



Establishing Partnerships for Global Service Learning in Engineering

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Establishing Successful Partnerships for Global Service Learning in Engineering

Abstract

Service learning experiences can be life changing events for both engineering students and faculty. These courses can provide educational context for the impacts – both positive and negative – that engineers have had and continue to have on the developing world. Non-traditional education abroad experiences in developing countries can be a challenge to organize, but can benefit greatly from strong partnerships with organizations in the host country. The University of Kentucky Appropriate Technology and Sustainability (UKATS) research group is an undergraduate, service learning and sustainability focused research group at the University of Kentucky (UK) College of Engineering Paducah Extended Campus Program. This group has established successful partnerships with Non-Governmental Organizations (NGO) in Cameroon and India as part of a non-traditional study abroad course in global service learning in engineering. The service learning projects undertaken by the UKATS research group as part of the EGR 390: Global Service Learning in Engineering course at UK are focused on the development and dissemination of technology based on the principles of appropriate technology and sustainability – particularly the societal impacts of those projects on the local communities. This contribution gives an overview on how these partnerships were developed and describes the importance of strong in-country partnerships for successful service learning experiences. In particular this contribution will illustrate how the need for community interaction is critical to the success of any project in a rural or developing community. The experiences of the UKATS group with the African Centre for Renewable Energy and Sustainable Technology (ACREST) in Cameroon and the Organization of Development Action and Maintenance (ODAM) in India will be described. In addition, lessons learned regarding properly preparing students for service learning based education abroad experiences will be described.

Keywords: Africa, Cameroon, India, education abroad

Introduction

Engineers play a critical role in society. Most people are well aware of the more visible contributions of the profession – from roads and bridges to clean water to manufactured products, pharmaceuticals, chemicals and computers. The list goes on and on. Despite these impacts however, most engineering students fail to realize the importance of their place in the global society. Global service learning courses can help educate engineering students as to the challenges in the developing world and how the engineering profession can address these challenges in an appropriate societal context. That said, in-country experiences in the developing world can be difficult for students due to both logistical and cultural barriers. A group of engineers, no matter how well intentioned, cannot simply show up in a rural area of an underdeveloped region and expect to be successful. Establishing an engaged in-country partner is critical for the chances of successfully meeting the objectives for an international service learning project

Challenges of Working in Developing Regions

International service learning projects differ significantly from traditional study abroad experiences. A traditional study abroad experience features a class or group of classes offered for a foreign university for college credit. Because of the university setting of a traditional study abroad program, room and board and classroom facilities are readily available. Although global service learning projects can be terrific learning experiences for students, the level of planning is much greater than for a traditional study abroad program. In addition, numerous other challenges are encountered when working in developing regions, as will be described.

Cultural challenges

Obviously the potential for a language barrier is perhaps the biggest challenge, but other cultural norms such as style of dress, local cuisine, religious preferences, alcohol use and gestures vary greatly from place to place. It is important not to inadvertently upset or offend residents of the host country. Often social norms, particularly with regard to the treatment of women and their traditional place in society, are very different from the experiences of the typical college student. A good in-country partner will be aware of the differences between western and local culture so that both the visiting students and the local community will be aware of differences, preparing both sides so that any misunderstandings are avoided.

Logistical challenges

Transportation in a rural region in an underdeveloped country is quite different from what students are most likely used to. Issues with clearing customs at the arrival airport are typical and having local support at the airport is invaluable. Outside the airport, travel takes longer and can be unpredictable. The means of transportation can also be quite different, ranging from autorickshaws, to motorcycle taxis to walking. Additionally, there can be safety issues for foreigners traveling in an unfamiliar region.

Lodging and General Safety

In a rural or underdeveloped region, western style lodging can be difficult to find. Indeed, part of the service learning experience is adapting to local norms with regard to lodging and general comfort. Limited electricity, limited communication options, lack of indoor plumbing and climate control are certainly common. That said, ensuring the safety of the travelers is paramount. Since it can be difficult to get information before traveling, complying with university requirement for vetting student accommodation prior to travel is a real challenge.

Community acceptance

Just because a project seems like it will be beneficial doesn't mean that it will be accepted by the local community. The project may address a problem that is not seen as important to the local community or may violate their established cultural norms. Simply having an idea does not automatically lead to a successful project. Although the objective of a global service learning in engineering course is the education of the participating students, the project is a waste of time if it does not benefit the local community. Furthermore, ensuring that the project is accepted by the community and sustainable using local resources after the students leave is also a key challenge.

Healthcare and hygiene

For global service learning programs held outside of a university setting, healthcare may be difficult to find in an emergency situation. Additionally, foodborne and insect borne illnesses are also common in many regions meaning that special precautions are needed to keep students healthy for the duration of their project. It should also be noted that students traveling to these regions should consult with a physician prior to departure regarding medications and vaccines recommended for the particular region. The U.S. Centers for Disease Control website is a good resource for students and faculty. The in-country partner should be able to ensure that the food prepared for students is effectively cleaned and cooked to proper temperatures to avoid illness. This should be a point of discussion between the faculty advisor and the in-country partner before departure.

What Makes a Good International Partner?

In addition to simply having a presence in the target country, an effective partner organization must have a number of key characteristics. Among these are:

Well established in the target country

Unlike in the United States, in many countries, foreign visitors are expected to register with local governmental authorities. This is necessary for local security as well as for the safety and well-being of the

travelers. If the in-country is well established and has a good relationship with local authorities, many problems can be avoided.

Experienced with international visitors

Strong community outreach does not always translate into the ability to host international visitors. Look for organizations who have experience hosting western visitors. This is particularly important with regard to health and hygiene. Keeping a group of visiting students from getting sick requires a good understanding of safe food handling and hygiene. An organization with hosting experience can also best prepare guests with regard to local customs and culture.

Strong local community ties

It is important for students to be briefed on local culture and customs. However, the local partner can also educate the local community about what to expect from their foreign visitors. A two-way understanding of cultural norms and expectations can help to avoid any inadvertent misunderstandings. A good partner organization should know and understand the community needs and be able to create and direct a project that is wanted, needed and accepted by the community.

Ability to handle transportation and logistical issues

Travel is often difficult in underdeveloped countries. Taxi service around large international airports has a reputation for being unsafe for foreigners. Having the in-country partner organize transportation is often the best option. In many cases prices are not fixed and haggling over cost is normal practice. The assistance of the local partner can ensure that reasonable prices are charged for transportation. In addition, the in-country partner is available in the event of unexpected travel disruptions.

Able to provide room and board for the group

Although the in-country partner may not maintain room and board facilities themselves, the partner will be the most important resource in securing housing that is safe and provides an appropriate level of hygiene. Of course it is important to realize that the accommodations in a rural or underdeveloped region will be very different from home. Ensuring the health and safety of the travelers are top priorities. A good in-country partner must provide help with selecting an appropriate location, if they do not provide this themselves.

Access to basic healthcare

Despite the best preparations, some students will get sick when visiting a foreign country. Although most illnesses will only require rest and fluids, the in-country partner must at a minimum have a plan to get to sick individuals to qualified medical professionals if the need arises. The visiting students and faculty should plan for minor medical needs such as bringing a first aid kit and medications such as a pain reliever, antibiotic ointments and medicine for stomach discomfort. It is of course recommended to consult the Centers for Disease Control prior to departure to check for recommended vaccines and a list of common illnesses, but the in-country partner should be able to inform the group of the types of previous incidences that have occurred.

Project sustainability

Once the student group returns home, it is the in-country partner who will bear the responsibility of continuing the project and addressing any problems that may arise. This underscores that the partner must be more than simply a provider of logistics services – they must be a fully engaged partner in the technology or technical solution as well. A successful partnership will only last as long as it is actively maintained. The university group and the in-country partner must establish a plan for maintaining the project after the students leave. Establishing channels for regular communication requires planning and commitment by both parties.

Organizational Partnerships

The UKATS research team has partnered with two NGOs to conduct global service learning experiences for undergraduate students. The first is the African Center for Renewable Energy and Sustainable Technology (ACREST), www.acrest.org, located in Bangang, Cameroon. The second NGO is the Organization of Development, Action and Maintenance (ODAM), www.odamindia.org, located in Tiruchuli, Tamil Nadu, India.

Recent Global Service Learning Projects

Two recent global service learning projects conducted by the UKATS research team highlight the results of two successful international partnerships. The first project was conducted in collaboration with ACREST in Cameroon and the second was conducted in collaboration with ODAM in India. Both projects were conceived based upon the principles of green chemistry, sustainability and appropriate technology (Schumacher, 1973).

Project 1: Developing a Novel Low Cost Biodiesel and Biochar Processor for Rural Cameroon Using Locally Sourced Materials and Feedstocks

The principle objective of this project was to develop a low-cost, environmentally benign technology for producing biodiesel and the associated raw materials, i.e. methanol and base catalyst, from locally available resources available in rural Cameroon in sub-Saharan Africa (Seay, *et al.*, 2014, Seay and Lumkes, 2014). To achieve this objective, three tasks were required:

- Design a low cost process for generating biochar and methanol by destructive wood distillation,
- Design a low cost process for generating biodiesel from locally sourced feedstocks,
- Complete the mechanical design and fabrication plans of a processor for producing biodiesel, biochar and methanol using locally sourced materials.

This project was initially conceived through the partnership with the ACREST. The processor that resulted from this project was designed to be simple to build and operate and to cost less than 100 USD. Locally sourced scrap materials such as discarded steel drums and junkyard automobile parts were the primary construction materials.

Although the production of biodiesel from vegetable oil and methanol from biochar production is certainly well understood, there are numerous technical challenges involved with adapting this technology for the developing world. Principle among these challenges are: ensuring that the design is robust enough to handle wide variations in feedstock quality; developing quality control safeguards for production in rural areas; and ensuring that the chemistry is well understood based on locally available resources.

In rural parts of Africa, electricity is often expensive and unreliable. Therefore the biodiesel processor needed to be designed to require no moving parts, operate without needing electricity and utilize a simple and innovative temperature control strategy. Although a loss in efficiency was expected due to the techniques employed, the student design was rugged and extremely simple to build and operate, making it ideally suited for small scale producers in the developing world.

The partnership with ACREST was critical to the success of this project. The ACREST facility is located approximately 275 km from the international airport in Douala, Cameroon. This meant that transportation would be a critical issue. In addition to organizing all in-country travel, room and board was provided at the ACREST guesthouse in Bangang, Cameroon. ACREST maintains a guest house in addition to the workshop and technology center. The guest house can accommodate up to 18 students and faculty. The ACREST staff prepares all meals and is trained to ensure proper hygiene for the visiting students. Because of the rural location the facility, it is necessary for ACREST to provide all services for visiting groups.

Although electricity and phone service in the village is limited, ACREST provides comfortable accommodations for all their guests which enhanced the student experience.

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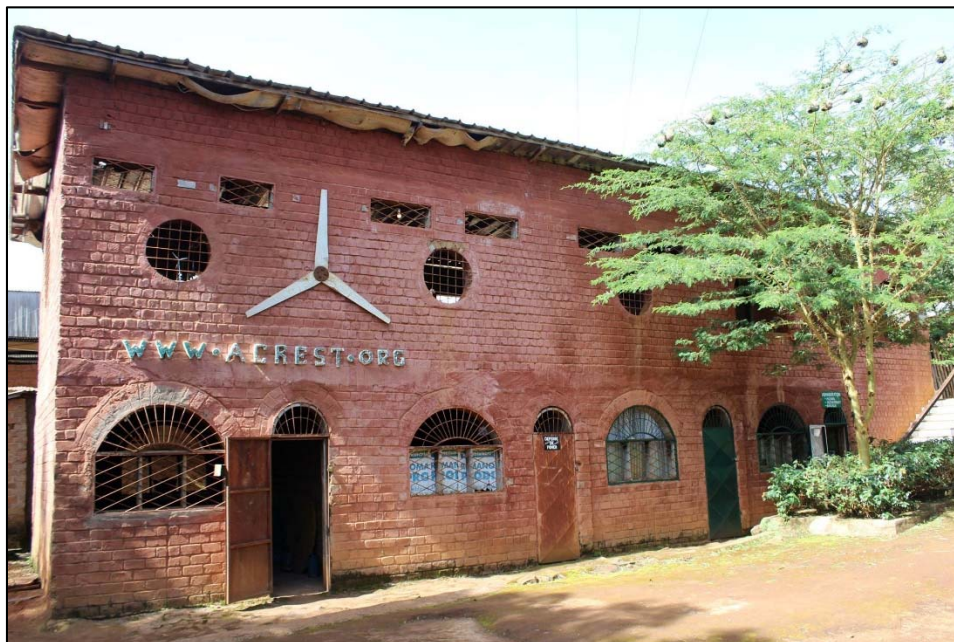


Figure 1. ACREST Workshop in Bangang, Cameroon

Project 2: A Green Chemistry Approach for Producing Non-Synthetic Pesticide in Under-Developed Regions

The main objective of this UKATS research team project was to develop a sustainable, low-cost method for producing a non-synthetic pesticide, wood vinegar, from already existing biochar production techniques present in rural regions of Cameroon, and Tamil Nadu, India. Collecting the wood vinegar reduces the release of volatile chemicals and tars into the atmosphere, which is the case when making biochar using current practices. As a result, this research focuses on minimizing atmospheric pollution by collecting and condensing the released chemicals into a useful and inexpensive, non-synthetic pesticide, herbicide, and fungicide known as wood vinegar. To achieve this goal, the tasks below were required:

- Design and optimize a production method for generating wood vinegar by pyrolysis of locally available biomass.
- Determine the composition of the wood vinegar and its variance as different biomasses are pyrolyzed.
- Conduct field studies in Cameroon and India for the use of wood vinegar as a pesticide, herbicide, and fungicide to enhance its effectiveness.
- Complete the mechanical design and fabrication plans for making wood vinegar using locally sourced construction materials to implement the prototype at ACREST and ODAM.

This project was conceived and conducted through the partnership with ACREST and ODAM. The description of the student team project will be to design and optimize the construction of the wood vinegar processor, and analyze its product for green chemistry use as a non-synthetic pesticide. The challenge to the student team was to fabricate this processor using only locally sourced materials present in rural regions while keeping cost below 100 USD.

To achieve this goal, the UKATS P3 research team developed a sustainable method for collecting, condensing, and transforming the waste gas produced from the production of charcoal into a non-synthetic pesticide, known as wood vinegar. The use of renewable feedstock leads to generation of safer, more sustainable pesticides, which minimize adverse effects on human health and environment. The results of this collaborative design project will combining engineering technology in a way that makes the collection and use of wood vinegar based pesticide easy and accessible to a wide array of potential users in the developing world.

As with the previous project, the partnership with ODAM was critical to the success of this project. ODAM maintains a technical facility in Tiruchuli, with kitchen and dining facilities, but does not have room to accommodate a large student group. Unfortunately there were no suitable lodging facilities in Tiruchuli. Because of this, ODAM arranged lodging at a facility in the nearby city of Aruppukottai, about 20 km away, and arranged daily transportation from the lodging location to the ODAM workshop. Due to the duration of the trip, ODAM also arranged for several excursions to nearby areas of cultural importance.

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Figure 2. ODAM facility in Tiruchuli, Tamil Nadu, India

Conclusions

In conclusion, the successful execution of a global service learning project is dependent on many factors, but perhaps the most important is having a strong in-country partner. Finding a partner is a critical first step for faculty interested in engaging in a service learning project in a developing nation. Overcoming cultural as well as logistical hurdles is certainly most effectively done with a committed partner organization. As a result this contribution has highlighted some of the key characteristics of an in-country partner and provided examples of how having such a partnership has led to successful project implementation in India and Cameroon.

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References

- Schumacher, E. F. (1973): *Small Is Beautiful: Economics as if People Mattered*, Harper & Row, New York, New York.
- Seay, J. and J. Lumkes (2014): “Multi-University Partnership for Global Service Learning in Sub-Saharan Africa”, *International Journal of Service Learning in Engineering*, Special Issue, pp 367-380, Fall 2014.
- Seay, J., I. Zama and B. Butler (2012): “International Partnership Helping to Bring Appropriate Biofuel Technology to Rural Cameroon”, *International Journal of Service Learning in Engineering*, Vol. 7, No. 2.