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A CASE STUDY OF HYBRID LEARNING IMPLEMENTATION IN CONSTRUCTION ENGINEERING

Charles Jahren^{1,2}, Aliye Karabulut-Ilgu¹, David Jeong¹, Larry Cormicle¹

¹ Department of Civil, Construction and Environmental Engineering, Iowa State University, USA

² cjahren@iastate.edu

Abstract: Hybrid learning is an educational approach that combines the elements of online and traditional face-to-face instruction. When planned and implemented well, hybrid learning provide benefits at the student, faculty, and institutional level. The experience of a major Midwestern university in implementing hybrid learning is reported in this paper. Included are six semesters of experience and incremental improvement with a construction equipment course, three semesters of experience with a construction scheduling course, and two semesters of experience with a cost estimating course. The three courses were led by three different faculty members with various expectations, preferences, and approaches. The case study discussion reported here demonstrates the robustness of the hybrid learning approach. Workflow and effort in developing the hybrid classes, online and computer software application tools, best practices and lessons learned are presented.

1 INTRODUCTION

Hybrid learning is an educational approach that combines the elements of online and traditional face-to-face instruction (Garrison & Kanuka, 2004). Because of its blended nature, hybrid learning is commonly referred to as *the best of the two worlds* as it has the potential to provide the benefits while avoiding the challenges of the two formats (Lampton & Hill, 2012). When planned and implemented well, hybrid learning provide benefits at the student, faculty, and institutional level (Dziuban, Hartman, Moskal, 2004). Online content can be used to address the knowledge, comprehension, and application levels of cognitive activity while the face-to-face learning addresses analysis, synthesis, and evaluation levels while reinforcing learning at the previously mentioned levels. For hybrid learning to be successful, the asynchronous online component needs to be carefully planned and balanced with the face-to-face activities. Well-planned asynchronous online activities can promote student learning with less input of instructor effort and the instructor effort that is diverted can be invested to provide more student engagement during face-to-face activities where students are learning at higher cognitive levels.

The experience of a major Midwestern university in implementing hybrid learning is reported in this paper. Included are six semesters of experience and incremental improvement with a construction equipment course, three semesters of experience with a construction scheduling course, and two semesters of experience with a cost estimating course. The three courses were led by three different faculty members with various expectations, preferences, and approaches. The case study discussion reported here demonstrates the robustness of the hybrid learning approach. Workflow and effort in developing each of the hybrid classes, online and computer software application tools, best practices and lessons learned will be presented next.

2 CASE DESCRIPTIONS

2.1 Case 1: Hybrid Learning in Construction Equipment

Construction Equipment and Heavy Construction Methods is a three credit junior level course required for construction engineering students. In the traditional format, the course included two lecture hours and a two-hour calculation lab each week. The overarching goal behind the conversion of the course from traditional to hybrid format was to replace the passive lecture content with the online content and use some of the time released in class time for active learning exercises. Additionally, depending on how much time spent on online activities, the contact hours were reduced to create flexibilities in to both students' and the instructor's schedule.

The construction equipment course was the first in the department that was converted to the hybrid format. The instructor worked with an instructional development team consisting of instructional designer, graduate and undergraduate students. Using the screen-recording software Camtasia Studio®, the instructor recorded the content that on which he would lecture when using a traditional format. Then, the instructional designer worked with undergraduate students to edit the video, slice it into more manageable short segments, enhance it using additional visuals, and create quiz questions. For a more detailed explanation of the workflow for the online component please see Mallen, Jahren, Koehler, & Karabulut (2014). An example video lecture can be seen at <http://www.screencast.com/t/A9MCvuwlyhOG>

Another unique feature implemented in this course was to replace the example problem sessions that typically follow a lecture presentation with online interactive exercises. These exercises were created using the content development tool Lectora®. The exercises present a problem statement which usually involves multiple steps. Students are required to go through each step to be able to reach a conclusion about the problem statement. Throughout this process, students are supported through additional explanatory videos and demonstration videos for how to solve the problem. A video explanation of how these online modules work can be seen at <http://www.screencast.com/t/MznFBUMh6aF>

The face-to-face component of the course involved having students work on more open-ended and real-life problems in teams of 3-4. A teaching team consisting of the instructor, and graduate and undergraduate teaching assistants facilitated the sessions. Rather than spending time lecturing on the content, the teaching team was able to work with individual teams and address any emerging issues, and answer questions. For example, in one of these face-to-face sessions, students were provided with an instructions sheet; plans and blueprints of the jobsite; and a crane chart document. Students were asked to work in groups of three or four to design the whole crane sequencing process using the concepts they learned in the online lectures and modules.

The conversion of the course from traditional to hybrid format provided several benefits at the student and instructor level. First, it created flexibilities both in students' and instructor's schedule. The instructor was able to balance out all the administrative and research responsibilities he held as the division leader without sacrificing any teaching load. Likewise, students were able to work on the class activities on their own time. Second, students were able pace their own learning thanks to the recorded content. In their end-of-semester evaluations, they indicated that they liked being able to pause, rewind, and re-watch the portions of the videos as opposed to one-time-shot in traditional lectures. Finally, this format empowered graduate and undergraduate students as they played a major role in facilitating the face-to-face sessions and provided them the experience of teaching a junior-level course.

2.2 Case 2: Hybrid Learning in Construction Scheduling

Construction Planning, Scheduling, and Control is a three-credit senior level course required for construction engineering students. In the traditional format, this course also included two lecture hours and a two-hour calculation lab each week. The overarching goal behind the conversion of this course to the hybrid format was to capture timeless, theoretical content that remains the same regardless of time in the best way possible so that students can watch it on their own time and at their own convenience. The online lecture development process was quite similar to that of the construction equipment course. First,

the instructor carefully analyzed the course syllabus to identify the topics that could effectively be converted to the online format. Then, he recorded the lectures using the screen recording software, Camtasia®. The instructional design team then worked on the recorded lectures to edit, animate, and produce the content. Every semester, feedback was collected from students on these online lectures to address any issues on a timely manner.

The conversion of this course to the hybrid format also provided two major benefits to the instructor and students. First, it created a flexible schedule for everyone. The instructor was able to travel to attend conferences on new construction scheduling technology without having to cancel any classes. In other words, he moved the topics around based on his travel plans so that students could do the online activities while the instructor was traveling. Similarly, students could work on the online activities at their own convenience and balance their workload. The second benefit was the learning gain for students. The informal feedback from the students and the anecdotal data from the instructor indicated that the students in the middle range of the grading scale were the ones who benefited the most from this format. Because they were able to pause, rewind, and re-watch the portions of the video, they were better able to retain the information.

2.3 Case 3: Hybrid Learning in Construction Estimating

Construction Estimating is a three-credit senior level course required for civil and construction engineering students. In the traditional format, this course also included two lecture hours and a two-hour calculation lab. The overarching goal behind the conversion of this course to the hybrid format was similar to that of the construction equipment. By taking the passive lecture component of the course to the online format, the instructor was able to create space in face-to-face classroom time for team-based learning and active learning exercises. The conversion process for this course has been a little more complicated than the other two courses, and it is still under development.

The process started with recording a regular classroom lecture. The instructor used a regular audio recorder to capture his traditional lectures. A graduate student transcribed the recordings, and the instructor cleaned up the transcripts to better fit into a screen capture format (e.g. removing student interactions, etc.). The instructor for this course is a non-native speaker of English and he wanted the lectures to be recorded by a native speaker, so transcripts were sent to a native speaker who recorded the audio for each slide of a lecture presentation. The instructional design team then combined the audio files with slides, added visuals, and inserted quiz questions, and uploaded the materials to the course management site.

Another online component in this course was software application tutorials. The instructional design team worked with a graduate student who had been a teaching assistant for the course before to create tutorials for the construction estimating software, WinEst. Students were required to use the software for a few class projects. The tutorials were created using the screen recording software demonstrating the main features of the application that could be helpful for students in completing their projects. These tutorial videos were posted on the blackboard and made available for students' convenience. However, they were not required as the online lecture videos were. Rather, they were provided as on-demand help videos. If students felt comfortable with the software, they did not need to watch the videos, or they could choose which ones to watch.

Finally, the instructor revised the face-to-face activities and lab assignments and converted them to more open-ended problem cases so that he could use the released class time for team-work and active learning. For this conversion, the instructor contacted industry leaders and asked them to provide real construction projects and data for students to work on. The homework and assignments were re-written based on the input received from the construction industry leaders. Although similar benefits are expected in this course, we have not collected any feedback from students yet.

3 LESSONS LEARNED

Based on our experience in hybrid course development in a construction engineering program, we can conclude that hybrid learning improves learning and provides benefits for students and faculty by creating a flexible teaching and learning environment. These kinds of innovative teaching environments enhance life-long learning skills in students, as they have to arrange their own learning and study agendas, keep up with different learning activities, and improve their meta-cognitive strategies to be successful learners. We can make the following practical recommendations for those who are interested in converting their traditional face-to-face classroom to a hybrid format.

- **Required online content:** Students need to be held accountable somehow to ensure they are engaged in the online activities. In our case, we have embedded quiz questions along the videos to gauge students' understanding of the content and motivate them watch the assigned videos which would be essential to be successful completing the in-class assignments. These quizzes were auto-graded and automatically recorded in the gradebook on course management site, which substantially reduced the instructor load.
- **Online support:** Because students will be learning a new concept on their own without an opportunity to ask for clarification immediately, the online environment should be designed in a way to facilitate student learning. In our case, we provided additional explanatory videos both for the content and how to solve problems.
- **Technical issues:** Technology should not get into way while students are trying to learn a new concept. Therefore, every effort should be made to reduce the number of technical issues to minimum, or they should be addressed in a timely manner.
- **Connection between online and face-to-face activities:** There should be a clear connection between online and face-to-face activities and they need to be meaningfully weaved together. This will help students better understand the rationale behind the hybrid format and how they can improve their learning in this new environment.
- **Preparing students:** Although the students engage in all kinds of online activities in their daily lives, this kind of learning environment can be new to them. Training students for hybrid format so that they know what it is, why it is done, and what is expected of them will help them be more engaged in their learning experience. In our case, we have found out that successful students used some study strategies (i.e. taking notes while watching, working on problems on one screen and watching the video on another screen, etc.) that helped them succeed in the course. We have taken those strategies and used them as recommendations for how to be succeed in hybrid courses in the following semesters.
- **Consistent structure:** A hybrid course may have different requirements for online and face-to-face activities and students may lose track of all the tasks they need to engage. Providing a well-established and consistent course structure will possibly help students keep track of the tasks.

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