High Altitude Water Shortage Issues in Peru.

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Engagement in Practice: Relationship Based Community Model addressing High Altitude Water Shortage Issues in Peru.

Abstract

In July 2018, a team of 8 students, a faculty member and a staff member from the University of Louisville left for Calca, Peru to meet with indigenous, marginalized communities to support and assist them in their efforts to address water access issues and concerns.

This project developed out a need to increase global opportunities at a four-year, mandatory co-op engineering program that offered few opportunities for global exposure. The result was the development of a semester-long annual course which culminates in a 16 day in-country experience. This program utilizes three partners: the indigenous communities, a local non-profit organization called Andean Alliance (that facilitates the relationship) and the university.

The course was designed to utilize a consulting model to work with the Peruvian community to assess an extensive problem and identify and define a subset of the problem where they can effect change. During the field portion of the trip, students integrate the use of drones, a GIS computer system, and flow calculation systems to create a document and map that identifies and quantifies water loss and canal damage, this data can be used to apply for federal funding to correct canal issues and improve water usage among the farming communities that were targeted.

Program improvements for the second year developed from technical issues from the first trip and a stronger understanding of the community needs. The semester course incorporated higher technical training, the addition of drone training and a technical support staff member. Future trips will incorporate additional technology and build upon the base map that was developed. It will also incorporate training with community members to increase data collection throughout the year and to inspire ownership of the project and the results.

Introduction

It is widely accepted that service learning is an enhancement of academic learning through community engagement. The demonstrated benefits of service learning when combined with coursework are significantly higher than the benefits of community service or volunteerism alone. As summarized by Meagan Vaughan and Janet Ellzey [1] "The reported benefits of Service Learning are promising. Improved student retention, interpersonal skills, cultural and racial understanding, academic achievement, sense of identity, sense of social responsibility, commitment to continued service, and involvement from underrepresented populations in engineering are all among the marked benefits of student participation in Service Learning programs."

To further augment the impact on the community, this project seeks to identify the needs of the community as stated and decided upon by the community members themselves. To facilitate this

process, the University of Louisville chose to identify a partner on the ground in Calca, Peru, the site for the project.

The Andean Alliance for Sustainable Development is a unique non-profit organization because they believe that the communities are more capable of eliminating their poverty than any development expert and therefore they rely on the communities to identify the projects that would provide the highest value. The Alliance seeks to create collaboration between communities and students to identify projects that cater to the unique needs and strengths of each community. This allows for higher community buy in and long term sustainability.

In the area known as the Sacred Valley, or the Calca region, agriculture plays a significant cultural and economic role. Changing weather patterns have disrupted water sources forcing farmers in the Peruvian Highlands to modify traditional practices to remain resilient.

In partnership with the Andean Alliance, the University of Louisville Speed School of Engineering students work with Peruvian communities to understand the irrigation challenges farmers face and develop tangible community-based projects to address them. The Andean Alliance focuses on a transitional learning experience for students that takes into consideration the needs and voice of the community. Significant time was spent with the community listening to the needs of the community and the potential impact.

In the following sections, the class, content and project implementation methods of this program are discussed. The hope is that the experience will help other universities identify ways to connect to this project for further assistance in the Andean communities, and particularly in the Sacred Valley.

Class Structure

The service learning program is presented as a course in which the students enroll. The course is listed as a special topics course - Current Topics in Civil and Environmental Engineering. The faculty instructor and technical support role are housed within this department although the course is open to engineering students from all disciplines. While some of the techniques that are used are most relevant to the civil engineering profession, the international consulting approach and the skills developed through project implementation are useful to engineers from all disciplines.

The objective of this course is for students to assess an extensive problem such as irrigation water shortages, and be able to identify and define a subset of the problem where they can effect change. Through this work, the student will review possible remedial actions and determine which are viable relative to social, cultural and economic resources.

To facilitate the community engagement and input, a consulting model is utilized. The consulting model takes into account the client's perspective of the issues at hand and integrates the client into the conversation from the beginning of the process. Similarly, the client is consulted at varying points of the project to ensure that the project and the resulting product will meet their needs. Contingency planning and risk calculation are also part of the learning of objectives of the

consulting approach. In addition, lessons in documentation and community presentation are also included.

Course Content – Cultural

Students start the semester with a brief introduction to the concept of service learning and the added benefits of community-based service learning. Case studies are presented that highlight successful and less than successful international service learning projects. The ethical complexities of engaging in development work and research are also discussed.

In addition, students examine the historical context of the importance of water throughout the many cultural societies in the country of Peru, with a strong focus on the Cusco Region. This information is used to inform the needs of the technical project as well. Cultural information is provided by one of the directors of the Andean Alliance. The director provides lectures either in person or via Skype and facilitates virtual meetings with key leaders of the community.

Calca, the primary city of the program, is one of 13 provinces in Southern Peru. The town center is a non-tourist area (no tourist attractions are located here). Spanish is widely spoken and taught in the education system although most families here speak Quetchua as their mother tongue. The rural areas of Peru are more populated by indigenous people. And while not a minority, they are marginalized in terms of income, healthcare and access to strong education.

Access to water and the elevation of altitude strongly influences agricultural practices in the mountains and valleys of Southern Peru. Students examined altitude issues that impact farmers in higher elevations and the health and economic implications. As part of the immersion program, students spend one day in a community of a higher elevation to assist with the construction of a greenhouse. Students hear and see first-hand the lack of agricultural diversity in the higher elevation. Anemia is considered a severe health issue in Peru affecting at least 50% of the population – primarily in the mountainous regions. Developmental and cognitive delays and stunted growth can be direct impacts.

To augment the cultural content of the course, once in country, the students visited three archeological sites including Urco, Pisac, and Machu Picchu. Each tour was led by an expert guide. Students also toured the Inca Museum in Cusco, Peru which provides a historical context of not only the Inca people, but also the generations from as early as 3000 BC in that region. Cultural activities are followed by formal discussion and guided reflection to create additional context regarding the technical project and the cultural and geographical influences that are important for consideration. Also in country, the students made an initial presentation to community leaders to ensure project objectives were in alignment with community expectations.

Course Content – Technical

The technical portion of the course is determined by the scope of the project that is identified. During the first two years of the program, using semi-structured interviews, the community identified water loss of the crumbling canal system as the community need that was the highest level of importance. Although the canals are repaired on a bi-annual basis, the maintenance has

not been adequate to maintain the supply of a reliable water source, impacting the agricultural yields and the community food supply.

The ultimate goal for the identified project was develop a viable asset management program. To support this effort, three objectives were identified: a map of the existing irrigation canals and critical components, a preliminary flow model of systems, a tangible platform for sharing the information.

To accomplish this project, technical content for the course was developed to provide instruction for the students in the areas of GIS systems, drone technology and the accompanying flight requirements as well as flow calculation methodologies.

The team participated in training on high accuracy GPS units to record data and Collector for ArcGIS to collect and share information. Students completed practice sessions to gain familiarity with the tools and software. Other content areas included drone regulations, photogrammetry, ground control points and map accuracy. In addition, students spent time in the flow lab reviewing three separate methodologies for calculating flow measurements. The students ultimately chose salt computation method based on the ease of use and the availability of resources in the region.

Outcomes

Community outcomes

The developed asset management model currently contains data for two separate communities. This data will allow decision-makers to prioritize repair efforts. It will also support the community leader's efforts to secure federal funding by providing essential data that can be used for funding requests. In total, the students successfully mapped 5 miles of canals, captured the location of over 500 distinguishing critical features (valves, damage locations, changes in elevation), with over 1,500 photo references across the 347-acre study area. Our goal for subsequent years will be to expand these efforts to other communities.

Student outcomes

The use of reflection was key method utilized to assist students with the internalization of the international project. The goal was to provide cultural experiences that would not only teach valuable engineering skills and a client-focused consulting model, but also aid students as they seek to gain cultural capital. A review of the feedback from students demonstrated that the outcomes spanned across personal, professional and cultural gains. The following responses came from a review of the qualitative responses.

> "I'm used to being told what the problem is and what should done to fix it so, figuring that out on my own was a bit of a struggle because the problem was so open ended. The thing is that the problem was still open ended in Peru as well. By listening to Julio and the other farmers, we realized that we needed to shift our focus a little from what we were originally thinking, but that adaptability really does define global citizenship. We think differently from the farmers in Sacclio,

so by listening to them, we were doing our best to aid them and we adopted their perspective which any global citizen should be able to do".

"Understanding global issues and how it impacts culture and daily life for people is a part of understanding issues which engineering can fix. Engineering and related industries are becoming more and more international and diverse. For engineering students to stay at the forefront of that movement is required for personal and business success."

Institutional outcomes

The project impact on the University of Louisville extends beyond the individual experiences of the students. Incorporating international experiences into the engineering curriculum changes the culture of a 95 year old model of engineering education that while successful, has not allowed our students to expand their understanding of global engineering principles.

Lessons Learned and Best Practices

The preliminary difficulty with this project was the initial ambiguity of how to create a project to address the need of the community. Our first team had various ideas of projects that might be helpful, but upon arriving in country and having further conversation with the community leaders, priorities shifted in importance. This change of course was difficult for some of the students to adjust to. However, this initial experience and the feedback from the students was helpful in identifying more specifically the community issues so that the following year, the project was able to grain traction quicker.

The program elements that lead to success included the utilization of a community focused partner in country that also assisted with program logistics. The second year of the program, we invited a student from the previous year to participate as a global student leader. This helped with student comfort level and consistency for the following year's program. The final crucial element of success was the consistent communication with the community leaders throughout the project planning and implementation. This continues to be part of the process as we plan out future program objectives.

Future goals include more formal assessment of cultural competencies gained by students through participation in the program. There is also a great opportunity to collect additional data, particularly water flow data during different times of the year to gain a more accurate picture of year-round water flow and distribution. Future goals also include expanding the program to include other universities with programs in complementary areas such as agriculture.

Conclusion

Over a two year period, 14 University of Louisville students participated in a course to expand their global perspectives and to utilize their engineering skills in global context. The result was a strong partnership between the University of Louisville, the Andean Alliance and communities of the Sacred Valley.

References

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2. Whitman, L. E., & Mason, C. (2013, June), *Assessing Service Learning Reflections* Paper presented at 2013 ASEE Annual Conference & Exposition, Atlanta, Georgia. https://peer.asee.org/19229