Crossing the Bridge to STEM Success

Some students may be potential candidates to pursue advanced studies and careers in science, technology, engineering, and mathematics (STEM) fields, but may face a few roadblocks, such as a disadvantaged background, inadequate study skills, or lack of knowledge about STEM careers. A summer bridge program can help these students overcome those obstacles to STEM success.

One such program is University of Cincinnati’s Emerging Ethnic Engineering (E³) Summer Bridge Program. E³ Summer Bridge not only aims to prepare incoming freshmen from historically underrepresented ethnic populations for engineering studies, it also helps them realize “they’re each other’s best resource,” says Kenneth Simonson, director of academics for the E³ Program. Collaborative learning is a key element of the seven-week residential program: Students work in four- to five-member heterogeneous groups throughout, an arrangement that fosters peer support and prepares them for their freshman and sophomore science and math classes, he explains.

Support for bridge students starts during the mandatory orientation session, when faculty and staff outline the program’s objectives to students and parents. In a separate meeting, parents receive an academic success plan detailing expectations for students during their five years in the E³ program.

E³ Summer Bridge students experience the workload and pace of college courses by taking calculus or pre-calculus, chemistry, English, and physics during the day, Monday through Thursday, and attending two-hour study sessions in the early evening, with current E³ students available to answer questions and facilitate collaboration. Bridge students who pass English during the summer receive advance standing for English 101 in the fall.

On Fridays, bridge students take field trips to area companies like General Electric Aircraft Engines Jet Engine Training Center, where they meet former E³ students working there and receive “an early introduction” to a potential cooperative education employer—one for whom they can work full- or part-time while completing their studies, says Simonson. The businesses benefit, too, he notes, because “they can get to [students] first.” He points out most E³ Summer Bridge students are from Ohio, and the number of “Ohio underrepresented ethnic students interested in and admissible to colleges of engineering” is low. “Companies want a diverse workforce, so there is intense competition for these students,” he explains.

During their final week, students take exams and attend exit interviews for each course. Instructors and students are required to complete a written analysis of the students’ performance for each of their courses. To reinforce what they have learned, students complete weekly homework assignments until fall quarter begins. “In the summer, we have them pretty much captured,” quips Simonson. “It’s a very comprehensive program.”

The collaborative learning efforts and friendships formed during the summer continue as the bridge students register “as a cohort” for their freshman and sophomore years, explains Simonson. Supplementary math and science sessions held during the academic year help students master the course material, he adds.

The E³ Summer Bridge formula has proven successful. Simonson estimates the graduation rate for participants is “20% higher than the national rate” for underrepresented ethnic students and “on par with the majority student
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graduation rate.” The program celebrated its 20th anniversary in 2008. Program funding comes from the university, the Ohio Board of Regents, and “a significant amount” from the National Science Foundation, says Simonsen. The program costs about $3,000 per student, but participants pay only a $125 application fee. “I call it their first college scholarship,” he observes.

A Bridge for Girls

Every summer, Radford University’s (RU) College of Science and Technology invites rising sophomore, junior, and senior high school girls to live for a week on campus in Radford, Virginia, and explore science, mathematics, and information technology. “The RU SUMMER BRIDGE PROGRAM (SBP) began in 2003 as a way to encourage young women to explore information technology as a college major and career choice,” says Ann Brown, assistant to the dean of the College of Science and Technology and SBP coordinator. The program was designed to “introduce the discipline in a fun and engaging way” to “girls who might not have considered information technology as a career choice,” she explains. Later, math and science were added to the curriculum.

This past summer, RU professors showed 42 students how to use math techniques to break secret codes and how to build an online social networking community from scratch. They introduced the girls to forensic anthropology and archaeology by having them use archaeological techniques to investigate mock crime scenes. In a biotechnology course, students analyzed food to determine if it contained DNA from genetically modified organisms. Courses are taught on-campus science labs, computer labs, and classrooms that are in themselves a learning experience, according to Brown: “The professors give these high school women a glimpse of what they would find in a college biotechnology lab, for example.”

She says the courses are “very hands-on, and the professors know each and every student by name. They talk with the young women about their career or college goals. Many of the professors are female and serve as role models.”

SBP students also visited the university’s planetarium and observatory. They learned about ethnobotany from RU’s greenhouse manager/biology instructor, Novozymes Biologicals, one of the program’s corporate sponsors, gave the girls “a tour of their lab, [and a] presentation of real-world biotechnology applications,” says Brown. “This made a great impression on the students about how science is used in medical, manufacturing, and other industries.” Funding from corporate sponsors makes it possible to provide students with free tuition, room, and board, she notes.

Current RU students serve as teaching assistants for the courses, eat meals with the girls, and live with them in the dorms, holding evening discussions about “college life and majoring in science, technology, and math,” says Brown. “Many of the participants stay in touch with their professors, counselors, and teaching assistants” after the program ends, and “the university stays in touch with the participants to encourage them to think seriously about attending college” at RU or elsewhere, she adds.

STEM Bridges in Hawaii

Kapi‘olani Community College (Kap CC) in Honolulu, Hawai‘i, offers an intensive three-week STEM Summer Bridge Program to help underrepresented 11th and 12th graders, such as Native Hawaiians, prepare for the rigors of college math and science courses. Each day includes a two-hour math preparation class and an hour of collaborative study, explains Kealani Noa, KapCC’s STEM Outreach coordinator.

Students complete several projects during the program. They construct a high-end personal computer and build underwater remotely operated vehicles. These projects “have been vital in increasing [students’] interest [in] and understanding” of math and science, observes Noa. “In addition, this program has allowed the Native Hawaiian students to reconnect with their cultural traditions. An example of this is the mapping project, which uses modern GIS (Graphical Information Systems) to map historically significant ancient sites,” she notes.

In another activity, students use ASSESSMENT AND LEARNING IN KNOWLEDGE SPACES (ALEKS), a web-based, artificially intelligent assessment and learning system “designed to help students learn valuable mathematical elements,” says Noa. “Students have consistently shown significant increases in their [University of Hawai‘i Compass Placement Test scores due to ALEKS],” she adds.

University of Hawai‘i at Mānoa’s Native Hawaiian Science & Engineering Mentorship Program (NHSEMP) has a seven-week program that also enlightens students about Native Hawaiian culture. “Students participate in math and Hawaiian Studies courses, STEM internships, and student and professional mentoring,” says Kelli Ching, NHSEMP project specialist. Community projects not only feature both Western and Hawaiian engineering and science expertise, but also allow students to apply classroom knowledge outdoors. “Past projects have included Native Hawaiian fishpond restoration, taro farming/planting, and haleau (ancient place of worship) restoration. Students also present cultural case studies in which they explore the connection between engineering science and Hawaiian culture through significant people, places, and values,” she notes.

NHSEMP staff believe when programs produce “high-quality Native Hawaiian student scholars, researchers, graduates, and STEM professionals, the expectations both inside and outside the Native Hawaiian community improve. Native Hawaiian communities will begin to see their own ‘ohana (extended family) members pursue science and engineering, and the mystery and skepticism of ‘that’s not for me’ will begin to disappear.”

Assessing Success

Last spring, Anoka-Ramsey Community College in Coon Rapids, Minnesota, received a $28,076 grant from the Minnesota State Colleges and Universities system to create the Success Stepping Into College (SSIC) Summer Bridge Program, a pilot program offering mini-courses in biology, math, computer science, and college success skills to underrepresented high school students interested in STEM fields. Students were introduced to educational pathways and careers in STEM fields through guest speaker presentations and field trips to St. Cloud State University, 3M Corporation, and Great River Energy.

Because the faculty had only brief, three-month span between obtaining the funding and the start date of SSIC, they had little time to recruit the target population, says mathematics instructor Megan Breit-Goodwin, who served as project director. So the 31 underserved students who showed up for SSIC wanted to attend college but were not necessarily interested in a STEM career path.

However, after three weeks of SSIC, some of the 27 students who completed the program changed their minds, reports Breit-Goodwin. Responses to an exit questionnaire indicated 81% felt SSIC helped them prepare for college STEM courses. 63% believed SSIC encouraged them to take STEM courses in college, and 44% considered pursuing a STEM career. She says the program will track the STEM course enrollment and performance of SSIC students this year.

In addition, participating faculty will provide data about creating and implementing the curriculum and how the SSIC experience will influence their curricula for courses they teach during the academic year. In follow-up interviews, instructors will discuss their experiences working with underrepresented students, shedding light on better ways to reach them, says Breit-Goodwin.

A Bridge to High School

Bridge programs are also available for students entering high school. The Baltimore Polytechnic Institute (BPI), a citywide science and engineering magnet school in Baltimore, Maryland, offers a two-week program attended by about 85% of incoming ninth graders, says chemistry teacher Klara Delle Hargrove. While BPI’s program focuses on language arts and math, “we don’t want [students] to think they only have to be successful in these two courses,” she asserts. Students sample a week’s worth of biology homework, learn skills such as scientific notetaking, and are introduced to the computer labs and software used in the science and engineering department. By the end of the program, the freshmen feel right at home, reports Hargrove. ●