When Opportunity Knocks – An Alternative Summer Engineering Internship

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Abstract

Over the past several years, the Mercer University School of Engineering has hosted students from the Brazil Scientific Mobility Program (BSMP). BSMP students are sponsored by the Brazilian government to study a year abroad at colleges and universities in the areas of Science, Technology, Engineering, and Math (STEM).

When advising these BSMP students, it became apparent they had significant challenges obtaining the required summer internships. While these were often good students, companies were somewhat hesitant to hire a student who had no intention of considering them for future fulltime positions. However, in lieu of a summer internship, they could perform research or work on engineering projects in a University setting. Thus was born the Mercer Summer Engineering Experience (MeSEE) program.

This paper describes the synthesis of the MeSEE program. A total of 95 students participated in the first ever MeSEE program during the summer of 2015. In the paper, we include challenges, successes and lessons learned from the program.

Keywords

Summer Internships, Engineering Projects.

Introduction

Over the past several years, the Mercer University School of Engineering has hosted students from the Brazil Scientific Mobility Program (BSMP). BSMP students are sponsored by the Brazilian government to attend a year of study at colleges and universities in the United States. Scholarships are awarded to students in Science, Technology, Engineering and Math (STEM) programs. In 2014-2015 the BSMP scholarship award included an intensive English language course, two semesters of academic study and allocated time for a summer internship.

When advising these BSMP students, it became apparent they had significant challenges obtaining the required summer internships. While these were often good students, companies were somewhat hesitant to hire a student who had no intention of considering them for future fulltime positions. However, in lieu of a summer internship, they could perform research or work on engineering projects in a University setting. Thus was born the Mercer Summer Engineering Experience (MeSEE) program.

This paper first describes opportunities available to engineering students during the summer months which go beyond the traditional classroom experience. The next section describes the Brazil Scientific Mobility Program and its requirement of a summer internship or practical experience. The final section describes the creation of and lessons learned for the MeSEE program launched in the summer of 2015.

Summer Opportunities for Engineering Students

In engineering education, summer opportunities for students such as internships, co-ops, research experiences for undergraduate (REU) and workshops create opportunities for students to gain practical work skills, enhance their chances of academic accomplishment, develop their professional credentials (including soft skills), and provide a competitive edge while pursuing their careers. The Research Experiences for Undergraduate (REUs) program helps students make an original intellectual or creative contribution to the discipline under faculty mentors as well as prepare them for the workplace and society. Moreover, the REU prepares students for graduate school. Internships, co-ops and workshops help students gain practical work experience in the field, which enhance their academic knowledge before graduation.

In the past decade, several researchers have described or developed opportunities in which students gain valuable experience not provided through traditional classroom learning. Delatte[1] described a summer Research Experiences for Undergraduates in structural engineering, funded by the National Science Foundation and operated at the University of Alabama, Birmingham. Nambisan et al.[2] summarized the efforts and outcomes of a pilot student internship program developed jointly in 2012 by the Iowa Department of Transportation (DOT) and the Institute for Transportation at Iowa State University. The interns valued opportunities to work in a professional setting, interact with other professionals and practitioners, experience real-world application of their course work.

Mitchell et al.[3] described the international Genetically Engineered Machines (iGEM) competition that in 2009 included 110 teams from across Asia, Europe, Latin America, and the US. Working at their own schools over the summer, the students used a kit of biological parts from the Registry of Standard Biological Parts, as well as new parts of their own design, to build biological systems that operate in living cells. Chesler et al.[4] designed the engineering virtual internships, which provided engineering experiences in the first-year curriculum. This approach was designed to (a) enable students to solve complex engineering problems in a mentored, collaborative environment; (b) allow educators to assess engineering thinking; and (c) provide an introductory experience that students enjoy and find valuable. Bozic et al.[5] conducted a study on engineering students, who confidently solved well-defined problems but were then exposed to ill-structured problems similar to the workplace. The objective of these internship-like courses was to provide students with a workspace simulation environment where they were exposed to complicated engineering problems. Oka et al.[6] described a learn-by-doing career education program at Niigata University. This novel program introduces students to a series of one-month internship practices so that students obtain a deeper understanding of the practical workplace. Han and Bang[7] discussed internships or field training that provided students with opportunities to develop skills, business interests and aptitudes in the actual workplace.

Building on these examples, the Mercer University School of Engineering developed the Mercer Summer Engineering Experience (MeSEE) program. As will be described later, the MeSEE program provided students with real-world engineering projects or research.

The Brazil Scientific Mobility Program

The Brazil Scientific Mobility Program (BSMP) is comprised of seven scholarship categories. This paper focuses on the undergraduate program which enables selected high performing undergraduate Brazilian students within the fields of Science, Technology, Engineering, and Mathematics (STEM) to participate in a three-part program abroad. Participants placed in the United States receive intensive English language learning instruction, placement at a prestigious higher educational institution for an academic year of studies and an applied internship or research period[8]. Since the inception of the BSMP students have been placed in 30 nations worldwide[9]. Upon completion of the BSMP, all participants return to Brazil for their continued studies and undergraduate graduation.

Mercer University hosts BSMP grantees throughout all three stages of the program. Intensive English language instruction is provided at the English Language Institute at Mercer University located in Atlanta, Georgia, various academic departments at Mercer University in Macon, Georgia host students for their academic year of studies and the Mercer University School of Engineering provides applied research experiences for students through the MeSEE initiative.

With the announcement of the program in 2011, Brazilian President Dilma Rousseff pledged the commitment of the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES- *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*) and the National Council for Scientific and Technological Development (CNPq- *Conselho Nacional de Desenvolvimento Científico e Tecnológico*) to administer the global scholarship program[10].

Together, CAPES, a branch of the Brazilian Ministry of Education and CNPq, an element of the Brazilian Ministry of Science and Technology aim to award 101,000 program scholarships by 2015 [11]. As of August 2015, CAPES and CNPq indicate that 87,826 scholarships have been implemented through Brazilian government funding and private sector involvement[9,12]. Of the 87,826 scholarship grantees, 39.3 percent are students of engineering and 27,317 have been hosted in the United States[9].

In the United States, the BSMP undergraduate program is administered by the Institute of International Education (IIE). IIE is responsible for immigration compliance of J-1 Exchange Visitor visa sponsorship within the non-degree classification, student placement, monitoring of academic progress, institutional billing and supplying host institutional support.

The Brazil Scientific Mobility Program's seven internationalization opportunities aim to bolster the commitment of advanced science and technology knowledge, research capacity, entrepreneurial strategy and cooperation within rising STEM professionals of Brazil and partnering nations[13].

In Portuguese the Brazil Scientific Mobility Program is known as *Ciência sem Fronteiras* (translating to Science Without Borders in English).

Academic Training Requirement

The culminating experience of the BSMP undergraduate program is the requirement for students to participate in Academic Training (AT). Academic Training is an employment authorization that is available for J-1 Exchange Visitors within the United States sponsored through the U.S. Department of State[14].

BSMP students are responsible for proactively networking and applying for internship positions, observerships, or research roles that are directly related to their course of study. Requests for Academic Training approval are submitted through the IIE Student Portal and reviewed by a team of immigration specialists to confirm that the proposed position or experience meets J-1 Exchange Visitor immigration and employment authorization regulations.

Specific to the BSMP element of Academic Training for the 2015 summer period, students were required to engage in an experience that was full-time at 30-45 hours per week, lasting 4-16 weeks and directly related to their course of study[15].

The Mercer Summer Engineering Experience

The Mercer Summer Engineering Experience was initiated in the summer of 2015 to provide the Mercer BSMP students an alternative to a summer internship. This program was offered as 3-credit special topic experiential lab courses and was available to traditional engineering students as well.

The MeSEE consisted of faculty-led teams of engineering students working on engineering projects or research. Faculty had freedom to define expectations and deliverables, working hours, meeting times and level of interaction. Teams typically consisted of anywhere from two to six students. The teams met for a minimum of 10 weeks over the 2015 summer term.

Program Initiation

The first step in beginning the MeSEE program was partnering with the Office of International Programs and obtaining buy-in from other key constituents within the University. These constituents included the Engineering Faculty, the VP of Finance and the Registrar. One constituent we overlooked initially was University Housing, this is discussed in more detail in the "Lessons Learned" section below.

International Programs - Because the MeSEE program originated from the idea of recruiting BSMP students, the Office of International Programs became the key partner for the successful implementation of this program. The International office was the single point of contact between Mercer University and the Institute of International Education (IIE), providing lists of BSMP students attending the program and for billing and payment for the program. The Office of

International Programs also was responsible for landing the students at Mercer, locating and assigning housing, obtaining student IDs, helping with meal plans, providing transportation to local shopping areas, and providing social events to expose Brazilian students to the local culture of Georgia throughout the summer.

Engineering Faculty – The engineering faculty were also a vital component of the MeSEE program. The faculty were responsible for developing projects or research, leading the student teams and evaluating the results. When presented with the concept of these summer MeSEEs, the faculty enthusiastically embraced the idea. Ultimately, 14 faculty developed MeSEE teams. The faculty were also instrumental in shaping the idea that this was an "engineering experience", helping avoid arguments as to whether we were doing "research" or "engineering projects".

VP of Finance – In order to ensure the program was financially viable, we met with the VP of Finance. The final agreement was that revenue generated from the program could be used to pay faculty stipends and other program costs, with any profit equally distributed between the University and the School of Engineering. In addition, all lab fees would be transferred to the School of Engineering.

Registrar – The registrar helped setup summer MeSEE course offerings, lab fees, and processes which allowed registration by invitation only. While the MeSEEs were listed as course offerings, only students recruited by the lead faculty could be registered for that faculty's MeSEE.

Student Recruitment

The faculty who led MeSEEs were responsible for recruiting a student team. To assist with this process, each faculty provided a form which identified the title, instructor contact information, the engineering discipline, dates, and a brief description of the research or engineering project. These MeSEE descriptions were then posted on the engineering website. The Office of International Programs solicited the help of IIE to market this opportunity to BSMP students. We also marketed to our own students. Students who were interested in a particular MeSEE contacted the faculty directly. Faculty were responsible for accepting or denying the contacts. Ultimately, 95 students were recruited to 12 faculty led teams led by 14 faculty. Of these 95 students, 89 were BSMP students and 6 were internal students.

Logistics

Each of the 14 MeSEEs were setup as unique 3-credit independent study courses for the Summer 2015 term. If the students were internal Mercer students, the logistics of registering the student for a MeSEE was relatively straight forward. The faculty lead simply let the Associate Deans office know who these students were. The Associate Dean then registered these internal students for the MeSEE as a credit bearing summer course. Note, because these were "invitation-only"

courses, students could not simply register for the course using our normal electronic registration procedure.

The logistics of registering the international BSMP students was much more complex. The process was more complex for several reasons such as: these students required additional approvals; most of these students were from other Universities, thus requiring new University IDs and orientation; and these students required housing and assistance with travel arrangements.

University IDs and Orientation – Approximately seventy of the BSMP students were from other Universities. Thus, requiring all the normal steps of orienting students to campus such as obtaining University IDs, attending safety and policy talks, learning the layout of campus, etc… While the University is well equipped to orient hundreds of students in the Fall, these normal resources were not readily available in the summer. Thus this burden of orientation fell on the Office of International Programs and Engineering.

Additional Approvals – The first step in approvals for a BSMP student was to have the MeSEE faculty lead sign their Academic Training (AT) form. The AT form was then processed by IIE. This step appeared to be a bottleneck due to the number of BSMP students nationally applying for AT approval and the staffing limitations of IIE. Some BSMP students did not receive approval until just before the start of the Summer session.

Housing – Unlike our local students, the BSMP students required assistance finding housing. We initially estimated about 40-50 BSMP students. However, because we did not have the proper controls in place, 89 BSMP students were recruited. This large increase beyond initial estimates stressed our housing capacities during the summer when we traditional have few dorms in operation. Fortunately the Office of International Programs was able to find housing for all 89 BSMP students.

Engineering Experience

The smoothest portion of the MeSEE program was the engineering projects themselves. Much of this can be attributed to the 14 experienced faculty who had excellent ideas for engineering projects and research. These faculty had anywhere from 3 to 25 years of experience working with students. Also, the 95 students were distributed across these faculty, resulting in small, focused teams.

The 14 faculty approached their MeSEEs differently. Some faculty included a research assistant to help guide the student teams. Other faculty spent significant time early in the program training students, and then turning them loose for the remainder. Other faculty had periodic status meetings to assess progress and to provide guidance throughout. Some faculty even felt comfortable enough with the teams to take a week vacation during the summer term.

Table 1 contains titles for the 12 faculty led MeSEEs during the summer of 2015. These projects required students with backgrounds in Biomedical, Computer, Electrical, Environmental, Industrial and Mechanical Engineering.

MeSEE Project Titles - Summer 2015
Mobile App Development for Public Health
Affordable Powered Hand Prosthesis Design and Development
Measurement of the thermal conductivity of natural and formed composite materials
Healthcare Data Analysis
Simulating human workload using Arena
Evaluation of intermittent sand filters design parameters for treatment of residential gray water
Design and Analysis of a 1-kW hydraulic turbine
Erosion measurement and prediction for various metals
Application of forecasting, sequencing and scheduling to University course offerings
Design , Simulation and Testing of a Flyback DC/DC Converter
Oxygen transfer studies in the activated sludge process
Mathematical/Statistical Models for Analyzing Manufacturing and Industrial Systems

Table 1 - MeSEE Project Titles

Program Benefits

Numerous benefits were gained from this program. Benefits included practical projects for students, research and design work for faculty, economic benefits, and valuable products.

Students - First, the students gained by working closely with a faculty on research or projects. Both the students and faculty were able to devote more concentrated time to these projects than is typically available during the Fall or Spring terms. The results were much more complete projects and a greater sense of satisfaction. Several teams were so proud of their results that they posted the projects on youTube©. For example, one team developed a prosthetic hand controlled by reacting to upper arm muscle movement, https://www.youtube.com/watch?v=TqT4MHqVFDE. Another team printed the major components of a quad copter https://youtu.be/JwQzwoAvHg8.

Faculty – One faculty commented about the program, "This is the most motivated I have been in years", referring to his recruiting an excellent team of students who designed a low-cost hydro-powered generator. Other faculty were also surprised and delighted by the results their teams produced in the short 10 week program. The general consensus for the reason behind the good results was that these teams were focused only on the MeSEE project. Their time was not divided between numerous classes and extra-curricular activities.

Economic Impact – The 2015 MeSEE program generated a $450,000 economic impact on Mercer and the local community. This impact was realized with tuition covering stipends for

students, housing for both the Mercer campus and nearby apartments, and food and entertainment spending in the community.

Products - Other teams designed and built successful products that have been put into use. For example, one team was tasked to develop a software tool that generated and then ranked all possible permutations of freshmen class schedules. This tool was immediately placed into use, helping schedule freshmen for the Fall 2015 term.

Lessons Learned

Housing – Obtain a housing allotment before recruiting international students. Develop an allocation method of students for each faculty based on the limited housing allotment.

Start and End Times – Have a single start and end time for all MeSEEs. Do not allow faculty to specify alternative start and stop times. Also, ensure the start and stop times are after the dorms have cleared from the Spring term and before the start of the Fall term.

Meals – Request the meal stipend option from IIE, not a meal plan. Summer meal plans often do not include the weekends or are limited at best.

Lab Fees – Lab fees are a challenge in that money is needed early in the MeSEE to purchase required materials. However, lab fees are typically not allocated until after fees are collected which happens well into the semester. Possible establishment of a miscellaneous budget line which can advance lab money to be spent before it has been collected.

Fiscal Year – Mercer's fiscal year end falls on June 30th. This makes the accounting difficult. There is no means of avoiding this, just be aware and work within existing guidelines.

Registration Process – Because of the "invitation only" nature of the MeSEE, while still listing the MeSEE experiences as courses, we developed a process whereby a single point of contact was required to register students. In addition, a University ID was required for each student, and each student had to access their account and acknowledge a "Responsibility Statement" prior to registration. Alternative processes may be possible to simplify this process.

IIE Approvals Process – Just as Mercer was somewhat overwhelmed with the number of BSMP students applying for the program, so too was the Institute of International Education. The BSMP students required approval of their AT experience. In some cases this occurred up to and past the start date of some MeSEEs. Accepting students and forming MeSEE teams by a set deadline closer to the start of the Academic Training approval period could enable a faster approval turnaround.

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