Use of Online Assessment and Collaboration Tools for Sustainable Building Practices Course

Dr. Rui Liu, The University of Texas at San Antonio
Dr. Yilmaz Hatipkarasulu, University of Texas at San Antonio

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Abstract

In the last decade, sustainable building and green construction practices became an important part of construction industry. The importance of this trend is reflected in higher education with the introduction of sustainable practices into construction curricula. There are several different methods of delivering sustainability content including stand-alone lecture courses, structured discussions in various construction courses, and a broader coverage of concepts across the curriculum. However, these methods are usually limited to a face-to-face lecture format because of the type and depth of the content. Case studies may be presented to demonstrate the application of the concepts, but the focus quickly shifts to a lecture format especially when codes, standards, and rating systems are to be covered. Attracting and maintaining student interest becomes a challenge under these circumstances. This paper presents the use of online assessment and collaborations tools for a sustainable building practice course to enhance the student learning experience. The tools that were implemented for this course included online quizzes and exams, instructor led digital discussion boards, and student led group sign-up and digital discussions. A simple survey was conducted at the end of the course to measure the effectiveness of the online tools and the students' perception of the online activities. Instructor's experiences and observations on the formation and maintenance of the system are also included in the paper.

Introduction

In the last decade, sustainable building and green construction practices became an important part of construction industry. The importance of this trend is reflected in higher education with the introduction of sustainable practices into construction curricula. In 2009, 36 out of 43 construction programs (83.7%) have implemented sustainable concepts into their curriculum in some manner (Johnson and Gunderson, 2010; Hyatt, 2011). In a similar study in 2011, 57% of construction programs indicated sustainability as "very important" to the future of the Architecture-Engineering-Construction (AEC) industry while 43% of the programs noted the subject as "important" (Becerik-Gerber et al., 2011). With the significant development of the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) certification program, sustainable construction, materials and certification processes became a necessary knowledge base for construction students.

There are several different methods of delivering sustainability content including stand-alone lecture courses, structured discussions in various construction courses, and a broader coverage of concepts across the curriculum. However, these methods are usually limited to a face-to-face lecture format because of the type and depth of the content. Case studies may be presented to demonstrate the application of the concepts, but the focus quickly shifts to a lecture format especially when codes, standards, and rating systems are to be covered. Attracting and

maintaining student interest becomes a challenge under these circumstances. Effective use of technology may be an efficient way to address this challenge.

On the other hand, the Net Generation or Millennials, do not consider technologies such as computers, internet, instant messaging, or blogging as high-tech items (Frand, 2000; Oblinger, 2003). This technology oriented profile changes the way that the information is delivered and assessed in an educational setting (Hatipkarasulu et al., 2008). In today's higher education system, podcasting lectures and working with wikis for course assignments are not considered radical.

Digital tools including online quizzes and discussion forums have been used to enhance student's learning experience and the research results indicate higher mid-term and final exam performances for students who had active participation of the online quizzes and discussion boards (Pai, 2012). In a five year experimental study, Salas-Morera et al. (2012), showed the positive influence of the use of online quizzes on students' academic outcomes. In the same study, it is noted that the students have a "high appreciation" of the role of these quizzes in their academic preparation.

This paper presents the use of online assessment and collaborations tools for a required sustainable building practice course to enhance the student learning experience at the University of Texas at San Antonio. It is important to note that the online tools did not replace the traditional lecture portion of the course but served as supplementary instruments. The tools that were implemented for this course included online quizzes and exams, instructor led digital discussion boards, and student led group sign-up and digital discussions. Blackboard platform was used to establish the digital content which facilitated a self-paced study of the course materials while maintaining an interactive environment. The group projects were designed to address the implementation of the rating systems which was discussed in course lectures. A real-life project was used to analyze the design and construction alternatives including the achievement of rating system points. A simple survey was conducted at the end of the course to measure the effectiveness of the online tools and the students' perception of the online activities. Instructor's experiences and observations on the formation and maintenance of the system are also included in the paper.

Course Components and Grading Structure

The required course consisted of two midterm exams (25% of the grade), a final exam (30% of the grade), homework assignments (15% of the grade), quizzes (10% of the grade), and a green building case study group project (20% of the grade). Participation in the online discussion board was structured as a bonus component which may contribute up to 2% of the student's final grade.

All exams were conducted in the classroom during the scheduled class hours. In addition to the traditional paper format, each exam had an online portion where the students were asked to log on to their blackboard account on their laptops and answer a set of questions in 50 minutes. The online and traditional portions of the exams were conducted in two different class sessions.

The online quizzes were designed as a tool to assess the students' understanding and knowledge of the class materials. To encourage the class attendance, the quizzes were unannounced where the instructor would ask the students to log on to the blackboard system and use the designated section. Figure 1 presents a screenshot of a typical online quiz question.

2. Commissioning Project Size

The individual serving as the CxA on a LEED for New Construction project shall be independent of the project's design and construction team if the project is larger than

	Student Response	Correct Answer	Feedback
	A. 30,000 sq. ft.		
	B. 50,000 sq. ft.	✅	
	C. 75, 000 sq. ft.		
	D. 100,000 sq. ft.		

General Feedback: EAp1

Score: 0/2

Figure 1. Online Quiz Question Example

In this format, students receive the results and feedback for the questions immediately after submission. The results are archived automatically where the students have access to questions and results any time during the semester. During the semester, the instructor used a total of 8 unannounced quizzes. To have a comparative student preference, 5 of these quizzes were delivered online and 3 were in paper format.

For their group project assignment, students were separated into three to five-member groups to conduct a green building case study. Each group was assigned a LEED certifiable project, which was evaluated according to the LEED 2009 rating system. At the beginning of the project, a guest speaker from a sustainability consulting company was invited to give students a lecture about a recently completed LEED silver project located in the San Antonio area. The guest speaker gave a brief introduction of the green design and construction, management of LEED certification process and how this project satisfied the LEED requirements. The students were asked to replicate the guest speaker's approach to analyze their projects.

As a bonus component to their final grade, the students were asked to suggest online discussion topics and participate in the selected topics. Although this component was only 2% of their grade, students were very active in selection of the topics as well as exploration of available resources on each topic. Figures 2 and 3 show sample screenshots of the discussion topic list and student comments.

The topics in the discussion board included green materials, new LEED certified buildings, problems of the LEED rating system, recycling, and green responsibility. Although not all students posted specific topics, all students participated in the discussion with comments.

Figure 2. Discussion Topics Raised by Students

Figure 3. Students' Feedbacks of One Discussion Topic

Student Survey Results

The following section presents the survey results from the sustainable building practice course which was offered in two sections with a total enrollment of 66 students (36 students in section 1 and 30 students in section 2). The response rate for the survey were 94% for section 1 (34 students) and 97% for section 2 (29 students).

The students were asked about their preference for exam and quiz format. As presented in Table 1, online format showed a slight advantage where 52% of the students preferred the online format while 19% had no preference.

Table 1. Quiz and Exam Format Preference

	Number of Students		
	Section 1	**Section 2**	**TOTAL**
Prefer Online Quizzes and Exams	15 (44%)	18 (62%)	**33 (52%)**
Prefer paper Quizzes and Exams	10 (29%)	8 (28%)	**18 (29%)**
No Preference	9 (27%)	3 (10%)	**12 (19%)**

The main reasons for those who supported the online assessment were noted as:
- "It saves paper and more sustainable to have online assessment.
- "Online assessments are viewable later for study."
- "It is easier and faster to do online questions."

Correspondingly, the main reasons behind paper assessments supporters were:
- "It is hard to carry a laptop for every class."
- "Used to paper test, feel connected when doing paper test."
- "Do not need to worry about computer and internet connection."

Although some of the responses can be attributed to personal habits and computer skills of the students, it is important to note that during the semester, the blackboard system at the university was going through a transition to a newer version of the system which created an unusually slow and problematic operation. In one of the online quizzes, the system completely shut down which was a particularly frustrating experience for the students as well as the instructor. With a well-operated and responsive system, the results are expected to be more positive for the online format.

The students were also asked whether the class included appropriate number of online quizzes. The majority of the students (51%) believed that the number of online quizzes were appropriate while 16% of the students did not have a problem with the number of quizzes but would prefer paper format. Only 6% of the students reported that they would not like to have any quizzes at all. Table 2 shows the student's opinion of the number of online quizzes.

Table 2. Number of Online Quizzes

	Number of Students		
	Section 1	**Section 2**	**TOTAL**
Have the right amount of online quizzes	16 (47%)	16 (55%)	**32 (51%)**
Prefer paper quizzes	7 (21%)	3 (10%)	**10 (16%)**
Would like to have less quizzes	5 (15%)	5 (17%)	**10 (16%)**
Would like to have more quizzes	3 (9%)	4 (14%)	**7 (11%)**
Would like to have no quizzes	3 (9%)	1 (3%)	**4 (6%)**

Although it was only 2% bonus points of the overall grade, the students show high participation in the online discussion board activities. Table 3 presents the online activity recorded throughout the semester at the discussion boards.

Table 3. Online Discussion Board Activity

	Section 1	Section 2	TOTAL
Number of students	36	30	**66**
Number of messages posted on discussion board	91	84	**175**
Number of messages read on discussion board	1310	1434	**2744**
Average number of messages posted per student	2.56	2.80	**2.65**
Average number of messages read per student	47.80	36.39	**41.58**

When the students were surveyed for their perception of the discussion board, 63% indicated that the board helps them understand and explore sustainable construction. Only 16% of the students provided negative feedback for the board while 21% were not sure. On the other hand, an overwhelming majority of the students (89%) perceive the discussion board as an effective tool. Tables 4 and 5 show the student perception of the board and its effectiveness. The top reasons for the discussion board supporters were:

- Getting more information about sustainability
- Exposing to more sources of green buildings
- Talking to others helps understand different aspects on sustainability topics

Table 4. Student Perception of the Online Discussion Board

	Number of Students		
	Section 1	**Section 2**	**TOTAL**
Online discussion helps me understand and explore sustainable design and construction concepts	20 (59%)	20 (69%)	**40 (63%)**
Does not help	6 (17%)	4 (13%)	**12 (16%)**
Not sure	8 (24%)	5 (17%)	**13 (21%)**

Table 5. Effectiveness of the Online Discussion Board

	Number of Students		
	Section 1	**Section 2**	**TOTAL**
Discussion board was effective	29 (85%)	27 (93%)	**56 (89%)**
Discussion board not was effective	1 (3%)	0 (0%)	**1 (1%)**
Not Sure	4 (2%)	2 (7%)	**6 (10%)**

The students were also asked about their confidence in providing input for a project in the LEED certification process. Only 3% of the students were not confident while 81% stated that they would be able to provide input for a LEED project. Table 6 presents the results for the confidence question.

Table 6. Confidence in Providing Input for a LEED Project

	Number of Students		
	Section 1	**Section 2**	**TOTAL**
I will be able to provide input for a LEED project	25 (73%)	26 (90%)	**51 (81%)**
I will not be able to provide input for a LEED project	1 (3%)	1 (3%)	**2 (3%)**
Not Sure	8 (24%)	2 (7%)	**10 (16%)**

It should be noted here that this required course is structured specifically for construction management students to explore sustainable building practices including means and methods of construction, certification systems and construction materials. The design aspects of the practice were covered with the assumption that the construction managers would be involved in the process early enough to provide input for the designers.

CONCLUSION

This paper presents the use of online assessment and collaboration tools for a required sustainable building practice course to enhance the student learning experience at the University of Texas at San Antonio. The digital tools were utilized as supplementary instruments including online quizzes, exams and discussion boards. In the survey conducted at the end of the semester, the students provided a positive perception of the online tools and indicated their effectiveness as a supplement. It is important to note that the course materials were primarily delivered in a traditional face-to-face lecture format and all online quizzes and exams were conducted during scheduled class times using laptops.

There were two important observations for the successful application of online tools. The first observation is the necessity to have an organized and well-maintained information technology infrastructure. During the semester, because of the system transition at the university, the students experienced down time and slow performance form the Blackboard system. This may be a significant detriment for implementation which creates a stressful environment for students as well as the instructor. The second observation is the recognition that the students may have different levels of computer skills. This becomes a visible problem especially for online exams where the students are under pressure to perform in a limited time frame. Durations for such assessment must be selected carefully.

For the instructors, the preparation for the class is the most important issue. Creating effective and practical online exams and quizzes take significant time; however, once the assessment tools are in place, the students receive immediate results and feedback on their performance. The students can review the questions and results throughout the semester since the system automatically archives the online activities. The discussion board also provides an opportunity to supplement the course content and readdress issues or questions. When there is an incentive to participate, such as bonus points to their final grade, the students show high participation knowing that their activities are recorded in the system.

Overall, the incorporation of the online tools to enhance the student experience provided a positive result. Our limited experience indicates that the approach may be successful in other lecture-based construction classes. It is important to recognize that the content of every construction class may not be appropriate for all of the online tools. Online exams and quizzes may present major challenges for numerical and application oriented classes. However, online discussion boards are appropriate tools for all classes as long as the content and responses are maintained in a timely manner.

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