Upside Down, Inside Out

FLIPPING THE CLASSROOM—A NEW TREND IN EDUCATION
Calculus I. Those of us who weren’t required to take it probably didn’t. Many engineering, chemistry, biology, math, and health sciences majors, however, find themselves in a calculus class fairly early in their college careers.

Just as industry is always looking to build a better mousetrap, educators are constantly evaluating their teaching methods and looking to improve the results. Members of the Department of Mathematics in the University of Hartford’s College of Arts and Sciences are no exception.

In fact, this group of innovative and dedicated faculty is working on the frontier of mathematics education. In March 2012 the department received recognition for the teaching of calculus from the Mathematical Association of America (MAA). In a survey of 900 undergraduate Calculus I courses nationwide, the MAA identified the University’s department, chaired by Professor John Williams, as one of the 17 most successful in the United States.

Innovation is nothing new for the University’s mathematics department, with its long history of pioneering new teaching strategies and integrating technology, its goal to enhance student success in the classroom.

“Well ahead of the rest of the country, our department piloted the use of computer labs in the mathematics classroom in the 1980s, the graphing calculator in the early 1990s, interactive online homework systems in the mid-1990s, and student response systems [clickers] in the mid-2000s,” says Mako Haruta, associate professor of mathematics.

Clickers, which work something like a TV remote, allow students to answer questions in a video. The idea is to get students engaged in answering questions and class discussion by incorporating an appealing technology. Students also work with computer algebra software, virtual graphing calculators, and e-textbooks.

In traditional math classes, college students sit in large lecture halls for many of their classes. The professors/experts talk and the students listen, participating in what educators call “passive learning.” They scribble down notes that they hope will help them sort things out later.

Outside of class, they do readings and review their notes. If they have questions, they may try to puzzle things out with a classmate. Asking questions in class can be embarrassing. Actually talking to a professor during office hours is a last resort.

In 2011 Jean McGivney-Burelle—associate professor of mathematics, director of the secondary mathematics program, and chair of the Department of Education in the College of Education, Nursing and Health Professions—learned about a new teaching method.

The new method is called “flipping/inverting the classroom,” and research is still in progress on which students benefit more from this method. In this new model, the lecture and homework elements are reversed. Outside of class, students viewed video lectures made by their mathematics professors before each session that replaced the professor’s in-class lectures. Class time transformed into a workshop where students analyzed data and solved problems together.

An internal grant from the University allowed the department to set up two classrooms designed to facilitate the new method. Students sit in small groups at multiple tables around the room. The professor moves from table to table answering questions and assessing whether students are grasping the material. If not, the professor stops the discussion and gives a brief explanation to the entire class.

Larissa Schroeder, assistant professor, says the fact that the department has a collaborative approach to new endeavors is what makes it all work.

In spring 2012 a core group of six faculty—Williams, McGivney-Burelle, Haruta, Schroeder, and Associate Professors Benedict Pollina and Fei Xue—applied for a National Science Foundation (NSF) grant, “Flipping Calculus,” which they received in spring 2013. The grant provided $172,136 to be used for expanding the department’s library of course material, preparing more faculty in the department to use this approach, and assessing the method’s effectiveness. The grant ends in 2015.

In general, student responses to the flipped classroom have been positive. Their comments indicate they felt less stressed were more comfortable, and that it is easier to learn, especially since they can rewatch the preclass lectures. These comments are from the evaluation forms that students filled out at the end of the course:

“I like that you can see what you will be learning ahead of time rather than just getting to class and trying to understand what the instructor is teaching.”

“I think watching the videos made me a better student, too . . . . It made me more aware of how much effort I put into my school work . . . . When you get into the real world . . . . you are not going to have someone holding [your] hand, teaching you how to do things, you are going to have to learn for yourself . . . . Those are really good skills you are developing for us.”

The department is also enthusiastic about the new model. Says McGivney-Burelle, “It’s already hard for me to think about returning to my former teaching methods.”

In the spring 2012 semester, Xue compared the results from flipping a portion of one of his Calculus II sections with one section that he taught exclusively in a traditional manner. He was looking for improvement in grades and in student engagement with the subject matter.

“The students did better on the finals and spent more time outside of class thinking about math on a deeper level,” says Xue, known as “Professor X” to his students.

This fall, the department is comparing sections of Calculus I that are flipped to sections that are not. Because there is a common final examination, they hope to get a clearer picture of whether flipping makes a substantial difference in learning.

Although flipping began in the sciences, technology, engineering, and mathematics disciplines, other areas, like the humanities and social sciences, are taking a look at this new approach.

After the math department received the NSF grant, the University applied for and received a $222,958 grant from the Davis Educational Foundation, established by Stanton Davis, the former chair of Shaw’s Supermarkets, Inc., and his wife, Elizabeth Davis.

“These funds will be used over the next three years to investigate how flipping can be done in other subjects such as psychology, English, or political science,” says H. Frederick Sweitzer, associate provost and dean of graduate studies.

“How does it work and how well does it work in an introductory literature course? We are trying that out this semester to find out. In general, what we are hoping to see is deeper learning, where students are engaged with the subject and the process of learning and carry their learning with them into future courses and experiences.”