

Final Report: 2015-2016 Teaching Innovation Grant in Flipped Course Development

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Fall 2016

Dr. Caryn Outten and Dr. F. Wayne Outten were awarded a Teaching Innovation Grant (\$7500) to develop flipped courses for the 2015-2016 academic year.

The goals of this project were:

1. To convert approximately $\frac{1}{2}$ of the CHEM 555 / BIOL 545 course into a flipped classroom format to facilitate active learning and student engagement. (taught by Dr. F. Wayne Outten)
2. To develop a new medical biochemistry elective course (CHEM 639 / BIOL 599) using the flipped classroom format to teach high level analysis of biomedical case studies. (taught by Dr. Caryn Outten)

Goal 1: Dr. F. W. Outten utilized many of the insights gained from the CTE flipped learning workshops to design and record condensed video lectures for 14 of the 27 total lecture periods in CHEM 555 / BIOL 545. Students were required to watch these 15-minute videos prior to attending the class period on that topic. Online quizzes administered through Blackboard were used to assure pre-class preparation by the students. Class time for these 14 lecture periods was then “flipped” and used to conduct a variety of active learning assignments. In the most common approach, students were randomly assigned to groups and worked together as a group on detailed case studies that applied the general concepts learned in the condensed video lectures. The course professor Dr. F. W. Outten monitored group discussions and answered clarification questions during this time (approximately $\frac{1}{2}$ of the class time). After this exercise the professor then opened the case study discussion to the entire class and began to work through the solutions using PowerPoint or white board resources. Each group was required to present their solution to a portion of the case study, followed by class-wide discussion of the solution including any alternate solutions. The professor guided this discussion to lead the class to the correct solution or (in some cases) to an appreciation that multiple answers may be correct for complex problems. A typical case study was 3-4 pages in length with 8-10 individual questions to be answered by extrapolating and interpreting the given information. Traditional lectures in the remaining 13 class periods were not able to be flipped with the resources of this grant but those lectures were augmented with i>clicker student response questions that could be used by the students for extra credit. Semester exam preparation was conducted by having students develop their own multiple choice questions using the PeerWise online course assessment tool. PeerWise question development also requires students to provide detailed explanations for why individual choices are correct or incorrect. The professor and other students then evaluated the total question bank, providing online suggestions for improving or correcting questions. Finally, each group in the course developed a Group Wiki page using the CampusPack tool on Blackboard. Group Wiki’s were focused on individual genetic diseases of metabolism, with a heavy focus on interpreting how genetic mutations lead to disruption of normal protein structure-function, which then leads to downstream perturbation of the metabolic pathways that utilize the mutated protein. Each group presented a 15-minute overview of their Wiki highlights over the last two class periods, followed by a question-answer period with other students and the professor.

Goal 1 Assessment: A true quantitative assessment was not possible due to the lack of a matched non-flipped course taught simultaneously by the same professor for comparison. However, Dr. F. W. Outten was able to use a combination of personal observations, comparisons of the current flipped format to student performance from the old lecture-style course, and student evaluations to provide a qualitative assessment of the new format. Based on previous class averages, the two recent classes taught using the flipped format performed 5-10 points higher than those taught with completely traditional lecture format. Exams used for each format were roughly equivalent (if anything the flipped format exams were more difficult due to the expansion of a short answer/essay section of the exam). In addition students largely indicated greater satisfaction with the flipped format. Some representative comments are shown below (verbatim) from course evaluations of the Fall, 2015 and Spring, 2016 semesters:

“I really really really liked the switched classroom. I thought that it really helped me learn the information and apply it in a way that was beyond just memorization. I also liked that you could watch the videos more than once.”

“Also, at first I wasn't a huge fan of the flipped classroom thing (a 15 minute video takes much longer than 15 minutes to watch and take notes on) but after posting the video transcripts I actually enjoyed it a lot. Using class time to apply information is extremely useful.”

“I LOVED (and truly benefited from) the flipped classroom style of learning at the start of the class. I felt like I was able to keep up with the material, and it really helped in preparing for the essay questions on the exam.”

Goal 2: After participating in several CTE flipped learning workshops and discussing best practices, pitfalls, successes, and challenges with the other flipped grant award recipients, Dr. C. Outten used this training to build a new, upper-level biochemistry course (Chem 639/Biol 599) designed for students interested in a career in the health sciences. This course was implemented first in Fall 2015 and again in Fall 2016 (and renamed Chem 655/Biol 599). In order to employ the flipped classroom format, she recorded 21 lecture videos (10-20 minutes) that explained various metabolic pathways in the human body. For these videos, Dr. Outten prepared Powerpoint slides by modifying and simplifying slides from a Medical School course she taught previously, and narrated each slide from a pre-written script. To ensure that students watched the videos prior to class, she posted short quizzes or brief writing assignments on Blackboard on the basic information provided in the video. Classroom time was then devoted to working through clinical cases directly related to the lecture video. For some lessons, the class worked through cases together, using clickers to pose questions that probed their understanding and helped lead them to the patient's diagnosis. For other lessons, students were divided into small groups of 3-4 to discuss and solve a clinical case study provided as a handout. The final assignment for the course was for each group to develop their own disease case study of their choice that was prepared and presented as a group wiki, providing an on-line workspace for collaboration between group members.

Developing and implementing this new course turned out to be a significant amount of work for the instructor, but the outcome was very satisfying as the students remained engaged and very

enthusiastic about the course material. The most time-consuming aspect of the course was developing material for the active learning sessions in the classroom. For five of the twenty-one lessons, Dr. Outten used case studies downloaded from the National Center for Case Study Teaching in Science collection (sciencecases.lib.buffalo.edu). In general, many of these available cases were intended for introductory biology or biochemistry course. Therefore, these cases were usually modified by Dr. Outten to make them more challenging for an upper-level biochemistry course. The other sixteen active learning sessions were developed by the instructor by gleaning clinical cases from four different medical biochemistry textbooks. Dr. Outten enhanced these cases with images, patient histories, clinical test results, and 10-20 clicker questions each lesson to gauge the students' understanding and guide them to the disease diagnosis.

Goal 2 Assessment: Since this was a newly designed course, there was no previous non-flipped version for comparison in order to assess the impact of this new format. Instead, questionnaires were deployed in the first third and last third of the semester both in the first iteration and second iteration of this course to solicit feedback from the students about the new course design. It was clear from these questionnaires that the majority of students greatly enjoyed applying what they learned to solving clinical, real-world cases. However, in the first iteration, several students commented that the instructor spoke too quickly in the videos, so the instructor slowed down her speaking pace for the rest of the videos that semester. Some videos were also longer than 20 minutes in the first iteration of the course, so all the videos were rerecorded in the second iteration to ensure that the pace was not too fast and each video was less than 20 minutes.

The first time this course was offered in the Fall 2015, Dr. C. Outten received outstanding reviews with an "Instructor Overall" rating of 4.86 out of 5 (Dept. avg. = 4.5) and a "Course Evaluation" rating of 4.68 out of 5 (Dept avg. = 4.45). The following excerpts from these course evaluations illustrate the students' strong enthusiasm for and appreciation of the flipped course format:

"I think the flipped classroom is so engaging because the set up forces you to apply what you learn. I felt comfortable asking questions and taking part in discussions. It was an incredibly positive learning environment."

"It was great to finally learn about some medicine and diseases. I genuinely believe this class will be a great prep class for med school. This has been probably my most enjoyable class of my college career."

"This course was interesting and challenging but I have learned more in this course than all other courses combined this semester. The flipped classroom set up is a great way to learn information and apply it."

Two former students who are currently in medical school also sent unsolicited emails to the instructor this fall highlighting the impact of this course on their current studies:

"I am currently in medical school and would be completely lost had I not learned the majority of this information from your class!"

"I just wanted to let you know how immensely helpful your class was in preparing me for medical school. I am so thankful to have taken that class."