Rising Sophomore Abroad Program: A Model for Professional Formation of Globally Competent Engineers

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Rising Sophomore Abroad Program at Virginia Tech: A Model for Professional Formation of Globally Competent Engineers

Introduction

There is increasing demand and a critical need for engineers in the workforce who are trained to work in globally distributed teams and prepared to solve ill-structured problems that diffuse across national boundaries.[1,2] To meet those workforce demands and needs, institutions of higher education must work to expand curricular and co-curricular programs to provide undergraduate and graduate engineering students with opportunities to engage in meaningful international education experiences abroad and at their home institutions.[3] Virginia Tech's Rising Sophomore Abroad Program (RSAP) is one approach for offering a global engineering experience for students. RSAP provides students with an opportunity to expand their global competencies while learning about differences in political, technological, social, cultural, educational and environmental systems through experience.

In this paper, we provide a program overview for RSAP and present quantitative and qualitative assessment results for the 2014 cohort. Based on these analyses, we propose a refined, more in-depth evaluation/assessment plan for 2015 to measure the extent to which RSAP student participants achieve program outcomes—this plan can serve as a model for other similar programs that seek to demonstrate value.

Rising Sophomore Abroad Program Overview

Background

The Rising Sophomore Abroad Program (RSAP) was established at Virginia Tech in 2008 by the College of Engineering. Currently housed in Virginia Tech's Department of Engineering Education as of Summer 2014, RSAP integrates an on-campus, semester-long experience with an international experience in a course entitled Global Engineering Practice: Leadership & Culture. For the first time in 2015, the program consists of two international module tracks: 36 first year engineering students will travel to Europe for two weeks to engage in local culture and customs during visits with engineering businesses and universities in Italy, Switzerland, and Germany, and 10 students will travel to the Dominican Republic to engage in a service learning experience. Students from both tracks enroll in the same in-semester course, which enables the class to consider differences in contexts and objectives from a variety of different perspectives.

RSAP provides students with an opportunity to expand their global competencies while learning about differences through experience. As a result, program participants develop: 1) an understanding of technology and business opportunities and challenges in different national contexts, and 2) an understanding of the implications of contextual differences for American engineers. Student interest and the number of participants in the program continue to grow, as measured by the two-fold increase in RSAP applications for 2015 to 137 and an expansion in class enrollment from 24 in 2014 to 46 in 2015 (including five students from North Carolina A&T University who enroll in the in-semester course and connect via video conference and participate in the international module as well).

Program Objectives

RSAP is designed to address three primary program objectives. First, the program provides students with an international experience that will expand their global competencies by traveling abroad and allowing them to learn in situ. Second, RSAP engages students in the culture and customs of people in foreign countries by visiting local businesses and universities and meeting and conversing with local people. Third, the program provides students with an opportunity to experience different countries where the political, technological, social, cultural, educational and environmental systems are different than that of the U.S. by completing in-class assignments that link to experiences when traveling abroad. Reflective assignments are completed after students finish the international module.

Program Components

Each spring, a new cohort of RSAP participants enroll in a semester-long course on Global Engineering Practice: Leadership and Culture. The course, which meets weekly for three hours, is designed to: 1) prepare students for travel abroad and 2) get students to consider engineering challenges and solutions from a global perspective. The length of the class period offers great flexibility and opportunity to employ a variety of active learning strategies[4,5] in addition to traditional pedagogical approaches for instruction. A sample of topics covered during the course include the following: 1) defining what it means to be a globally competent engineer; 2) communication and culture; 3) engineers working abroad; 4) country overviews; 5) student briefs on "what we'll see"; and 5) survival skills for independent travel abroad.

During the month of May, RSAP participants embark on a two week in-country experience throughout Italy, Switzerland, and Germany or a one-week experience to the Dominican Republic. To broaden their knowledge of engineering, with an added international perspective, students participate in a diverse array of technical visits, lectures, and tours. Table 1 provides a sample of technical tours planned for RSAP: Europe participants in May 2015.

Table 1. Sample of technical visits, lectures, and tours planned for RSAP: Europe 2015.

Country	Technical Visits/Lectures/Tours	Focus Area
Italy	Lamborghini Museum and Factory	Automotive
	Barilla Academy and Factory	Food Processing
	Italian Fashion School in Milan	Design/Manufacturing
Switzerland	Grimsel Power Plant Tour	Hydroelectricity
	Entlebuch Biosphere Tour	Conservation
	Lake Constance Region & Conservation Efforts	Conservation
	Bodensee Solar Boat Lake Cruise	Solar Energy
Germany	Audi Museum Ingolstadt	Automotive
	Food Processing Factory Tour	Chemical/Manufacturing
	Innovation Academy	Renewable Energy
	Pharmaceutical Company Tour	Pharmaceutical
	Deutsches Museum	Science & Technology
	Robotics company	Industrial Manufacturing

Assessment Results for the 2014 Cohort of RSAP

Aligned with new faculty leadership of the program, an assessment plan was enacted for 2014 for the seventh cohort of RSAP student (prior cohorts did not have such purposeful data collection). That year, the Global Engineering Practice: Leadership and Culture course identified three overarching objectives and six, mapped, learning outcomes (see Table 2). The outcome evaluation was performed after the program was completed. A third party evaluated the program utilizing a parallel mixed methods design. The data collection included student e-portfolios containing in-class assignments/assessments, a pre- and post-cultural intelligence assessment (CQ), a pre- and post- Global Competency Activity created by Dr. Brent K. Jesiek, and summative course evaluation (EPEV). Together these data (when available to the evaluator), were used to assess the overall success of the program.

Table 2. Course Objectives and Student Learning Outcomes for RSAP 2014

RSAP 2014		Assessment Results
Course Objectives	1. To provide students with an international experience that will expand their global competency by traveling to, and throughout Germany, Switzerland, and Italy (GSI) and allowing them to learn through experience.	Met
	2. To engage students in the culture and customs of people in GSI by visiting local businesses and universities and meeting and conversing with local people.	Partially Met
	3. To provide students with an opportunity to experience different countries where the political, technological, social, cultural, educational and environmental systems are different than that of the United States by completing in-class assignments that link to experiences when traveling abroad.	Could not be assessed
Student Learning Outcomes	Students who successfully complete the course will be able to: 1. Understand technology and business opportunities, challenges, and problems in GSI and their implications to American engineers.	Met
	2. Have a solid understanding of the definition of a 'global engineer' and the skills needed to function successfully as an engineer in a range of different cultural settings.	Met
	3. Recognize the value of the political, technological, social, cultural, educational and environmental history of Germany, Switzerland and Italy and their effects on how engineering is practiced within those countries and globally.	Could not be assessed
	4. Understand and appreciate cultural diversity and how culture and engineering impact global society.	Partially Met
	5. Understand the expansive aspects of engineering and how GSI and you (the student) are interrelated.	Met
	6. Engage in a multicultural environment through the use of new languages on a basic level.	Not Met

Course Objectives

Of the three course objectives, one was met (Objective 1), another partially met (Objective 2), and the third (Objective 3) could not be assessed as data (in-class assignments) were unavailable to the evaluator. Objective 1 was met because students were able to recognize the need for thorough communication and language skills, both geographical and cultural knowledge of the countries visited, the need for flexibility in both scheduling and personal attitudes towards other cultures, and to be "open-minded" towards other cultures across the globe. Objective 2 was partially met because while students visited a variety of companies throughout the duration of the trip including Audi, ABB, Alp Transit and visiting a variety of cities such as Heidelberg, Munich, and Darmstadt, the lack of language preparation seems to have been the largest negative on the experience. From the End of Program Evaluation we find that 19 of 24 students (79.2%) stated they wish they had more foreign language experience.

Student Learning Outcomes

Of the six (6) student learning outcomes (SLO), three (3) were met, one (1) was partially met, one (1) was not met, and one (1) could not be assessed by the evaluator. SLO 1 was met because more than half, 61%, of students stated that they strongly agreed that the program helped increase their knowledge about engineering in other countries and cultures, while 35% of students agreed with the same statement. SLO 2 was also met because, once again reviewing responses from the EPEV, it was found that 65% strongly agreed and 30% agreed that the program helped them improve his or her intercultural skills, and 96% either strongly agreed or agreed that the program helped them improve his or her knowledge about other cultures. These responses correlated 99.4% and 100%, respectively, with knowledge about engineering in other countries and cultures, leading to the evaluation that this outcome was met. The third SLO to be met, SLO 5, found that 91% of students strongly agreed or agreed that the experience helped them gain the skills necessary to work in a global collaborative environment and 50% strongly agreed and 36% agree that the program helped them understand how to work with local groups that might have different values, beliefs, and perceptions of engineering-based concepts than he or she does. These two questions had a correlation of 99.6%, showing how the two constructs related to one another.

The fourth student learning outcome (SLO 4) was partially met because students showed that they understand and appreciate cultural diversity seen in 17 of 22 (77.3%) post-travel responses to the Global Competency Activity but not how culture and engineering impact global society. SLO 6 was not met because there was no opportunity for students to learn a new language before they travelled, even at a basic level and data from the EPEV shows that 19 of 24 (79.2%) students wish they had more expertise in another language. Most felt that more preparation in this area would have enhanced the experience. SLO 3 could not be assessed by the evaluator because there was no data of the course content available for examination.

Planning for Future Growth

To accommodate increased student demand, we increased the size of the 2015 RSAP cohort and have plans to further expand the program in the years to come, adding additional international

module tracks. To prepare for growth, we have: 1) updated program objectives; 2) revised course learning outcomes to allow for additional international tracks; 3) developed a logic model for RSAP; and 4) prepared an evaluation plan to assess immediate and long-term impacts of the program. We use the sections below to elaborate on each.

Updates for RSAP 2015 - Objectives for Program & Student Learning Outcomes for Course

Informed by assessment findings from 2014, program objectives and course learning outcomes were updated and improved for RSAP 2015 (see Appendix A, Table A2). With minor revisions, 2014 course objectives were re-categorized as program objectives for 2015. Student learning outcomes from 2014 were revised to guide course development for 2015.

Program Logic Model

Prior to expanding the program, we developed a logic model for RSAP to link program inputs, outputs, and outcomes. Logic models "can serve as the foundation for making decisions about programs or evaluation activities".[6] Each component of the logic model accounts for important programmatic details, such as: 1) inputs - *what we invest*; 2) activities - *what we do*; 3) participants - *who we serve*; 4) short-term outcomes - *changes in learning*; 5) medium-term outcomes - *changes in action and behavior*; and 6) long-term outcomes - *ultimate benefit*.

The expanded logic model, prepared for and in coordination with RSAP faculty leaders, is provided in Appendix Table B1. An abridged version is illustrated in Figure 1.

Figure 1. Program Logic Model developed for RSAP (abridged version).

Proposed Evaluation Plan for RSAP 2015

Overview

After linking program inputs, outputs, and outcomes, we propose a refined, more in-depth RSAP evaluation plan. The purpose of the evaluation is to: 1) examine the extent to which RSAP objectives and outcomes are being achieved; 2) identify whether changes in student global competency skills have occurred; and 3) judge the overall value of RSAP and its relative value compared to other international engineering education experiences offered through Virginia Tech. The following questions are used to guide and develop the evaluation plan for 2015.

1. To what extent do RSAP student participants achieve program outcomes?
2. How does RSAP participation influence students' curricular decisions, on-campus experiences (co-curricular, extra-curricular), and career pathways?

Cross-sectional and longitudinal data will be collected from RSAP participants and alumni to address the questions highlighted above. The data will include both direct and indirect measures of: 1) student learning with respect to international challenges and opportunities, global competency, technical and cultural aspects of engineering, etc.; 2) student experiences and participation in co-curricular and extra-curricular activities; and 3) career pathways after graduation. The following section provides an in depth discussion of selected methods for collecting information from RSAP participants. This plan can also serve as a model for other similar programs that seek to demonstrate value.

Information Collection

We will use direct (i.e. samples of work, written essays, and portfolios) and indirect (i.e. surveys, interviews, focus groups, and journal entries) measures of student learning and development to evaluate RSAP. Participant data will be collected at multiple junctures of the student experience: 1) before, during, and after course; 2) before, during, and after in-country experience; and 3) before and after graduation. Table 3 provides an overview of proposed methods for collecting information from RSAP participants and alumni. Selected methods for information collection are informed by program evaluation literature relevant to engineering education and international engineering experiences.[7,8,9]

Table 3. Method for collecting information about RSAP.

	Course			in-Country Experience			Graduation	
	Before	During	After	Before	During	After	Before	After
Global Competency Scenario	X		X			X		
Sojourn Readiness Assessment	X			X				
Cultural Intelligence Survey	X		X					
Reflective Activities (journal, blog, etc)	X	X		X	X			
Cognitive Observation Portfolio						X		
Evaluation Survey			X			X		
Interviews & Focus Groups							X	
Engineering Career Pathway Survey								X

Program outcomes for RSAP will be evaluated on an annual basis. Personal products and self-report information from current RSAP participants will be used to evaluate short-term outcomes (i.e. changes in learning). Self-report information from RSAP alumni on "attitudes, behavior, personal characteristics, and academic/professional history"[10] will be used to evaluate medium-term and long-term outcomes (i.e. changes in action/behavior and ultimate benefit, respectively) for the program. The timeline for collecting participant information, from a cohort perspective (i.e. 2015 RSAP cohort), is presented in Figure 2.

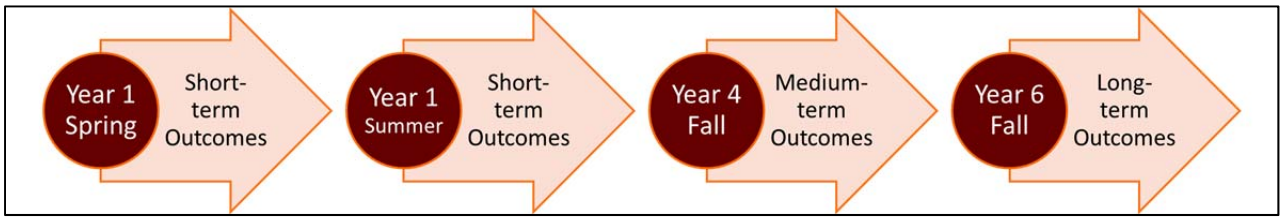

Figure 2. Proposed time for collecting information from the 2015 RSAP cohort.

Reporting Procedures

Program evaluation updates will be delivered to RSAP faculty leaders twice per academic year in the early fall and late spring. Evaluation results will be released in the form of: 1) a mid-year memo and verbal presentation; 2) an end of year written report with an executive summary and a verbal presentation. Contents of the mid-year memo and presentation will include findings related to student learning outcomes (i.e. short-term outcomes). The end of year written report and presentation will focus on program outcomes, progress, and impact to date (i.e. medium and long-term outcomes).

Summary

To meet workforce demands for globally competent engineers, institutions of higher education must provide engineering students with the opportunity to engage in meaningful international education experiences. Virginia Tech's Rising Sophomore Abroad Program (RSAP) is one approach to offer a global engineering experience to first-year students.

While student interest and the number of enrolled students in the program continue to grow, it is important to measure the extent to which RSAP student participants achieve program outcomes. In this paper, we provide an overview of RSAP and share a logic model for the program. Using this information, we propose a refined, more in-depth RSAP evaluation plan to assess student learning and program outcomes. This plan can serve as a model for other international engineering education programs that seek to demonstrate value.

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Appendix A

Table A1. Course Objectives and Student Learning Outcomes for RSAP 2014

RSAP 2014	
Course Objectives	1. To provide students with an international experience that will expand their global competency by traveling to, and throughout, GSI and allowing them to learn through experience. 2. To engage students in the culture and customs of people in GSI by visiting local businesses and universities and meeting and conversing with local people. 3. To provide students with an opportunity to experience different countries where the political, technological, social, cultural, educational and environmental systems are different than that of the United States by completing in-class assignments that link to experiences when traveling abroad.
Student Learning Outcomes	Students who successfully complete the course will be able to: 1. Understand technology and business opportunities, challenges, and problems in GSI and their implications to American engineers. 2. Have a solid understanding of the definition of a 'global engineer' and the skills needed to function successfully as an engineer in a range of different cultural settings. 3. Recognize the value of the political, technological, social, cultural, educational and environmental history of Germany, Switzerland and Italy and their effects on how engineering is practiced within those countries and globally. 4. Understand and appreciate cultural diversity and how culture and engineering impact global society. 5. Understand the expansive aspects of engineering and how GSI and you are interrelated. 6. Engage in a multicultural environment through the use of new languages on a basic level.

Table A2. Updated for RSAP 2015: Objectives for Program & Student Learning Outcomes for Course.

RSAP 2015	
Objectives for Program	1. To provide students with an international experience that will expand their global competency by traveling abroad and allowing them to learn in situ. 2. To engage students in the culture and customs of people in foreign countries by visiting local businesses and universities and meeting and conversing with local people. 3. To provide students with an opportunity to experience different countries where the political, technological, social, cultural, educational and environmental systems are different than that of the U.S. by completing in-class assignments that link to experiences when traveling abroad.
Student Learning Outcomes for Course	Students who successfully complete the course will be able to: 1. Have a solid understanding of the definition of a 'global engineer' and the skills needed to function successfully as an engineer in a range of different cultural settings. 2. Understand global challenges, technological problems, and business opportunities and their implications for American engineers. 3. Understand how differences in political, technological, social, educational and environmental contexts influence engineering practice. 4. Understand and appreciate cultural diversity and how culture impacts engineering in a global society. 5. Engage in an international professional environment.

Appendix B

Table B1. Expanded program logic model developed for RSAP.

Logic Model for the Rising Sophomore Abroad Program	
Inputs *What we invest*	• Faculty and GTA/GRA time (estimate .75 and .5 FTE, respectively) • Administrative support (estimate .25 FTE) • Participant grants for students who demonstrate financial need • Classroom space and technology
Activities *What we do*	• Outreach and student recruiting for RSAP • Facilitate application and selection process • Host semester-long course on Global Engineering Practice: Leadership and Culture • Facilitate a learning experience that co-enrolls students from North Carolina A&T (HBCU) and Virginia Tech (PWI) • Lead two week in-country experience in Italy, Switzerland, & Germany • Use social media to share student experiences throughout RSAP • Connect with RSAP alumni using social media and semester reunions • Conduct research to inform pedagogical approaches on how to develop globally competent engineering graduates

Partici-pation
Who we serve
	<u>Direct service for:</u>
	• 36 first year engineering students each spring semester
	  o 28 students from Virginia Tech
	  o 8 students from North Carolina A&T
	• 67 RSAP alumni via social media and face-to-face reunions
	  o 24 students in 2014
	  o 24 students in 2013
	  o 19 students in 2012
	<u>Indirect service for:</u>
	• Stakeholders interested in research on international engineering education
	• all first year engineering students (e.g. orientation) and broader student body (e.g. outreach, blogs, etc.) at Virginia Tech

Short-term Outcomes *Changes in learning*	<u>Immediately after RSAP experience, student participants will be able to:</u> 1. Have a solid understanding of the definition of a 'global engineer' and the skills needed to function successfully as an engineer in a range of different cultural settings. 2. Understand global challenges, technological problems, and business opportunities and their implications for American engineers. 3. Understand how differences in political, technological, social, educational and environmental contexts influence engineering practice. 4. Understand and appreciate cultural diversity and how culture impacts engineering in a global society. 5. Engage in an international professional environment.

Medium-term Outcomes *Changes in action and behavior*	Before graduation (and post RSAP), student participants will: • Students engage in meaningful global experiences (i.e. Internships, REU, Study Abroad) • Participate in internationally focused campus activities & student organizations (i.e. Engineers for a Sustainable World, Engineers without Borders. etc.) • Enroll in internationally focused courses (i.e. foreign languages, international minor, etc.) • Serve as thought leaders across campus on contemporary issues within a complex and global environment Advance College of Engineering Strategic Plan in the following manner: • Expand opportunities for international experiences in the COE • Engage in multi-organizational and multi-national research to inform pedagogy (i.e. active learning, multidisciplinary explorations, research, co-ops, internships, and problem-solving in a globally complex environment)
Long-term Outcomes *Ultimate benefit*	After graduation, student participants: • Graduate with engineering degrees and enter workforce or graduate school: o trained to work in globally distributed teams o prepared to solve ill-structured problems at a global level o better prepared to work in different cultural context Advance College of Engineering Strategic Plan in the following manner: • "Offer innovative undergraduate degree programs that include flexibility for active learning, multidisciplinary explorations, research, co-ops, internships, and problem-solving in a globally complex environment".[15] • "Offer degrees and research opportunities that feature applications to critical national needs, cross-disciplinary knowledge and global engineering skills".[16] • Increase the number of Virginia Tech engineers in the workforce who are: o trained to work in globally distributed teams o prepared to solve ill-structured problems at a global level o better prepared to work in different cultural context