Flipping Without the Cold Turkey

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Abstract

Flipping is an appealing method to engage students for meaningful and active learning. However, the work needed to generate the content the students will use outside the classroom and to coordinate the activities the students will do inside the classroom seems daunting. This paper provides ideas to reduce the start-up costs in time and energy, essential elements to include in the implementation of the flip, and instructor and student behaviors that may need adjusting for a more effective flipped experience. These helpful hints are based on the author's experience in flipping her sophomore-level chemical engineering required course for the first time last fall.

Introduction

My decision to flip was based on a disconnect between my reality and my vision for my sophomore-level chemical engineering required course. Students tended to sit passively in my lectures (sometimes) taking notes, but I wanted (and tried) to engage them in the course material through examples interspersed between the main concepts. I longed to interact with and help them on a one-on-one basis, but my office hours were only populated by the top few students in the class. I knew students struggled with the homework, but they turned to on-line solutions rather than the teaching assistant or me (resulting in more copying and less learning). In Fall 2012, I was invited to attend the Frontiers of Engineering Education (FOEE) symposium.[1] I learned about a new pedagogical technique: flipping. Through a reversal of when the course elements were delivered, flipping sounded like a great solution to the issues I was experiencing in my class. The students would gain the course concepts through 5-10 minute lecture recordings (podcasts or screencasts) viewed outside of class, and the class time would focus on small-group problem solving facilitated by an instructional team. With this method, I did not have to sacrifice course content in order to give the students direct experience and immediate feedback while they practiced the critical problem-solving skills for the course.

Working Smarter, Not Harder

When I began in earnest to plan for flipping my course, I had nightmares of being chained to a computer for the entire summer as I worked on developing podcasts and other materials for the students to acquire content outside of class. Thankfully, I took time to think about the materials to which I had access and to search for materials that others had already accumulated. There is no need to start from scratch and reinvent the wheel, so to speak! For content delivery, I realized that I already had a variety of modes at my disposal. First, I had recorded all my lectures from the Fall 2012 offering of the class using Panopto lecture capture. Thus, I could edit these files into smaller snippets and cut out announcements and other parts of the lecture that were time specific. I also had been teaching a web-based version of the course during spring and summer, so I had access to those web-course lessons.[2] Then, I began exploring my network: I was

participating in the FOEE Virtual Community of Practice (VCP), and I knew that there was a VCP based on the course I was teaching.[3] I contacted the Mass & Energy Balances VCP facilitator, and he directed me to a website where screencasts for the course had been developed and compiled through an NSF grant.[4] Counting the textbook, I had four modes of content delivery without spending an inordinate amount of time! Through the developers of the screencasts, I found a clearinghouse[5] of multiple-choice questions that I could use in quizzes to ensure that the students had reviewed the content outside of class. Another possible resource is the textbook publisher (sometimes they have question banks, PowerPoint presentations, etc. that accompany textbooks); however, they did not have any resources for my particular class/textbook. Professional societies (e.g., AIChE) and ASEE divisions (e.g., ChED) could provide further networking opportunities to gather needed materials.

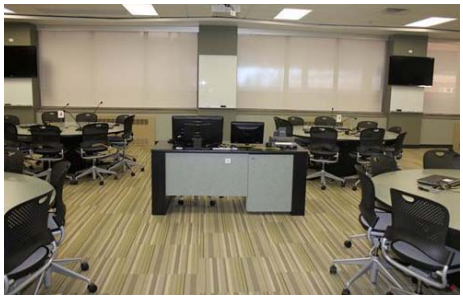

Figure 1. TILE space used for flipped courses at the University of Iowa.

I also had access to human and technical resources on my campus that could advance my flipping goal. The Center for Teaching[6] provides support for enhancing pedagogical skills. The director was helpful in connecting me to the network of faculty members on campus who were already flipping in their courses. The sita (Student Instructional Technology Assistance) program[7] provides support for various software programs available at the university, such as our course management system (ICON), web conferencing tools (Blackboard Collaborate), and lecture capture tools (Panapto and Camtasia). The sita consultants were especially helpful to me as I set up the automatically graded on-line quizzes for each class period. The TILE program[8] provides resources to design collaborative, interactive classroom settings and activities. The TILE Essentials program introduced me to the possibilities and capabilities of the TILE spaces, which come equipped with round tables, white boards around the room, and computers and projectors for each table (see Figure 1). The tables of nine can be broken into three groups of three, the computers can be used for group work on problems requiring work with Excel and other engineering software, and the whiteboards can be used for group problem-solving during class. Although the TILE spaces can facilitate team work in many aspects, a "traditional" classroom could be bent to similar purposes by providing desk pads for team problem solving or having students bring their own laptops to class.

In my case, many of the pieces to begin the flipping process fell into place quickly. It may take longer to assemble the needed materials. There is no reason why the flipping process cannot be more gradual (e.g., flipping portions of the course each semester). The materials could also be refined over time (e.g., starting with raw lecture captures and then editing them down to podcasts in subsequent years). Flipping does not need to be an all-or-nothing approach.

Implementing the Flip

One of the best pieces of advice that I received as I prepared to flip my course was to make the case for the flip with my students. Flipping is a big change, and the students will have some reservations, fears, and/or resistance to the change. I started the first class by having them look

at the classroom and describe what they saw that was different from a regular lecture hall (e.g., tables for nine instead of individual desks, no lectern, whiteboards around the perimeter of the room, etc.). Then, I explained what flipping is and why it would be beneficial to them in theory (according to pedagogical principles) and in practice (according to the feedback from previous students). Before the end of class, I asked them to respond to a "minute paper" with what excited them about flipping and what concerns they had. I went over these responses in the following class period (e.g., to the concern that "I will not be able to sleep in class," I responded "True, but now you'll really get your money's worth out of your tuition").

Tentative Schedule of Topics
MWF 12:30-1:20 PM, 134 TH

Date	Textbook[1]	Lecture Capture[2]	Screencasts[3]	Web Course Lessons[4]
8/26	Ch. 1	Introduction to ChE		1.9
8/28	§ 2.1-2.6	Sections 2.1-2.6	Engineering Calculations Unit conversions (7:17) Systems of units (9:21) Force and weight (6:20) Significant figures (5:47) Dimensional homogeneity (6:57) Dimensionless groups (4:26)	2; 3.1-3

Figure 2. Example of content delivery modes available for each class period.

One of the major benefits of a flipped class for the students is flexibility – flexibility in when and how they obtain the course content. In the initial class, I also spent some time helping the students assess their choices in my class (see Figure 2): (1) textbook, (2) lecture captures, (3) screencasts, and (4) web-course lessons. I encouraged them to make use of the textbook and at least one other mode of content delivery. I instructed them to sample all the modes to see which one(s) matched their learning styles best. For content that was more challenging, they should review one or more of the remaining modes. While reviewing for exams, they had multiple practice problems (with solutions) by accessing all four modes of delivery.

Humans need accountability, and a flipped class is no exception. The students are getting used to taking responsibility for their own learning, and some type of check is required to ensure they are not falling behind in reviewing the content needed for the in-class problem-solving activities. In my course, I have the students complete a graded, on-line quiz the morning before each class. (Another idea is to have a quiz at the beginning of class using clickers, raised hands, etc.) Each quiz has three parts: (1) a survey of what delivery mode(s) they used for the content that day, (2) several multiple choice questions that probe basic concepts from the content assignment, and (3) a "What was the muddiest point for you today?" question. I review the results to see if there are any particular concepts I need to address in class that afternoon, and I respond to each muddiest point individually in the on-line quiz feedback feature.

Team selections for both instructors and students are the next important pieces of the flipped class to put into place. It may take some experimentation to determine how many people are needed on the instructional team to help the students in the learning activities for a particular class. In my course last fall, I had 54 students, making 18 teams of 3, and the course activities focused on solving engineering problems. The instructional team of 3 (myself, a graduate teaching assistant, and a faculty volunteer) was generally sufficient to circulate the room and answer questions in a timely manner. When asked what improvement could be made to the class, the majority of students replied "having more instructors in the classroom." Thus, in the

next iteration this fall, we have added an undergraduate teaching assistant who is paid to help just during class time (i.e., 3 hours/week).

Structuring the teams smartly can help reduce the instructional team workload, increase student learning, and even out the pace of the teams in the class activities. I used a tiered strategy for my teams: each team had a student from the top third, middle third, and bottom third of the class. However, I never let the students know this basis was used for team assignments (I let them think it was a random basis). The class fractions could be calculated from student GPAs, performance on tests, etc. Just putting the students in these teams does not necessarily mean that they will function well together. I used techniques from Karl Smith's cooperative learning workshops[9] to ensure all team members were participating in the class exercises (e.g., assigning each member a task – reader, recorder, and idea coach – or randomly asking team members to answer questions). I also mixed up the teams throughout the semester (e.g., after each exam), so that the students got to know more of their peers and work with a variety of personalities.

There are many ways to structure class time in a flipped class. In general, I used the same pattern throughout the semester: (1) the students worked a simple problem individually at their seat as soon as they arrived (they could talk amongst themselves and/or ask the instructional team questions), (2) I presented a quick (5-10 minutes) overview of the main concepts for the day and how they connected to the learning objectives for the class, and (3) the students worked more advanced problem(s) in teams on the whiteboards while the instructional team monitored their progress. At the end of the class, I would review what content they needed to cover before coming to the next class, remind them to take the on-line quiz that corresponded to that content, clarify what team problems needed to be submitted on-line (that they might not have completed in class that day), assign any out-of-class homework problems, and/or instruct them to read and contemplate more complex problem statements that we would work on in the next class. I also followed up after class with the same information in an email to provide the students with a concrete checklist of my expectations (the students requested and appreciated this extra service).

Addressing Issues

The start of my flipping experiment was not without growing pains. At first, I was very uncomfortable not lecturing. Eventually I came to grips with the change in philosophy: my sense of worth as an instructor was not based on how well I demonstrated my understanding of the material in front of the class, but on what I most enjoyed—helping students experience the "Aha!" moment when *they* reached a true understanding of the material. I initially thought that the students could accomplish more than they really could in the 50-minute class period and expected to be able to get through more problems than was possible. After a few flipped class periods, I got a better sense for how much time problems would take so that I was not pushing the students at a frenetic pace. I also relaxed my expectation that all problems had to be solved in class and instead required the students finish and submit problems after class as needed. Finally, I had to become more adept at managing class activities. I "trained" the students to reconvene (e.g., when a timer went off or when I clapped my hands) when we needed to move on to the next activity or to point out a common pitfall I was seeing among the teams. The students also grew accustomed to the pattern of activities as the semester continued.

Likewise, the students had to adjust to the new learning style. One of the biggest hurdles was to be more disciplined in their time outside the classroom. They really do need to devote an hour or two out of class for every hour in class, and they can no longer wait until the night before to do all the homework. One student shared with me that, at first, they hated having to keep up with what was going on in class every day; however, their opinion positively changed once they realized that they no longer needed to cram for the exams. They also have to be proactive in asking questions in class from their peers and the instructional team instead of spinning their wheels on a problem for a while. Initially, I perceived that there was a (prideful) reluctance to show that they did not understand or were confused during class. After a rough first week of flipping, I admonished them to "Be HAP-I:" (1) be helpful in answering questions from their teammates and table mates, (2) be active in the problem-solving exercises – not wallflowers waiting for others in their team to answer the challenges, (3) be prepared for the coming class by reviewing the content and reading through the assigned problems, and (4) be inquisitive and ask as many questions as they need to gain a clear understanding of the material. After this pep talk, the flipped classes went much more smoothly, and both the students and I enjoyed our time together more fully.

Conclusions

Although flipping provides opportunities to engage students at a higher level of learning and activity in a classroom setting, it can take a lot of time and energy to revamp a lecture-based course, as well as to adjust instructor and student attitudes toward this pedagogical technique. The level of work can be reduced through: (1) using resources available on campus and throughout professional and educational networks and (2) avoiding and/or addressing common pitfalls during the implementation of the flip. The transition may be rocky at first, but course corrections along the way and in each subsequent iteration can lead to a more satisfying educational experience for all those involved.

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