By Karen Leggett

Encouraging STEM Students to Study Abroad

Traditionally, science, technology, engineering, and math (STEM) students haven't gone abroad in large numbers. Times are changing.

"IF THERE WERE A MATHEMATICS PROGRAM IN HUNGARY FOR ST. OLAF COLLEGE STUDENTS, WOULD ANYONE COME?"

A Hungarian mathematician asked the question of an American colleague in 1983. Almost 30 years later, thousands of students from some 800 U.S. colleges and universities have attended the Budapest Semester in Mathematics, one of the oldest college programs specifically aimed at STEM students. "The Budapest Semester has become almost essential for mathematics majors at liberal arts colleges if they are thinking about graduate school in mathematics," says Margaret Robinson, a mathematics professor at Mount Holyoke.

Global experience is increasingly perceived as essential to career success in science, technology, engineering, and math. More schools are committing themselves to education abroad as not only desirable, but expected. Peggy Blumenthal, chief operating officer at the Institute for International Education, cites the 2008 Newport Declaration to Globalize U.S. Engineering Education and Research in which representatives of more than 30 institutions agreed to integrate global education into their engineering curriculum because "it is imperative that all engineering students develop the skills and attitudes necessary to interact successfully with people from other cultural and national environments." At the same time, Rensselaer Polytechnic Institute (RPI) launched its Rensselaer Engineering Education Across Cultural Horizons (REACH) program with the expectation that all undergraduate engineering students will participate in an international experience. With high praise for RPI's commitment, Blumenthal adds that "unless you make international experience mandatory, some professor will say it's not that important."

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Although the percentage of American STEM students studying abroad is still small—3.2 percent of all education abroad students in 2008 were in engineering, 1.6 percent in math or computer science—Blumenthal says the trend line is good. There are more schools starting their own small programs, expanding options, or linking to consortia. The Global Engineering Education Exchange Program (Global E3) now fosters exchanges among 40 U.S. and 60 foreign institutions. The two-year-old Research Internships in Science and Engineering (RISE) enables U.S. undergraduates to work with German doctoral students in their labs during the summer. International Student Exchange Programs (ISEP) has 160 member institutions and an entire section of its Web site promoting education abroad for STEM students, including opportunities in 15 countries from Australia and France, to Botswana, Sweden, and the United Arab Emirates. An ISEP fact sheet debunks myths about STEM education abroad by pointing out that spending a semester abroad does not have to be more expensive than studying in the United States, many foreign universities offer courses taught in English, and those in countries like Germany, Mexico, France, and Finland have some of the most high-tech and innovative research institutions in the world.

A host of scholarship organizations offers incentives for STEM education abroad at the graduate and undergraduate level: the David L. Boren Scholarships funded through the Department of Defense, the Benjamin A. Gilman International Scholarship Program, the Whitaker International Fellows Program in biomedical engineering, Fulbright Scholars, and the Winston Churchill Foundation Scholarships.

IIE's 2009 report, *Promoting Study Abroad in Science and Technology Fields*, says "curricular innovation, international collaborative research, development of dual/joint-degree programs across borders and distance

University of Rhode Island class of 2012 student Colleen Grinham, who is majoring in German and engineering interned with Bayer AG in Leverkusen, Germany.

learning will all be needed to provide students with an international perspective and to produce globally competent professionals." The greatest proliferation of such programs is in the engineering field, where ABET—accrediting agency for college and university programs in applied science, computing, engineering, and technology—says it is eager to facilitate innovation. ABET Executive Director Michael Milligan adds, "We are 100 percent behind international engagement… we accredit 180 programs in 20 countries." One track at the ABET conference in October is devoted exclusively to education abroad.

Sending Engineers Overseas

The University of Rhode Island's (URI) 23-year-old International Engineering Program offers dual degrees in a foreign language and engineering in five years. During the fourth year, students study at an overseas technical school for one semester, taking cross-cultural and language courses, as well as engineering courses in the target language. The second semester includes an internship. "We send mechanical engineers to Hasbro in Rhode Island for the summer," explains Sigrid Berka, executive director of the engineering program, "and then they will spend six months at Hasbro in China." Sophomores and juniors in the program now live in language dormitories at URI. Berka is convinced that the living and learning community contributes to the student success and language retention.

Several schools have incorporated international experiences into their existing work-coop programs. Debbie Donohue, director of the Georgia Tech Work Abroad Program, says the International Plan at Georgia Institute of Technology was created in 2005 to increase the number of undergraduate students who graduate with global competence in their major. It requires proficiency in a foreign language and a minimum of 26 weeks of international work, research, or study. Internships range from three to 12 months. Students do not receive course credit for the internship but most are paid. In 2005, 31 students went to 11 countries. Last year, 215 students went to 30 countries. Donohue is trying to promote longer stays and ultimately hopes to have everyone graduate from Georgia Tech with an international experience. In 2010, 41 percent of Georgia Tech undergraduates participated in one of the school's international programs.

"I gained international work experience, learned German, and was paid in euros. I also made lifelong friends in Barcelona, Paris, and Berlin," said Payam Sasha Eslami, an industrial engineering student at Georgia Tech who interned at Continental AG.

Like many of her counterparts at other universities, Donohue says 50 percent of her leads for new internships come from faculty. She worked with the U.S. Chamber of Commerce in Egypt to start programs there and is beginning to work in Jordan. Donohue notes that the cultural transition has been most challenging in Japan, where interns are at the bottom of the ladder in a very hierarchical, traditional culture.

Worcester Polytechnic Institute (WPI) requires all students to complete three projects, including an interdisciplinary project at one of 26 overseas project centers. Each project center hosts 24 students and two faculty members for eight weeks. Students pay the regular WPI tuition plus additional costs that can be included in refigured financial aid packages. A faculty director helps identify projects and a local coordinator provides continuity. In Venice WPI students in electrical and mechanical engineering and physics developed a system to evaluate the condition of decorative outdoor wrought iron.

WPI's Director of Global Operations Natalie Mello has been honored both for the school's project-based approach but also the training program and operational handbook developed for all resident faculty advisers at the overseas project sites. Mello says bringing in outside experts to provide cross-cultural, medical, and emergency safety training has been well worth the investment.

At Bucknell, the engineering school includes international experience in its vision for all graduates. Bucknell offers an "introduction to study abroad" for first-year engineering students; soon the session will be available online. Jennifer Ellis Fritz, the assistant director for international dducation, begins advising students as soon as they show the slightest interest to make sure they can make education abroad fit into their degree plans. Students receive

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one credit for a three-week summer program called Engineering 290, which is led by engineering faculty and offered in a different country each year. It includes a classroom focus on global ethical, environmental, and economic issues plus company visits.

Drexel University was an early participant in Global E3 exchange programs and now has its own cooperative agreements with schools like NTU in Singapore. Students must pass their courses, explains Assistant Vice President Daniela Ascarelli, but grades come back from overseas as credit-no credit, which is reassuring to some students. Ascarelli also notes that more and more partner institutions are offering courses in English.

The University of Pittsburgh's Swanson School of Engineering touts its Plus3 program—three credits for two weeks overseas with engineering and business faculty. "It lays the foundation for longer stays," says Kristine Lalley, director of international engineering programs, including alternative energy research projects in Brazil or the study of ancient engineering at Macchu Picchu in Peru.

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Regine Lambrech, the former director of global initiatives and education at Columbia University, believes it's best to organize engineering internships after the junior year, when students have some engineering experience and can be useful to an employer. "Each side gets a good look at the other," says Lambrech. Should there be resistance on the home campus, Lambrech advises taking faculty to visit foreign labs to increase their comfort level. Martha Merritt, associate dean at the University of Chicago, echoes that sentiment: "Build a community of understanding among deans on campus. Have them visit overseas centers so that it's not just paperwork flowing through the offices. They melt when they see the opportunity that being abroad brings to students."

The University of Colorado at Boulder encourages all students to have at least one international experience. Students are able to study at partner universities, earn an International Engineering Certificate, or work for an overseas company during the summer. Three students were test driving cars for BMW while another worked on a space project in Milan. "You need to start early with students and plant the seed," says Sherry Snyder, director of student programs.

The University of Colorado is also home to Engineers Without Borders (EWB), which collaborates with local partners in developing countries to implement sustainable engineering projects. "We started with 18 students and faculty in Belize in 2002; in 2010, we sent 1,297 students to partner with 240 communities in 40 countries," says Jenny Starkey, public relations manager. There are nearly 200 university chapters of EWB, initiated by students with faculty and professional advisers. "These students want to be part of something much bigger," says Starkey. "EWB requires relationships to be built through different cultures, requiring people to listen actively, and engage in the community."

Beyond Engineering

"There are so many solutions and opinions lurking around every corner," blogged an Auburn University student named Kelly, "but what is the right path?" Kelly taught science to children in Tanzania, where math education Professor Lisa Kasmer launched a program with a colleague from Purdue University and then moved it to Grand Valley State Univer-

sity in Michigan. "If you can do well teaching in Tanzania for four weeks, building relationships with kids with whom you have nothing in common, you will be ready to go as a student teacher." Kasmer admits that establishing and coordinating a solo program like this is not for the faint of heart. "Make contacts, do the ground work, and get it well thought out before you propose your idea to the international committee," she advises.

Kathy Palumbo, director of nursing at Genesee Community College, has established a brand new nursing exchange program with Southbank Institute of Technology in Brisbane, where a Genesee faculty member used to teach. Palumbo felt it would be valuable for her nursing students to have a concentrated, hands-on experience in a universal health care system, interacting with patients in a different, but still English-speaking country. During the pilot project in 2010, two students worked side-by-side with nurses in Australia. In addition to the high cost of living in Brisbane, the biggest problem turned out to be obtaining specialized work visas for students involved in direct patient care. Palumbo is now investigating the feasibility of moving the program to Canada or Great Britain.

Also on a very small scale, zoology professor John Cavitt at Weber State University in Utah coordinates student exchanges with the University of Nayarit in Mexico. Each year, a few American and Mexican biology students compare the behavior of migratory birds that winter on the western coast of Mexico and summer around Bear River Migratory Bird Refuge in Utah. "Many of our students have never been out of state," says Cavitt, "One is now doing graduate work in tropical biology." Now Cavitt is team teaching a course in Spanish, sociology, and zoology. After six weeks in class, 30 students will go to a fishing village in Mexico where the local leaders have asked for help in restoring a mangrove forest.

The math program in Budapest began with a few professors who were friends. Budapest program alumni now work for the National Security Agency, airlines, technology start-ups, Microsoft, and Apple, says Paul Humke, a professor at St. Olaf College who is also the North American director for the Budapest program. Humke was there at the beginning of the Budapest Semester more than 30 years ago. "I had no idea what I was doing. I just knew it was a good thing. It has enriched my life in amazing ways." And students' lives as well, of course. "The courses are intense enough to satisfy the next Fermat, yet it's such a close knit and enthusiastic environment that you can't help but be pulled into the complex and fascinating world of mathematics," said Chris Zanoni, who went to Budapest from the University of Wisconsin. "Mix it all in a world as warm and friendly as Budapest, and it's paradise." **IE**

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