AC 2005-611: INTERNATIONAL STUDY AS A COMPONENT OF THE UNDERGRADUATE EXPERIENCE IN ENGINEERING

Janet Ellzey,

Kathy Schmidt, The University of Texas at Austin

Ted Aanstoos, The University of Texas, Austin

Educating the Global Engineer: A New International Program at The University of Texas at Austin

Janet L. Ellzey, Ted A. Aanstoos, Kathy J. Schmidt

College of Engineering, The University of Texas at Austin

Abstract

External advisors (alumni and industry) stress the importance of international experience, awareness of global issues, and cultural diversity awareness as desirable traits of new-hire engineers. Similar goals appear in the ABET 2000 criteria. The Mechanical Engineering Department at The University of Texas at Austin is developing an International Engineeering Program with the goal of increasing the number of undergraduate students with international experience. A pilot six-week summer program in 2004 involved nine students earning six credit hours in Grenoble, France. The program consisted of an upper-division technical elective "Engineering Standards and Industrial Policy in a Global Environment" and an American history course, "American Foreign Policy." Student performance and feedback from this pilot semester yielded positive results, and based on this success two additional programs are planned for Summer 2005. Both of these will be two-course, six- credit hour programs, one held at INSA Toulouse, France, and the other at University College London. This paper reports on the benefits of the international studies program to our students and faculty, and the evolution of the program offerings to take advantage of lessons learned. Program financing is discussed as are curricula development, student recruiting and advising, and advanced instructional technology requirements including classroom enhancement tools and electronic portfolios. Future plans for the program include a full spring semester abroad, extension of the summer program to Latin America, and a possible joint master's degree program. These expanded international study options will be available to students in all College of Engineering departments.

Introduction

Engineering as a professional field has become more international in its character with the increasing importance of multinational corporations and international collaborations. Employers today want international acumen, discipline-cutting experience, and cultural diversity. Yet engineering education has not fully responded to this growing need for an internationally trained workforce. At The University of Texas at Austin (UT Austin) approximately 2000 students participate in Study Abroad experiences in 2004. These students come primarily from Liberal Arts where the educational culture has promoted and supported international experiences for their students for many years. In the College of Engineering, however, only 12 students out of approximately 5000 undergraduate students participated in a study abroad experience for the fall 2004 semester. Many aspects of the educational culture in engineering discourage international experiences for students. The major difficulty in planning a semester in a foreign country is the transfer of credit. Since there are no free electives in the engineering curriculum,

the courses taken at the foreign university must meet specific curricular requirements. Another important consequence of the rigidity of undergraduate study in engineering is that freshman level language courses are not counted towards the degree, a constraint that makes it difficult for students to develop the skills necessary for success at a foreign university. All of these problems are a result of educational priorities that emphasize, with good reason, the technical competence of its graduates.

And yet, there is a growing demand for educational innovations in engineering that encourage a broader approach to education. The engineering accreditation board, ABET has clearly charged colleges of engineering with demonstrating that their graduates understand the impact of engineering solutions in a global context. One way to accomplish these goals is through international experiences. In response, many engineering schools are developing full-semester study abroad options. Perhaps the US university most active in overseas education is Georgia Tech, which has grown their international programs over the past seven years into a set of 22 programs, involving more than 750 students, representing more than a third of their annual undergraduate degrees awarded.[1] Many of these students study at the permanent GT Lorraine campus, where 76% of the participating undergraduate students are in engineering disciplines. The International Engineering Program at the University of Rhode Island is essentially a distinct academic department, offering dual degrees in engineering and a foreign language (French, German, or Spanish); the IEP program housed more than 160 students in 2001-2002.[2] The Engineering International Programs office at Iowa State University offers study 28 abroad programs in 15 countries, including Europe, Asia, Mexico, and Australia, and industry-funded scholarships are available to students who participate in the programs.[3] The Boston University College of Engineering began their programs in 2001, leading to a full semester of four courses at a German partner--three taught in English, the fourth an intensive German language course. This February-July term is designed so as not to extend normal degree completion time.[4]

The College of Engineering at the University of Texas at Austin has recently made a commitment to expand international opportunities for engineering students. The long term goal is to provide international experience for 200 students a year or approximately 20% of the graduating class. There are three pathways that will be developed over the next few years: (1) summer school programs abroad led by UT Austin faculty (2) semester long programs at foreign universities (3) international internships. In this paper we focus on the first summer school program held in 2004, and on the two summer schools planned for 2005.

Summer school in Grenoble 2004

Program development and organization. The summer program followed one session of the summer school calendar starting in early June and ending in early July. The program consisted of two courses: one engineering technical elective and a second course that fulfilled three hours of the six hour credit requirement for American History set by the Texas legislature for all state university undergraduate students. Six hours of summer course credit (considered a full course load) is required in order to be eligible for financial aid. The history course met Monday through Wednesday three hours per day and the engineering course met Monday through Thursday two hours per day. This left Friday through Sunday free for travel and other activities.

Dr. Janet Ellzey, the program director for the Summer School in Grenoble, developed and taught the engineering course. The history course was taught by a local faculty member from the University of Grenoble, Prof. Francis Feely. Prof. Feely is an American citizen who had received his Ph.D. from an U.S. university. These qualifications simplified obtaining approval for his course to count towards the American history requirement. France was selected primarily due to Dr. Ellzey's familiarity with the country and language resulting from her extensive work and travel experiences there. Grenoble was selected primarily due to the availability of an educational provider, Academic Programs International (API), who had an office there and could provide dorms and other local support.

The program was initiated in summer 2003, one year in advance of the proposed date of the summer school. During this initial phase, we attempted to obtain industrial funding to support most of the costs of the program. We were not successful in this proposal and so the program costs were rolled into a program fee that was paid by the student participants. The program fee was $3650 and included the cost of the dorms, the second course, some meals, a 2.5 day orientation/excursion in Paris, a 1.5 day excursion to Geneva, and various other activities. In addition, the students paid for three hours tuition (approximately $900), travel, some meals, and other expenses. Estimated total costs were between $5000 and $6000 for the entire six week program.

Logistic details dominate the planning process for study abroad coursework. University of Wisconsin (Madison) faculty warn that, although the perceived benefits to an engineering education from study abroad are real and worthwhile, there exists a "myriad of details" that must be addressed for a program to be successful. These include not only logistical requirements of international travel such as passports and visas, but also the necessary building of "cultural awareness" as a key pre-condition to a student benefiting from study abroad.[5] Our program was organized through the Center for Global Educational Opportunities, C-GEO), the office at UT Austin that is responsible for providing study abroad experiences for our students. Most of the logistical details, such as contracting for dorm rooms and arranging the excursions, were handled by the educational provider, API.

Nine students participated in the program, eight Mechanical Engineering (ME) students and one Architectural Engineering student. Six of the students were graduating seniors and were taking their final technical elective as a part of this program. Two students were juniors and one student was a sophomore. The gender breakdown was six women and three men. This gender mix seems to echo the experience of educators at Rensselaer Polytechnic Institute, who note that well-designed study abroad programs can be a means of attracting women into engineering and science education.[6] None of the students who participated in the program spoke any French. The preponderance of ME students was most likely due to the fact that the program director, Dr. Janet Ellzey, is a ME faculty member and she recruited most heavily in this department. The program was originally targeted for juniors but the large participation by graduating seniors added to the richness of the program because these students had taken internships and so had industrial experience that gave them an additional perspective. In addition, the maturity level of the students is most likely one reason there were no disciplinary or behavioral problems of any kind.

Educational components. Some engineering study abroad course work stems from institutional requirements. The general requirement at Union College is for three courses in "other language, culture, and disciplines." Their department of Civil Engineering satisfies part of this requirement with an option for study abroad (summer or whole term).[7] As stated above, our program consisted of two courses: an engineering technical elective and an American history course (satisfying institutional requirements). The engineering course "ME379M Engineering Standards and Industrial Policy in a Global Environment" included topics such as national and international standards organization, ISO 9000, ISO 14000, environmental policy and regulation, engineering disasters and corporate responsibility, worldwide energy usage, and the relationship between society and technology. Several lectures were given by visiting faculty or industrial representatives. The instructor translated articles from Le Monde, the centrist Parisian newspaper, related to business and technology in order to prompt discussion about varying views on technical and political issues related to technology and its development. Classes were two hours and consisted of a one hour lecture by the instructor followed by presentations by student teams on related topics that had been assigned the previous day. Information for the homework assignments was obtained through the web at an Internet café.

Three educational excursions were arranged. The first was to the ISO and to the World Intellectual Property Organization (WIPO) in Geneva, Switzerland. The group left on Friday morning and had one hour lectures at the ISO and WIPO. The next day the group toured the United Nation's building. The second excursion, a two hour trip from Grenoble, was to a nuclear power plant in Bugey France. The group was given a lecture on nuclear power and a tour of the facilities. These two excursions were organized by API. The third excursion was organized by one of the students who had a job offer from Schlumberger. Schlumberger has a technical facility in Grenoble and the group visited the facility one morning for a lecture and a tour.

The American history course HIS317 American Foreign Policy covered time after the Normandy Invasion and consisted of readings and films related to the topics. Students were given brief reading assignments on a regular basis that they summarized for the class. In addition, each student read and reviewed a book on a topic related to the course.

Lessons learned

We think it is important to verify the body of (mostly) anecdotal evidence of the value of international experience for engineering students. Others agree—researchers at the Global Engineering Exchange Program are conducting on-going research using data to quantify the career advantages resulting from international study experience at the undergraduate level. This research is using data from program alumni feedback as well as surveys of industry hiring practices.[8] We sought extensive feedback from our Grenoble students, who rated the program as excellent. Both courses were very well received. Although the students had little or no experience with the topic of standards or technical policy, they embraced the subject with enthusiasm. One student confessed to not knowing what ISO meant prior to the course. Another student acknowledged that after the course he realized how much responsibility engineers have to society. Many students recognized after the course that technology is greatly affected by the social, political, and economic environment in which it is developed.

The major difficulties to this course related to logistical problems with the dorms, meal plans, and excursions due to inadequate local support. The students were able to cope with these challenges in a way that did not diminish the richness of the experience. The absence of local support also showed that the students were able to function effectively on their own.

Student comments indicated that they felt the price was too high and that the excursions were not necessary. The students, possibly in part due to the mature participants in this program, traveled extensively on their own. During the three day weekends, they went to Barcelona, Prague, Oslo, Florence and various other locations in Europe. These weekend trips were completely planned by the students demonstrating that they did not need excursions planned by the organizers. Although the educational excursions to the nuclear power plant and to Geneva were very well received, the students had mixed responses as to whether these trips were worth the time and the obvious cost they added to the program fee. Thus, future programs will not include overnight excursions.

Although the history course was very well received by the students, their inability to communicate in French was a hindrance to their integration into the local community. Engineering students typically do not express enthusiasm for studying language but the students acknowledged that some language skill would have been beneficial.

One of the shortcomings of the program was that the group did not integrate into the local university environment. Although the students met other students in the dormitories, they did not have the opportunity to meet French engineering students or to learn about engineering education in France. This was due to the fact that the program was organized by an educational provider who had contacts with the language department at the University of Grenoble and not with the engineering schools. Thus, the classroom was in the language department whose faculty and students had understandably little interest in socializing with the participants of the program. From the standpoint of the College of Engineering at UT Austin, these summer schools are avenues to build relationships with foreign engineering schools for faculty exchanges and research collaboration as well as for student education. Thus future programs will be managed through the engineering schools in order to promote interaction between our engineering programs.

Summer school in Toulouse 2005

Based on our experience with the Summer School in Grenoble in 2004, we have made various changes in the organization of the programs for the future. The Summer School in Toulouse is being organized through Institut National des Sciences Appliquées (INSA) in Toulouse, France. The program will consist of the engineering course described above, ME379M Engineering Standards and Industrial Policy in a Global Environment, taught by Dr. Janet Ellzey. In contrast to the program in Grenoble, the second course in Toulouse will be French language taught by the language department at INSA.

The courses will be taught in the engineering school and the students will stay in dorms close to the engineering complex. In general, French students are not at the university during the

summer but efforts will be made to integrate our students into the local environment. French students will meet our students upon arrival and participate in social activities. Local educational and cultural excursions will be organized by INSA. The tentative dates for this program are June 1 to July 9, 2005. The estimated program fee is $2500 that includes the cost of the French course, the dormitory room, and local excursions. In addition, the student will pay tuition for one three hour credit course, and for meals, travel, and other expenses.

Summer school in London 2005

A second summer school will be offered in London in collaboration with University College London (UCL). UCL was founded in 1826 to offer an alternative to the social exclusivity of Oxford and Cambridge. In 1878, it became the first British educational institution to admit women on an equal basis with men. UCL has a rich multi-cultural history and was the first university in England to admit students without regard to class, ethnic background, or religious preference. It is now home to over 18,000 students and 3,800 academic and research staff. Students from more than 130 countries outside the UK are enrolled at UCL.

Two three hour courses will be taught at UCL. The technical course, ME 379M--International Engineering: Practice and Professionalism in the 21st Century, will be taught by Ted Aanstoos, while the second, which is provisionally titled Artists, Pirates, and the Management of Innovation, will be taught by UCL faculty. The ME 379 course will include a wide variety of topics in an international setting, using a project-based team approach. Topics will include international technical standards, international environmental regulation, corporate responsibility, and multinational business structure. The UCL-taught companion course will address the management of innovation in corporations and in society. Various case studies from history and business will be examined. Both courses satisfy UT Austin technical or social studies elective requirements. The six week program at UCL is structured after the Grenoble-Toulouse model, with class held Monday through Thursday, and course work built around modules and designed for collaborative teams. Both programs are open to upper division, major sequence engineering students of all disciplines at UT Austin, and the UCL courses are also open to any interested UCL students based on class size limits. Because proper preparation is essential to every international experience, both summer courses in 2005 carry a mandatory pre-departure orientation component to be given in the spring. This orientation is designed to introduce students to the academic, cultural, and personal aspects of studying in another country.

The tentative dates for the UCL program are June 14 to July 22, 2005. The estimated program fee is $3500, which includes accommodation and international health insurance. In addition, the student will pay tuition for one three hour credit course, and for meals, travel, and other expenses. Normal financial aid is available for this program (at a higher level than for domestic courses), as are scholarship and grant funds.

Conclusions

The College of Engineering at the University of Texas at Austin is committed to expanding international experiences for engineering students. Both industry and educational experts agree that a global perspective is important for tomorrow's leaders. Based on the success

of a six-week program in France during summer 2004 consisting of a technical elective and a history course, the college is developing two similar programs for summer 2005 in Toulouse, France and London, England. Future plans include semester-long programs and international internships.

Bibliographic information

1. Lohmann, Jack R. Georgia Tech's strategies for global engineers. ECI Conference on Enhancement of the Global Perspective for Engineering Students by Providing an International Experience, Tomar, Portugal, 2003
2. Website, International Engineering Program, University of Rhode Island. http://www.uri.edu/iep/. December, 2004.
3. Website, Engineering International Programs, Iowa State University. http://www.eng.iastate.edu/intlprogs/. December, 2004.
4. Eisenberg, Solomon R. et al. Developing a study abroad opportunity for engineering undergraduates. ASEE Annual Conference Proceedings, 2003 ASEE Annual Conference and Exposition: Staying in Tune with Engineering Education, 2003, p 4099-4104
5. Machotka, Marianne et al. Study abroad: Preparing engineering students for success in the global economy. ASEE Annual Conference Proceedings, 2002 ASEE Annual Conference and Exposition: Vive L'ingenieur, 2002, p 12037-12045
6. Gerhardt, Lester A. et al. Educating the global engineer: A program to promote study abroad, international exchanges and diversity in undergraduate engineering. ASEE Annual Conference Proceedings, 2002 ASEE Annual Conference and Exposition: Vive L'ingenieur, 2002, p 11755-11770
7. Jewell, Thomas K. Gaining global perspective through terms abroad. ASEE Annual Conference Proceedings, 2003 ASEE Annual Conference and Exposition: Staying in Tune with Engineering Education, 2003, p 11137-11145
8. Spodek, Susannah R. et al. Study abroad: Impact on engineering career. ASEE Annual Conference Proceedings, 2003 ASEE Annual Conference and Exposition: Staying in Tune with Engineering Education, 2003, p 12565-12571

Biographical information

JANET L. ELLZEY, PhD has been on the faculty in the Department of Mechanical Engineering since 1990 where she holds the rank of Full Professor. She is Associate Director of International Studies for the Chair of Free Enterprise and the Associate Department Chair for International Studies. In addition to her teaching and research responsibilities, she is focusing on developing international educational opportunities for engineering students.

TED A. AANSTOOS, MS is a Senior Lecturer in the Mechanical Engineering Department. His technical interests include electromechanical energy storage systems and devices for space and vehicular applications. His teaching interests include engineering design and graphics, design projects, and ethics and professionalism. Mr. Aanstoos is a Fellow of ASME International and a Registered Professional Engineer in Texas.

KATHY J. SCHMIDT, PhD is the director of the Faculty Innovation Center for the College of Engineering at the University of Texas at Austin. In this position, she promotes the College of Engineering's commitment to finding ways to enrich teaching and learning. She works in all aspects of education including design and development, faculty training, learner support, and evaluation.