition such as critical evaluation. The use of Portal-based online assessment to assess learning outcome toward subject objectives can take many forms including: Publication of documents on the web; Labelling of on-line pictures; Manipulation of online graphs; Completion of online quizzes.

It is also believed that project-based assignments are considered effective in demonstrating learning of technical contents. Unfortunately, most of the existing online assessment tools do not incorporate the conception of project-based assessments so far.
The proposed Portal could offer great potentials to present students with more complex pre-defined scenarios through the use of interactive resources (images, sound, simulation, and animation). The key point is to draw image resources from the Portal and then use them to devise more reflective and well-grounded questions for students to answer. From the perspective of students, their learning outcome can be better matched to the learning objectives through this way. The Portal could provide a reservoir for teachers to draw their appropriate images to help students to better understand the context of their test questions while designing the questions. This way, the answers provided by student are more reflective of their learned knowledge and those images associated with the questions can leave them deep understanding of the questions themselves, which in turn is an implicit way of learning as well.

PROPOSED METHODOLOGY FOR PORTAL DEVELOPMENT AND EVALUATION

The next step of this research includes three aspects: 1. to develop the portal, 2. to apply the portal to actual courses teaching and learning, and 3. to evaluate the effectiveness of the portal. This section provides brief discussion of such future work - the development methodology of the Portal and the evaluation methodology for the learning effectiveness via the Portal.

Portal development methodology

The growing amount of multimedia content and the heterogeneous access points of the conventional Web 1.0-based content management system (e.g., WebCT and Blackboard) inhibit efficient search and navigation, making it difficult for learners to find relevant contents. Conventional e-learning systems such as WebCT and Blackboard struggle with heterogeneity and the distribution of content and metadata over several repositories. The systems currently in use dominantly do not consistently support desirable features such as full-text search across all media types, or browsing based on taxonomies that adapt to new content. Furthermore, the rapid development of Web 2.0 technology has brought us from Web 1.0 into the era of Web 2.0 which is a more interactive and social technology platform, more suitable for collaborative learning. Early research and practice in e-learning for construction was mainly based on Web 1.0 platforms such as WebCT and Blackboard, where students experience, practice and demonstrate the technical, process and managerial aspects of the construction activities through static, non-interactive, non-intelligent web workspace.

What is particularly timely about the potential development of social technology for learning and teaching at the moment is the recent development in Web 2.0 technology is
very popular now. Students are familiar with Web 2.0 technology such as Facebook, Google Docs, and Google wave, (students’ computing literacy is ready) and therefore, our education system should catch up with their progress, which is critical. These technologies can be easily and intentionally configured to allow third-party customization to be created and embedded into the current pedagogy. Furthermore they are increasingly supported online by a significant and committed community of users and developers.

The core technology driving the design of the Portal is the semantic web. They are adopted to improve searchability (e.g., by semantically interrelating content) and to enhance the usability and attractiveness of content by combining the collective expertise of the learning and teaching community. The Portal will support:

- the organisation and composition of learning material
- search and reuse of multimedia contents
- discourse about learning materials
- collaboration between teachers by applying Web 2.0 technology

This Portal will help teaching staff and students to personalise and socialise content management, as well as assess and improve content quality. The Portal will enable each learner of a personal workspace in which each learner is able to manage the collaborative creation and sharing of content, and the search for related content. The development of the Portal will adopt SIOC (Semantically-Interlinked Online Communities) which provides methods for interconnecting discussion methods such as blogs, forums and mailing lists to each other.

**Portal evaluation methodology**

To assess the impact and effectiveness of the innovative Portal-based learning and teaching strategies, both standardised and customised surveys may be used. The standardised survey is the ones being used by universities, such as the Course and Teaching Evaluation and Improvement (CATEI) survey used by The University of New South Wales. The customised surveys means the ones specifically designed to evaluate the effectiveness of the Portal towards students learning. The previous study by Zou (2007) provides a base for designing the customised survey, details is presented in next paragraph.

In order to gain a good understanding of the students’ perception and experience on the Portal-based learning and teaching, two customised surveys will be conducted. The first survey (pre Portal implementation survey) will be conducted before the implementation of the Portal based learning. The second survey (a post Portal implementation survey) will be carried out immediately after the implementation of the Portal based learning. This research method was successfully used by Lindh and Soames (2004) and Zou
In order to allow the students to express themselves freely in the survey, they will remain anonymous throughout the research. The software SPSS (Statistics Package for Social Science) will be used to analyse the data and its significance. It is also suitable to conduct focused student group workshop and discussion sessions to gather relevant qualitative data. Furthermore, “action research” methodology may also be used from teacher perspectives.

**CONCLUDING REMARKS**

This paper has discussed the advantages, and schemas of designing a Portal for learning and teaching construction technology courses in university education. The paper, through presenting a conceptual framework, also discussed how the Portal may be designed, developed and used by teachers and students. The objective of the proposed Portal-based learning is to improve student learning experience and outcomes by adapting new generation ICT (e.g. Web 2.0 and social semantic webs). Clearly, the main contribution of the proposed conceptual framework is its adaption and application of the emerging new generation ICT, in which students are in favour of, into university education. Future research work include actual development and implementation of the proposed e-portal, using thousands of photos the authors have accumulated from their teaching of the relevant construction technology courses, and the evaluation of its effectiveness in students learning experience and outcomes. Once the portal is developed and validated, it is possible for its much wider application worldwide, through open access or selected partnering universities.

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