
AC 2012-3892: STUDY ABROAD IN BRAZIL: A PILOT PROJECT IN THE COLLEGE OF ENGINEERING AT VIRGINIA TECH

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Eileen Van Aken, Ph.D., received her B.S. in industrial engineering and operations research from Virginia Tech. She also received her M.S. and Ph.D. degrees in industrial and systems engineering from Virginia Tech. In 1996, she joined the ISE faculty as an Assistant Professor, was promoted to Associate Professor with tenure in 2003, and promoted to Full Professor in 2011. In 1999, she founded the Enterprise Engineering Research Lab for which she continues to serve as Director. She currently holds the position as Associate Department Head and Undergraduate Program Director. Prior to joining the ISE faculty at Virginia Tech, she was employed for seven years at the Center for Organizational Performance Improvement at Virginia Tech and was also employed by AT&T Microelectronics in Richmond, Va., where she worked in both process and product engineering. Her interests in research and teaching include performance measurement and management systems, organizational improvement, team-based work systems, and lean work systems. Her research has been funded by both industry and federal agencies. Van Aken has authored more than 70 papers in refereed journals and refereed conference proceedings and has been responsible for bringing in more than \$3 million of externally-funded research to Virginia Tech. She has given dozens of invited presentations and workshops to disseminate research findings to both the academic community and to practicing managers, both nationally and internationally. Van Aken has served on many department, college, and university committees at Virginia Tech, including key departmental committees such as the Undergraduate Program Committee (which she currently chairs), Graduate Program Committee, and Search Committee. She has also been involved in serving the College and University in recent years through her involvement in AdvanceVT, a program funded by the National Science Foundation with the aim of increasing the role of women faculty in science and engineering. The AdvanceVT program and NSF grant funding has enabled Virginia Tech to make significant progress in this area, as well as progress in instituting and revising faculty work-life policies and programs that benefit all faculty. Van Aken holds senior membership in both the Institute of Industrial Engineers and the American Society for Quality, and is also a member of the American Society for Engineering Management and American Society for Engineering Education. She is currently serving as Immediate Past President and member of the Board of Directors of the Society of Engineering and Management Systems (one of IIE's societies) and she served as Chair for three years of the Engineering Management Track at the Industrial Engineering Research Conference. She served as the Co-chair for the overall technical program at the IERC in 2011. She served as Chair of the U.S. Senate Productivity and Quality Award Program for Virginia for two years, after having served on the Board of Directors and as an Examiner for several years. In 2002, she was inducted as a Fellow in the World Academy of Productivity Sciences and in 2010 was inducted as a Fellow in the American Society of Engineering Management.

Study Abroad in Brazil: A Pilot Project in the College of Engineering at Virginia Tech

Abstract

In 2007, a study abroad project funded under the Funds for Improvement of Post- Secondary Education (FIPSE) program (US-Brazil Program) of the Department of Education began at Virginia Tech. This is the first such project for engineering students at this university. Faculty members from four departments (Engineering Education (EngE); Industrial and Systems Engineering (ISE); Civil and Environmental (CEE); and Materials Science and Engineering (MSE)) participated in this project. Project investigators collaborated with investigators from two U.S. universities and three Brazilian universities and developed a student exchange program. Seven students have studied in Brazil for at least one semester and the project expires in 2012. This paper discusses: (i) key strategies for recruiting students to the study abroad program, (ii) issues involved in developing Memorandums of Understanding and Student Exchange Agreements between Virginia Tech and Brazilian universities, (iii) Portuguese language training and course transfer issues from Brazilian universities, (iv) experiences of students, and (v) an “International Engineering Certificate” which is under development for undergraduate students in the College of Engineering.

1.0 Introduction

An International Faculty Development Program (IFDP) has been implemented at Virginia Tech since 2005 to encourage and train faculty to internationalize the university’s curricula. The lead author represented the College of Engineering on the first cohort of IFDP which included 13 faculty from various colleges across the university and co-authored the cohort’s report that included various recommendations to internationalize curricula [1]. As a result of participating in the IFDP, the lead author led various initiatives targeted at internationalizing the freshman engineering program (also called General Engineering (GE)) at the university. A major grant under the Department-Level Reform (DLR) program of the National Science Foundation facilitated implementation of various international activities into this program, particularly into the large first-semester required engineering course, ENGE 1024 “Engineering Exploration,” having an annual enrollment of approximately 1,450 students [2]. This 2-credit course is required of all engineering freshmen and is offered by the Department of Engineering Education (ENGE). The course includes a 50-minute lecture and several hands-on activities that are targeted at promoting international awareness and developing global competence. Instructors discuss issues related to international education raised in national publications such as *The Engineer of 2020*, *Educating the Engineers of 2020* by the National Academy of Engineering (NAE) [3] [4]. Some examples of hands-on activities with an international flavor include: a world map activity [2], an 8-week long sustainable energy design project (SEDP) [5], and a 20-minute study abroad presentation by an upper-class student with experience in study abroad. These study abroad presentations were included in ENGE 1024 beginning in spring 2005, and this practice continues at the time of this writing. Since then, more than 50 upper-class students with study abroad experiences in Australia, India, New Zealand, China, Ireland, Italy, South Africa, France, Spain, Russia, Brazil, and the United Kingdom have shared their experiences with engineering

freshmen. Students have reacted positively to these presentations. Figure 1 shows students' responses in the last four years to the exit survey question shown below.

Class Exit Survey Question: *Please recall a guest presenter discussed his/her study/work abroad experiences with you in your lecture class. I found this presentation:*

- Response Category:
1. *Very useful and it motivated me to consider study abroad options in future*
 2. *Useful but it's too early to make plans for studying abroad*
 3. *Useful but I'm not interested in studying abroad*
 4. *Not useful*
 5. *None of the above*
 6. *No answer*

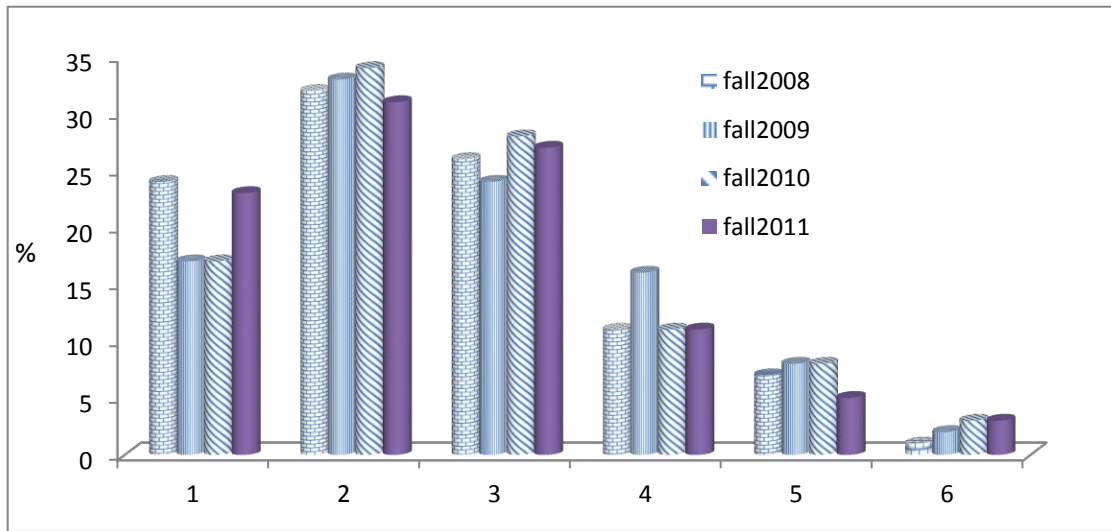


Figure 1: ENGE 1024 Exit Survey Responses, Fall 2008, 2009, 2010, 2011 (n= 314, 329, 610, and 211, respectively).

In spring 2007, an opportunity arose to collaborate with investigators at two universities in North Carolina for developing a proposal for the Funds for the Improvement of Post-Secondary Education of the Department of Education (FIPSE) under the US-Brazil program. Thus began the first FIPSE-supported project for engineering students at Virginia Tech. Faculty members from four departments (Engineering Education (ENGE); Industrial and Systems Engineering (ISE); Civil and Environmental (CEE); and Materials Science and Engineering (MSE)) participated in developing a semester-long student exchange program in Brazil. Faculty members from three Brazilian universities (Universidade Federal do Rio de Janeiro, Pontificia Universidade Católica do Paraná, and Universidade Federal do Juiz de Fora) developed the Brazilian component of the project. Seven engineering students from Virginia Tech have studied in Brazil for at least one semester during this project, which expires in 2012. The rest of the paper is organized as follows. In Section 2, we discuss various preparatory activities that were initiated for launching the FIPSE project. Section 3 presents examples of course transfer issues that students and faculty encountered with an example from the ISE department. This project also initiated the development of an International Engineering Certificate for undergraduates in the College of Engineering and Section 4 will present the status of this certificate. All students

were required to submit a completion report after returning from Brazil. A summary of students' reflections is presented in Section 5. Finally, we summarize the paper in Section 6 with our own reflections and recommendations.

2.0 FIPSE Project Implementation Activities

Engineering Departments Involved: The lead author, a faculty member in ENGE, invited other engineering faculty to participate in the FIPSE project; faculty from ISE, MSE, and CEE expressed interest at that time and hence the study abroad opportunities were made available to students majoring in these departments. A core group of four faculty (one each from ENGE, ISE, CEE, and MSE) was formed for implementing project activities. Key activities of the core group included: (i) recruiting and identifying qualified students for this program, (ii) evaluating potential applicants and selecting students to study abroad, (iii) writing proposals to seek additional funding from the College of Engineering's International Programs office, (iv) identifying and evaluating transferability of Brazilian courses for students, (v) advising students on pre-departure activities and during their semester abroad; and (vi) advising Brazilian students during their time at Virginia Tech. In addition to the core faculty, some faculty and staff members from participating departments also assisted in implementing project activities.

Student Recruitment: At Virginia Tech, all engineering freshmen are admitted into a year-long General Engineering program and students transfer into one of 12 engineering departments as sophomores after completing freshman year requirements. The lead author advertised the project in ENGE 1024 and all freshmen learned about project activities beginning in spring 2008. Presentations were also made multiple semesters in introductory sophomore-level classes in the three degree-granting departments represented (i.e., Introduction to Civil Engineering, Engineering Economics (the first in-major course taken by ISE students), and Introduction to Materials Science and Engineering) to recruit potential candidates. Students were required to complete an application form and also submitted a 1-page essay discussing their motivation for pursuing the program. The core faculty evaluated all applications and made final selections by issuing award letters. All awardees were expected to submit a study completion report and were also required to make a short presentation in ENGE 1024 after their study abroad to share their experiences with freshmen. Seven students (3 from CEE, 1 from MSE, and 3 from ISE) were selected for the program. Student GPAs at the time of application ranged from 2.80 to 3.95. All students selected for the program had to also register through the university's study abroad office (just like any student at the university doing a study abroad). Officials at this office assisted students in applying for admission into the selected Brazilian university and in obtaining travel documents (i.e., a visa) and in advising them about other foreign travel related issues.

Language Training: The medium of instruction in Brazil is Portuguese and students needed a basic familiarity with Portuguese before leaving for their semester-long study in Brazil. This turned out to be one of the major challenges for investigators since Virginia Tech does not offer regular, formal courses in Portuguese. Funding obtained from the College of Engineering enabled us to hire a temporary Portuguese instructor twice for a semester-long course. However, the course was not able to be offered as a for-credit course due to insufficient language instruction credentials of the instructor (needed for university accreditation processes) – the instructor was, however, Brazilian and thus able to provide effective instruction, although students had to take the course above and beyond their regular semester credit load. This

instructor was again hired by another FIPSE project group for a second semester. Out of the seven students in our program, we were able to provide formal Portuguese instruction to all but one of the seven students due to resource constraints and non-availability of trained Portuguese instructors. We used project funds to purchase Rosetta Stone CDs for assisting students in learning basic Portuguese prior to their studies in Brazil. Almost all of the students went through a 4-6 week long intensive Portuguese course in Brazil prior to beginning their formal study program in Brazil. Further, all students took a Portuguese language course during their semester abroad, in addition to their other courses.

Faculty Visits: The core group of faculty visited faculty and administrators at the three Brazilian universities (see Figure 2). The first trip was undertaken in June 2008 to begin the university partnership and meet faculty counterparts in various departments. During these trips, the following activities were performed: meetings with departmental faculty and university administrators for initiating student exchange activities, review of course syllabi for identifying potential courses for U.S. students to take, visit of labs and experimental facilities, and seminars to exchange ideas and develop collaborative activities. Faculty groups from Brazil also visited Virginia Tech multiple times and issues for implementing project activities were discussed.



Figure 2: Faculty Visits to/from Virginia Tech to/from Brazilian Universities.

MOUs: Because the FIPSE project involved student exchange, formal Memorandums of Understanding were developed with the assistance of the international program office at Virginia Tech. Language and translation issues became a challenge in this activity. Virginia Tech signed a separate MOU with each Brazilian university, in both English and Portuguese. Students from Virginia Tech paid tuition at their home institution for their studies at Brazilian universities. Conversely, Brazilian students studying at Virginia Tech did not have to pay our tuition.



Figure 3: Presentation of a MOU to Visiting Brazilian Faculty.

Student Scholarships: Each student received between \$4,200-4,500 for his/her semester long study in Brazil which included \$3,750 from FIPSE funds with the rest coming from their respective engineering departments. Students made their own travel and living arrangements in Brazil. The Brazilian host universities provided some assistance in identifying suitable

accommodations. Finding safe and inexpensive living arrangements proved to be a challenge for students attending one of the universities in a very large city.

3.0 Course Transfer Issues: Example from Industrial and Systems Engineering

For the purpose of this paper, the ISE Department is used as an example to demonstrate the types of activities necessary to support transfer of courses for students at Virginia Tech. One of the aims of this program was not only to provide an opportunity for study abroad for engineering students, but specifically to facilitate the process of taking in-major courses during the semester abroad. At Virginia Tech, many engineering students believe a study abroad is not possible for them because of the difficulty in finding equivalent courses elsewhere and thus, because of this, the likelihood that students will fall behind in their degree progress, delaying their graduation by a semester or even a year. Those engineering students who have completed a study abroad typically have taken non-engineering courses (to satisfy liberal education electives) or fundamental engineering, math, or science courses. Therefore, part of this program's activities needed to focus on identifying equivalent courses in the three Brazilian universities, in the industrial engineering department, that would satisfy the course requirements here.

After identifying the junior year as the most likely time that ISE students would pursue a study abroad (based on previous students' plans), the first step was to identify and obtain course syllabi from the Brazilian institutions for the potential junior-level courses here. For the most part, it was not a problem to obtain English translations of course syllabi, although some syllabi did not have much detail. After each ISE student decided which university they would attend (based on discussion with the ISE Undergraduate Program Director), the relevant course syllabi were then evaluated by the various ISE instructors here for potential transfer. The rule of thumb provided by the registrar's office was that, for any transfer course, if it met 70% or more of the equivalent class here, it is typically approved (this is the case for any transfer course – whether in the U.S. or abroad). This meant that the ISE faculty needed to be willing to be flexible in accepting a course that might lack some of the material which would be covered when they teach their particular course. In order to support this study abroad program, all faculty willingly did this; in fact, in most cases, we found that the courses were a strong match for ISE courses here. In the case of one student who wished to take a Facilities Planning and Material Handling course in Brazil, there was a good match for everything the Brazilian course covered with the exception of one major topic, making the course about a 60% match. In this case, we allowed the student to take the Brazilian course but then upon her return, she had to complete a 1-credit independent study (advised by the regular Facilities course instructor here) to fully satisfy the course requirement here. The course was not designated in her transcript record as satisfying the ISE 3214 course until she successfully completed the independent study. This plan was all pre-approved prior to the student leaving for Brazil – this was important so that the student knew exactly what she needed to do during her semester abroad. To ensure a smooth course registration process, significant communication occurred between faculty at both universities prior to the student's departure. This overall approach enabled the student to take, complete, and transfer four industrial engineering courses during her semester abroad (in addition to the Portuguese language course she took); return here in order to take one required junior-level course, not offered in Brazil, in the second summer session; and still graduate within four years. The other two ISE students participating in this program attended a different Brazilian university

together at the same time and each took three industrial engineering courses, which were also pre-approved before their departure.

In summary, to facilitate engineering students taking in-major courses abroad, it takes some work on the part of departmental administrators and faculty to evaluate potential transfer courses for students before they leave. However, once this is done, any subsequent student will already have a concrete plan for what they should take. The “start-up” cost (in terms of time) was not significant but simply required some planning and communication with Brazilian faculty counterparts, as well as the College of Engineering staff who manage the course transfer process.

4.0 International Engineering Certificate

In order to recognize the unique and significant achievement of students participating in this program, and to serve as a mechanism to attract more engineering students to participate in international activities, the core faculty team for this project developed a draft of an International Engineering Certificate. After reviewing similar certificate requirements at a number of other universities, the following requirements were identified to earn the certificate at Virginia Tech:

1. Successfully complete an international engineering experience outside of the U.S. for a minimum of six weeks, by completing academic engineering coursework, engineering research, or engineering work (i.e., internship)¹.
2. Complete a cultural experience through 3 credits or more of academic coursework. This cultural experience may be related to further language study, culture, art, history, or literature. It must be relevant to the country for the international engineering experience.
3. Give a 20 minute formal presentation on the study abroad experience judged by faculty on completeness (covering the engineering work completed, cultural experiences, and impact on student) as well as presentation quality.
4. Be in good academic standing within the student’s Department and in the College of Engineering.
5. Provide service to the Department and/or College to help promote international engineering experiences (e.g., presentation in class or information session, mini-article in newsletter or magazine, etc.).

¹*Note: Students are strongly encouraged to obtain an engineering experience in a country where they need to learn a foreign language.*

These requirements were presented to the College of Engineering International Programs Faculty Committee (IPFC), which approved them. The proposed certificate is still in the process of being discussed and reviewed at the college level – i.e., by the College Undergraduate Curriculum Committee. At this point in time, this is not planned as a certificate which would be noted on students’ transcripts but rather, would be an “informal” certificate awarded by the College of Engineering and the respective Department for a given student.

There are several points to note regarding this set of requirements. First, there was much discussion regarding whether mastery of a foreign language should be a requirement (as it is with a number of such certificates at other universities). Because Virginia Tech is still in a learning curve with respect to study abroad programs for engineering students, the IPFC decided not to include it at the time being because there are a number of existing international programs across the College of Engineering where students can have an international experience (a course/lab, a

faculty-led program, student exchange program, etc.) in countries that are English-speaking or where the instruction is in English but in a non-English speaking country. In order to recognize (and recruit further) students in these programs, the IPFC decided to not include foreign language mastery at this time but noted that it might be added at a future time when study abroad becomes more widespread. Second, the first requirement specifies that the certificate will be awarded to students doing coursework, research, or engineering work abroad – thus, this provides flexibility for students having a variety of experiences (not just formal coursework at another institution) to receive this certificate. For example, there are a number of students who go abroad to complete an undergraduate research experience or to work as an intern abroad, but who do not take any coursework. Yet, these experiences significantly influence a student’s global competency as well. Third, there was discussion about the duration of the time required to be abroad to earn this certificate. The six week minimum was selected on the basis of reviewing current programs in the College of Engineering as well as certificate requirements at other universities. Although one-week programs such as a short faculty-led program or humanitarian projects (whether associated with a course or not) are certainly impactful to a student, they were believed to influence global competence significantly less than an immersive experience lasting six weeks or more. Most students who do complete a study abroad at Virginia Tech remain in country for about 5-6 months. Fourth, the IPFC specifically decided not to specify that the BS degree in engineering needed to be completed in order to receive the certificate. If a student were to have an international experience meeting the requirements above in their sophomore or junior year, the IPFC wanted them to be able to earn this certificate in order to help them be more competitive based on this experience, whether for future internship searches, full-time job searches, or graduate school applications. The Committee did, however, specify that students have to be in good academic standing in order to receive the certificate. Lastly, there are a number of implementation issues to further define and resolve, such as who actually verifies completion of all requirements and holds records of students receiving the certificate (given that it would not appear on the student’s transcript) –whether the Department or the College of Engineering. These, and other, implementation issues are in the process of being defined at the time of this writing.

5.0 Summary of Students’ Reflections

All students were required to submit a study completion report after completing their studies in Brazil. Table 1 presents a summary of students’ quotes from these reports.

Table 1: Student Perceptions of Study Abroad Experience.

Positive Perceptions	Negative Perceptions	Miscellaneous
<p>“One of the greatest assets I left with was a new outlook on my studying. I spent much more time studying normal classes whilst learning a new language in comparison to anything I’ve yet to do in my academic career.”</p> <p>“Another thing I greatly treasure is my experience with big city life.</p>	<p>“I was unable to travel very much due to financial restraints, but there is a great deal of things to do within the city of Rio de Janeiro.”</p> <p>“The one cultural phenomenon I was frustrated with, though, was lack of punctuality. Classes would start late, the buses would come late, friends would meet you later</p>	<p>“I know of a good number of exchange students who were robbed, some on multiple occasions. This may not be able to completely be prevented, but loss can be minimized. I carried close to nothing with me outside of my apartment.”</p> <p>“Although a study abroad</p>

<p>Rio de Janeiro is a very large city and the life there was much different than any area I have previously lived. I learned how to use resources in order to survive in this sort of environment. It also provided with more insight as to whether I would like to live in a comparable city.”</p> <p>“Participation in study abroad programs significantly broadened my cultural knowledge and contributed to [my]personal and professional goals. [I am] currently examining various opportunities to pursue graduate studies in Germany.”</p> <p>“The classes in Brazil are definitely taught from a different perspective, with less focus on homework and tests but more focused on projects with actually companies similar to senior design capstone. It was a really good experience for me to get experience in an actual engineering setting. My projects were at an oil company for facilities planning, and at the local fire station for ergonomics.”</p> <p>“How many people can say they have spent a free semester abroad and had an amazing experience learning, traveling, trying new things, and meeting new people? Thankfully, I can say I am one of those people.”</p> <p>“My experience abroad was absolutely amazing and I would do it 100 times over. It helped me grow intellectually and personally. It harbored many challenges and oftentimes was extremely difficult. However, these challenges allowed me to grow and opened up an experience that will forever change my life for the better.”</p>	<p>than was planned, and so forth. It was quite a challenge getting used to that and I was thankful to come back to American standard of time.”</p> <p>“If I had to suggest one aspect for improvement, I would say that the program coordinators should find out and confirm course equivalencies <i>before</i> the semester abroad starts.”</p> <p>“Although nothing was particularly hard, gathering the paperwork and getting the Visa took a significant amount of time and effort.”</p> <p>“My main criticism of the program comes from the lack of communication during this preparation phase. I did not know what I needed to do to prepare and no one could tell me. My department didn’t know what was going on and when I went around with transfer credit paperwork, no one knew what to do. Things were made even more difficult because the engineering department requests syllabus paperwork for transfer credit but they don’t use syllabus at UFRJ. This made for a lot of headaches when trying to get classes to transfer and it is something I am still working on now. I think things could be made much smoother with some guidance and communication during the preparation phases.”</p>	<p>experience may delay graduation or will result in higher course loads to compensate for unavailable classes during semesters abroad but I feel that studying at a foreign educational institution with foreign students is an excellent way to assimilate a foreign culture and language, and longer stays have higher returns than short stays on language learning, friendships, and enjoyment of a place.”</p> <p>“I had started my Portuguese learning with Rosetta Stone which was good to learn the basics, but it was dull and not very interactive. Also, the software was focused on the style of Portuguese they speak throughout Brazil, but not in Rio.”</p> <p>“People did not appear to be rushing or stressing over every little thing. People greeted each other with kisses on the cheeks and hugs. Lunch was a one to two hour event where people took the time to catch up and spend real time together enjoying each other’s company.”</p> <p>“I recall, with a grin on my face, a comment one of my UFRJ professors said during class: if the only thing that Virginia Tech succeeds in teaching you guys is how to figure things out for yourself when you don’t have help, then we’ve done a good job.”</p> <p>“My language struggles were helped immensely by the intensive course offered through UFRJ. When taking such an intense class and being surrounded by the language 24/7 it is amazing how fast your brain is able to absorb the language. We would spend all day in and out of the classroom and would speak only Portuguese. English was only used as a last resort in communications. This was a huge challenge but it paid off.”</p>
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6.0 Summary

The first FIPSE-supported project at this public university has been successful in developing student exchange activities for engineering students with three Brazilian universities. Seven U.S. students completed a semester-long study in Brazil during 2008-11. Six Brazilian students studied for a semester at Virginia Tech as part of this exchange program. One of them has joined the graduate program in the ISE department at Virginia Tech. The authors are expanding the scope of their collaborative activities. In summer 2010, three Brazilian universities provided supporting letters for a comprehensive program proposal that was submitted by the authors to the U. S Department of Education. Currently, the authors are working to develop a long-term collaborative relationship with a fourth Brazilian university (PUC-Rio). For this purpose, both authors will lead a workshop on “Methods and Strategies for Engineering Education, Curriculum Design, and Program Assessment” which will be held at PUC-Rio during April 18-20, 2012. Forty participants from this and other universities are expected to attend this workshop. The objectives of the workshop are to: (i) Introduce methods and strategies related to first-year engineering education, technology in the classroom, curriculum design, and academic program assessment, (ii) Present findings from selected engineering education research projects conducted at VT, (iii) Identify areas of collaboration between VT and PUC-Rio related to student design projects, and (iv) Identify specific ideas for PUC-Rio faculty to apply methods and strategies in programs and courses.

Students’ quotes in Table 1 present very positive outcomes of the FIPSE program. Almost all students shared their Brazil study experiences with engineering freshmen by making formal presentations and students reacted positively to these presentations (as shown in Figure 1). Based on conversations with our students, it is suggested that an immersive and meaningful study abroad experience should last at least 3-4 months. Also, GPA should be one of the important considerations in selecting students for a study abroad program, particularly the ones that involve instruction in a foreign language and taking engineering courses abroad (like this program entailed). Student recruitment activities should begin in the freshman year courses and repeated in sophomore classes. Students should be provided with adequate guidance before, during, and after the program on course transfer related issues. Also, study abroad offices should have trained staff to assist in necessary paperwork, such as application to the university and obtaining visas. The authors did encounter significant problems in obtaining visas initially for the first trip. Lastly, foreign language departments at universities should seriously consider offering formal Portuguese classes given the educational opportunities offered in Brazil.

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