

## Project Year

2016-2017

## Project Title

Videos and Clickers to Flip the ChemBE Gateway Course

## Project Team

Jeff Gray, Whiting School of Engineering, Chemical and Biomolecular Engineering, Faculty  
Nicolas Perez Gonzalez, Whiting School of Engineering, Chemical and Biomolecular Engineering, Fellow

## Audience

The audience for this project are the students taking *Introduction to Chemical and Biomolecular Process Analysis* in Chemical and Biomolecular Engineering (ChemBE). This course is the “gateway” course for ChemBE, so is composed of mostly sophomores and freshmen. The estimated enrollment is 60-70 students.

## Pedagogical Challenge

We have been working towards making the ChemBE curriculum more attractive for potential students. In a changing world, staying still with old guide books and manuals is no longer acceptable. Given that this class is the ChemBE gateway course, we put extra effort to show students a broad range of potential applications in which they could develop themselves. At the same time, we explain the complex concepts associated with process analysis. We use a relatively new textbook ([Introduction to Chemical Processes: Principles, Analysis, Synthesis](#) by Regina Murphy) that has few resources for active learning or flipped classrooms. Available resources in chemical engineering (e.g., LearnChemE.com) are restricted to the legacy textbooks and limited to traditional petrochemical applications. It remains challenging to teach when little interactive material covering current topics of chemical engineering (biotech and nanotech) is available.

## Solution

We will create resources toward a dynamic flipped classroom. This will involve (1) editing videos recorded from past classes and (2) adding multiple iClicker questions per class to improve the interactive quality of this course and the experience of our students.

We hope to improve academic performance by focusing on the students and their learning process rather than focusing on covering all topics. A flipped classroom model will allow us to more rapidly identify misconceptions and speak to the needs of the students. We believe that generating more group activities within the classroom will allow students to create a community in the department of Chemical and Biomolecular Engineering.

## Assessment Strategy

We will assess the impact of the new material by comparing performance throughout the semester with the previous semester. In addition, we will survey students to get first-hand information about their perception of the flipped classroom and the iClicker questions. We will work with CER to develop further pedagogical measures.

## Faculty Proposal

The pedagogical challenge we are having with this introductory class in Chemical and Biomolecular Engineering is in teaching the key concepts to our students in appropriate and effective ways. This course is the first interaction students have with the field and therefore it plays a crucial role for students when choosing their concentration. We believe that the right first experience would encourage students from all backgrounds to pursue ChemBE.

Currently, for a class of roughly 70 students we have four TAs. One of these TAs is a graduate student and the other three are undergraduate students. The class is divided into several sections. Each student attends 3 weekly lectures and 1 PILOT session (which has approximately 12 students). PILOT sessions have been shown to be an important piece of support for students given that they practice the material and interact in small groups to tackle problems. In PILOT, the TA guides the small groups through the questions without directly giving answers. Every week, the subgroups are switched so the students get to know everyone in the PILOT sessions. This approach also creates the foundation for a long-term community for ChemBE students.

I plan to flip the classroom for this introductory course, using the lecture time to briefly review concepts and spending more time discussing concepts through problems. I have some experience using iClicker questions in individual lectures, and it has been useful for me to identify when the students do or do not understand the material. I would like the students to apply key concepts and guide them during the class instead of covering the material. I will use Nicolas' assistance to organize material for online lectures (taped in 2014), create new videos when needed, and generate new material such as iClicker questions and solved problems relevant for current industries. I want to create a stronger framework to encourage independent study and teamwork during class.

In order to proceed, I will be structuring the material for this new dynamic by introducing time for problem solving and for discussion of concepts where I would use iClicker questions. In parallel, Nicolas will be focused in providing the extra material needed for the lecture time.

To measure the impact of flipping the classroom we will compare performance of students from this semester to the previous semester and will survey students. I will work with CER on assessment.

Finally, once the work has done editing online classes and creating new questions, this material will be used each year in future versions of this introductory course.