



ENGINEERING + MATH = 3 Rs

Recognizing mathematics as “an essential language and toolkit” for engineers, the colleges of Engineering and Liberal Arts and Sciences are collaborating to transform the way calculus is taught.

“Our objectives include what we call the ‘Three Rs’—retention of students, retention of material, and relevance to engineering. We want to think of engineering and physics problems as opportunities to provide context to the mathematics,” said Harry Dankowicz, engineering faculty coordinator for the CoE/LAS Calculus Project initiated in 2005.

Reflecting on the objectives, Umberto Ravaoli, senior assistant dean for undergraduate engineering programs, noted, “Although most of our first-year students have successfully navigated high-school calculus, many are unable

to apply what they have learned outside of a narrow range of problems.

“Math faculty still provide all of the lectures,” he said. “The discussion sections/labs form the soul of our course that was inspired by the findings of our Physics Education Research Group, and by a large body of research that documents the numerous benefits produced by the active engagement of students in STEM courses.”

During twice-weekly active-learning sections and labs, students use worksheets, designed cooperatively by math and engineering faculty, that present applications of the week’s material. Graduate teaching assistants from both math and engineering guide the group-work labs.

Dankowicz and another engineering faculty member regularly visit discussion sections as “super TAs,” assisting students

and the TAs. Thirty-eight sections per week reach about 500 students.

Following a visit to Illinois, Richard Felder, co-director of the ASEE National Effective Teaching Institute, took special note of the initiative. “For more than four decades, I’ve heard engineering professors complain about how poorly prepared in math their students are,” Felder said. “They can do the basic math operations, but most of them have no idea how to apply their math knowledge to science and engineering problems.

“That is why I was so pleased to hear about this project, where you have engineering and math faculty members doing what my colleagues have insisted all these years couldn’t be done: actually talking to each other and working together to develop and incorporate engineering problems into the calculus course. If it succeeds, it could be revolutionary.”