Improved student learning

It's a given: Instructors teach because they are interested in student learning. One of the biggest wins for these PIs were the documented increases in student learning in their courses, measured by test scores as well as the ability to give more difficult assessments and still see students succeed.

Greg Story, associate professor of physics, set out to improve student learning by eliminating easy access for students to online solutions for homework problems. He did that by designing a database of new homework problems in conjunction with a group of undergraduate students who had already taken his class. During the semester with the new problems, he saw significant improvement of the students' test scores in comparison to their homework scores compared to previous semesters.
"Over time, I have actually made the tests harder, because otherwise I would be giving huge numbers of A's," he said. "They are clearly learning more."
Additionally, he feels that the undergraduate student workers who helped him showed "incredible improvement" in their thinking and talking about physics from when they started designing problems until the end of the semester.

Ana Ichim, assistant professor of economics, and Sarah Steelman, assistant teaching professor of economics, measured student performance on exams of those who participated in the game project intervention against those who did not. Those who participated performed better on exams by one-half a letter grade on average. The estimated effect was statistically significant across the board, but slightly larger for the lowest quartile of students, meaning that low-performing students benefited more, on average, from the peer learning.

Beth Cudney, associate professor of engineering management and systems engineering, was able to design increasingly harder exams and yet students scored 8-10 points higher on these tests in her redesigned course. The more difficult exams focused on application questions rather than regurgitation of information or simply solving an equation. Cudney also observed the students' selection and use of statistical tools for semester projects at a more appropriate and higher level than she had seen previously.

Fiona Nah, professor of business and information technology, assessed student achievement in the redesigned course by examining common exam questions in the semester previous to the redesign and during the redesign. Of the 12 common questions, chi-square tests showed that 33 percent of students had significant improvements (i.e., $p < 0.05$) in the redesign semester. Her conclusion was that blended learning offered by the redesign helped to achieve improved learning.

Jossalyn Larson, assistant teaching professor of English, saw an increase of almost 8 points for the average final grade in her redesigned course compared to previous semesters. She also noted that the standard deviation in grades went down dramatically, indicating to her that students were experiencing similar gains in learning, and fewer students were left behind.

Nishant Kumar, associate teaching professor of mechanical engineering, began noticing how the concept problems he developed for homework helped the students on their midterm and final exams, their FE exams and their senior exit exams. "It definitely has made a difference," he said. "The concept problems really helped them a lot on FE exams."

After his initial redesign, Xiaoming He, assistant professor of mathematics, taught the course again collaboratively with a University of Missouri-Columbia professor to distance students as well as students on campus in a course sharing project. "The students said they learned a lot. Most students were able to grasp the concepts to get an A," said He. "Through teaching evaluations, (we learned) students realized they learned a lot and expressed their appreciation," He said.

Yinfa Ma, Curators' Teaching Professor, notes the more active learning component of his redesigned class as well as the additional skills students are learning. "Teaching was mostly one way before," he said. Now, "the discussion is exploding. Students learn so much more. They learned to quantify data, give oral and written reports. Students became part of the teaching process themselves. Actually they teach me! They go to the board, they present their data and tell me how they solved their problem. It also increased their writing skills; they had to write a publishable paper. They do a lot of work but they love it!"