Quality Approaches in Higher Education

Measuring student expectations of course redesign in hybrid courses.

Blending the Best of Both Worlds: Overcoming Skepticism in a Hybrid Engineering Course

Susan L. Murray, Kelly L. Jones, and Julie A. Phelps

Abstract

In a blended (or hybrid) course a portion is taught face to face in a classroom and at least one-third of the coursework is online. Students receive personal contact and interaction with the instructor during the classroom portion and also have flexibility in the pace, access, and repetition of online content. In this article, we explore 49 graduate engineering students' expectations for a required operations management course that was redesigned from a traditional to a blended format. The majority of these students had no prior experience with blended (77.6%) or online (55%) courses. The pre-survey showed students were hesitant or unsure about taking a blended course. The same students were also surveyed at the completion of the course to determine how their expectations matched with their experiences. Most of the students (85%) expressed the desire to take another blended course based on their experience in this course.

Keywords

Higher Education, Student Satisfaction, Online Classes, Engineering

Introduction

There has been an explosion in online courses over the last decade at institutions of higher education across the United States and elsewhere. According to I. Allen and Seaman (2013), 6.7 million students, about 32% of the higher education student population, took at least one online course in 2011. The growth of online courses in engineering programs, however, has been slower than other fields of study (Allen, Artis, Afful-Dadzie, & Allam, 2013; Kinney, Liu, & Thornton, 2012; Bourne, Harris, & Mayadas, 2005). Many instructors are hesitant to attempt to teach difficult subjects, such as engineering and mathematics online; consequently, online learning has not become as popular in engineering education as in other disciplines (Bourne et al., 2005; Kinney et al., 2012). However, that perspective may be changing as new learning technologies provide greater pedagogical potential, and new formats such as blended learning are developed and practiced (Allen et al., 2013; Kinney et al., 2012). Blended learning combines elements of traditional classroom-based instruction with newer digital online learning experiences. Students attend face-to-face classes with the instructor for parts of the course and complete online coursework in between face-to-face meetings. Blended courses may enhance student satisfaction and engagement (Kuo, Belland, Schroder, & Walker, 2014). Blended learning offers substantial potential for teaching and learning in higher education and may be an effective pedagogical design for many types of engineering courses. Bourne, Harris, and Mayadas (2005) observe, "It is likely that the first movement toward more online learning will come in blended environments in which courses are offered on campus but with a significant online component" (p. 141). This research sought to determine if there was a difference in students' perceptions of blended learning before and after taking a newly redesigned blended course. Our goal was to explore whether students in a graduate engineering management course were reluctant to take a blended course and to see if those student views changed after completing such a course.

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Redesigning a Graduate Engineering Management Course as a Blended Course

This study examined students' expectations and experiences in a required course in operations management in the engineering management master's degree program at Missouri University of Science and Technology (S&T). The class is typically taught multiple times a year, both face to face and live streaming over the Internet for distance students. The engineering management master's degree is a "broadening" degree. Students enter the program with a bachelor of science degree in almost any engineering and science focus imaginable. The students received their prior education either domestically or internationally. Some have just finished their bachelor's degree, and others have not taken a class in more than 20 years. This results in widely varied levels of preparation among the students and wide-ranging instructional needs. The required master's course is typically taken in the student's first semester. It is often the most difficult course for the students due to its quantitative nature. It is a challenging course for faculty due to the wide range of students' abilities and backgrounds. In 2014, the class was redesigned as a blended course from a traditional three-credit hour, face-to-face format. The students did not have a choice of class format. It was the first time the class was taught in a blended format and was the first semester in the master's program for all of the students. This limited students' prior knowledge and expectations for the blended class structure. All of the other classes in the students' degree program were in a traditional, face-to-face format.

Literature Review

The review of related literature is organized into three major themes: engineering education and online learning, an overview of blended learning, and the importance of social presence in blended courses.

Online Learning and Engineering Education

Early research (Angulo & Bruce, 1999) showed most students would not consider taking a course that had a significant amount of web-based content in place of class meetings. Martinez-Caro and Campuzano-Bolarin (2011) explain, "Previous research explained that e-learning is generally most effective when used as a supplement to, rather than a replacement for, engineering education" (p. 473). Allen, Artis, Afful-Dadzie, and Allam (2013) note that while students still report a preference for face-to-face classes, online programs continue to increase. Online learning is a major part of the higher educational landscape today, and online programs are growing at a dramatic rate, but this trend is not as strong in engineering education where most online programs are offered only at the graduate level (Allen et al., 2013; Bourne et al., 2005; Kinney et al., 2012). Bourne et al. (2005) observe, "Engineering education has traditionally had various delivery-centered constraints. Online methodologies will ultimately assist in equipping graduates to learn more broadly and deeply and to become lifelong learners" (p. 135). Blended learning, which combines traditional, face-to-face class time with new online course delivery, may open new doors of possibilities in engineering education (Allen et al., 2013; Bourne et al., 2005; Kinney et al., 2012).

Blended Learning: The Best of Both Worlds?

Definitions of blended learning, sometimes called hybrid, vary greatly, and colleges use different measurements of online and face-to-face content to define blended in the context of each individual institution. Allen and Seaman (2013), in partnership with the Online Learning Consortium (formerly Sloan-C), classify courses with between 30 and 79% of instruction delivered online as blended. Blended learning is a growing trend, with at least 55% of colleges and universities in the United States offering at least one blended course (Allen & Seaman, 2013; Kuo et al., 2014). Blended learning is growing in popularity, particularly among graduate students who value flexibility and graduate schools that want to reach more students (King & Arnold, 2012).

Blended learning may be the "third generation" of distance education (Kuo et al., 2014, p. 361) due to ways in which it combines features of both on-ground and online instruction (King & Arnold, 2012). Martinez-Caro and Campuzano-Bolarin (2011) studied modes of instruction and report, "Student satisfaction was significantly greater in blended courses than in face-to-face courses" (p. 480). Possible advantages of blended learning include learner-centered course designs, flexibility in scheduling for students and the institution, cost savings, increased student satisfaction and engagement, and fewer students dropping courses than in completely online learning (Bourne et al., 2005; King & Arnold, 2012; Kuo et al., 2014). For engineering education, blended learning may offer significant opportunities. Martinez-Caro and Campuzano-Bolarin (2011) state, "Blended learning appears as a solution to the need to update traditional engineering classes because of demand from a society motivated by the strong upsurge of information and communication technologies" (p. 480).

There are also possible disadvantages with blended learning. First, unlike online learning programs, blended courses are only available to students who are able to travel to campus for assigned face-to-face meetings, which may limit the geographic reach of a blended learning program. Second, blended learning can be ineffective and disengaging if instructors do not blend key course components in the most well-suited delivery mode when combining face-to-face and online instructional methods (Ally, 2008; Bourne et al., 2005; Carman, 2005; King & Arnold, 2012). Third, blended

courses, if done well, are time consuming to design and to teach. Blended learning may impose serious demands on instructors' time. King and Arnold (2012) advise, "Faculty need to be prepared for the initial time commitment involved in preparing a blended course. Sometimes a complete course redesign is necessary which can require extensive time and resources on the professor's part" (p. 2).

The Critical Ingredient: Social Presence

It can be difficult for students in online environments to connect with their instructors. Most online courses are heavily text-based, and the instructor can be seen as an invisible force on the other end of the network connection (Clark & Mayer, 2011). Lowenthal and Dunlap (2010) state that students in online courses often report feelings of loneliness and isolation; therefore, instructors teaching online, blended, and distance courses should establish trustworthiness with students by being visible and maintaining a strong social presence (Aragon, 2003).

In technology-mediated communication, social presence is defined as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Short, Williams, and Christie, 1976 as cited in Aragon, 2003, p. 65). Bourne et al. (2005) describe social presence as "a key determining factor in whether people learn well online" (p. 133). Therefore, instructors' social presence may be the key ingredient to creating successful blended courses. Martinez-Caro and Campuzano-Bolarin (2011) report, "Class attendance, access to teacher, collaboration with classmates, and motivation were found to be predictors of satisfaction in blended environments, with access to the teacher being the strongest predictor of all" (p. 481). The importance of instructor presence in blended courses should not be underestimated.

Research supports the significance of social presence in online learning (Clark & Mayer, 2011; Sung & Mayer, 2012; Akyol & Garrison, 2008); therefore, instructors need practical strategies and examples to help them establish a strong sense of presence (Baker & Edwards, 2011; Jones & Phelps, 2014; Lowenthal & Dunlap, 2010). As noted by Baker and Edwards (2011), instructors who establish and maintain social presence with students online are more successful than instructors who do not. Designing a blended course with strong social presence is difficult and time consuming; however, it appears that investments of time and effort in building and strengthening social presence in online and blended courses yields positive learning outcomes for students.

Blended Course Design Rationale and Key Elements

Effective blended courses require effective instructional designs. King and Arnold (2012) explain, "It is not enough to simply 'slap' technology onto what is already being done in traditional courses. Most courses will need to be redesigned to reflect best practices of teaching blended courses" (p. 13). However, it is difficult for instructors to determine best practices for blended learning because there are no universal standards or designs for online or blended courses (Ally, 2008; Bourne et al., 2005; Carman, 2005).

The effectiveness of online courses and the best practices for online instruction are still not fully understood (Ally, 2008; Bourne et al., 2005; Carman, 2005; King & Arnold, 2012). Ally (2008) explains that no one single theory is recommended for online learning. Therefore, we must combine multiple theories to develop effective online learning experiences. Suggestions for best practices can be gleaned from blended learning scholarship and research (Bourne et al., 2005; King & Arnold, 2012). For the redesign of this engineering management course, the professor worked with an instructional designer to ensure that the course design and delivery would motivate, engage, and facilitate effective learning for students. The new blended class provides a face-to-face introduction of each topic, combined with self-paced, online practice giving each student an educational experience that better matches the student's needs. The new format replaces half the traditional classroom time with online content.

There are multiple benefits to the new blended design. The university will benefit from having less required classroom time and space. For example, the live-video classroom space for the distance students is expensive and a scarce resource that is difficult to schedule. More important, the students will benefit from having both live classroom interactions with the instructor and flexible online content. Students who are struggling in the class can watch numerical problems being solved repeatedly online with the opportunity to repeat or watch extra examples as needed. Students who are excelling in the class can watch problems being solved to help them master concepts, and they can take advantage of as much bonus content as they desire, potentially reducing their level of boredom with the class. All of the students will benefit from the flexibility of the blended course structure. The new blended design includes weekly modules covering one or two textbook chapters. The in-class portion continues as a mixture of lectures and hands-on problem solving. The online portion is a combination of materials. Figure 1 is a screenshot of the first online module in the learning management system.

Student attitudes toward online learning can be affected by technological issues, including Internet speed, access issues, and digital literacy skills (Alghazo, 2006; Ally, 2008). In their study of online engineering courses, Kinney, Liu, and Thornton (2012) found that students rated three technologies as the most effective for online learning: recorded online video, online course materials, and the course website. The online aspect of this course

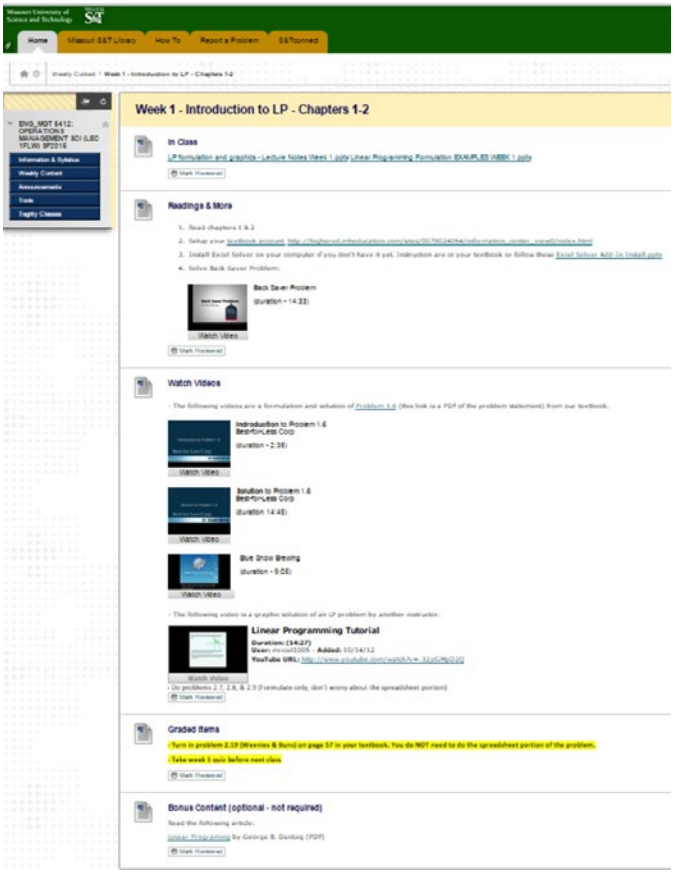

Figure 1: Screenshot of Module 1 of the Blended Class

was delivered through Missouri S&T's learning management system, Blackboard. It was designed with careful attention to the organization and quality of the instruction videos, online course content, and online course structure. Carman (2005) recommends five elements for designing blended courses based on a blending of instructional design theories: live events, online content, collaboration, assessment, and reference materials. Each module in this engineering management blended course includes:

- *Live events:* In-class content, including the PowerPoint slides and examples used in the classroom. Each module is introduced by the instructor and the textbook readings. The face-to-face class meetings focused on application of content to real-world problem solving.
- *Collaboration:* During the face-to-face class meetings, students worked on problems in small groups, and they also worked in small groups on a modeling project together outside of class.
- *Online content:* This content included video clips focused on problem solving. The instructor created several of the videos that included her voice, increasing instructor presence. Other videos were curated from instructor-reviewed sources. Students were encouraged to work interactively with the short videos. They were allowed to proceed at their own pace and repeat the material as needed. The instructor decided to include videos in every module to "help bridge the gap between faculty and students when not meeting face-to-face" (King & Arnold, 2012, p. 3).
- *Assessment:* Assignments, including reading assignments and homework problems continued to be assigned to students in the blended course, similar to what was done in the traditional course. At the end of each module, students completed a graded assessment activity. A multiple-choice quiz was provided and graded by the learning management system, providing immediate feedback to the student on his or her understanding of the material.
- *Reference materials:* In addition to the required textbook and online videos, the course site also contained bonus content geared toward the students who were excelling and wanted more material. This is optional content that is not covered in a traditional class due to time constraints.

Forty-nine students completed this new blended course and there were no withdrawals. The course lasted eight weeks, with face-to-face meetings every week.

Methodology

In this exploratory study, students' attitudes about the structure of the course and the flexibility of the blended model were assessed through pre- and post-surveys. The questions on the pre-survey were revised and repeated on the post-survey. Additional questions were added to evaluate the students' actual experiences. The learning management software (Blackboard) and streaming video analytics (Kaltura) were used to track when, how often, and how long students accessed the educational material (required assignments, video of problem solutions, and bonus materials). The surveys were administered on the first day of class and after the final exam. The pre-survey was on paper and the post-survey was online; the students remained anonymous for both.

The pre-survey explored students' prior experience with blended and online courses. They were asked how prepared they felt for the graduate class based on their previous coursework and knowledge of the class subject. The remaining questions used a Likert scale to explore their expectations of the class in general and in comparison to a traditional face-to-face class. The post-survey consisted of 23 statements with a five-point Likert scale ranging from "strongly agree" to "strongly disagree". This survey provided

an assessment of their experience and an opportunity to compare their expectations before the class with their actual experiences.

The class enrollment was 49 graduate students. All 49 students participated in the survey and, of that, seven (14%) were female. They rated their level of computer expertise as novice (6%), intermediate (76%), and expert (18%). Seventy-seven percent had not taken a blended class prior to this course. Their experience with online classes varied: 0 (55%), 1 (6%), 2 (14%), 3 (12%), 4 (8%), and 5 or greater (4%). Based on previous coursework their self-perceived level of preparation varied: strongly prepared (8%), prepared (20%), somewhat prepared (31%), unprepared (39%), and strongly unprepared (2%). The majority of students had no prior experience with blended (77.6%) or online (55%) courses. The pre-survey showed students were hesitant or unsure about taking a blended course.

Results

Before the course began, only 5% of the students believed that they would have a successful learning experience in a blended course. However, the post-course survey showed that 85% of students felt that the blended course format helped them be more successful in learning the course material. The majority of students (85%) expressed the desire to take another blended course based on their experience in this class. Table 1 summarizes the students' expectations of the blended course prior to taking the class. It shows a combination of uncertainty and reservation about participating in a blended course.

Table 2 summarizes the students' experiences taking the blended course. At the end of the course, the post-survey included the statement, "The online content motivated me to do more learning/studying than I would have done otherwise." Most students "strongly agreed" (21%) or "agreed" (29%) with the statement and fewer "disagreed" (15%) or were "neutral" (35%). The vast majority of students (96%) felt that being able to work on the online content at their own pace was beneficial. Only two students (4%) felt they were not able to learn material equally well in the online and traditional portions of the class.

When comparing student performance in the blended course with students in a prior traditional face-to-face section of the same course taught by the same instructor, the grades were slightly better in the blended class. The homework assignments were the same for the two classes, and the exam questions were similar in difficulty and concepts tested, but different specific questions were used to avoid an unfair advantage for latter students with copies of the old exams. Overall, the course grades were within one standard deviation of each other with the blended class having a higher average.

The campus uses an online teaching evaluation completed anonymously by students using a four-point scale. The overall

Table 1: Pre-Survey Student Opinions

Opinion	1 Strongly Agree	2 Agree	3 Unsure/ Neutral	4 Disagree	5 Strongly Disagree
A blended class will be beneficial.	0%	5%	26%	45%	24%
A blended class will allow me to be successful.	0%	5%	52%	33%	10%
I would prefer to take a traditional class instead of a blended one.	0%	5%	51%	34%	10%
A blended and traditional course will be equally effective ways to learn.	2%	5%	57%	29%	7%

Table 2: Post-Survey Student Opinions

Opinion	1 Strongly Agree	2 Agree	3 Unsure/ Neutral	4 Disagree	5 Strongly Disagree
Being able to work through online material at my own pace was beneficial.	67%	29%	2%	2%	0%
A blended class helped me to be more successful in learning course material.	48%	35%	15%	2%	0%
The online content motivated me to learn/ study more than I would have otherwise.	21%	29%	36%	15%	0%
I would like to take another blended in the future.	65%	21%	20%	2%	2%
I was able to learn through the online and classroom components equally well.	56%	31%	8%	4%	0%

campus average was 3.10, and the average for the blended class was 3.83, which is significantly higher than the campus average and higher than the instructor's average of all classes taught at 3.55 that year.

Discussion: Lessons Learned

For instructors and instructional designers developing a blended course, we would offer the following suggestions:

- *Make the explicit, implicit.* You will see the students less often. Deadlines, policies, and the like must be clear to the students as they work alone.
- *Determine what material is best suited for face-to-face class meetings and for online learning.* A great deal of thought should be given to what material students will want and need personal interaction with the instructor. What material will students wish to see repeated (such as detailed problem solving, steps using computer software, etc.)? This type of material may be best suited for online delivery. What problems will students want to discuss with the instructor, and what misconceptions or knowledge gaps could make learning content more challenging? Those topics may be best suited for face-to-face class meetings.
- *Be very organized.* Students need to understand clearly what they are expected to do in class, outside of class, and online.
- *Be consistent.* Where is material located? The online content should be formatted consistently.
- *Be purposefully present.* The instructional development literature on social presence for instructors in online learning is significant. Ensure the instructor's "voice" is present in the online content. Instructor-created videos may promote social presence in blended and online courses (Jones & Phelps, 2014). Respond to students' questions quickly and provide timely feedback on assessments.
- *Make materials easy to update.* The first time a class is offered in the blended format, it will be very labor intensive. Minimize what needs to be changed when the class is offered repeatedly. For example, referring students to the schedule rather than giving specific dates or chapters can prevent the need to record a video again (Jones & Phelps, 2014).
- *Reflect on the blended teaching and learning experience.* King and Arnold (2012) recommend that instructors take time at the end of a blended course to review what went well and what areas of the course could be improved. Additionally, instructors should continue to look for new scholarship and creative ideas to support best practices in blended learning.

Conclusion

This exploratory study was designed to examine graduate students' perceptions of blended learning before and after they completed a newly redesigned blended engineering management course. The differences between the pre- and post-surveys were striking. The graduate students had uncertainty and reluctance to participate in a blended course. However, after experiencing the benefits in flexibility and work pace, the vast majority of students stated positive views about the experience and the concept of blended education, in general. The students' performance and grades were comparable to sections of the class that were taught face to face by the instructor previously. The instructor's teaching evaluations were also higher for the blended class than prior evaluations. Results of this study indicate that as engineering educators, we need to educate students about blended courses and expect reservations among students in blended courses compared to those in traditional face-to-face courses. Sharing students' positive experiences with blended courses may also help with marketing blended courses to engineering students who may be reluctant or fearful of registering for these new course formats.

Recommendations for Future Research

Additional research is needed to design effective blended learning courses for graduate engineering education. Blended learning delivery models and methods will likely continue to grow and become more prevalent in engineering education (Bourne et al., 2005). Consequently, it is important for instructors to gauge students' perceptions and reactions to blended learning experiences and to share blended learning resources and strategies. To develop best practices for blended learning in engineering education, future studies are needed to add to our understanding of students' attitudes and performance in blended courses and to examine what types of learning activities are best suited for a blended course design. Such future studies could compare engineering students' perceptions and performance in face-to-face, online, and blended courses. Other topics viable for future research include the impact of instructor presence in blended learning courses, comparisons of students' expectations with their experiences in blended courses, instructors' perceptions of blended learning in engineering education, and student outcomes in blended learning engineering programs.

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