Building Sustainable International Partnerships Through Capstone Design Projects

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Since 2005, the Department of Civil and Environmental Engineering (CE) at Rose-Hulman Institute of Technology (RHIT) has incorporated at least one international design project into its 31 year old, year-long, client-based capstone design course. During this period, 78 students have worked on 19 projects in nine countries: Ghana, Trinidad, Pakistan, Sudan, India, Zimbabwe, Uganda, Haiti and Kenya. The CE Department at Rose-Hulman for the most part, has collaborated with Kwame Nkrumah University of Science and Technology (KNUST), Ghana. To foster cross-learning for students from the two institutions a "Joint Project Model" was implemented. Through this Global Service-Learning (GSL), students from Ghana and the US experience the global-working environment. However, since 2016 we have not been able to build on our collaborative work with KNUST due to challenges associated with this model. These partnerships are very complex due to working across cultures. Furthermore, the policies of each country's government and the colleges and universities involved play an important role in shaping the realities of the experience. This paper discusses efforts made at building sustainable overseas partnerships with an academic institution and a renowned consulting firm in Ghana utilizing a Global Service-Learning (GSL) model. Additionally, the paper describes the assessment tool planned for these partnerships.

Keywords: partnerships, global, service-learning, assessment.

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Background Information

In global capstone design (an engineering signature pedagogy), students experience the global-working environment and are exposed to international design codes and standards as well as local construction practices. This invaluable experience cannot be taught in the classroom and prepares students for their future careers in an increasingly globalized profession. These partnerships are very complex due to working across cultures. Additionally, the policies of each country's government and the colleges and universities involved play an important role in determining the nature of foreign study opportunities and in shaping the realities of the experience (Altbach[1]).

Since 2005, the Department of Civil and Environmental Engineering (CE) at Rose-Hulman Institute of Technology (RHIT) has incorporated at least one international design project into its 31 year old, year-long, client-based capstone design course. International design collaborative efforts were implemented through an overseas academic institution, partnerships with the Rose-Hulman Engineers Without Borders (RHIT-EWB) Student Chapter and projects provided by clients from the problem-source countries. Since its inception in 2005, 78 students have worked on 19 projects in nine countries:(Ghana, Trinidad, Pakistan, Sudan, India, Zimbabwe, Uganda, Haiti and Kenya). In 2006 the CE Department began collaborating with Kwame Nkrumah University of Science and Technology (KNUST), since the first author is a native of Ghana.

In the first form of the international collaboration with KNUST (2006-2007 academic year), each institution pursued its own design itinerary but both partner institutions used the same problem and design objectives. Feedback received from the students indicated a lack of cultural experience between the students at both institutions.

Consequently, the next model selected for this collaboration consisted of a parallel design project in

which the student teams from both institutions worked independently on the same project, but they were encouraged to share and discuss data and ideas to solving the problem. Sharing of ideas was achieved via video conferencing, teleconferencing etc. This was the model used for 2009 and 2010 academic years.

Finally, to further foster collaboration and cross-learning between students from both institutions a "Joint Project Model" was implemented in 2011 and 2012. In this model, RHIT students were paired with KNUST students to design project in Ghana as one cohesive team. This model facilitated continuous dialogue between the students. The design team typically met once a week to assess the progress of work. However, since 2016, collaborative work with KNUST has stalled due to the cost involved for both institutions and the challenges associated with the "Joint Project Model."

A paper published by Aidoo et al.[2], discusses some of the major impediments that were encountered with the collaboration with KNUST: semester mismatch, travel and cost of collaboration

Semester Mismatch

One of the biggest challenges encountered with the collaboration with KNUST was the different academic timeline in both institutions: KNUST is on the semester system and RHIT on the quarter system. In KNUST the senior design project is done within the fall semester whereas at RHIT the senior design lasts the entire academic year.

Travel

Another challenge for both institutions was the cost of travel to the project source country. Since 2006 when the collaboration started, only one senior design team from RHIT has visited Ghana. In a paper published by Aidoo et al.[3], results obtained from alumni survey indicated that a site visit was crucial to the proper completion of international projects.

Financial Cost of Collaboration

A relatively new challenge for both institutions was the financial cost involved with the "Joint Project Model." Most of the cost issues have been raised by KNUST (i.e. cost related to project meetings via video-conference, obtaining engineering data etc.).

Some of these issues are typical of collaborations with institutions located in developing countries. KNUST and RHIT have met to discuss potential solutions to these challenges in order to re-establish collaborative efforts between the two institutions. The lessons learned and challenges encountered over the years of the KNUST-RHIT joint project model have led the authors to develop global capstone design experiences utilizing a Global Service Learning (GSL) model. Our goal will be to use this framework to promote success and sustained international partnerships the world over.

Introduction

Global Service-Learning

Global Service-Learning is a curricular model that lies at the intersection of service learning, study abroad, and global education. Bringle et al.,[4] define it as:

A structured academic experience in another country in which students (a) participate in an organized service activity that addresses identified community needs; (b) learn from direct interaction and cross-cultural dialogue with others; and (c) reflect on the experience in such a way as to gain further understanding of course content, a deeper understanding of global and intercultural issues, a broader appreciation of the host country and the discipline, and an enhanced sense of their own responsibilities as citizens, locally and globally (p.19).

The GSL model differs from domestic service-learning models in five key aspects (Hartman & Kiely[5]):

1. development of intercultural competence in students;
2. critically examining students' own assumptions around power, privilege, and hegemony;
3. experience situated within a global marketization of volunteerism;
4. student immersion; and
5. engagement of critical global, civic, and moral imagination.

Objectives of Global Capstone Design

Through the design process and interaction with the stakeholders of the project, students will demonstrate the following learning objectives across three categories Technical, Professional and Social:

Technical

- Investigate appropriate technologies for specific regions of the world.
- Apply relevant design codes and standards for different countries.
- Incorporate local construction materials and local construction practices in design, and
- Experience the global working environment.

Professional

- Communicate and work effectively in a multi-disciplinary team.
- Apply effective time management skills, and
- Demonstrate a sense of responsibility to partners.

Social

- Incorporate cultural and social aspects in the design process, and
- Work with local engineering students, professionals and stakeholders to complete an engineering project in the host country.

Building Sustainable Partnerships

Long-term relationships with project partners are the key to building sustainable collaborative work. Although most sustainable partnerships grow from personal relationships between individuals it is important to establish a relationship based on both personal and institutional levels. This will allow for a broader participation from all stakeholders ensuring the long-term viability of the partnership. Long-lasting partnerships often generate the greatest impact and the greatest potential for student learning.

In the summer of 2019, the first author travelled to Ghana to explore potential partnerships with an academic institution and a civil engineering firm. Specifically, the author sought to re-establish collaborative work between Civil Engineering Department of KNUST, Ghana and the Rose-Hulman Civil and Environmental Engineering Department. In addition, the author sought to establish collaborative work between ABP Consult, a civil engineering firm in Ghana and the Rose-Hulman Civil and Environmental Engineering Department.

The main objective was to have face-to-face meetings with the potential partners to gain first-hand knowledge of their goals, concerns and challenges for this collaboration to be a "win-win" for all parties involved.

Collaboration with Overseas Academic Institution

In the summer of 2019, the first author had a face-to-face meeting with the Provost of the College of Engineering, KNUST. The goal was to establish a framework to renew and modify the existing memorandum of understanding (MOU) that was established in 2007.

The discussions were positive and indicated KNUST's willingness to continue with the collaboration on international design projects as done in the past, however, the MOU can be renewed to make it a "win-win" for both institutions. Student exchange opportunities and faculty development were the two main areas of discussion. The new MOU should include but not limited to the following characteristics:

- applicable to other departments at both institutions.
- include student and faculty exchange opportunities
- include faculty development opportunities, and
- identify potential funding opportunities.

Plans are far advanced for the Provost of KNUST and the Senior Director of the Center for Global Engagement of Rose-Hulman to visit each other's institutions to explore other avenues for collaboration.

Collaboration with Overseas Consulting Firm

ABP Consult Ltd., is one of the leading private consulting firms in Ghana. It provides engineering services to private, public and international institutions. It's a wholly Ghanaian-owned entity of professional engineers, environmentalists, quantity surveyors, technicians etc. The firm started operations in 1969.

ABP Consult was selected as one of the consulting firms for capstone design collaboration due to its long-standing experience of similar collaborative efforts with KNUST. Additionally, the types of projects undertaken by ABP Consult, will offer the students the technical, professional and social expertise required by the Accreditation Board for Engineering and Technology (ABET). Most importantly, through this partnership, students will understand the impact of engineering solutions in a global, economic, environmental and societal context.

For a long-lasting partnership with ABP Consult, both partners have agreed in principle to pursue humanitarian projects in under-developed communities in Ghana. Such projects will be initiated by creating master plans for the development of such communities. Subsequent senior design teams will work on different aspects of the master plan until the entire project is completed (could take 3 to 5 years to complete). Thus, ensuring the longevity of the partnership and providing a meaningful global service-learning to the students. This could be a viable way of upgrading existing infrastructure in such communities. Long-term benefits of such projects could be exposure of the company and promoting the types of engineering services they provide through publications and presentations at professional meetings or conferences.

Assessment Plan

As a growing discipline with a limited base of empirical evidence, GSL literature lacks sufficient amounts of work focused on the evaluation design and use of data in GSL experiences (Lough & Toms[6] and Hartman & Kiely[5]). Traditionally, assessment of service-learning programs focuses on the student experience via reflection or self-report survey. Assessment of students in this project will focus on knowledge, skills, ability around global engineering (via global engineering competency survey and cases) as well as affective changes (via reflection journals and global sensitivity index) within the student due to practicing global engineering.

In order for GSL projects to be sustainable, faculty and community partner experience also need to be assessed as they are crucial to the learning experience. Faculty assessment focuses on their preparation to become global educators including the knowledge, skills, abilities, motivation, and professional development they need to have the self-efficacy to lead a GSL capstone design project. Community partner assessment focuses on the impact the student project had on the community, formative feedback on the partnership with the student, and reciprocity (i.e. does the community benefit from the relationship or is it a burden to them?). Table 1.0 provides a summary of the assessment plan for the study.

Table 1.0. Assessment Plan for the GSL Project Model

Control Students	**Global Design Students**	**Global Partners**	**Faculty**
Survey: Global Engineering Competency Scale	Survey: Global Engineering Competency Scale	Interview	Survey: Professional Development Motivation etc.
	Guided Reflection Journals	Guided Reflection Journals	Guided Reflection Journals
Survey: Global Sensitivity Index	Survey: Global Sensitivity Index		
Global Design Cases			

Future Work

Through collaborations with KNUST and ABP Consult, these partnerships in the long-term will seek to address the following research questions:

- What project models are employed and how can we maximize these models based on the level of collaboration?
- Which project models are preferred when working with academic institutions versus engineering firms?
- What financial models are employed by successful academic institutions?
- What are the faculty rewards or incentives required to support these collaborative efforts?

It is anticipated that successful implementation of the partnerships in Ghana, will lead to long-lasting collaborations with academic institutions and consulting firms in other countries and continents.

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