One Part Online Technology mixed with One Part Old School Instruction: How One Construction Program Enhances Student Learning through a Recipe of Blended Learning

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Abstract

Concern that the larger class sizes are reducing student-instructor interaction and impacting student learning has motivated faculty to examine alternative teaching and classroom management approaches. One such approach involves the use of a “blended learning” which combines the convenience of online instructional delivery with traditional one-on-one classroom instruction. Whereas the online content provides students with information in a manner that is flexible in time, place, and pace, the classroom element provides them with an opportunity to get instructor guidance, collaborate with peers, practice applying concepts, and exploring topics in greater detail. The online and classroom portions are blended through their integrated and synergistic nature.

This paper summarizes the results of a project in which a “blended learning” model was used for two different required courses (taught by two different faculty) within the Construction department. One course was a sophomore level “Introduction to Structures” course and the other was a senior level course in cost estimating. The outcomes of the study revealed several interesting results regarding student reactions to blended learning, the role of blended learning in creating a student-centered learning environment, and the importance of active learning activities in keeping students engaged and motivated.

Keywords

Blended learning, online instruction, construction

Introduction

This section addresses the primary motivations for initiating the project and provides details regarding how the online and face-to-face elements are blended within each course. The authors also provide background information regarding the evolution of blended learning with an examination of how its implementation has evolved with technological advances in computing.
Project Motivation

Since its inception in 2013, the Department of Civil Engineering and Construction’s (CEC) growth has nearly doubled to over 800 students. While both programs have been able to accommodate this growth by adding course sections and increasing class sizes, swelling class sizes has sparked concern amongst faculty regarding the impact of larger classes on student-instructor interaction and student learning. In lieu of this concern, CEC instructors are looking for alternatives to traditional lecture-based classroom teaching approaches that enhance students’ learning experience while also motivating them to take a more active role in their learning.

Having taught a large variety of lecture-based and fully online courses within the department, the authors decided to each experiment with a “blended learning” for each one of their courses. The basis of this approach is to incorporate the attributes of online course delivery (flexibility with time and pace, efficiency) with the attributes of a classroom environment (opportunity to ask questions, get instructor guidance, explore topics in greater detail). The approach involves “blending” the use of online technology to provide students with background material, example applications, “big picture”, and practical applications, with classroom content aimed at strengthening student learning through collaboration with peers and direct interaction with instructors.

Two required courses (one taught by each faculty member) within the Construction program were selected for this project. One course was a sophomore level “Introduction to Structures” course and the other was a senior level course “Construction Cost Estimating”. Since the courses are at two different academic levels, there was two different sets of students in each course. Both courses were selected due to their large amount of content (well-suited for online delivery) and abundance of active learning components (problem solving sessions, software applications) that require student-instructor interaction. Having taught the courses several times in the past, both instructors were keenly aware of which topics would be most suitable for online instruction and which would be more appropriate for face-to-face instruction.

Course Information

Introduction to Structures is a required in both the Construction Engineering and Construction Management curriculum and usually taken during the first semester of the sophomore year. This course is a lecture only style course (no laboratory component) with enrollment that varies from 40 to 50 students per semester. Every week, students are required to review two online lessons which are available from Thursday morning (8:00 am) until Sunday evening (midnight). Each lesson contains a combination of PowerPoint presentations (covering lecture style content with derivations, etc.), lightboard videos showing problem solving examples, and Internet-based videos (YouTube, etc.) highlighting real-life applications. Each lesson includes an online quiz which serves as a gateway to the upcoming face-to-face sessions held the following Monday and Wednesday (there is one quiz linked to each day). Students who don’t score a minimum quiz grade of 70%, or don’t attempt the quiz, are considered absent for the upcoming face-to-face class (counting against their attendance grade) but are allowed to participate in the in-class
learning activity. Since the course is also officially held on Fridays, the instructor uses this day as an optional recitation/exam review session for students requiring assistance in the course.

Each face-to-face session starts with a 10–15 minute lesson overview in which the instructor highlights the concepts covered in the online lesson. In doing so, he addresses the concepts addressed within the online quiz while also emphasizing how the lesson’s content relates to previous and/or upcoming lessons, the course, and the profession. The remainder of the class time is devoted to a variety of hands-on learning activities including: problem solving sessions and computer-based activities with commonly-used software (MS Excel, Bridge Designer, and SkyCiv). The majority of these activities are performed in groups of three which provides a collaborative environment for students to share ideas and pose questions to other students that require critical thinking.

Construction Cost Estimating is also required for both construction management and construction engineering students. Traditionally, the course meets for 2 hours of lecture and 2 hours of laboratory time with lecture time devoted to covering topics related to the laboratory instruction. Under the blended course format this changed. Approximately 1 hour of lecture time was placed online. The students were asked to explore readings and topics related to the weekly laboratory. These explorations were in the form a reading with a corresponding discussion or assignment. The class then met for a single 3 hour block on Thursdays with all blended learning activities due the Tuesday night before.

At the beginning of the face-to-face session blended course materials were reviewed and any questions pertaining to the online components of the course were answered. Then the instructor would begin the in class lesson and laboratory. The laboratory consisted of hands on activities and software based learning using programs such as Bluebeam Revu and OnScreen Takeoff. The activities were done in groups of 2 to aid in collaborative problem solving.

**Evolution of Blended Learning**

While the term “blended learning” (also known as “hybrid learning” or “mixed-mode learning”) is defined in the educational literature a large variety of ways, the basic premise remains that it is an educational approach that combines online digital media with traditional classroom methods. Earliest references to blended learning were vague, and highly variable regarding the online technologies and pedagogical approaches used. Bonk and Graham’s 2006 publication entitled ”The Handbook of Blended Learning Environments: Global Perspectives, Local Designs” challenged the vagueness of earlier references and clearly defined blended learning systems as systems which “combine face-to-face instruction with computer mediated instruction”¹. Other researchers such as Hartman et al. (2007) expanded on this definition to include that blended learning “combines face-to-face classroom instruction with online learning and reduced classroom contact hours (reduced seat time)”⁵ while Chan and Koh (2008) concluded that blended learning is “the ability to combine elements of classroom training, live and self-paced e-learning, and advanced supportive learning services in a manner that provides a tailored learning”². A more current interpretation of blended learning comes from Friesen (2012) in
which he suggests that blended learning "designates the range of possibilities presented by combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students."4.

In order to understand the development of blended learning, we must examine the evolution of technology-based training. Computer-based training has its origins with the emergence of minicomputers and mainframes in the 1960s. One such example was a computer-based training network called PLATO (Programmed Logic for Automatic Teaching Operation) developed by the University of Illinois in 1963. Limited by the number of interface connections, mainframe-based training gave way to the use of satellite-based videos in the 1970s. This technology allowed companies to train their employees through video networks, empowering them to expand their training programs since the instructor no longer had to physically be on site. One of the most successful satellite-based training case studies is the Stanford University Interactive TV network. Stanford devoted resources to their video network in the 70’s and 80’s so that professors could hold classes in multiple locations throughout SF at once3. As technology continued to evolve, CD-ROMs emerged in the 1990’s as a dominant form of distance learning technology. CD-ROMs had two major advantages: they were easily distributed via mail and they could hold large quantities of information. However, the limitation with CD-ROMs was the inability to for instructors to track student progress. This need led to the emergence of Learning Management Systems (LMS) which allowed educators the ability to monitor course completion, enrollment data, and user performance within the CD-ROM network3.

The use of computers to train employees gained popularity in corporate America in the late 1980s6. Shortly following the unveiling of the World Wide Web, the University of Phoenix became one of the first programs to offer formal online education programs. This prompted other for-profit and not-for-profit institutions to follow suit including New York University Online in 1998 and California Virtual University (consortium of 100 universities and colleges) also in 1998. By this time, computers were no longer just for companies or the wealthy few, but for the masses. As more households were able to purchase computers for the families to enjoy, computer technology advanced to include more immersive graphics, sound, and video capabilities while browsers increased connection speeds. Companies no longer had to distribute CD-ROMs to their users, since they could upload material, assignments, and learning assessments via the web to users who have access to this information with a click of a mouse.

Modern blended learning is delivered online. Ranging from webcasting (synchronous and asynchronous) to online video (live and recorded), learners now have a wide range of technology tools and applications at their disposal. Companies and institutions of higher education can educate students anywhere at any time, while online learners have access to courses anywhere in the world.
Methodology

This section provides detailed information as to how the “blended learning” model was evaluated in each of the two courses. As such, it discusses the methodology used to collect data at beginning and end of the semester as well as the type of qualitative and quantitative data that was collected. It is important to note that, prior to collecting data from either course, approval for the project was granted to the instructors through the University’s Institutional Review Board (IRB).

Pre-implementation Assessment

Towards the beginning of each course, both instructors provided their students with a brief orientation to blending learning through a short video entitled “Blended learning & Flipped Classrooms” (Osmosis, 2017). While there is an abundance of videos available online that demonstrate these approaches, this video was selected based on its quality and clarity.

Following the orientation, the instructors used a questionnaire to assess the students’ opinions regarding the use of the blended learning approach and how it might impact their learning. The following represent a representative sample of the comments received from the questionnaire:

Are there any advantages with combining online sessions with traditional face-to-face instruction?

- The online component allows students to do assignments at their convenience and at their pace.
- The biggest benefit is being able to solve the problems in class (with the instructor there to guide you) versus traditional homework which leaves you on your own.
- This format caters to a lot of student types.
- In class session provides me with more one-on-one time with instructor.
- Leaves more time for professor to answer questions during class.

Are there any disadvantages of combining online sessions with traditional face-to-face instruction?

- It’s more of a struggle to get answers to my questions if the lesson is online.
- Students might forget about assignments.
- You have to be determined to learn the material on your own, which can take more time.
- There is no guarantee that a student will do their part.
- You have to wait to ask all your questions until class days.

What are your opinions regarding the student’s role in the “blended learning” approach?

- I like it because it allows students to come to class with questions, not leave class with questions.
- It takes more work at home to succeed, but I think you learn more.
• Students must review the material ahead of time and come to class ready with questions.
• The success of the course is completely in the hands of the student.
• You must be responsible for teaching yourself and asking questions.

What are your opinions regarding the teacher’s role in the “blended learning” approach?

• The teacher needs to be able to answer emails and be available to students as much as possible.
• He/she needs to make sure the information is provided ahead of time and be willing to help students during class.
• The teacher has to explain the material well enough (online) so that the student won’t need help with the online work.
• They are serving as a coach rather than a teacher.
• The teacher helps the student learn the material better by guiding them through their homework.

Do you have any concerns regarding the instructor’s use of the "blended learning" approach for this course?

• I have a concern regarding the quizzes taken at the end of the lectures online. I feel like I usually have too many questions unanswered and am not fully ready for the quiz.
• Class always tends to be fast paced, so I fall behind easily if I don’t understand a piece of the puzzle.
• It’s difficult to learn complex material from simple PowerPoints and videos.
• Since I’m not tech savvy, I tend to like more face-to-face learning better than online.

The information collected from the questionnaire was not only useful in understanding student perceptions and concerns relating to the blended learning, but in helping the instructors design and implement strategies aimed at improving student learning while also addressing the students’ concerns.

Post-implementation Assessment

Students from both classes were asked to complete an end-of-semester questionnaire which was completed anonymously. The questionnaire contained two types of questions aimed at addressing two areas:

• Short answer questions that address student perspectives of blended learning
• Likert-scale questions that address the impact of the blended learning on student learning and problem-solving skills. The Likert questions were separated into three broad categories: instruction, technology, engagement and satisfaction.

The qualitative questions from the end-of-semester questionnaire were evaluated by reading through the students’ answers and summarizing their responses. Conversely, the quantitative
data from the Likert-scale questions was analyzed at the class-level using spreadsheets that evaluate statistical measures such as the mean, standard deviation, etc. As shown in Figure 1a and 1b below, information relating to student gender and GPA was also collected in an effort to determine if a correlation exists between these parameters and student perceptions regarding blended learning. This type of analysis will most-likely be performed at a later date, once multiple semesters of data have been collected and the sample size is statistically significant.

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**Figure 1a. First Page of the End-of-Semester Questionnaire**

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TCM 2235 & TCM 5431 – Fall 2018
Blended Learning: End-of-Semester Questionnaire

The following questions relate to the instructor’s use of the “blended learning” approach (combining online content with traditional one-on-one instruction) throughout this course and will only be used in understanding your initial perceptions of the teaching method. The instructor appreciates your honesty in answering the questions and assures you that your answers will not have any impact on your course grade. Please do not write your name anywhere on this sheet.

**General Information**

1. Please indicate your gender:
   a. Male
   b. Female

2. Please indicate your overall grade point average within the following ranges:
   a. < 2.0
   b. 2.1 – 2.5
   c. 2.6 – 3.0
   d. 3.1 – 3.5
   e. > 3.5

**Part 1: Questions pertaining to the Blended Learning**

3. What did you like most about the “blended learning” approach used for this course?

4. Was there anything about the “blended learning” that you did not like?

5. If you could offer one suggestion to improve the “blended learning” experience, what would it be?

6. In what ways did the “blended learning” environment help you learn this semester?

7. In what ways did the “blended learning” environment not help you learn this semester?
Part 2: Likert-Scale Questions Pertaining to the Blended Learning

Please use the table below in rating different aspects of the blended learning environment. Use the following scale for your evaluation:

1 = strongly disagree  
2 = disagree  
3 = neither agree or disagree  
4 = agree  
5 = strongly agree

<table>
<thead>
<tr>
<th>Instruction</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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<tbody>
<tr>
<td>1. The online and face-to-face activities were blended effectively.</td>
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<td>2. The use of blended learning technology (online lessons, videos, etc.) in this course encouraged me to learn independently.</td>
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<td>3. Blended learning activities enhanced the interaction between teachers and students.</td>
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<td>4. I am satisfied with the level of effort this course required.</td>
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<td>5. Having a portion of the course online provided me with more flexibility.</td>
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<tr>
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<tr>
<td>6. The technology used for blended teaching was reliable.</td>
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<td>7. The online content (PowerPoints, videos) was effective in helping me learn.</td>
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<td>8. Using my personal devices (smart phone, tablet, etc.) helped me learn.</td>
<td>□</td>
<td>□</td>
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<td>9. Technical problems were not frequent and did not adversely affect my understanding of the course.</td>
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<tr>
<th>Engagement and Satisfaction</th>
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<tr>
<td>10. Blended learning activities are interactive.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
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<tr>
<td>11. Blended learning is more convenient than face-to-face learning.</td>
<td></td>
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<td>□</td>
<td>□</td>
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<td>12. The instructor’s use of blended learning helped me think more in-depth about the subject.</td>
<td></td>
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<tr>
<td>13. I am willing to take another course that uses blended learning.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
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<tr>
<td>14. Overall, the use of a blended learning format improved my understanding.</td>
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<td>□</td>
<td>□</td>
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<tr>
<td>15. I would recommend blended learning courses to my friends.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
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<tr>
<td>16. I would recommend developing and using more blended learning courses within the Civil Engineering and Construction department.</td>
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<td>□</td>
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</table>

Figure 1b. Second Page of the End-of-Semester Questionnaire
Results:

This section presents the qualitative and quantitative results collected through the end-of-semester questionnaire regarding student perspectives of the blended learning.

Qualitative Data Analysis

At the conclusion of each course, students completed a questionnaire containing five short answer questions addressing their views on the use of the blended learning model for their course. The following provides a representative sample of the comments received from the questionnaire:

What did you like most about the “blended learning” approach used for this course?

- This approach provided me with time flexibility and the ability to work at my own pace.
- It allowed us (students) to interact more with the professor.
- I liked seeing the material online first before I had to apply it in class.
- It helped me learn to be more responsible for my own learning.
- The in-class and online sessions kept me from falling behind.

Was there anything about the “blended learning” approach that you did not like?

- At times it was hard to pay attention to the online lectures.
- Sometimes it was difficult to teach myself the material.
- I wish Folio showed which questions I got wrong on the online quizzes.
- I don’t like learning from videos.
- Sometimes it was difficult to complete the online lessons prior to the lectures.

If you could offer one suggestion to improve the “blended learning” experience, what would it be?

- Offer more recitation (in-class) review sessions on Fridays.
- Fully explain how to operate the online portion of the course on the first day of class.
- Try teaching some lessons face-to-face and having homework online.
- Update the older videos with new Lightboard videos.
- Use more tutorial videos online for references.

In what ways has the “blended learning” environment helped you learn this semester?

- The combination of in-class work and online lessons made the class more personal.
- I benefited from teaching myself the material one way, and having the professor teach it another way.
- It helped me become more self-disciplined and responsible for my own learning.
- It helped me at my job where I have to learn on my own.
- Group work was a good way for us to learn from each other.
In what ways did the “blended learning” environment not help you to learn this semester?

- It was difficult when certain people within the group hadn’t prepared ahead of time.
- I felt that it was harder for me to learn online than face-to-face.
- If you miss a lesson or class, the next was difficult to learn.
- I often had questions with the online material that I couldn’t ask about.
- It makes it easy to put things off to the last minute

Qualitative Data Analysis

Table 1 summarizes the student responses taken from each course during the Fall 2018 semester (total enrollments of 40 and 37 respectively) to Likert-scale questions from the end-of-semester questionnaire. For the Introduction to Structures course (TCM 2235), the average response was a 4.42 with a low of 4.26 and a high of 4.61. For Construction Cost Estimating (TCM 5431), the average, low and high scores were 4.08, 3.62, and 4.59 respectively.

Scores from each course show some interesting trends. Whereas the highest scoring category for TCM 2235 was for the Technology category (average score of 4.47), the highest scoring category for TCM 5431 occurred within the Engagement and Satisfaction category (average score of 4.10). For the TCM 2235 course, this trend was most likely due to instructor’s use of two of the University’s newest technologies, Lightboard and Kaltura, which clearly pleased his students. In the case of TCM 5431, the scoring within the Engagement and Satisfaction category illustrates how the students within this course valued most the interactive nature and convenience of the blended course format. For the TCM 2235 course, the lowest scoring question (4.26) was for question 8 (using my personal devices helped me learn) whereas for TCM 5431 the lowest score (3.62) occurred for question 3 (blended learning activities enhanced the interaction between teachers and students).
Table 1. Student Rating Data from End-of-Semester Questionnaires for “Introduction to Structures” (TCM 2235) and “Construction Cost Estimating” (TCM 5431)

<table>
<thead>
<tr>
<th>Questions Relating to Blended Learning</th>
<th>Average Student Rating (Scale: 1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TCM 2235</td>
</tr>
<tr>
<td><strong>Instruction</strong></td>
<td></td>
</tr>
<tr>
<td>1. The online and face-to-face activities were blended effectively.</td>
<td>4.45</td>
</tr>
<tr>
<td>2. The use of blended learning technology (online lessons, videos, etc.) in this course encouraged me to learn independently.</td>
<td>4.39</td>
</tr>
<tr>
<td>3. Blended learning activities enhanced the interaction between teachers and students.</td>
<td>4.48</td>
</tr>
<tr>
<td>4. I am satisfied with the level of effort this course required.</td>
<td>4.39</td>
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<tr>
<td>5. Having a portion of the course online provided me with more flexibility.</td>
<td>4.61</td>
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<tr>
<td><strong>Technology</strong></td>
<td></td>
</tr>
<tr>
<td>6. The technology used for blended teaching was reliable.</td>
<td>4.61</td>
</tr>
<tr>
<td>7. The online content (PowerPoints, videos) was effective in helping me learn.</td>
<td>4.42</td>
</tr>
<tr>
<td>8. Using my personal devices (smart phone, tablet, etc.) helped me learn.</td>
<td>4.26</td>
</tr>
<tr>
<td>9. Technical problems were not frequent and did not adversely affect my understanding of the course.</td>
<td>4.58</td>
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<tr>
<td><strong>Engagement and Satisfaction</strong></td>
<td></td>
</tr>
<tr>
<td>10. Blended learning activities are interactive.</td>
<td>4.32</td>
</tr>
<tr>
<td>11. Blended learning is more convenient than face-to-face learning.</td>
<td>4.32</td>
</tr>
<tr>
<td>12. The instructor’s use of blended learning helped me think more in-depth about the subject.</td>
<td>4.42</td>
</tr>
<tr>
<td>13. I am willing to take another course that uses blended learning.</td>
<td>4.45</td>
</tr>
<tr>
<td>14. Overall, the use of a blended learning format improved my understanding.</td>
<td>4.26</td>
</tr>
<tr>
<td>15. I would recommend blended learning courses to my friends.</td>
<td>4.35</td>
</tr>
<tr>
<td>16. I would recommend developing and using more blended learning courses within the Civil Engineering and Construction department.</td>
<td>4.45</td>
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</table>
Discussion:

This project entailed the conversion of two traditional style courses, offered at two different academic levels, into blended learning courses that integrated online elements with in-class teaching elements. By reviewing the qualitative (pre-implementation and end-of-semester) and quantitative assessments of each course, the instructors gained valuable insight regarding student reactions to blended learning, strategies for better integrating the online and classroom elements, and approaches for improving student learning by keeping students engaged and motivated.

Observations relating to blended learning classrooms include:

- Students like the flexibility (both in time and pace) of the online component paired with the interactive nature of the face-to-face active learning sessions.

- Students prefer the collaborative in-class problem solving environment to the traditional method of using homework assignments as a student’s first exposure to problem solving.

- When integrated properly, the online and classroom components can complement each other nicely. Whereas the technology based components (Lightonboard, Kaltura, etc.) are affective in providing students with needed background and application information, the classroom element provides them with an opportunity to get instructor guidance, collaborate with peers, and practice applying concepts.

- Having frequent (but low stake) activities both online and in-class helps students take a more active role in their own learning. These also keep them from falling behind.

Based on suggestions provided for both courses through end-of-semester questionnaires, both faculty members have decided to incorporate the following changes into their courses for the upcoming semester:

- Each course will allocate a portion of the first lesson to demonstrating the online elements of the course.

- Both instructors will utilize recitations and/or tutoring sessions to provide students with additional support and assistance.

- Both courses will upgrade the quality of the blended learning materials by developing additional Lightboard videos and screen capture technologies.
References


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Dr. Rogers is an associate professor in the Department of Civil Engineering and Construction at Georgia Southern University. Prior to joining the University, he worked at the Institute for Water Resources and spent several years working throughout Latin America on various WASH related projects. His other interests include water and sanitation systems, hydraulics, water resources, and design build delivery systems.

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