



Strategies for Increasing Student Participation in International Programs

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Abstract

This paper describes the strategies utilized by the Bagley College of Engineering at Mississippi State University, a tier one research university located in the southeastern US. In the institutional strategic plan, the university recognizes the need to apply their academic, scientific, and extension capabilities to global challenges while providing students with an international perspective that expands their future opportunities. To increase international opportunities for students, the College of Engineering has focused on *opportunity*, *benefit* and *affordability*.

To increase opportunity, courses offered as faculty-led study abroad programs have been selected from those that can be applied to the most number of engineering programs. Starting summer 2015, Technical Writing was offered in Munich in collaboration with Munich University for Applied Sciences. This course is required for all engineering students. Students also have the option to take Engineering Economy in France. This course counts as an elective in all engineering programs. Starting summer 2016, we will offer Engineering Mechanics I in Cardiff, UK. This class is required for seven of the 11 engineering programs. These courses are offered at international universities where we currently have established activities, either through bilateral exchange agreements and/or active research collaborations.

The greatest challenge to increasing participation in international activities is communicating to students the benefits of a global experience, especially in a state that has one of the lowest percentages of passport holders in the country. To increase awareness, the college has initiated a student ambassador program. Ambassadors meet with classes to talk about opportunities, share their personal experiences and testify how the experience has been of benefit, both professionally and personally. The college has also introduced a minor in Global Engineering Leadership as an academic incentive to students.

Finally, to make international opportunities affordable, the university has introduced study abroad scholarships for incoming freshman students meeting certain criteria (in-state residency and minimum ACT scores). In fall 2015, ~240 study abroad scholarships were awarded, 164 of which were offered to engineering students. Additionally, the college has been able to offer substantial scholarships from gifts received from engineering alumni and industry sponsors.

The strategy to increase opportunities for students, communicate benefits of study abroad, and enhance affordability has been effective since first implemented. The college has witnessed a 56% increase in students participating in international programs since 2014. Although this is a modest increase in terms of absolute numbers, the college is on a trajectory to meet its goal of having >200 students per year participate in study abroad by 2020.

Introduction

There is little argument that we live and work in a global economy. As such, it is imperative that engineers have a deeper understanding and appreciation of other cultures. In fact, the

Engineering Accreditation Commission of ABET, states this as an expected student outcome in General Criterion 3 (h) “the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.”¹

Traditionally, engineering programs have sought to achieve this objective through courses alone. Requiring students to take history, foreign language, geography or similar courses was thought to prepare engineers to function effectively in a global economy. Recently this has been found to often be ineffective. As a result, some engineering programs have introduced international engineering programs for undergraduate students, such as those at the University of Rhode Island and the University of Wisconsin-Madison. These programs, especially when combined with appropriate coursework, offer the opportunity for students to learn and experience different cultures at both a cognitive and emotional level. Researchers have quantitatively shown that students who participate in these programs have higher levels of global awareness.²

Expanding students’ perception of other cultures is critical to their success as engineers. Additionally, if these students are to become leaders in the profession, it is imperative that they understand and appreciate the diversity of cultures in the world. There is an immediate need for this at Mississippi State University, which is located in a state with one of the lowest percentages of passport ownership in the nation at just under twenty-percent while the United States as a whole is just under fifty percent.³ This is strong evidence that most in-state residents have never travelled outside of the United States. A certain percentage of those have likely not travelled abroad as a result of financial constraints, but there must also be a number who have the financial needs but merely lack the inclination or opportunity to travel. Importantly, while Mississippi ranks at the bottom for percentage of passport holders, this is not an anomaly for addressing issues of limited global awareness. Rather, we are at the center of an entire region with limited global exposure.

Informal discussions with students who have participated in study abroad opportunities have revealed that these students’ outlook on the world was changed and their ability to be more accepting of different cultures was enhanced. We believe this also decreases a student’s resistance to change and will therefore make them a more effective engineer in today’s constantly changing world. In a recent study on the environmental awareness of engineering students and their resistance to change, Weber found that students who lived in or near urban areas had less resistance to change.⁴ Given we are a rural state, it stands to reason that engineering students would tend to be more resistant to change than those from other, less rural states.

In addition to producing engineering graduates who can function effectively in today’s economy, engineering colleges desire to produce leaders who can thrive in the global economy. This requires a broad understanding of the world, global issues, policy, and leadership fundamentals. Within our college of engineering, which teaches the majority of our in-state student engineers, several programs along these lines exist but they are not unified into a coherent program nor do they have a specific engineering focus. We have built upon our existing strengths and combined the appropriate programs into a unified global engineering program, the minor in Global Engineering Leadership, to debut in Fall 2016.

Opportunity

For many years, the college of engineering has been a part of various consortia and bilateral exchange agreements that have allowed students to spend a semester studying at international partner universities. These programs offer opportunities for students to study in virtually any geographical region from Australia to South East Asia to Europe to South America. However, the number of students that participate in these semester long programs is relatively small and the majority of students are interested in faculty-led summer study abroad programs. These programs offer the security of being taught by faculty from their home institution, providing familiarity, being able to take a class with students from their own department, offering companionship, and often reduce the need to be conversant in a foreign language. Other factors, such as cost, articulation of courses to the home institution and parental anxiety, make faculty-led programs more appealing to students.

In 2013, only one faculty-led engineering program was offered. Students with a desire to study abroad had other options through the university or third-party providers in subjects such as foreign languages or international business, but very few that would count towards their degree program. At that time, the strategy for developing new study abroad programs was to send out a request for proposals to all faculty. This passive approach did not generate many proposals and of those submitted, many were very discipline specific and did not appeal to a wide range of engineering students. Consequently, of the few programs offered, many did not have enough students register for them to be viable and they were cancelled.

In 2014, a more proactive strategy was developed to provide additional opportunities for students to participate in summer study abroad programs. The first requirement was that the courses to be offered should be integrated with the curriculum. The college of engineering offers 11 undergraduate programs and courses were identified that counted towards the most number of degree requirements to maximize the benefit to the most number of students. The first course selected was engineering economy, which was already being offered, and could be included as an engineering elective in all programs. The second program developed was Technical Writing, a course required for all undergraduate students. The third course, introduced in summer 2016, was Engineering Mechanics I (Statics), a requirement for seven of the 11 engineering programs. The study abroad courses and the programs to which they apply are summarized in table 1.

Table 1: Summary of relevance of faculty-led study abroad courses to the different engineering curricula.

	<i>Engineering Mechanics I (Statics)</i>	<i>Engineering Economy</i>	<i>Technical Writing</i>
<i>Aerospace Engineering</i>	R	E	R
<i>Biological Engineering</i>	R	E	R
<i>Chemical Engineering</i>	R	E	R
<i>Civil Engineering</i>	R	E	R
<i>Computer Engineering</i>		E	R
<i>Computer Science</i>		E	R
<i>Electrical Engineering</i>		E	R*
<i>Industrial Engineering</i>	R	R	R
<i>Mechanical Engineering</i>	R	E	R
<i>Petroleum Engineering</i>	R	E	R
<i>Software Engineering</i>		E	R

R = Required, E = Elective, *Electrical Engineering requires Technical Writing; however, it is taught in conjunction with the senior capstone design course and students must register for the designated section of the course.

In addition to ensuring the programs offered could be integrated in the curricula and were relevant to students, it was important to ensure the offerings were sustainable. The willingness and availability of faculty to teach courses each summer was a main concern. To alleviate this concern we only considered courses that had multiple instructors on campus who would be willing to teach overseas. Our second consideration was location. We wanted to choose destinations that would be appealing to students and their parents and where we would be able to offer the courses for several years. We therefore selected destinations in Europe that were considered relatively safe and affordable. Additionally, we opted to partner with universities where we already had existing relationships, either through bilateral exchange agreements or research collaborations. Table 2 presents data showing the demand for the selected courses based on the number of students enrolling in the on-campus offerings, the international location for the study abroad course, and the type of existing relationship between our institution and the host institution.

Table 2: Data for faculty-led study abroad courses. On-campus data are for the 2015-16 academic year.

<i>Faculty-led Study Abroad Course</i>	<i>Number of On-campus sections</i>	<i>On-campus students enrollment</i>	<i>Study Abroad Location</i>	<i>Research Collaboration</i>	<i>Bilateral Student Exchange Agreement</i>
Engineering Mechanics I (Statics)	13	639	Cardiff University, UK	✓	✓
Technical Writing	26	485	Munich University of Applied Science, Germany		✓
Engineering Economy	2	437	Albi School of Mines, France		✓

Benefit

Having created various opportunities for students to participate in faculty-led study abroad programs, in courses that were applicable to the majority of students in the college and that were in high demand, it became important to communicate the benefit of education abroad to students and parents and provide incentives to encourage greater participation. Our first tactic has been to increase awareness in students and their parents even before they attend their first class as freshman. Global experience has become a part of our recruitment rhetoric and we focus on the number of engineering companies within the state that are either from overseas or are US companies with extensive international operations. We emphasize the benefit of having an appreciation for the global marketplace, even for students who wish to stay in Mississippi after graduation. During freshman student orientation, as part of the academic session, we tell parents to get their child a passport as part of their high school graduation gift. In doing so, we are creating the expectation among parents and students that an international experience should be part of their engineering education.

To help promote continued awareness among students, we have initiated a student ambassador program. Student ambassadors are easily recognizable by their T-shirts that say, “I studied abroad... ask me where.” These act as an ice-breaker and are intended to help start conversations from curious students who want to know more about the study abroad experience. Student ambassadors accompany the director for international programs when she visits classes to discuss the various opportunities and can offer their perspective on study abroad. The Director for IP will visit all engineering introductory courses to continue the message freshman students received before enrolling in courses. As the majority of students don’t study abroad until their junior or senior years, ambassadors and the IP director will visit other engineering classes for

sophomores and upperclassmen. Ambassadors will also help at the college of engineering booth at the university study abroad fairs.

To increase the incentive to study abroad, the college of engineering has introduced a minor in *Global Engineering Leadership*. The minor is designed to enhance students' knowledge of engineering practice in the global marketplace. Students completing this program develop proficiency in a foreign language, have experience living and studying in a foreign country, and become familiar with engineering leadership and management techniques. A total of 18 hours are required to complete the minor, including a required course in "Challenges in Global Engineering". The curriculum outline is shown in table 3.

The foundation of the minor is the *Challenges in Global Engineering* course. Upon completion of the course students gain a broader perspective of global challenges facing engineers today, including specifics of managing international engineering projects, engineering standards, economic, legal, and environmental issues. Students have an understanding of the role of culture in engineering design and problem solving and global trends in engineering. They are exposed to engineering work in various countries through projects that focus on real-world case presentations and case reports. Students also learn to explore resources, strategies, and options to solve problems in a globalized engineering world.

Students are required to take six hours of a foreign language. Foreign languages not only provide the necessary skills for effective communication in a non-native language, they in fact form the basis for understanding a people's culture. The specific language is selected in consultation with the students' academic advisors and can be used to fulfill the university general education requirements. Ideally, and if possible, the chosen language would be relevant for the student's follow-on study abroad course. However, we believe there is value in completing a foreign language even if a student ultimately completes a study abroad in a country that does not speak the studied language.

Students are allowed to take six hours of approved leadership electives to round out the course requirements for the minor. These courses could include engineering and public policy, law and ethics, cross-cultural management and leadership, and project management.

Table 3: Educational requirements for the minor in Global Engineering Leadership.

<i>Curriculum Outline</i>	<i>Credit Hours</i>
<i>Challenges in Global Engineering</i>	3
<i>Foreign language</i> ^{1,2}	6
<i>Language I</i>	
<i>Language II</i>	
<i>Relevant Overseas Engineering Experience e.g.</i>	3
<i>Faculty-led Study Abroad in an engineering course</i>	
<i>International Engineering Internship</i>	
<i>Semester-long Engineering Exchange Program</i>	
<i>Overseas Service Learning (e.g. Engineers Without Borders)</i>	
<i>Leadership Electives</i>	6
<i>International Business Law</i>	
<i>Construction Engineering and Management</i>	
<i>Analysis and Mitigation of Conflicts, Claims and Disputes</i>	
<i>Civil Engineering Comprehensive</i>	
<i>Social and Ethical Issues in Computing</i>	
<i>Managing Software Projects</i>	
<i>Introduction to Engineering and Public Policy</i>	
<i>Engineering Entrepreneurship Seminar</i>	
<i>International Business</i>	
<i>International Economic Development</i>	
<i>International Economics</i>	
<i>Engineering Economy I</i>	
<i>Engineering Administration</i>	
<i>Project Management</i>	
<i>Engineering Laws and Ethics</i>	
<i>Cross-Cultural Leadership</i>	
<i>Socially Responsible Leadership</i>	
<i>Cross-cultural Management</i>	
<i>International Logistics</i>	
<i>International Transportation</i>	
<i>International Supply Chain Management</i>	

Notes: ¹ Must be a modern language. The six credit hours must be of the same language. ² The foreign language studied does not have to be the same language spoken in the country of the overseas engineering experience, though this is highly desirable. Students are strongly advised to complete the language component before their overseas experience.

Affordability

The university is located in a rural state where there is a high level of poverty. In 2014, 53% of graduating students had taken out loans to pay for their education and the average level of

indebtedness was \$29,365. The financial aid statistics for the university are shown in Figure 1. These data indicate that there is a high financial need among students at the university and the cost of studying abroad could be prohibitive for many families. The college of engineering actively sought sponsorship from alumni and industry partners so students could receive scholarships to offset the cost of study abroad. In 2016, the college of engineering awarded \$50,000 in scholarships to students at an average of \$2,500 per student. In addition to the college study abroad scholarships, the university introduced study abroad scholarships to students entering the university in 2015. In-state students who attained a composite score of 30 or above on the ACT received a study abroad scholarship of \$1,000 to \$4,000. The amount awarded to each student is determined by their ACT score and high school GPA. The university awarded ~240 study abroad scholarships in fall 2015 to incoming freshmen. Of those, 164 were awarded to engineering students.

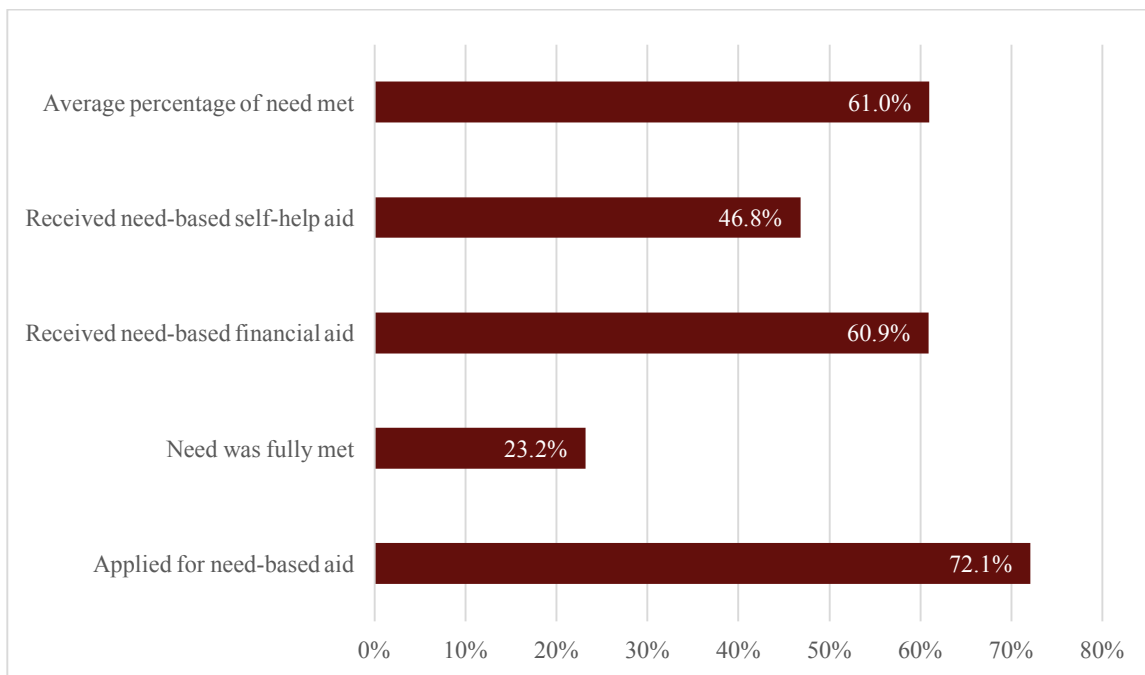


Figure 1: Financial Aid statistics for students attending the home institution in 2014. Data obtained from US News and World Report.

Impact

As seen in Figure 2, there has been a significant increase in the number of students participating in education abroad since the new strategic initiatives were systematically introduced in 2014. The number of students participating in semester or year-long exchange programs has remained consistent with an average of 6.8 ± 1.92 students per year over the past five years. For spring 2016, six students are spending the semester at an international university, five in Italy and one in Australia. The biggest increases in student participation are seen in the faculty-led programs with engineering-led programs increasing by 2.5-fold between 2014 and 2015 and non-engineering-led programs increasing by 3.3-fold between 2013 and 2015. Data for non-engineering-led programs are not available for 2016; however, 46 students are registered for

engineering-led programs for summer 2016, showing a further 31% increase over the previous year and a 229% increase compared to two years prior. For the upcoming summer, 22 students will take *Engineering Economy* in France, 16 students will take *Technical Writing* in Germany, and 8 students will take *Engineering Mechanics I* in the UK. Overall, the number of students participating in an international experience increased by 56% between 2014 and 2015, with early indications that this trend will continue into 2016.

These early results are certainly encouraging but it is important to provide context. The number of student participants represents approximately 2% of the undergraduate engineering student body. It should also be noted that different majors are better represented than others in global programs. Biological engineering, industrial engineering and mechanical engineering have the highest representation compared to civil engineering, electrical engineering and computer science that are poorly represented. This indicates the importance of academic advisors in the individual departments promoting awareness of education abroad opportunities with their students and faculty making students aware of the impact of engineering solutions in a global context.

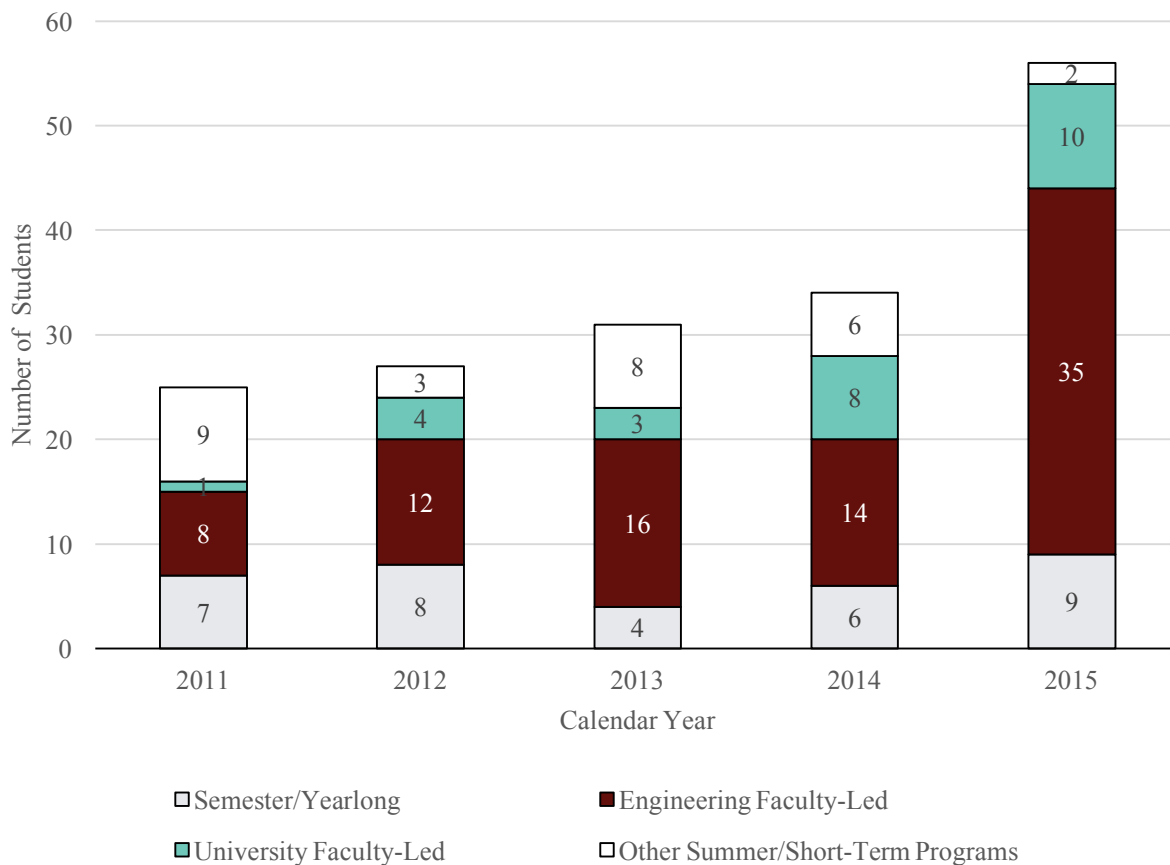


Figure 2: Engineering student participation in international programs between 2011 and 2015.

Summary

The college of engineering has implemented a strategy to increase the number of engineering students participating in international experiences. First, we have introduced faculty-led summer

study abroad programs that are integrated with the curriculum and satisfy degree requirements for our students. Second, we have recruited student ambassadors to increase awareness of various opportunities that exist. We have developed a new minor in Global Engineering Leadership as an incentive for students while simultaneously helping to better prepare them to work effectively in a global marketplace. Finally, the college and the university have been able to develop scholarships so students from all financial backgrounds have the opportunity to gain valuable international experience.

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