Mara R. London, Gonzaga University

Mara London is an assistant professor of Civil Engineering at Gonzaga University. Her research and teaching focus on water quality and treatment. She was one of two faculty members to travel to Zambia, Africa to assess the feasibility of developing an engineering study abroad program.

Jillian Rae Cadwell, Gonzaga University

I am an assistant professor in the Civil Engineering Department at Gonzaga University. I earned a Ph.D. from the University of Colorado at Boulder in Civil Engineering. My research incorporates biology, ecology, and fluid mechanics in the context of the stirring and mixing of reactive species. One of my primary concerns is with the effect of turbulent mixing on ecosystem health. My interest in understanding interactions between biological systems and the physical environment emerges from an interdisciplinary background in engineering, hydrology, and environmental science. I am also interested in pedagogy, specifically student learning styles. My goal is to engage all students in my classes by presenting material in such a way as to stimulate students with different learning styles (e.g. active learners, reflective observers, outcome-focused learners).

J. Alexander Maxwell, Clarkson University

J. Alex Maxwell is a graduate student at Clarkson University. His primary research involves mercury cycling in the Adirondack park; however, he has remained involved in water quality projects in developing countries as an alumnus of Gonzaga University. In the summer of 2010, he traveled with Gonzaga faculty to Zambia to assess the feasibility of developing an engineering study abroad program.
Introduction

Multiple studies have documented that women value career paths that incorporate a clear social purpose and provide opportunities to help others\textsuperscript{1,2}. Furthermore, studies have shown that the general public does not view engineering as a discipline that plays a viable role in solving the problems of society\textsuperscript{2,3}.

Currently, recruitment and retention of women pursuing engineering degrees at Gonzaga University is in accord with the national average. Described here are efforts to recruit, retain, and attract additional female students through the on-going development of an independent engineering study abroad program in Africa that integrates engineering and social justice projects. The motivation to focus on a study abroad program as a recruitment and retention tool is three-fold, (1) women in engineering study abroad at approximately twice the rate of men\textsuperscript{4}, (2) a desire to support the university’s mission to provide service in remote parts of Africa\textsuperscript{5}, and (3) the opportunity to incorporate into the curriculum a direct connection between engineering and public service.

Program Development

Development of a quality study abroad program, let alone one in a remote area, requires a substantial amount of planning and navigation. During the summer of 2010, two civil engineering faculty, one recent alumnus, and one staff member spent five weeks traveling and researching in communities throughout Zambia, Africa, to investigate program potential. An assessment of program feasibility was made at three potential sites: the remote town of Zambezi, a small village at the Chimfunshi Wildlife Orphanage, and the growing Zambia Catholic University outside the city of Kitwe. During the trip, the development team was able to inspect various teaching and housing facilities, develop local contacts and community partners, gather a volume of logistical details, and evaluate course and project opportunities and their potential impact on local communities.

Assessment results indicated that an ABET-approved sustainable systems and design technical elective (at any of the three locations) is the most appropriate type of course to implement. The course would take the form of a pre-immersion, one-credit course in the spring and a three-credit, four-week international technical elective/socially responsible engagement experience during the summer. This type of course has the potential to be interdisciplinary, not only opening up the program to as many students as possible, but enabling the recruitment of faculty from throughout the engineering school. Additionally, a sustainability theme encompasses many different subject areas (e.g., water, building materials, energy). Therefore, each summer the course can be tailored to suit interested faculty and students.

For now, plans are to advance a program based out of the Chimfunshi Wildlife Orphanage. This location provides several advantages:
Abundant sustainability-focused projects and educational opportunities.
Existing collegial relationship with local community leaders and decision makers.
Ample teaching and housing facilities.

Initial Pilot Project

As establishment of a permanent program continues, a pilot water treatment project at Chimfunshi has been incorporated into senior design curriculum. Currently, community members use an undesirable bacteria-laden surface water source, rather than a chemically and biologically safe ground water source located nearby. This is due to the unpleasant aesthetics (color, taste) and reddish/orange staining caused by high concentrations of iron in the ground water. Students are currently conducting laboratory experiments and developing community- and household-scale prototype designs of an effective, yet inexpensive and simple iron removal water treatment system.

This project was the most popular civil engineering (CE) 2010 – 2011 senior design project (out of a total of 12). Forty-three percent of female CE seniors, and 23% of CE seniors overall, ranked the Zambia project as their number one choice. The senior design team includes two women who are currently working on the project during the 2010 – 2011 academic year.

Future Plans

Presently, four students (two female), one engineering faculty (female), and one teaching assistant are planning to travel to Chimfunshi, Zambia, during the summer of 2011. The group will implement the aforementioned water treatment project and the students will take part in a pilot three-credit technical elective course. This trip also will offer opportunities to further interact with the community and refine plans for future projects. Figure 1 below shows the proposed timeline for continued program development. Program evaluation and impact on recruitment and retention of female students will be assessed through surveys of current and prospective students and learning outcome measurements.

Summary

By integrating engineering and social justice projects, this study abroad program in Africa has the potential to elevate recruitment and retention of female students. Over the next few years, program evaluation, refinement, and publicity will continue, as will outreach to prospective students. As program development progresses, the goal is to qualitatively and quantitatively demonstrate its impact on both the current and prospective student body.
References


4] Salisbury, M., Paulsen, M., & Pascarella, E. *To see the world or stay at home: Applying an integrated student choice model*. Retrieved from University of Iowa, College of Education web site: 
