

Design of large enrollment flipped introductory science courses

Discussion leaders: Dr. Matteo Broccio and Dr. David Nero, Physics and Astronomy

Dr. Broccio and Dr. Nero discussed the design of their flipped large enrollment introductory physics courses for which they have received a dB-SERC Course Transformation Award. Dr. Broccio's course is the first semester introductory physics course for life science majors and typical enrollment is over 200 students. Dr. Nero's course is the second semester introductory physics course for engineers and physics majors, and typical enrollment is 120 students. Both Dr. Nero and Dr. Broccio will implement their projects in the fall semester.

Dr. Nero has received a Course Transformation Award for the first semester introductory physics course which he implemented in fall 2014. The evaluation of the transformation effort was encouraging and therefore, the department chair allowed him to continue teaching using the flipped approach in the spring of 2015. Dr. Nero has previously discussed the design and evaluation of that course. For more information see:

[Planning and design of two flipped/Just-in-Time Teaching physics courses course via dB-SERC Course Transformation Award](#)

[Assessment of a large enrollment flipped introductory physics course](#)

Both Dr. Broccio and Dr. Nero will teach two sections, one flipped and one traditional in order to perform the assessment of the course and minimize confounding variables. For the flipped classes, students who enroll in them should know that the classes are not traditional – they will include a short description of the design of the course and the advisors in the engineering department (engineering students make up a majority of introductory physics students in the calculus-based classes) will also discuss this with incoming students.

Both courses will involve half of the face-to-face time students would get with the instructor in a traditional class:

- Students have to watch online lecture videos each week which can take up significant time. It is therefore unreasonable to expect students to do 50% more work than in a traditional class.
- The class is broken up in two groups and the instructor meets with each group half the time.
 - For example, if the class has 120 students and it's scheduled Tue-Thur, the instructor will meet with 60 students on Tue, and with the other 60 on Thursday.
- This approach has the benefit of reducing class size and making it more amenable to group activities.

Dr. Broccio

Framing the transformation

- Students enter natural science classes, especially introductory ones with certain expectations about how the class should be taught – typically they expect to sit passively while being lectured to.
- Thus, if the instructional strategies used are significantly different from traditional lecturing (as a flipped class is), the instructor should spend some time discussing with students what they should expect in the course and why the particular strategies being used have been chosen.
- Dr. Broccio plans to adapt an approach outlined in the following paper:
 - G. A. Smith, [First-Day Questions for the Learner-Centered Classroom](#), NTLF **17**(5) (2008).
- First class:
 - Dr. Broccio will begin by asking students the following question:
 - “Thinking of what you want to get out of your college education and this course, which of the following is most important to you?”
 - a) Acquiring information (facts, principles, concepts).
 - b) Learning how to use information in new situations.
 - c) Developing lifelong learning skills.
 - The majority of students will most likely select goals b and c.
 - There will be a discussion about all three goals and why each is important and stress that learning takes work. He will then ask students another question:
 - Of these three goals which do you think would be best achieved in class working with your classmates and me?
 - a) Acquiring information (facts, principles, concepts).
 - b) Learning how to use information in new situations.
 - c) Developing lifelong learning skills.
 - Students are likely to recognize that goals b and c will most likely require working with other people and getting feedback from the instructor.
 - After this, Dr. Broccio will discuss how the class is structured.

Course structure

- Pre-lecture: watch recorded lectures, answer online questions
- In class: group activities designed to help students grasp the concepts learned outside of class
- Post-class: homework designed to provide further practice
- Exams will be the same as in a traditional course.

Dr. Broccio discusses the benefits of the flipped class and why this approach works, and provides supporting evidence from an article published in science by Carl Wieman:

L. Deslauriers, E. Schelew, C. Wieman, [Improved learning in a Large-Enrollment Physics Class](#), Science **332**(6031), 862-864 (2011).

After this, Dr. Broccio discusses learning goals for the course.

- This is the first slide that students in the traditional lecture will see.

Lecture videos

- Since students do not necessarily know what the best approach is to learn from the videos, Dr. Broccio will first discuss in class what they should be doing and also post a video about it.
- Each lecture video is 5-10 min long

- Made using Active Presenter – a free software that can be used to capture and annotate anything on a computer screen.
- The platform used in the course for delivering the lecture videos to students is [my pitt video](#), which has many useful features.
 - For example, it can track how many minutes students spend watching the videos and send reminders to students who spend below a certain amount a week.
 - Students can comment at specific points in a video – can be used by instructor to identify points of confusion.
- Each video lecture ends with a question on which students get 2 attempts (100% if got correct on first attempt, partial for second)
 - These questions are designed to capture certain student

Pre-class online questions

- For each main learning objective covered in the online videos, there is an associated checkpoint question students answer before coming to class.
 - Students' answers to these questions provide feedback to the instructor about common difficulties which he can spend time addressing in class

In-class

- Dr. Broccio already knows that he will have 8 Undergraduate Teaching Assistants (UTAs) which he will utilize to facilitate in-class group activities.
 - The UTAs will be walking around, ensuring students stay on track, answering student questions, providing guidance to students where necessary
- Class will always start with review questions which are closely related to the online videos. If Dr. Broccio finds that a significant fraction of students are having difficulty with certain online pre-class questions, he will discuss those as well.
- Interactive lecture demonstrations
 - Dr. Broccio will use many of these throughout the course.
 - The instructor presents a particular experimental setup and what he/she will do.
 - Students are asked to predict what will happen and why (in groups).
 - Students submit their predictions via clickers
 - The instructor does the experiment and the outcome is explained.
 - Students are asked to discuss the outcome with peers and make sense of why it occurred.
 - The instructor then guides an in-class discussion to help students recognize the relevant physics principles and how to make sense of the outcome.

Out-of-class

- Recitations:
 - Students will be working on group activities in groups of 3-4.
 - The activities typically involve problem solving and are guided via worksheets.
 - While students are working on them, the UTAs are walking around facilitating group work and clearing up points of confusion.
- In addition to homework, students will have to complete weekly computer explorations.
- These are simulations in which students can change various parameters and observe the outcome of an experiment. They are similar to hands-on exploration activities students are sometimes asked to complete in the Physics Exploration Center (PEC), except they are online.

Dr. Nero

Dr. Nero's approach is similar to the approach he has used in the past (which he discussed in previous dB-SERC lunches, see the beginning of the document), which is also similar to Dr. Broccio's approach.

A few differences:

- For the lecture videos, Dr. Nero starts with a blank powerpoint on which he annotates with a pen.
- His past experience with this approach is that students like it because they can follow along.
- He uses Ink2Go which is a \$20 software that can be used to annotate any screen capture.
- The platform he uses is Classroom Salon (free).
 - Students can post both anonymously or use their names. In the past, Dr. Nero has found that nearly all students use their names.
 - A question was asked regarding transcripts: are they available on the platforms you are using?
 - While the platforms are my pitt video and Classroom Salon, the videos themselves are hosted on youtube, and youtube does provide an automatic transcript, which is decent (if the person talking does not have a strong accent).
- Regarding student commenting on videos – this is certainly desirable, but it doesn't seem to be a good idea to force students (via grades) to post a comment each week – many students will comment things like “this was a good video” at the end of the video.