UC Engineering STEM Education for the 21st Century

By: Desiré Bennett

Through several initiatives including dual enrollment programs, minority participation alliances, and programs specifically targeted to spark and promote interest in math and science, UC is leading the way in STEM education.

The University of Cincinnati prides itself on being a premier, public, urban research university dedicated to superior education, experience-based learning, and research with a commitment to excellence and diversity.

UC is also committed to supporting the growth and quality of STEM (Science, Technology, Engineering and Mathematics) education by connecting students, teachers, and administrators to each other and to resources through innovative programs.

The University’s implementation of and participation in projects such as the Ohio LSAMP Alliance, the dual-enrollment engineering course, and the CEEMS program shine a light on UC’s role as a proven leader in STEM education.

INCREASING UNDERREPRESENTED UNDERGRADUATES IN STEM FIELDS

UC will share a $3.5 million National Science Foundation grant to help increase underrepresented student graduates in STEM disciplines. The grant, awarded through the LSAMP (Louis Stokes Alliances for Minority Participation) Program, establishes an alliance that will work to double the number of bachelor’s degrees completed in STEM fields at partner institutions within five years.

Alliance-wide activities will include:

- Innovative curricular reforms in mathematics
- An interactive web site
- Shared online courses and workshops
- Diversity sensitivity training
- A research conference.
As part of involvement in the program UC will provide:

- Advisement and counseling
- Residential summer bridge programs
- Paid undergraduate research opportunities
- Mentoring, tutoring, and supplemental instruction

The UC implementation team consists of staff and faculty from CEAS, A&S, and Allied Health, with Ken Simonson serving as the UC campus director for the team.

According to Simonson, UC's sub-award is over $242,000 spread out over five years. All funds, except for a small amount for student travel, will go to students in the form of tuition scholarships as a strategy to recruit them to a UC bridge program, one of which is the Summer Bridge Scholars program.

“The alliance partners agreed that the majority of campuses would use their sub-award as stipends and or scholarships to attract students to their bridge programs and or other academic support initiatives,” said Simonson. “Most campuses have academic infrastructure in place and therefore we limited funding for programmatic and administrative areas. There were some campuses who may have received a few more funds because of their lack of existing academic infrastructure.”

The Ohio alliance includes seven four-year institutions and four community colleges. The alliance will also collaborate with community partners, an industry advisory board and other programs supported by the National Science Foundation.

**SOLVING THE STEM SHORTAGE WITH FLIPPED INSTRUCTION AND DUAL ENROLLMENT**

In an effort to solve the STEM shortage and to give high school students a head start in college STEM studies, the University of Cincinnati is offering a new dual enrollment program. The dual enrollment program was created to generate interest in engineering courses from high school students including women and minorities. Dual enrollment provides high school graduates with UC college credit for courses taken during their high school experience.
In the program students complete their first level of college engineering courses before ever stepping foot on UC’s campus. More than 520 students from 12 area schools, including four all-girls schools, are participating in this innovative program which offers first level college courses in high school. Ten schools are offering the program’s courses as dual enrollment, meaning students receive both high school and college credit.

“We saw an opportunity to provide content in a way that was engaging and accessible,” said Eugene Rutz, College of Engineering and Applied Sciences (CEAS) academic director. “By using video to record small lectures of our faculty and staff on engineering topics such as ‘What is engineering?’ ‘What is the engineering design process?’ We can make these available to the students and schools at their convenience, as often as they want.”

Using a flipped classroom model, UC delivers online lectures to the high school students who view lectures by CEAS faculty via webcasts at their convenience. Classroom time is led by high school teachers who lead engineering-based project activities and discussions on how the lessons will apply to their lives and careers.

On Tuesday Oct. 22, 2103, Rutz and Gretchen Kellerstrass, a mechanical engineering technology freshman who participated in the dual enrollment course while in high school, will lead a free live webinar to discuss the aspects of the program delivering from their two distinct perspectives.

**EQUIPPING TRI-STATE TEACHERS WITH TOOLS TO IMPACT STEM EDUCATION**

The College of Engineering and Applied Science is leading an interdisciplinary effort which reaches far beyond the boundaries of the university’s campus.

That effort, the Cincinnati Engineering Enhanced Mathematics and Science Program (CEEMS), aims to elevate STEM education by building a collaborative, sustainable, education licensure and degree-granting infrastructure throughout the tri-state.

The [CEEMS program](#), which is spearheaded by Prof. Anant Kukreti who directs management and design of the CEEMS effort and serves as Principal Investigator on the project, was designed to address and meet the growing demand for engineering-educated teachers with a goal of equipping teachers with the skills needed to provide students with opportunities to reach and surpass Ohio New Learning Standards for Science, Common Core Math Standards and the Next Generation Science Standards in addition to providing students with...
a universal skill set.

The program is led by the University of Cincinnati in partnership with 14 school districts and is an interdisciplinary effort which includes A&S and CECH in addition to CEAS.

Now in its second year, the CEEMS program is shaping up to have a promising future. In 2011 the National Science Foundation (NSF) awarded CEEMS a $9.2 million grant for five years. Teachers are now beginning to implement units (learned via the CEEMS Summer Institute) in their classrooms.

On a recent fieldtrip to the CEAS Rapid Prototyping Lab, located on UC’s Victory Parkway Campus, Winton Woods assistant principal Craig Filipkowski talked about the importance of the high school’s participation in the CEEMS program.

“One of the struggles that educators have had traditionally within mathematics in particular is trying to make it relevant to the student. The project-based learning gives students a final product, gives the student a hands-on experience that they can relate to, and you can kind of see that relationship in that with the math,” he said. “Coming out here [to UC’s campus] on these kinds of fieldtrips puts everything into perspective.”

Sam Antoline, Mechanical and Materials Engineering adjunct faculty member and head of the CEAS Rapid Prototyping Lab, says the these types of campus visits facilitated through the CEEMS program are invaluable. “Students may not think they’re paying attention right now but somewhere in their subconscious these things are registering. And eventually as they get toward the end of their high school career, they’re going to choose a path – and if this sticks and it’s a fit for someone then it’s worth all of the effort.”

Winton Woods high school geometry teacher, Katie Powers, recently began implementing challenged-based learning in her classroom. “Doing challenged-based learning is a new style of learning for my students so some of the students had a really hard time being creative and coming up with ideas because they’re never asked to do that type of thing in a math class,” she said. “So part of the learning was learning how to work with a team. Overall they learned how to come together to present and to come up with their final product.”

Powers says that she will continue to work with her students to promote challenged-based learning throughout the school year.
CEEMS is funded by the National Science Foundation, grant #1102990 and is in its second year. Upon its conclusion, more than 1500 teachers and 30,000 students will have benefited directly from their participation and experienced centered instruction.

UC efforts in collaboration with collegiate, secondary and primary school partners are bringing an entire generation of tri-state students into an educational awareness of the STEM disciplines and the careers that await them in engineering and technology.