2018

Hybrid-flipped classrooms – challenges and opportunities (WIP)

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Abstract

In the 2013-14 academic year, we embarked on an effort to flip two engineering courses in our department – a year-1 problem solving and programming course (Y1PS), and a year-3 numerical methods course (Y3NM). Initially, the Y3NM course, which we were also teaching for the first time and revising significantly as we did, was conducted in a standard flipped model wherein students viewed video lectures and took diagnostic quizzes prior to attending class, and where class time itself focused on discussion and problem solving. In contrast, based on our significant prior experiences teaching the Y1PS course, and upon its organization as a mixed-mode lecture/problems solving course, we did not take a standard flipped approach to it. Instead, in the Y1PS course, students watched videos during the class periods themselves; such a structure was facilitated by the classroom having one computer per student, to accommodate the programming portion of the class. We refer to this "watch in class" model as a hybrid-flipped classroom, and have found this approach to work significantly better in terms of student engagement and learning than the standard flipped model did for us. With that experience, we modified the Y3NM class to the hybrid-flipped model in subsequent offerings. We recognize that the hybrid-flipped model is resource intensive because it requires far more classroom technology than traditional lecture, and also that our positive results are in part due to the computer-intensive nature of both courses in which we have implemented this model. We report here about our experiences, both positive and negative, with flipped and hybrid-flipped approaches, and provide guidance for instructors considering such changes themselves.

Disciplines

Engineering Education

Comments

This proceeding is published as Raman, D. Raj, and Amy L. Kaleita. "Work in Progress: Hybrid-flipped Classrooms: Challenges and Opportunities." Paper ID #23175. In *2018 ASEE Annual Conference & Exposition*. DOI: 10.18260/1-2--31289. Posted with permission.

2018 ASEE Annual Conference & Exposition
Paper ID #23175

Work in Progress: Hybrid-flipped Classrooms: Challenges and Opportunities

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Abstract
In the 2013-14 academic year, we embarked on an effort to flip two engineering courses in our department – a year-1 problem solving and programming course (Y1PS), and a year-3 numerical methods course (Y3NM). Initially, the Y3NM course, which we were also teaching for the first time and revising significantly as we did, was conducted in a standard flipped model wherein students viewed video lectures and took diagnostic quizzes prior to attending class, and where class time itself focused on discussion and problem solving. In contrast, based on our significant prior experiences teaching the Y1PS course, and upon its organization as a mixed-mode lecture/problems solving course, we did not take a standard flipped approach to it. Instead, in the Y1PS course, students watched videos during the class periods themselves; such a structure was facilitated by the classroom having one computer per student, to accommodate the programming portion of the class. We refer to this "watch in class" model as a hybrid-flipped classroom, and have found this approach to work significantly better in terms of student engagement and learning than the standard flipped model did for us. With that experience, we modified the Y3NM class to the hybrid-flipped model in subsequent offerings. We recognize that the hybrid-flipped model is resource intensive because it requires far more classroom technology than traditional lecture, and also that our positive results are in part due to the computer-intensive nature of both courses in which we have implemented this model. We report here about our experiences, both positive and negative, with flipped and hybrid-flipped approaches, and provide guidance for instructors considering such changes themselves.

Introduction
The qualities of excellent instruction are fairly well understood, even if there remain arguments about the details (e.g., Keeley et al., 2016). But investing the time to prepare and deliver high-quality lectures, to develop appropriately rigorous homework assignments and to grade them, and to be available to students outside class and online, is difficult for many faculty members, and certainly for many in engineering discipline. For this reason, approaches that facilitate high-quality instruction with lower time investments are valuable. As we have noted elsewhere (Jarboe et al., 2016), technology-enhanced education has been used to break down distance barriers for centuries. More recently, video-based lectures delivered via the web not only break-down distance barriers, but enable one critical teaching function – the delivery of content through lecture – to be replicated with virtually zero additional effort by the instructor. This is a non-trivial advance: releasing an instructor from the task of delivering yet another lecture allows focusing instructor effort on relational, interactive, and thoughtful engagement with students, rather than on regurgitating the same lecture semester after semester.

Like many programs across the country, our engineering degree program enrollments have grown steadily (in our case, at nearly 5.4% annually since 2006, meaning core courses are virtually double in throughput). Motivated by growing student numbers we embarked on an effort to use video lecture delivery in two key courses taken by all engineering students in our department. We did so nearly five years prior to the writing of this work-in-progress, and here we report on the development of the materials, our experiences using the video lectures in class, student responses to the video lectures, and experiences with sharing the video lectures with new instructors.

This project began in the 2013/2014 academic year, when were assigned to co-teach both the year-1 problem solving and programming course (Y1PS), as well as a year-3 numerical methods course (Y3NM).

In the case of the Y1PS course, one of us had 10 semesters experience teaching the class solo, and we had recently co-taught a section of it. Enrollments were sufficiently high that we were assigned two sections of the course, with each section meeting twice a week for 110 minutes. We envisioned using video lectures to allow one of use to create and deliver lectures for each class meeting, which could be used by both of us in a mode where students watched the lectures on the lab computers, with at least one of us and an undergraduate TA in the room at the same time.

In the case of the Y3NM course, our department curriculum committee, based upon multiple data points, had determined that a major revision of the course was warranted, and we had agreed to lead this effort and redevelop the course. Complicating our plans for the Y3NM course were space constraints that arose just weeks before the semester started – we had 50 students enrolled in the course but had teaching lab space for only 40, and due to campus-wide record enrollments, could not find a suitable lecture room to accommodate a joint lecture session. Again, the possibility of video lectures was appealing, in this case because it would allow us to circumvent the lack of a large lecture room, transferring that function to a location of each student's own choosing, and letting us focus instruction on two lab sections.

Materials and Methods

The Y1PS course comprised approximately 24 content-focused lecture periods – the remaining six were used by introductions, exams, and review sessions. Existing lectures for the Y1PS course were in a PowerPoint format. These were modified to contain breakpoints, typically with an "in-class problem" (ICP) at the break, so that lectures had two to four ICPs.

The Y3NM course comprised approximately 10 major topics spanning the first 12 weeks of the semester, and then focused on a student project for the remainder of the semester.

In both cases, after reviewing and editing the slide set, the "recording instructor" would create a lecture video, or more often a series of linked lecture vides for the Y1PS class, using Panopto (Seattle, WA) software at our desktop computer. We used low-cost (ca. 120USD) interactive tablets and styluses to enable annotation of the PowerPoint slides as we recorded each lecture or lecture segment. For programming- or spreadsheet-focused lectures, we used Microsoft Excel, VBA within Excel, MATLAB, or Simulink as appropriate, and could readily switch the video capture between the programming environment and the relevant PowerPoints as needed. Our practice of splitting the lectures led to typical segment lengths of 5 – 15 minutes, and total video content per class period of 30 – 40 minutes.

From a delivery standpoint, we initially used a flipped model in the Y3NM class. Lecture videos were posted several days prior to class, and student were asked to watch the video(s) and often to follow up by taking a pre-quiz. Based on student questions in the live lecture, we came to believe that the flipped model was not working in the Y3NM class – students were watching the videos but cursorily only, and we repeatedly found ourselves re-teaching content that was in the videos rather than focusing on demonstrations and problem solving. For these reasons, we shifted to the hybrid flipped model for the Y3NM class in subsequent semesters.

In the Y1PS class, we never used a traditional flipped model, but instead required students to bring headphones into class, where they would watch the videos under supervision of a faculty member and/or undergraduate TA.

At the end of the 2013/14 academic year, we promulgated a xx question survey to students who had taken both the non-flipped version of the Y1PS course in the fall of 2013, and to those in both of our sections of the spring 2014 hybrid-flipped version of the same course – this gave three treatment: F13, S14A, and S14P (for AM and PM sections of the course).

Results and Discussion

The S14A respondents (n = 12) had more unhappy answers overall, even to issues that were unrelated to the class per se (e.g., pre-class motivational level), making it difficult to make comparisons between this group and the others. We therefore are not reporting on these results.

The S14P respondents were low in number (n=4), but comparing them to the F13 respondents (n = 12), illustrated a few interesting findings. Specifically, when examining responses where there was more than a 0.5 difference in average response on a 5-point Likert scale, the following were observed:

- Hybrid-flipped (HF) students found the teaching style less effective (4.0 vs 4.8).
- HF students felt more connected to their TAs (4.6 vs 3.7). This was the biggest between the groups. The TAs were different fall to spring, so it is hard to know if this was in part an effect of TA personality.
- HF students found the programming tasks more meaningful (4.4 vs 3.8), less boring (1.6 vs 2.3), more helpful to their career goals (4.4 vs 3.8), and were less intimidated by the programming portion of the class (2.0 vs 2.5).
- HF students felt less qualified for the engineering topics portion (4.2 vs 4.8). Interestingly, this effect agreed with our perceptions of how readily we were able to translate our programming lectures into videos, compared to our engineering topics lectures (e.g., statics, simple kinematics)
- HF students looked forward to class less for the engineering topics portion (4.0 vs 4.5), but paradoxically found the engineering topics portion less boring (1.6 vs 2.4), and found the engineering topics more helpful to their career goals (4.4 vs 3.8)

Based on other research we have done (e.g., Kaleita and Raman 2017), as well as on our experiences as instructors, we believe there are significant differences in Fall and Spring students in the Y1PS class. Between that and the low n, the numbers here must be interpreted with caution. Interestingly, the hybrid-flipped students reported less satisfaction with the *style* but more satisfaction with the *outcomes*. One wonders if the newness of the style was less comfortable, but then the students liked the learning they were doing as a result of it. We have, in the intervening six semesters, become far more adept at seamlessly blending the live portions of both classes with the video lectures that support them. Although we have not done follow-up detailed surveys, we have regularly collected student evaluation of instruction (SEI), and those numbers suggest we have generally become more effective at using this hybrid approach. Similarly, the SEI results we have had on the Y3NM class, and the unsolicited student comments about the class, indicate that the hybrid-flipped model is working very well for that content. In both classes, we have since moved away from the team-taught approach that we used while developing the videos, and instead each solo one of the two courses. Furthermore, we have used the videos to expand our reach while maintaining teaching consistency, by allowing new faculty members teaching the Y3NM class to use the same videos, and by allowing a graduate student who was soloing with the Y1PS class to use them. Both these instructors commented on how helpful having the video lectures was to their taking on these new classes. Both were able to stamp the class with their own imprint, because the hybrid-flipped model does not fill the entire class period with video – instead it allows instructors to engage students as they struggle to work the ICPs and homework problems.

Conclusions

If classroom computers are available, and if the instructor(s) are willing to make a significant up-front investment, a hybrid-flipped model frees instructors from the mind-numbing recitation of the same lecture semester after semester, while letting students watch the lectures at their own pace. Instructors can then focus their energies on being more thoughtful about answering student questions and cultivating more one-on-one interactions with students. In our experience, this approach has genuinely enabled us to extend our reach in the classroom, benefiting students in the process.

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Appendix 1: Survey Questions

1. In which semester were you enrolled in this class?
2.
3. Please indicate how much you agree or disagree with each of the / following statements. (5 pt Likert)
    a. I am excited about becoming an engineer.
    b. I feel highly motivated to stay in engineering.
    c. I feel highly motivated to continue to use programming.
    d. I feel confident in my developing engineering abilities.
    e. I feel confident in my programming abilities.
    f. I feel confident in my ability to be a successful college student.
    g. I am capable of doing well-documented engineering analyses.
    h. I am able to write computer programs to perform a specific task.
    i. I feel confident in my math and trigonometry abilities.
    j. My experience in this class inspired me to stay in engineering.
    k. I found the teaching style in this class to be effective.
    l. I felt connected to my in-class instructor in this class.
    m. I felt connected to the online instructor in this class.
    n. I felt connected to my TA(s) in this class.
    o. I would be excited to take another flipped class.
    p. Before the start of the semester that I took this class, my motivation to learn the material in this class was higher than for most other ISU classes I've taken.
    q. At the mid-term of the semester that I took this class, my motivation to learn the material in this class was higher than for most other ISU classes I've taken.\
    r. Compared to other ISU classes I've taken, the teaching methods used motivated me to master the key concepts in the course.

4. Consider how often each of the following will be true for both the programming aspects of the class... : **Programming**
    a. I had the qualifications to succeed in this class.
    b. I looked forward to going to this class.
    c. The tasks required of me in this class were personally meaningful.
    d. I felt very competent in this class.
    e. This class was boring.
    f. The tasks required of me in this class were valuable to me.
    g. I possessed the necessary skills to perform successfully in this class.
    h. This course helped me achieve my career goals.
    i. I felt confident that I would be able to adequately perform my duties.
    j. The tasks required of me in this course were a waste of my time.
    k. This class was not important to me.
    l. I felt intimidated by what was required of me in this class.
    m. This class was interesting.
    n. I felt I would be unable to do the work in this class.
    o. I believed that I was capable of achieving my goals in this class.
    p. This class was exciting.

*4 Continued: Consider how often each of the following will be true for both the programming aspects of the class... : **Programming***

q. I had faith in my ability to do well in this class.
r. I lacked confidence in my ability to perform tasks in this class.
s. The information in this class was useful.

5. Consider how often each of the following will be true for both the programming aspects of the class... : **Engineering Topics**
   a. I had the qualifications to succeed in this class.
   b. I looked forward to going to this class.
   c. The tasks required of me in this class were personally meaningful.
   d. I felt very competent in this class.
   e. This class was boring.
   f. The tasks required of me in this class were valuable to me.
   g. I possessed the necessary skills to perform successfully in this class.
   h. This course helped me achieve my career goals.
   i. I felt confident that I would be able to adequately perform my duties.
   j. The tasks required of me in this course were a waste of my time.
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   p. This class was exciting.
   q. I had faith in my ability to do well in this class.
   r. I lacked confidence in my ability to perform tasks in this class.
   s. The information in this class was useful.

6. How important are each of the following factors to the quality of a / flipped class?
   a. Organization of content
   b. Personality of online lecturer
   c. Online teaching style of the online lecturer
   d. Frequency of tasks
   e. Ability to work problems at the same time as they appear in the video
   f. Ability to pause, speed-up, fast-forward, or repeat parts of the video
   g. Quality of TA support
   h. Having an actual instructor in the room for part of the time