Innovative teaching

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Innovative teaching method improves learning

Gilbert Baladi, professor of civil and environmental engineering, and Ronald Rosenberg, College of Engineering associate dean emeritus, have teamed up to improve student learning in CE 221 – Statics.

CE 221, one of the first technical classes taken by engineering students, is notorious for being difficult for the majority of students. Most of students in the course—which is required for several majors—are sophomores.

“It’s not an easy course,” admitted Baladi, who has taught the class for seven years.

Over the past seven years, annual enrollment has grown from about 400 to more than 700. During that time, the course has been progressively moving from traditional teaching methods to online content.

During fall semester 2015, the course is being taught for the first time as a partially “flipped” class; rather than going to class three times a week, students will attend class twice a week and complete work online once a week. By fall 2016, the aim is to have one session in class and two online.

“Data from the past seven years has indicated that student learning has been enhanced tremendously,” Baladi said. “The average on the tests is higher and the average on the homework is higher.”

Specifically, fall semester 2013, the average score on the first exam was 76; in fall 2014, the average jumped to 91. The final exam score was much higher, and the overall semester score was much higher—with an increased number of students receiving a 4.0.
“One of the reasons we went in this direction was the price of the textbook we were using. When it hit $300, we said, ‘that's enough,’” Baladi said. The textbook has been replaced by a $99 course pack and online material.

Statistics across fields and across universities show that when a textbook is required, especially in a large-enrollment course, only about 30 percent of students buy the book. This spring, out of 264 students enrolled in CE 221, all of them bought the course pack.

“This is tremendous, because it means the students are actually getting the material you want them to have,” Rosenberg said.

The course is composed of three major parts—lectures with illustration and extensive examples (which students can view as a PowerPoint slideshow or as a video), practice problems worked out step-by-step online as well as with only the answers, and an active problem pool for homework assignments. “And we are seeing the benefits of this,” Baladi added.

“This semester, we added the homework component online,” said Baladi. “We opened the second homework on Wednesday, and by Friday more than 70 students had done the homework. Typically they wait until the last minute to complete homework assignments!”

Online, a student can attempt a specific homework problem three times; he or she immediately receives feedback on
whether the answer is right or wrong. After the third incorrect attempt, the correct answer is given. The student can then re-click the same problem and try again with a new set of values.

“For some students, it may take five attempts to get it right, whereas another student may get it right on the first try. And that’s okay, as long as the student is willing to learn,” Baladi said.

“I believe this immediate feedback helps a student guide himself or herself toward learning,” Rosenberg said.

“Last spring, when we tested the “active problem” pool with about 270 students, statistics showed that student performance was significantly higher. That gave us a lot of incentive to continue to refine and improve what we’re doing,” Rosenberg said.

“We can analyze our data in two ways. We can determine the weak spots and strengths of an individual student, and we can pinpoint areas of the material where, collectively, student performance is not so strong. We can then put more resources into figuring out what we need to do better, or more thoroughly, in a specific area,” Rosenberg continued.

“An advantage with putting homework online is we can spot exactly which students are having trouble. We can spot it early, we can talk to them about what they did and didn’t try to do. We can shift the responsibility for their learning to them; we point out all of the resources available to them,” Rosenberg said.

“We regard this course as a ‘leader’ course in looking at ways to do these things. Our long-term goal is to teach the computer to handle more complex problems; and over time, I think we’ll be able to do that.”

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