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Assessment

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Evaluation of Hybrid Course Implementation in Construction Engineering

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Abstract

Engineering educators call for a widespread implementation of hybrid instruction to respond to rapidly changing demands of 21st Century[1]. In response to this call, a junior-level course in the Construction Engineering department entitled *Construction Equipment and Heavy Construction Methods* was converted into a hybrid instruction model. The overarching goal in the hybrid course development was to take the content that can be engaged outside the class to an online platform so that class time can be used more efficiently for authentic, realistic, open-ended problems and homework assignments. This study reports the design, development and evaluation of this hybrid course and provides practical implications for hybrid course development.

Introduction

Hybrid learning, interchangeably referred to as blended learning, can be defined, in its most generic sense, as an educational approach that combines online instruction with face-to- face instruction[2, 3]. Because of its blending feature, hybrid format is also considered as the best of two worlds providing the benefits of both the online and face-to-face environments[3]. In hybrid learning, lectures can be replaced by interactive activities, which can be facilitated by teaching assistants under the supervision of the instructors. The professor then has more time to interact with individual students and enhance the quality of the course through sustained course development and innovation[2, 4].

When executed well, hybrid instruction provides several benefits at the student, faculty and institution level. Researchers argued that blended learning courses were in high demand because of the increased convenience and flexibility, and learning outcomes were higher than traditional and face-to-face counterparts. Similarly, the majority of the faculty was satisfied with their blended learning courses and blended learning provided benefits at the institutional level by improving the efficiency of classroom use [5]. A recent meta analysis of online education by the U.S. Department of Education also revealed that students in online learning conditions performed modestly better than students in face-to-face conditions; and students in hybrid learning conditions performed better than both completely online and face-to-face conditions[6].

Prior research indicates that people choose blended or hybrid instruction for three main reasons: 1) improved pedagogy, 2) increased access/flexibility 3) increased cost effectiveness[7,8]. Hybrid learning approaches increase the opportunities for active learning strategies, group work, and learner-centered pedagogies[9]. Learner flexibility and convenience is also of growing importance as more non-traditional students, who have job and family commitments, seek additional education[7, 10]. In addition, hybrid teaching holds the potential to address the cost problem by "taking faculty out of the easily automated business of delivery of information and allowing them to refocus their attention with students on critical thinking skills"[1].

Maximizing success in a hybrid learning environment requires reconceptualization of teaching, learning and assessing. As Peercy and Cramer noted "successful hybrid teaching cannot be a mish-mash of traditional lecturing with some online content but rather a thoughtful re-design of course pedagogy and meaningful interactions with students."[1]. In the hopes of improving learning while providing some flexibility for students and instructors, a junior level construction engineering course, entitled *Construction Equipment and Heavy Construction Methods*, was converted from traditional face-to-face instruction to hybrid format starting in the summer of 2012. This study reports the design, development and evaluation of this hybrid course and provides practical implications for hybrid course development.

Description of the Hybrid Format

The overarching goal in the hybrid course development was to take the content that can be engaged outside the class to an online platform so that class time can be used more efficiently for open-ended problems and homework assignments. The course syllabus was carefully analyzed to identify what could easily go online and what needed to be covered in the class (See Appendix A)

Online Activities

Online activities for this hybrid course involved *lectures* and *modules*. Lectures that were normally given in a traditional face-to-face classroom format by the instructor are made into online videos through screen recording and voice-over narration. Many times, lectures that are given in class are merely a transfer of knowledge with limited student interaction. Those types of lectures are a good fit for online lecture videos and allow students to obtain information that they need outside of classroom time. This, in turn, frees up face-to-face classroom time that can be used to apply the knowledge obtained through the lecture. The online lectures in this hybrid course introduced the course concepts through visually enhanced, relatively short videos by checking comprehension along the way. Interested readers can see a sample lecture video in here: http://www.screencast.com/t/A9MCvuwlyhOG. Our experience has also shown that it takes less time to cover the same amount of material online in comparison to face-to-face lecture.

After the instructor screen recorded a given topic, an instructional design assistant engaged in some post-production, which included three main tasks: chunking the video, adding visual enhancement, and adding comprehension questions. In the online course design literature, it is recommended that the videos should be around five minutes to keep students engaged in the material[15]. Bearing this in mind, the videos were chunked into relatively short, manageable parts. Then, the presentations were visually enhanced by adding images, highlighting important information based on the principles of the cognitive theory of multimedia learning[16]. Finally, comprehension questions checking students' understanding of the material were integrated. Students had two attempts for these questions and they received immediate feedback whether they got the right answer or not. These scores are recorded in the course management system, i.e. Blackboard Learn, and included as part of the overall course grade. In total, there were nine online lecture videos in this hybrid course.

Online modules are interactive exercises that demonstrate how to solve problems in construction engineering and allow students to practice solving similar problems in a step-by- step, interactive, scaffolded learning environment. Twelve modules were developed using the e- learning software, Lectora, for this hybrid course. Four main instructional design decisions were made for development online modules: 1) scaffolded problem solving, 2) step-by-step problem solving, 3) immediate explanatory feedback, and 4) multiple attempts (See Figure 1).

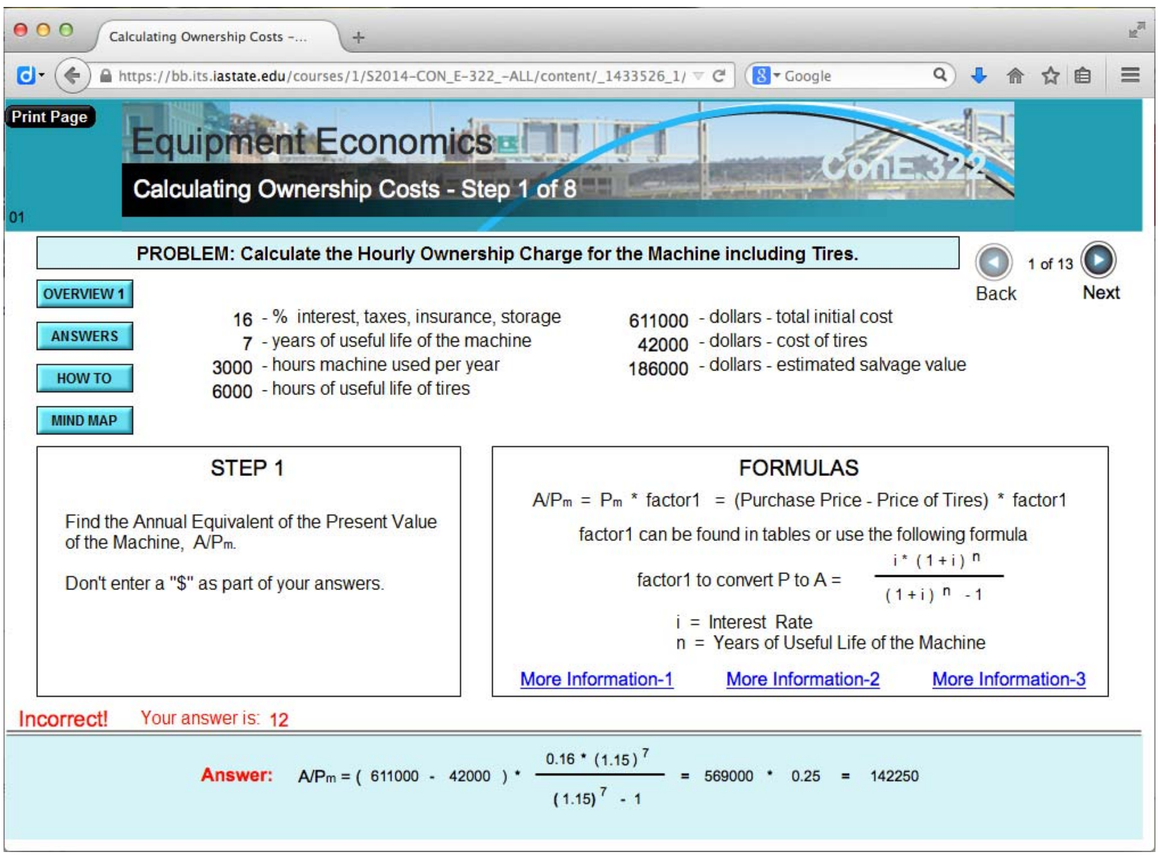

Figure 1. Example online module Link: http://www.screencast.com/t/MznFBUMh6aF

To scaffold student learning in complex problem solving, worked-examples were provided to demonstrate how to solve a particular problem. These worked examples were called "how-to videos" and provided as on-demand help options. Students had the opportunity to see the solution process of a problem with a different set of data if they had difficulty solving the problem.

A complex problem statement was chunked into multiple steps and students were asked to submit their answers for each step. The underlying reason for taking students through the steps of a problem was to help them understand what they needed to do to reach a solution to a complex problem. They were expected to implement this strategy in open-ended problems they solved during in-class sessions.

Students were allowed two attempts in a given question to get the right answer. This was particularly important for questions that require a numeric entry in order to avoid any calculation errors. Students also received automated explanatory feedback to ensure they knew what the right answer was and they did not carry mistakes over.

Face-to-Face Activities

Taking the lecture and problem practice parts of the course to the online platform forced the instructional design team to reflect more on the in-class activities. Homework assignments and in-class activities were revised and converted into more open-ended, real-life exercises on which students can work in small groups under the supervision of the instructor and teaching assistants. In these activities, the instructor and the teaching assistants played a facilitative role rather than directing the instruction. For example, three homework assignments were converted to ill-defined problem format. Homework assignments were also chosen from real construction projects taken place on and around campus. Other in-class activities involved students presenting information, analyzing real-life scenarios and providing alternative solutions, working on hands-on projects.

Research Methodology

The summative evaluation included in this paper was collected in Spring 2014, in which 19 students were enrolled. Out of these 19 students, 13 students participated in focus group interviews. Pseudo names are used throughout this report to protect the identity of the participants. All the interviews were administered during a class period in week 14 of a 15-week semester in Fall 2014 in the regular classroom where students had met throughout the semester. A semi-structured interview protocol including questions about the main aspects of the course was followed allowing room for follow-up questions. The interviews took an average of 30 minutes. All the focus group sessions were audio-recorded and transcribed verbatim for analysis. The data were manually coded for recurring themes and categories.

Results and Discussion

Student Identified Benefits of Hybrid Instruction

Focus group interview findings pointed out that hybrid instruction provided two major benefits for students: *flexibility* and *pacing of the learning*. Students repeatedly referred to the flexibility of the hybrid format as an advantage. They indicated that they enjoyed being able to do the online activities on their own time without being restricted to classroom time as pointed out in this comment:

> I liked hybrid learning, as far as, you only have to come in to class certain amount of days and then the rest you do it in your own time, which is really good. It just adds a lot of flexibilities into my schedule, which is the biggest thing, so a lot of open times. And I can do it, you know, either early in the morning or late at night and I don't really have to worry about with everything else I have going on. (Ray, Focus Group 1, p. 1)

Another flexibility that hybrid format brought was that students were able to plan and work ahead if they preferred to do so. All the online lectures and modules in this course were made available from the beginning of the semester but they were closed after the due dates. Students appreciated this flexibility because they could work ahead if they knew they had a busy week coming up as Brad said “If I have an hour gap, I'd like to fill it with something. And the ability to sit down and work something like this, I feel like, yeah, just knock it out” (Brad, Focus Group 1, p.2)

Another advantage of hybrid format identified by students was the ability to pace their own learning. They repeatedly referred to being able to pause, rewind, and replay as one positive aspect of hybrid learning. For example, Sam mentioned that he was able to go back and review the material when he did not understand it or skipped parts of the video if he was confident in his knowledge in that area. Sam noted:

[I liked] being able to pause it. If you need to replay it, if you didn't get it all the first time, you can replay it and go back over it whereas other stuff you can also click ahead if you already know everything. So, it gives you that option. Kind of go in your pace. (Sam, Focus Group 3, p. 2).

The online component also provided opportunities for students to run the lecture videos while they are working on their homework assignments so that they could practice what they learned immediately. For instance, Brad mentioned how having videos available helped him do the homework assignments.

> While you are working on the module, being able to have the video up while you are working on the video at the same time; it will play along and go step by step to keep up instead of frantically writing a bunch of notes while you are sitting in the class (Brad, Focus Group 1, p. 6)

Student Identified Challenges of Hybrid Instruction

The analysis of focus group interviews revealed three main challenges in this hybrid course: *technical issues*, *course organization*, and *communication issues*. Although the instructional design team tried to do their best to test and debug all the online activities, they were unable to avoid some technical glitches which hindered student learning at times as Brad pointed:

The frustrating part was when you go through all that spending 15 minutes on the problem realizing that you had the right answer all along and then the computer was wrong...I just wanted to throw a chair to the computer, so yeah, it is just a lot of weird things in the system. (Brad, Focus Group 1, p. 4)

Another challenge for students in this hybrid course was related to *course organization*. The way the syllabus was designed was not consistent in terms of when things were due. In other words, there was not a specific day of the week that students would do an online activity and another day for in-class activities which created confusion at times. For example, Bruce noted:

> One of the things I found frustrating was coming to class and thinking that I had my homework done because I had it in my hand. And then oh, we had a module due last night. Just having to be aware of the, there is in-class and out-of-class, I didn't care for that [others approving]. That got kind of confusing sometimes. (Bruce, Focus Group 2, p. 6)

One final challenge identified by students was *communication* issues. Because students missed the opportunity of asking questions while watching the lectures and modules, they needed to compensate for that via online communication. However, there was not a set agreement between students and the teaching staff about how soon emailed questions would be answered, which sometimes resulted in delayed communication.

Overall, the findings of this study indicate that hybrid instruction has the potential to transform engineering education by creating “space” in face-to-face meeting times for more open- ended, realistic problems that can be worked on in small groups by adding advantages like flexibility and learner pacing. However, hybrid course design requires a careful reconsideration of learning objectives, learning activities, assessments, as well as communication channels. Based on the findings of this study, we can make the following practical recommendations for those who are interested in converting their traditional face-to-face classroom to a hybrid format.

1. Make the online component required
2. Provide scaffolding for online activities
3. Reduce the number of technical issues to a minimum
4. Meaningfully weave the online and face-to-face activities
5. Train students for the new format
6. Provide a well-established and consistent structure
7. Communicate with students in new ways

Limitations and Recommendations for Future Work

Like most studies, this study encountered some limitations that should be taken into consideration when interpreting the results. One limitation concerns the low number of participants. Because the hybrid format was implemented in this particular course, we had to limit the participant pool to the students who were enrolled in the course. However, four more courses are currently in the process of conversion from traditional face-to-face format to hybrid instruction. A larger scale study involving all the hybrid courses might give a more generalizable data set informing the effectiveness of hybrid instruction.

Bibliography

1. Peercy, P. S. and Cramer, S. M., “Redefining Quality in Engineering Education Through Hybrid Instruction,” *Journal of Engineering Education* 100 (2011): 625-629.
2. Garrison, D. R. and Heather K., “Blended Learning: Uncovering its Transformative Potential in Higher Education,” *The Internet and Higher Education* 7 (2004): 95-105.
3. Lamport, M. A. and Hill, R. J. “Impact of Hybrid Instruction on Student Achievement in Post-Secondary Institutions: A Synthetic Review of the Literature,” *Journal of Instructional Research*, 1 (2012), accessed June 12, 2014 http://www.gcu.edu/Academics/Journal-of-Instructional-Research/Impact-of-Hybrid-Instruction--.php
4. Kenny, J. and Newcombe, E., “Adopting Blended Learning Approach: Challenges Encountered and Lessons Learned in an Action Research Study,” *Journal of Asyhncronous Learning Networks* 15 (2011): 45-57
5. Dziuban, C. D., Hartman, J. L., and Moskal, P. D. "Blended Learning." edited by Center for Applied Research EDUCAUSE, 2004, accessed June 12, 2014 https://net.educause.edu/ir/library/pdf/erb0407.pdf
6. Means, B., Toyama, Y., Murphy, R., Bakia, M., and Jones, K., "Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies." Washington DC: U.S.Department of Education, Office of Planning, Evaluation, and Policy Development, 2010.
7. Graham, C. R. "Blended Learning Systems: Definition, Current Trends, and Future Directions.". In *Handbook of Blended Learning: Global Perspectives, Local Designs*, edited by C. J. Bonk and C. R. Graham, 3-21. San Francisco, CA: Pfeiffer Publishing, 2006.
8. Vignare, K., "Longitudinal Success Measures of Online Learning Students at the Rochester Institute of Technology." In *Elements of Quality Online Education: Practice and Direction*, edited by J. Bourne and J. C. Moore, 261-78. Needham, MA: Sloan Consortium, 2002.
9. Collis, B., “Course Redesign for Blended Learning: Modern Optics for Technical Professionals,” *International Journal of Continuing Engineering Education and Lifelong Learning*, 13 (2003): 22-38.
10. Kaleta, R., Skibba, K. and Joosten, T., "Discovering, Designing, and Delivering Hybrid Courses." In *Blended Learning: Research Perspectives*, edited by A. G. Picciano and C. D. Dziuban, 111-43. Needam, MA: The Sloan Consortium, 2007.

Appendix A Course Schedule

Con E 322 - Fall 2014
Construction Equipment and Heavy Construction Methods
T & Th 12:10 - 2:00 PM
Hoover 1312, Town 0322

Prd	Day	Date	Topic (Matches Chapter Title in Text Book and Notes)	Classroom or Online	Reading Material
1	T	8/26	Introduction; Machines Make It Possible Lecture Assigned: Online Module #1 Equipment Cost-Fundamental Concepts & Equipment Economics	In-class and Online	Ch 1
2	TH	8/28	Hourly Equipment Cost Lab Assigned: HW #1 Cost of Equipment Problems Due @ Noon: Module #1	In-class	Ch 2
3	T	9/2	Mobile Equipment Power Requirements Lecture Assigned: Online Module #3 Mobile Equipment Power Requirements Example Problems, HW #2 Machine Equipment Power Requirements Homework Due @ Noon: HW #1	In-class and Online	Ch 6
4	TH	9/4	Equipment Productivity Fundamentals Lecture Assigned: Online Lecture Excavators, HW #2a Equipment Productivity Assignment Due @ Noon: Module #3	In-class and Online	Ch 9
5	T	9/9	Trucks and Hauling Equipment Lecture Assigned: Online Module #5 Excavator Example Problems Due @ Noon: HW #2 and #2a, Online Excavator Lecture	In-class and Online	Ch 10
6	TH	9/11	Howe Hall Mass Excavation Problem Lab Assigned: Online Module #7 Short Queuing Problem, HW #4 Howe Hall Excavation Lab Problem and #4a Excavator Home Problem Due @ Noon: Module #5	In-class and Online	CAT Handbook
7	T	9/16	Short Queueing Problem Lab Assigned: Online Module #8, HW #5 Queuing Home Problem Due @ Noon: Module #7 and HW #4a	In-class and Online	
8	TH	9/18	Grading Lab	In-class	
9	T	9/23	**NO CLASS** Assigned: Online Lecture Dozers and Online Module #10 Dozers (two example problems), HW #9 Bulldozer Home Problem *Due @ Noon: Module #8, HW #5 (leave in box outside Town Engineering Room 024)* ***CAREER FAIR***	Online	Ch 7
10	TH	9/25	Long Queuing Problem Lab Assigned: Homework #6 Long Queuing Lab Problem Due @ Noon: HW #9, Module #10, Online Lecture Dozers	In-class	
11	T	9/30	**NO CLASS** **Assigned:** Online Scrapers Lecture, Online Module #11 Scraper Selection (Performance Charts), HW #7 Scraper Home Problem	Online	CAT Handbook and Ch 8
12	TH	10/2	Exam 1 Review, Scraper Example Problem Due @ Noon: Online Scrapers Lecture, Module #11 and HW #6	In-class	

13	T	10/7	**Exam #1** **Assigned:** Online Module #13 Howe Hall Backfill Design Due @ Noon: HW #7	In-class	
14	TH	10/9	Backfill Process Design Lab Assigned: Homework #10 Howe Hall Backfill Lab Problem Due @ Noon: Module #13	In-class and Online	CAT Handbook
15	T	10/14	Backfill Process Design Lab Cont'd Assigned: Online Concrete Placement Lecture Due by END of class: HW #10	In-class and Online	CAT Handbook Ch 16
16	TH	10/16	Concrete Placement Lab Assigned: Online Pile Driving Lecture, HW #15 Class Presentations Due @ Noon: Online Concrete Placement Lecture	In-class	Ch 18
17	T	10/21	**NO CLASS** **Assigned:** Online Crane Lecture; Module #17a Crane Safety	Online	Ch 17
18	TH	10/23	Pile Driving Lab **Assigned:** Online Module #17b Crane Load Chart Example #1, HW #15 Due @ Noon Module #17a, Online Pile Driving Lecture	In-class and Online	Ch 17
19	T	10/28	Crane Load Chart Lab #1 Assigned: HW #11 Crane Example Problem and 12 Crane Capacity Problem Due @ Noon: Module #17b, Online Crane Lecture Due @ end of class: HW #11 and #12	In-class and Online	
20	TH	10/30	Field Trip - Caterpillar Dealer - Ziegler, Altoona Assigned: Homework #16 and Module #16 Tower Cranes	In-class	
21	T	11/4	Automatic Machine Guidance Lecture Assigned: *Online Module #19 Crane Load Chart Example #2* Due @ Noon: Module #16 and Homework #16	In-class	
22	TH	11/6	Crane Load Chart Lab #2 Assigned: Homework #13 Crane Capacity Problem and #13A Crane Lab Problem Due @ Noon: Module #19 Due @ end of class: Homework 13 and 13A	In-class and Online	
23	T	11/11	Crane Sequencing Lab	In-class	
24	TH	11/13	**EXAM #2**	**In-class Exam**	
25	T	11/18	Automatic Machine Guidance Guest Speaker Assigned: Online Asphalt Paving Lecture and Online Concrete Paving Lecture	In-class	
26	TH	11/20	**NO CLASS** Assigned: Geotechnical Materials, Compaction, Stabilization, and Testing Online Lecture Due @ Noon: Online Asphalt Paving Lecture and Online Concrete Paving Lecture	Online	Ch 4 & Ch 5
11/24 -11/28 THANKSGIVING BREAK NO CLASS					
27	T	12/2	Construction Process Design Lab Assigned: Homework #14 Construction Practice Design Homework Due @ Noon: Online Geotech Lecture	In-class	CAT Handbook
28	TH	12/4	Construction Process Design Lab Due @ end of class: Homework #14	In-class	CAT Handbook

29	T	12/9	Group Presentations Due: Homework #15	In-class	
30	TH	12/11	Group Presentations Due: Homework #15	In-class	
Finals week 12/15-12/19 FINAL EXAM - time TBD					