

September 2008

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Recommended Citation

Johnson, Pauline D. and Johnson, Philip (2008) "Developing Contemporary Engineering Skills through Service Learning in Peru," *Journal of Community Engagement and Scholarship*: Vol. 1 : Iss. 1 , Article 12.
Available at: <https://digitalcommons.northgeorgia.edu/jces/vol1/iss1/12>

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Developing Contemporary Engineering Skills Through Service Learning in Peru

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Abstract

International service learning at The University of Alabama engages students in leadership and teaming roles. In Peru, students practiced skills that meet challenges of engineering in a global society and demonstrate accreditation learning outcomes not easily taught in traditional classrooms. Students in settings like this also get first-hand experience in what engineering is ultimately about: building things that make people's lives better. Assessing the experience in a post-trip survey, students rated teaming lessons, communications, and experiential learning skills as particular strengths.

Introduction

Rapid globalization across many fields is causing dramatic changes in the engineering profession, influencing the manner in which products are invented, designed, and manufactured (Polczynski, 2006). Outsourcing engineering services to developing countries is now commonplace. However, data from the Institute of International Education (2006) shows that, among the students going abroad on international educational experiences, engineering ranks in the bottom three disciplines. The synchronization of engineering education outcomes with the profession's evolution is critical if graduates are to be successful on a global stage.

Updated standards for engineering degree programs reflect this need by expanding the traditional toolbox of engineering technical skills to include soft-skill proficiencies. Specifically, "an ability to function on multi-disciplinary teams ... design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, and sustainability ... and the broad education necessary to understand the impact of engineering solutions in a global, economic,

environmental, and societal context" are current ABET (Accreditation Board for Engineering and Technology, 2000) outcome criteria.

It is a difficult challenge to implement these soft-skill experiences in a meaningful way in the classroom in a curriculum that is already full. The international engineering service learning experience provides an excellent opportunity to develop these skills and prepare students for the challenges of modern engineering.

International Service Learning Benefits

International service learning can have a profound effect on students, faculty, and those with whom they collaborate, with spillover effects for faculty recruiters, advisers, peers, and their home institutions. Furthermore, a proportionally higher number of women and honors students participate in service engagement than are represented in the general engineering student body. The benefits of global experiences for students include development of leadership, teaming, management, communication, and cross-cultural skills; flexibility, adaptability, maturity, independence, and the ability to analyze, adjust to, and appreciate local customs and cultural contexts; and the acquisition of a global perspective, appreciation of the societal implication of their work, and the satisfaction of working with a client to take an international community project from conception and planning through installation. Experience abroad forces students to deal constructively with cultural differences and situations they would not otherwise face.

The International Engineering Service Learning Program at The University of Alabama was established to incorporate these opportunities for growth into the student learning experience to prepare students for the challenges of the modern engineering profession. It does this by getting students ready to serve as effective, en-



UA engineering students discuss drinking water problems with a village leader in El Chino, Peru.

gaged, and ethical professionals by promoting and supporting student engagement in meaningful service for academic credit through two University of Alabama centers, the Center for Ethics and Social Responsibility and the Center for Community-Based Partnerships. These centers provide administrative and seed-funding support to promote student engagement in service learning.

The engineering service experience in Peru was structured within the Engineers Without Borders™ model. This program integrates interdisciplinary engineering service learning with community partners, practitioner oversight, and faculty mentoring.

Strong collaborations were established with Peruvian partners from Nature and Culture International and Programa de Conservación y Uso Sostenible de la Diversidad Biológica (Program for Sustainable Use and Conservation of Biological Diversity) in Iquitos, Peru. They provided logistical assistance and community liaison. In addition the local engineering college at Universidad Particular De Iquitos (University of Iquitos), gave us access to field equipment and joined our students and faculty on field testing, surveys, group discussions, shopping for supplies for our upstream village projects, and evening social out-

ings.

Our target communities were five remote Amazonian villages accessible only by boat from the city of Iquitos in the Amazon Jungle of Peru. Iquitos is the largest city in the world with no access by road. Student-generated service project ideas were developed from conversations with the community during an initial survey trip. This was followed up by two campus-based design projects. A capstone senior design team designed an observation tower to attract ecotourism dollars, and an independent study technical elective student designed a primitive wastewater latrina (latrine) system. Two project installation trips to Peru followed. Projects resulting from this collaboration include soil, water percolation, and topographic surveys, a generator installation to hook up village lights, latrine installation, and most recently the installation of 18 solar panels in three villages. Successive groups are attempting to build upon previous learning. Future teams will construct two rainforest observation towers in sensitive bio-diverse habitats as part of a wider effort to develop sustainable local income from ecotourism in order to prevent deforestation for subsistence agriculture.

Elements of the program include revolving leadership and multi-disciplinary teaming roles



University of Alabama engineering professors Pauline Johnson (second row, fourth from left) and Philip Johnson (third row, third from left, in the Indiana Jones hat) gathered students and villagers for this photo in Chino, Peru, three hours from Iquitos by fast boat. Iquitos is the largest city in the world without access by road. Co-author and community partner Noam Shaney, director of Nature and Culture International, is on the second row, third from left, next to Pauline.

in satisfying pre-, peri-, and post-trip project deliverables. Students are required to incorporate into the project realistic limitations such as technical, economic, environmental, cultural, ethical, social, and sustainability constraints, together with on site procurement, project management, and implementation. Reflection through daily journal entries and evening project meetings reinforced experiential learning. Course outcomes and experiences were evaluated through an end-of-trip report and assessment survey.

Assessment of Learning Outside the (Classroom) Box

Twenty-six students have participated in three Peru trips to date. Pre-2008 students completed standard University of Alabama course evaluations that were largely useless for this type of learning experience; however, the open-ended comments solicited by faculty as feedback proved insightful and useful in planning subsequent trips. The five students on the 2008 solar panels installation trip participated in a formal post-trip assessment. Students scored elements of the experience using a five-point evaluation scale on 12 course elements that included ABET outcomes. In addition, the students were asked four open-ended questions that allowed for qualitative as-

sessments and additional comments (Table 1).

The average score of 4.8 is quite high, indicating strong agreement that the course was a valuable learning experience. Among the outcomes that serve as an assessment basis for engineering accreditation, students agreed strongly that it was an effective learning experience with regard to communication, learning outside the classroom, teaming, and assessment of societal impacts. They agreed, but not as strongly, that it was a valuable learning experience regarding leadership.

In the qualitative section of the survey, students were asked to identify five areas of learning not found in a traditional classroom. They were also asked about challenges, unexpected events, and personal growth. Five students provided eight responses each for a total of 40 comments.

Of these responses, seven dealt with communications, particularly the challenges and successes with technical communications given limited language skills and non-technical clients. Example: "The form of communication didn't matter as long as the ideas were able to cross the language barrier." Five more responses dealt with cultural issues. Example: "Developing countries don't really run on a schedule, but still manage to get things done." Four responses addressed

Table 1. Specific Course Learning Outcomes

This trip was a valuable learning experience with respect to:	Mean	Accreditation Outcome
functioning as a member of a team	4.6	✓
developing leadership skills	4.0	✓
developing organizational and communication skills	5.0	✓
experiential learning without the aid of formal instruction	5.0	✓
examining possible/actual economic, environmental, and societal impacts of a specific, relatively constrained engineering solution	4.8	✓
project management in an international setting	4.8	
understanding the importance of stakeholder (village) input to project planning, scheduling, and/or installation	4.6	
professional career development	4.8	
experiencing another culture	5.0	
my own personal growth experiences	5.0	
expanding my view of the developing world	5.0	
I would recommend this trip to peers	5.0	
Overall average	4.8	
5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree		

positive aspects of teaming. Examples: “Being an effective supportive member of a group.” “The area in which I grew most was working as part of a team and communicating effectively.” Three more dealt with ingenuity. Examples: “I learned to look for alternative and nontraditional methods to accomplish tasks.” “How to make things work with what you have.” “About solar panels and how to install them.”

Others addressed leadership, coping, personal growth, and the value of international travel. Examples: “Helped reinforce leadership skills.” “I could make it without everyday luxuries like electricity and toilets.” “If I push myself I can do things I never imagined.” “I grew most in the knowledge of international traveling. Even though I had been overseas before, this trip was a much better experience. We were given more responsibilities ... I was happy to grow in this area because of my very big interest in traveling and seeing the world.”

While the number of students evaluating their experience is low, their assessment is consistent with feedback the instructors have received over and over again following similar service learning trips.

Learning outside the classroom box is the “real deal,” our students continually tell us. And teaching outside that box has similar rewards for faculty.

Future assessments will include a pre-trip

evaluation to better measure learning outcomes. A question will also be added to solicit suggestions for future trips rather than leave this as an implied question under “other comments,” though when asked if they would recommend this trip to others, three gave it a 5 (strongly agree), one a 10, and one “5 x 1000!”

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