Work in Progress: Flipping Synchronous Online Courses to Increase Engagement and Enhance Learning

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Introduction:
Many universities are increasing educational opportunities through online learning platforms. Despite the clear value of increasing access to a variety of students, there is strong evidence that many students find succeeding in online courses challenging[1]. In the Department of Bioengineering at the University of Washington, we have recently moved our professional program to a fully online format. Here, I present the structure being used for two fully online courses in the Master in Pharmaceutical Bioengineering program that promotes the success of our students.

Many online programs rely entirely on recorded material, assignments, and discussion boards. This delivery method is effective and allows students to progress through the courses at individual paces. However, this format does not provide a strong learning community. Research has shown that student learning increases with peer teaching, and that strong learning communities often lead to greater understanding and engagement [2]. Building community is especially challenging when students are not physically in the same classroom. As our students come from around the country, there are never in the same location for class. To develop a sense of community between and among the faculty and students, we chose to have a synchronous online meeting each week in our courses.

Many of the challenges faced in online education are similar to those experienced in lecture-based courses, but magnified, including low student engagement, lack of interactivity, and loss of focus [3]. To address these concerns, many classroom-based courses have moved toward active learning and flipped classroom models [1],[4]. Online courses with a synchronous component are an ideal setting for a flipped classroom. As recorded material is expected in online courses, there is little pushback against delivering content through pre-recorded lectures. Therefore, the synchronous online meetings can be spent in small-group active learning activities and full-class discussions.

This type of course requires extensive technological tools. At the University of Washington, we use Zoom for our synchronous meetings. This platform ensures that only our students have access to our online classroom. Students interact through microphones (VOIP) and web cameras. Additionally, screen sharing is used for discussions and presentations. Zoom has excellent small group capabilities.

Example Discussion Questions for Paper
“Structure-based discovery of opioid analgesics with reduced side effects”
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1. Why do they think this new compound might make a better drug than the two currently in clinical trials (TRV130 and heroin)? Are you convinced by the data they present that this new compound would make a better drug?
2. While the PZM21 compound appears promising given its assay and in vivo results, what are some of the shortcomings of this designed molecule that might prevent it from being as successful in clinical trials as TRV130 and heroin?
3. Habit formation drug use is thought to occur through valence of the dopaminergic reward pathways. How do the data presented here support a role for G-proteins in this process?
4. Why did the authors decide to use the inactive state receptor when it cannot always be relied upon? What would be the benefit (if any) if the researchers had initially or also docked the ligands to the active form of mOR?
5. Metabolism of PZM21 in mice was relatively slow (8% metabolized over an hour.) do you think it will be comparable in humans? Though PZM21 had few side effects (mild defecation reduction,) do you believe there might side effects that may result from long-term use?

Figure 1: Questions for discussion of paper in flipped online course
Description of Course Structure
In the synchronous sessions, most of the time was spent in small-group discussions. In a Molecular and Cellular Biology course, the students read five scientific papers, and were assigned to a paper discussion group that stayed the same throughout the course. This was intended to enable students to form strong connections with two to three other students. Students submitted discussion questions prior to the class discussion. I selected among these for discussion in the groups. There were five sets of student groups, and each group discussed a different set of questions. This enabled a jigsaw-like activity where students in each group presented the consensus of their discussion to the class after the small group discussion [5]. An example of the types of questions used in these paper discussions can be found in Figure 1.

In both the Molecular and Cellular Biology course and the Pathophysiology course that followed it, there were discussions of questions and problems related to the course material. For these discussions students were assigned randomly to groups of three or four students each week. This enabled the students get to know all their peers. Students discussed the answers to the questions in these small groups, and then an individual or a group was called on to explain the answer the entire class. An example of a question and the Zoom interface the students seen can be seen in Figure 2.

These courses are designed for professional master's students, many of them have jobs or family commitments that make it impossible for them to join every week. To enable students to make up the information missed, the synchronous sessions were recorded and made available to students through our learning management system, Canvas. This ensured that these recordings were only available to students in the course, protecting student privacy. Though attendance was not taken, students were given a participation grade for each session based on their contributions to the group discussions. To prevent penalizing students for attending to other commitments, the lowest participation grade is dropped, allowing students to have no penalty for missing one of the ten sessions.

Results
As I began teaching this course as an online course, I do not have information about student performance from the in-person version of this course to compare with. Therefore, the effectiveness of the course is evaluated by focus group-like course assessment discussions conducted by a third party and end of course evaluations. In the focus group-like assessments, students indicated the course format allowed them to build a learning community. Based on surveys and reviews, students found this combination of recorded lectures and “in-class” discussion and problem solving to be useful. Some students even indicated that this format is more effective than traditional, in-person course formats. Student interactions in the discussion
groups helped them to develop metacognition by seeing what other students understood that they did not. Additionally, they shared their expertise and learned from their colleagues’ expertise. Students indicated the usefulness of these discussions in both Mid-Quarter Reviews and Course Evaluations. A majority of students (18 out of 32) mentioned the benefit of these sessions in the open-ended course evaluation question: What aspects of this class contributed most to your learning? Example responses for this question include:

"I also, to some extent, liked the in-class discussions. They were both challenging, collaborative and nerve-wracking at the same time."
"I think the most beneficial aspect of the course was the discussion. Whether it was about content or a paper, gaining the perspective of peers and the professor was enhanced my comprehension greatly."
"The videos worked best for my base knowledge, but I feel that the class discussion problem sets were the best for my overall understanding."
"The discussions made me think more about what I learned and the papers allowed me to gain knowledge on how what I learned may be applied in the real world in the context of pharmaceutical bioengineering."
"The classes were always good. I was never once bored. Using the Socratic method keeps everyone on their toes."
"Practice questions during class were helpful in applying my notes and understanding their context."

A few students (2 out of 32) expressed frustration with the discussions in answer to the question: What aspects of this class detracted from your learning? These results indicate that this flipped format is effective in helping students learn.

The technology allows the instructor to join the breakout rooms, so I get a chance to overhear students' conversations. Often students were discussing jobs, relevant things they have read in the news, or other courses they are taking as well as the course material. Indicating the strength of the community built by these discussions goes beyond the course.

Conclusion and Discussion
Though these students are master's students, and are more mature than many undergraduates, there is no indication that their maturity plays a role in the effectiveness. I believe these tools and this course structure would benefit many types of students. This structure would be useful for teaching courses where students solve problems and are asked to use the knowledge they gained in a new way. As this describes most courses, I think this this applicable to many online courses and programs. Though much of the course structure can be scaled to larger groups of students, as the instructor one would be less able to interact with each. This will increase one of the limitations of this course structure, difficulty interacting with quieter students. It is difficult to assess the understanding of students that are not active in the discussion. This can be mediated by calling directly on students during the group discussion.

These preliminary results indicate that challenges in online education can be addressed by techniques that have been shown effective in traditional formats, such as flipped classrooms that focus on peer teaching and problem-based discussions.
References


