CREATING A LEARNING COMMUNITY AND BUILDING ENGAGEMENT IN ONLINE ENGINEERING COURSES USING ACTIVE LEARNING INSTRUCTIONAL PRACTICES AND EDTECH TOOLS

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Research widely agrees that student engagement can have positive impacts on student learning and achievement. Many institutions have adopted best practices designed to enhance engagement in the classroom in response to the growing research that supports these instructional best practices. Similarly, as online learning trends soar, universities are also beginning to explore what engagement means for the online learning community. Active learning has been translated to the digital platform, but with asynchronous sessions and activities, many wonder if substantial engagement and student achievement are possible to the same degree as they can be in face-to-face courses. In an attempt to begin addressing this question, this article examines how one engineering faculty member shifted his face-to-face course to a hybrid format while incorporating the same degree of active learning and engagement practices that were present in the ground format. This article will discuss how the course was shifted, what impacts were present for students, and the faculty's reflection on how the shift impacted his craft.

KEY WORDS: active learning, engagement, online learning, curriculum development, backward design model, hybrid classes, STEM learning, higher education, online STEM

1. BACKGROUND

1.1 Shift to Online Learning

Over the last several years, colleges and universities have seen a rise in online enrollment. Between 2016 and 2017, over 31% of all students enrolled at a public

authors found was that, outside of delivery modality, active learning increases student achievement much more than traditional lecturing does (Felder and Brent, 2009).

2. COURSE SHIFT PROCESS

After participating in a faculty development program on active learning and student engagement, one engineering professor from a large southwestern university began implementing various instructional best practices he had learned into his F2F courses. When the school of engineering began to offer engineering courses and programs online, this professor made the decision to transition from F2F to online courses. One caveat to his transition included the creation of a hybrid class: one that would be primarily conducted through a digital platform but would still provide opportunities to meet in person several times throughout the semester.

The course selected for transition was an undergraduate 200-level materials science (MSE) course. As a foundational course, the purpose of the course is to introduce students to the basic concepts of materials science, particularly the relationship between structure processing-property performance and key terms students will need to utilize in subsequent MSE courses. Table 1 includes the 13 learning outcomes for the course.

The course followed a structural pattern to provide consistent expectations to aid in student success. The pattern included lectures in the form of videos with embedded questions. These were chunked to increase engagement, and PlayPosit (2020), described in full below, was the platform used to manage the videos and questions. Homework assignments were lecture-based and also derived from the e-book for the course. In addition to the formative assessment provided by the homework, four exams and one final exam were also utilized to assess the course. Recitations were conducted weekly through the virtual meeting platform ZOOM and included interactive learning activities and quizzes. Types of these assignments included Kahoot! (2020) activities, group worksheets, and quizzes.

To help with the transition process, this professor enlisted the help of the university's Global Outreach and Extended Education (GOEE) office, an instructional design team created to help faculty migrate course content to online platforms using pedagogical and curricular ideologies. The goal of the first meeting between the professor and the GOEE team was to create a schedule for the course migration task. Weekly meetings were also established to maintain open lines of communication and to measure and ensure progress.

The GOEE team also employed the Backward Design Method (BDM) as the primary means of creating the scope and sequence of the course as it pertains to the assessment of the content (Wiggins and McTighe, 2005). The BDM begins by prioritizing the goals/

assessment that they had chosen to align. Because the professor had already begun employing active learning strategies in the F2F course, much of the original course content was migrated to the online course. One significant change, however, was with regard to the lecture material. The professor fragmented the lectures into more digestible chunks, and he also used the technology tool PlayPosit to embed questions into the lectures as a formative assessment to address any muddy points or common misconceptions of the material. An example of this EdTech tool is illustrated in Fig. 1.

FIG. 1: Embedded question in chunked lecture for online engineering course

Another facet to the course's organization was that the material was organized into modules that contained the course content by week so that students could access materials chronologically. The first module, entitled Getting Started, was reserved as a repository for guidelines on how to navigate through the course and all of the new features for students. For example, instructions on how to use the LMS and some of the newer technology tools were inserted into this module. Similarly, this module contained activities designed to build community and student-to-student engagement through activities like introductions, discussions using the EdTech tool VoiceThread, and how to manage group assignments. Figure 2 shows an illustration of VoiceThread in use.

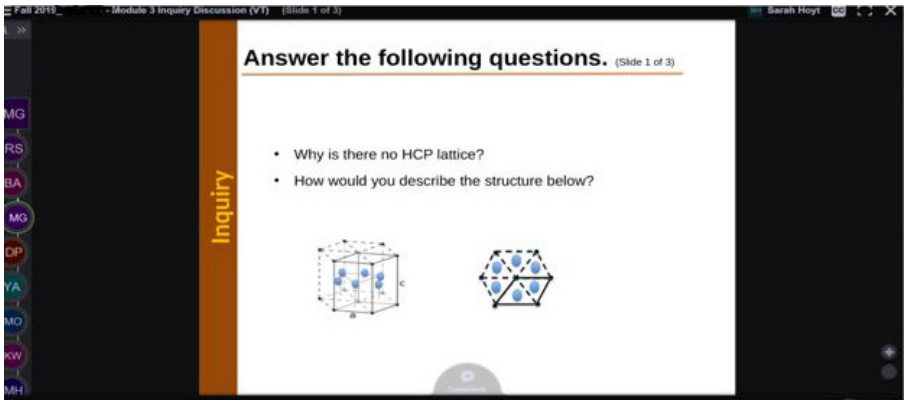

FIG. 2: VoiceThread sample with media and discussion forum

Once the course was built into the LMS, the team continued to meet to discuss what was implemented well and what needed to be modified, either within the same semester or for

3. METHODS

To measure student impact from an achievement standpoint, grade point averages (GPAs) were examined from the same course taught traditionally (e.g., “Sage on the Stage”), the F2F format with active learning, and the online format with active learning. The traditional format was designed around lecture-based classes where the instructor spent the majority of the class time lecturing and assigning homework to be done outside of class. The second class format included a modification of the original material. The lectures were segmented by active learning strategies like Think-Pair-Share and Muddiest Points for formative feedback (Lyman, 1981; Mosteller, 1989). The online course utilized a hybrid approach: the majority of the class and work was performed online while the main assessments were held F2F. The coursework for the online platform was organized using the BDM, and assessments were linked to course outcomes and learning objectives. This course also utilized a collection of e-books written by both instructors (Theodore and Alford, 2018). The same instructors were used to ensure that the content was uniform in each course. The sample size differed among the course platforms; the traditional F2F lecture course contained three sections and 143 students, the F2F active learning course contained two sections and 71 students, and the online active learning course contained only one section of 64 students.

4. RESULTS

For each average student grade, a 95% confidence interval was constructed using the samples. After analyzing GPAs and grades of D, E, or Withdraw (DEW) rates for the aforementioned courses, the following results emerged: the online active learning course format yielded the highest average grade with a margin of error of ± 7.3. For the same group of students, the DEW rate was the lowest at 4.6%. In the F2F active learning course, the average grade for the course was 84% with a DEW rate of 13%. The traditional F2F course yielded the lowest average grade of 78.3 and the highest DEW rate at 40%. The lowest course evaluation was obtained the for the F2F course format. Table 2 illustrates the aforementioned data.

While it is acknowledged that other factors can influence GPA and DEW rates, one should note that significant research supports the idea that active learning boosts student achievement and engagement (Freeman et al., 2014). Research also supports the idea that when a professor incorporates multiple opportunities for teacher-student and student-student interactions, student achievement is increased (Kim and Sax, 2009).

students in different time zones. In F2F office hours, a student would be able to leave the meeting with a hard copy of the problem discussed. With the aid of a digital whiteboard, the student was still able to receive a digital transcript of the problem or concept discussed, and they were also posted to the online course forum for all students to view. This was a benefit: once a professor realizes that more than one student is struggling with the same problem, he/she is able to post a clarification immediately to the entire class rather than having to wait for the next scheduled course meeting. The students reported that they valued having a digital transcript of the discussion or problem.

Similarly, the “Tea with the Professor” and the recitation components of the course worked really well at building community and engagement, not only between peers but also between the professor and students. The small breakout rooms during recitation also allowed for some individualized instruction and provided opportunities to engage with students on issues that pertained to their need and ability in the course.

Asynchronous student-student engagement was facilitated with subsequent VoiceThread questions and Muddiest Points on an electronic post-it platform, as illustrated in Fig. 4 below. The professor valued this method because students reported that they sometimes understood their peers more than the explanation offered by the professor. The professor also found that this method was extremely effective in addressing misconceptions. The added benefit of the asynchronous delivery of these misconceptions meant that the professor could catalog them on the electronic post-it boards for students to continue to reference as needed.

FIG. 4: Linoit Digital Post-It Platform example

6. CONCLUSION

Shifting courses to an online platform still requires professors to incorporate sound pedagogical best practices in order to not only engage students but to also foster an environment that allows students to access the course content. The good news is that there are a myriad of EdTech tools to help facilitate active learning and engagement-style teaching in an online class. One key takeaway from this examination of course migration is that building a course with student-student and student-instructor interactions is essential for building and sustaining a learning community in the digital world. Another component essential to effective course migration is the use of an organizational model that utilizes student learning objectives and assessment as the vanguard for course design. Leading with those two components, as is done using the backward design model, provides instructors with an organized mode of content delivery that is focused on content learning rather than pacing or timing. Prioritizing content and building opportunities for students to engage with the material are the cornerstones of student performance and success in digital curricular design.

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