

An Online Year in Review of a Construction Management Sustainability Course

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This paper presents the delivery system for an online construction management course in sustainability and the built environment at a major university. Information about the course layout, assignments, discussions, and assessments are provided in this paper. The course provided a systems approach to green building science, including sustainable site development, water use efficiency, renewable energy, improving material use, indoor environmental quality, and design innovation. The authors conducted surveys to obtain the students' perspectives about the course. This study compared students' perspectives about the online course using a Likert-type survey questions from two different quarters of the same sustainability and the built environment course at a four-year university. The paper presents and discusses the results of these student surveys. Results provided insight on areas to improve the online course for future users. Preliminary findings suggest the primary area for improvement should focus on improving the discussion forums, as well as enhancing the course delivery. This paper aims to provide information and guidance to assist educators in enhancing online education in the area of sustainability and the built environment.

Key Words: Online learning, sustainability, construction education, students' perspectives

Introduction

The process of what is defined as construction is expanding in the ever-changing global market (Benhart & Shaurette, 2011a; Bernold, 2005). Construction management programs are changing their teaching methods in order to properly prepare graduates for the changing pace of industry. Construction professionals now have to do more than just problem solve. They must be able to be innovative both in design and in execution, utilizing creative thinking alongside mathematical and building science principles. They must also be able to work within multidisciplinary teams of other industry professionals and communicate effectively across those disciplines. The construction industry continues to transform as both economic conditions and a growing interest in sustainability are shifting its focus. There has been a push by many universities to incorporate sustainability in the built environment into their curriculum (Tinker & Burt, 2004).

Individuals walking around school campuses often see today's students engaged with technology such as smart phones and laptops for both social and educational purposes. Higher-education students have been classified as "21st-century learners" or "digital natives." These students multitask and use images to convey content whenever possible, are digitally literate and mobile, and assume computers are part of the life experience. They also crave interactivity, read images well, prefer visual and kinesthetic activities over reading and listening activities, and desire random access. Today's students want to be challenged to reach their own conclusions, and need practical applications in real-world contexts (Rodgers, et al., 2006). Traditionally, learning in an institutional setting has taken place in a classroom, but this is starting to change with the increased use of technology (Allen & Seaman, 2007).

In an effort to enhance the quality of educational experiences for 21st-century learners, educators have started to adopt a blended learning approach. Numerous models of blended learning are designed to integrate both face-to-face

and online learning in order to recapture the traditional values of higher education, while also meeting the demands and needs of the 21st century (Garrison & Vaughan, 2008).

Classes are beginning to transfer from an in-class setting to a more online setting. There are many different types of online learning: Traditional, which is 0% online, Web Facilitated, 1% to 29% online, Blended/Hybrid, 30% to 79% online, and Online, which is more than 80% online (Allen & Seaman, 2007, p.4). Educational institutions have adopted learning management software to host the online interface. Classes then have their own specific webpage to facilitate assignments, discussion, assessments, and other interactions with students. Students and teachers can access this webpage anytime and anywhere. All interactions between the students and instructor, as well as between students themselves, occur in these online environments.

Online classes are very convenient for students since the work can be completed on their own time (Farrow, 2013). Online learning is also asynchronous, meaning that it can be conducted without the constraints of time or place, and through a network of people (Allen & Seaman, 2007). Essentially, online classes can be completed “anytime, anywhere” (Richardson, Swan, 2003, p. 2). This allows students to access and view the course material on their own time, instead of being constrained to traditional class times. Students are busy, whether it be with other classes, jobs, or extracurricular activities, so having the flexibility to “attend” class anytime helps them stay on top of a full load. Another big advantage to online learning is the fact that students have the ability to work at their own pace (Richardson, Swan, 2003 p. 2).

Since online learning is still considered a relatively new concept that many students have not been exposed to, there are some criticisms of the method (Richardson, Swan, 2003, p. 2). Research has recognized a common error of designing a new technology that attempts to mirror older ones (Clark & Mayer, 2008). For example, one main criticism is that there are no face-to-face interactions between the students and instructor (Richardson, Swan, 2003, p. 2). Due to the limited interactions between the students and instructors, educators are worried that students can feel disconnected from the learning environment (Richardson, Swan, 20013, p.2). Concerns such as these were the impetus for this paper.

On-line Delivery System for a Sustainability Construction Management Course

Cal Poly, San Luis Obispo recently launched an online Sustainability in the Built Environment course. This course offered a systems approach to green building science, including sustainable site development, water use efficiency, renewable energy, improving material use, indoor environmental quality, and design innovation categories. This was the first time that an online class was offered in the Construction Management Department at Cal Poly, San Luis Obispo. This course was first offered Summer quarter; however, this study was conducted on the students who took the class Winter and Spring. Offering this online class in the summer allowed students who normally have off campus internships to continue working toward degree completion. To many busy students trying to graduate on time, this is very appealing. This course was not only a required major class for construction management students, but is also a general education course option, which allows students from various majors to enroll.

The average class size was 40 students. Since also a general education course, there are seats available for non-major students. Of the surveyed students, 52% of the winter class and 82% of the spring class were Construction Management majors. Online class formats are relatively new for students at Cal Poly, San Luis Obispo, and 58% of the students both quarters reported that this was their first time taking an online class. Their resulting perspectives on online learning will be discussed in this paper.

Research Question

This study attempted to answer the following question: Has the on-line delivery of the sustainability course been successfully incorporated into an undergraduate construction management program?

Course Chunking

This course used the “Course Chunking Approach” when developing its organizational layout. Course Chunking was utilized by setting a repetitive schedule, meaning that each week the students had to complete the same type of assignments, discussions, and quizzes. Also, as this course was an asynchronous, the material changed each week, but the type of deliverables remained similar. These methods allowed the students to create a routine and accurately keep track of the course. For example, each week the students were required to complete one discussion, one assignment, and one quiz. Since this class did not physically meet during the week, it could be difficult for the students to understand what is due when. To address this, each week a folder labeled “What’s Due This Week” was made available, allowing students to view when assignments were due. The goal was to have an asynchronous course that provided the students with the freedom to complete the assignments, discussions, and quizzes at any time within a given time period. This posed a good chance that a student could forget to turn in an assignment or participate in a discussion. The course chunking organization and having the “What’s Due This Week” folder eliminated most student confusion and late assignments.

Course Material

There were many different types of material sources that this course pulled from. Since there were no physical meeting times to make the material less dry, this course needed to possess material that encouraged students to participate and complete assignments. The main source of information was derived from the two required course textbooks, which were sponsored by the U.S. Green Building Council. To accommodate the different learning types, the course material had to vary enough to appease all students, while also being presented correctly (Allen & Seaman, 2007). This course offered many different types of course material, including videos for the students to watch, online-based games to solidify the material, as well as different case studies to explore. In both surveyed classes, a majority of the students agreed that the activities (i.e. mind map and water game) helped them learn and retain the material the most. These online activities are meant to simulate activities that are conducted in a traditional classroom setting.

Assignments

Each week there was an assignment due on Friday by 11:59pm. These assignments were usually related to the assigned readings and videos, and consisted of general questions to be answered in paragraph form. Unlike the discussion assignments, once turned in, students could not see each other’s responses. The assignments were designed to check the students’ comprehension of what they read and watched.

Discussions

Each week there was a discussion in which the students were required to participate. The students are required to post a response to the assigned topic by Wednesday of that week, in addition to two other students’ posts by Friday. Requiring that the students respond to others’ posts involved reflecting upon the ideas of fellow students. Since a variety of majors are enrolled, this offers a unique, interdisciplinary aspect to the class. Students’ perspectives are influenced by their areas of study, and, as there was no one right answer to the forum questions, it allowed them to synthesize and reflect on different viewpoints.

The class consisted of four different types of discussions:

1. Case Study based discussions: The majority of the discussions that the students participated in were based off of them finding a building that excels in a particular LEED, or Leadership in Energy & Environmental Design category (i.e., Sustainable Sites, Water Efficiency). In each of these discussions students are required to include pictures of the building. For this students were given access to the U.S. Green Building Council (USGBC) website where they can look up LEED certified buildings. On this website they were able to access pictures, a brief narrative of the project, as well as the LEED scorecard for the building. Students were then required to discuss how this building excelled in that particular category. Requiring students to research and complete this discussion allowed them to discover ways in which buildings are made sustainable.

2. Evaluate a current building discussion: For these types of discussions, students are to evaluate current buildings in their community and discuss how the building was inefficient. For each of these discussions, the students are required to include pictures of the building they are discussing. Many times, students chose to write about the houses they currently live in, as the majority of the houses in the area are old and inefficient. Having students look at a building and discuss how it is not efficient and what could be done to improve the building helps solidify the concepts and objectives of this class.
3. Activity-based discussions: These discussions are meant to incorporate and accommodate different types of learning styles. The goal of these activities was to deviate from the standard writing-based activity. An example of one of these activity-based discussions is the mind map activity. This discussion takes place early in the course and allows students to illustrate connections between different aspects of sustainability. This also allows students to utilize their creativity, as this mind map was either hand drawn or made using a digital design program. Since sustainability and, even the built environment, was new to some students taking the class, it was interesting to see how they created and analyzed connections. Students' mind maps tended to cater to each one's field of study, as the class was comprised of a variety of majors. This gave students the opportunity to understand viewpoints other disciplines may have on a particular subject.
4. Game-based discussions: There was only one type of discussion that incorporated some type of game and, as a result, it fosters competition between the students. For this discussion, the students complete an online game based on water efficiency. The game was set up like a PacMan game, and, throughout the game, questions come up regarding water efficiency. At the end of the game, the students are scored based on the amount of questions they answered correctly. The students were not required to post a write up, but instead post a screenshot of the score they received. Since all of the students can see the posts, it created a competition to see who can get the higher score.

Quizzes/Final

Each week the students were required to take a quiz. These quizzes typically consisted of 10 multiple choice questions that the students have 15 minutes to complete once they have started. The questions for these quizzes are derived from the reading assigned for that particular week, and, at the end of the course, there was a 50 question multiple-choice cumulative final. These questions were similar to the weekly quizzes and the students had the standard three hours to complete the final once they had started.

Instructor Assessment of Students

In terms of when assignments, discussions, and quizzes were due, this online class took a different approach. For example, the initial discussion posts were due at 11:59 pm every Wednesday and the students were required to respond to at least two other students' posts by 11:59 pm every Friday. The assignments were due every Friday by 11:59 pm and the quizzes were to be completed by 11:59 pm on Friday. The grading policy for late assignments was fairly strict. If the assignment was not submitted to PolyLearn in time, a zero was given for that particular item. Some students thought this policy was extreme, but they had a full week to complete these tasks and submit them any time before the deadline. Also, this type of policy was similar to how bids are read in the construction industry. If a bid is late, then typically the bid will not be read.

The following criteria were used to assess the students' performance:

- Discussions: 30%
- Assignments: 20%
- Quizzes: 20%
- Final Exam: 30%

Students' Perspectives of the Online Class

A survey of the student's perspectives of the course was conducted in the Winter Quarter and in the Spring Quarter. The survey was created to obtain student feedback and ensure this online class was effective, as well as to identify

potential areas of improvement. The class size was 38 students in Winter Quarter and 30 students answered the survey. The class size was 37 students in Spring and all 33 students answered. The survey was anonymous. The results of the students' perspectives are in Table 1. A questionnaire was developed by using Olbina's (2008) questionnaire. It was put through a peer review process that customized it for the purposes of this study. The students answered on a rating scale of 1 to 5, with 5 being the highest. The results are posted as the percent of students that scored each question in the corresponding column.

Table 1

Results of student perspectives

	Questions	Scale for Student Responses					Mean Response	Quarter
		1	2	3	4	5		
1	How would you rate your understanding of Sustainability in the Built Environment?	6.5%	0.0%	0.0%	41.9%	51.6%	4.32	W
		0.0%	0.0%	6.1%	63.6%	30.3%	4.24	S
2	How would you rate your awareness of the different sustainability categories and how they are related? (i.e. Water Efficiency and Sustainable Sites)	0.0%	0.0%	3.2%	41.9%	54.8%	4.52	W
		0.0%	0.0%	3.0%	63.6%	33.3%	4.30	S
3	How would you rate the level this course encouraged active self-learning?	0.0%	0.0%	9.7%	32.3%	58.1%	4.48	W
		0.0%	3.0%	21.2%	39.4%	36.4%	4.09	S
4	How would you rate the improvement of your sustainability vocabulary?	3.2%	0.0%	0.0%	45.2%	51.6%	4.42	W
		0.0%	0.0%	18.2%	51.5%	30.3%	4.12	S
5	At what level did this course encourage independent and critical thinking?	0.0%	0.0%	6.5%	54.8%	38.7%	4.32	W
		0.0%	3.0%	15.2%	60.6%	18.2%	3.85	S
6	How well did the discussion forums help improve your understanding of the material?	0.0%	0.0%	19.4%	35.5%	45.2%	4.26	W
		3.0%	3.0%	27.3%	39.4%	27.3%	3.85	S
7	How would you rate how well the discussions helped improve your communication skills in an online class environment?	0.0%	0.0%	19.4%	41.9%	35.5%	4.03	W
		0.0%	3.0%	21.2%	45.5%	27.3%	3.88	S
8	How well did this online class environment positively impact your learning ability?	3.2%	0.0%	6.5%	38.7%	48.4%	4.19	W
		0.0%	3.0%	24.2%	54.5%	18.2%	3.88	S
9	How would you rate your overall satisfaction level of online classes in higher education?	0.0%	3.2%	3.2%	32.3%	61.3%	4.52	W
		3.0%	0.0%	12.1%	45.5%	39.4%	4.18	S

Discussion of Survey Results

The authors performed the following tasks to analyze the survey results:

- Evaluation of the frequency of responses.
- Evaluation of the mean response value.
- Comparison of the frequency of responses for Winter and Spring
- Comparison of the values of the mean response for both Winter and Spring. (Based on Olbina, 2008 p.55)

Ratings with “values of 4 and 5 were considered positive, 3 neutral, and 1 and 2 negative.” (Olbina, 2008 p. 55) The following results were derived from the student evaluations using the methodology stated above:

1. 94% of the students in Winter and 100% of the students in Spring felt that their understanding of Sustainability in the Built Environment increased after taking this class. The mean response was above 4.2 both quarters. The high level of response demonstrated that the students did absorb from the class and increase their knowledge. Between the Winter and Spring, the mean decreased by 0.08. Although the frequency of positive responses decreased, the mean remained nearly the same. This shows that there is some work to be done to help improve and maximize the information the students take away from this class.
2. 97% of the students in Winter and 97% of the students in Spring felt that they were aware of the differences between the different sustainability categories and how they were related. The mean response was 4.52 and 4.30 in the Winter and Spring quarters, respectively. Although there was a lower frequency of positive responses in Spring, the mean response is still very high. There were 3% of the students each quarter who were neutral. The high level of response showed the students are more aware of the different areas of sustainability and the built environment after taking this class. The mean decreased by 0.21 in Spring compared to Winter. The decrease in the mean is something to be addressed, and there may need to be adjustments on how some of the information is given to students so as to clarify it.
3. 96% of the students in Winter and 76% of the students in Spring agreed that this course encouraged active self-learning. The mean response for Winter was 4.48 and the mean response for Spring was 4.09. 24% of the students were neutral about whether this course encouraged self-learning in Spring. The mean did decrease by 0.39 from Winter to Spring. Since this is an online class and there is no in class meeting time, it is imperative that the students self-teach the material. This is done through the assignments and discussions, but there might need to be more instruction or examples given to demonstrate what is expected. With more explanation of course expectations, the students may self-teach more.
4. 97% of the students in Winter and 82% of the students Spring felt that their sustainability vocabulary increased after taking this class. The mean response for Winter was 4.42 and the mean response for Spring was 4.12. There were 18% of the students in Spring that were neutral regarding this question. Sustainability concepts contain a lot of new vocabulary, which students are exposed to in this class. There was a decrease of 0.30 in the mean between the two quarters. Since the terminology is crucial to fully comprehending sustainability concepts, more should be done to ensure that students are grasping and understanding these new terms. Also, since this is a general education course, some non-majors may have been exposed to this terminology for the first time. Because of this, some students may take longer to completely understand these terms.
5. 94% of the students in Winter and 85% of the students in Spring thought this course encouraged independent and critical thinking. There was a decrease of 0.47 in the mean between the two quarters. This large of a difference between the two quarters is something to take note of. As with many courses, critical thinking is a vital component of the students’ understanding; the ability to think critically about the topic stimulates learning. Even though the majority of the students who did not agree were neutral about this question, some modifications should be made so that everyone feels this class encouraged students to think critically.
6. 81% of the students in Winter and 70% of the students in Spring felt that the discussion forums helped improve their understanding of the material. The mean response was 4.26 and 3.85 for Winter and Spring, respectively. The discussion forums are a very unique and important part of this class, as they allow

students to share and discuss their thoughts on a particular topic. Also, it facilitates different viewpoints on topics since there are non-majors in the class. The majority of the students who did not agree with this question were neutral that the discussions do help to a degree. Some adjustments may be necessary to help improve the discussions.

7. 81% of the students in Winter and 76% of the students in Spring thought that the discussions helped with their communication skills in an online class environment. The students who did not feel the discussions helped them with their online communication skills were neutral about the question. The mean response was 4.03 and 3.88 for Winter and Spring, respectively. There was a decrease in the mean of 0.15 between both quarters. As over half of the students in both Winter and Spring have never taken an online class before, it becomes clear that they also have never communicated in an online class environment before. And so, they have no means to measure or compare the differences.
8. 90% of the students in Winter and 85% of the students in Spring felt this online class environment positively impacted their learning ability. Only 3% of the students in Winter felt that this class did not positively impact their learning ability, and the other students in both quarters felt neutral about this question. The mean response for Winter was 4.19 and the mean response was 3.88 for Spring, which is a decrease of 0.31 between the two quarters. Again, online learning is new for most of the students who took this class, so it might take a while for them to get used to the differences in online material delivery, compared to a traditional classroom setting.
9. 94% of the students in Winter and 85% of the students in Spring were satisfied with the use of online education in higher education. 3% of the students in both quarters were not satisfied with the use of online classes in higher education. The mean scores were between 4.15 and 4.55, and the mean decreased by 0.33 between the two quarters. Online learning is new to students, especially at Cal Poly, but a majority of the students were satisfied with the use of online classes in higher education. Online education may become more prevalent at universities because it allows students to “attend” class within their own schedule.

Conclusion

The authors believe that the on-line delivery of the sustainability course has been successfully incorporated into an undergraduate construction management program. Some modifications have been made based on student feedback. Every quarter there has been a student survey sent out. The survey has allowed the instructor to gather feedback, both positive and constructive, regarding this course.

There were two questions that particularly highlighted the strongpoints of this class. They were the question regarding understanding the different sustainability categories and the question regarding whether the class encouraged active self-learning. Because the topic of sustainability is a complex one with many aspects, having almost all the students between two quarters agree that they understand the different sustainability categories is an accomplishment. The second strength that the survey revealed was in the area of self-learning. Because self-learning is of critical importance in an online course, having 82% of the students both quarters agree that this course encouraged self-learning is another big accomplishment.

Two questions revealed areas for improvement. The first area for improvement is associated with the discussions and how they contribute to the learning and understanding of the material. Of both quarters surveyed, 74% of the students agreed that the discussions help improve their understanding of the material, while 23% were neutral. This shows that there may need to be some improvements to the discussion boards, as well as more investigation to uncover areas of the course that students feel are lacking. The second area that needs improvement is how the discussion boards improved their communication skills in an on-line class environment. 78% of the students over both quarters agreed that discussions did improve their communication skills, and 20% of the students were neutral. To potentially improve the discussion boards, examples of well-written discussions should be shared with the students. If they understand what quality work looks like, then they can potentially improve their discussions to match that quality.

As with many university classes, consistent improvements must be made. Much additional work is required to continue the development of undergraduate online education in sustainability and the built environment at Cal Poly, San Luis Obispo. Continued input from the students is necessary to enhance online delivery of material. Additional

surveys may be performed in order to analyze the results of future improvement to the course. A potential area of further research would be to have peers assess the course based on a quality online teaching assessment rubric.

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