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Using the Fair Trade Learning Framework to Improve the Outcomes of Engagement Between Universities and off-Campus Partners: Applications and Implications for Program Design

NORA P. REYNOLDS
Community-based Global Learning Collaborative and Haverford College
Haverford, PA

NORDICA A. MACCARTY
Oregon State University
Corvallis, OR

KENDRA V. SHARP
Oregon State University
Corvallis, OR, USA

ERIC HARTMAN
Haverford College & Community-based Global Learning Collaborative
Haverford, PA

ABSTRACT

As global engineering education projects and programs are initiated, too often social outcomes and long-term impacts are assumed to be positive. This is particularly true for sustainable development projects, which often have an inherent assumption of positive transformation through engineering solutions. We argue that a focus on technical deliverables absent prioritization of how and with whom our partnerships happen is less likely to actually lead to our desired social outcomes and longer-term impacts. We draw from the fields of community-based global learning, global development, and program evaluation to provide tools and insights for university-based engineering teams and off-campus partners to improve their long-term outcomes and impact. In particular, we draw on the fair-trade-learning (FTL) framework and core principles. We suggest adaptations to the FTL framework for engineering education, namely (i) broadening the definition of "community" to explicitly incorporate multiple types of off-campus partners, including for-profit enterprises; and (ii) more clearly distinguishing between outputs (e.g. deliverables), outcomes, and longer-term social impacts. Our analysis suggests integration of the FTL core principles of partner/community voice and direction and dual purposes increases the likelihood of achieving the desired social impact.

Key words: Engagement, Global Programs, Social Impact

INTRODUCTION

Increasing demand for internationalization in higher education and the growing inclusion of global learning outcomes in engineering curricula has led to a proliferation of real-world engineering education projects related to global sustainable development. Too often, as these global engineering education projects, partnerships, and programs are initiated, social outcomes and long-term impacts are simply assumed to be positive based on the intended benefits. Given the tormented history of development projects around the globe (Carr 2011; Easterly 2007), it is critically important to understand the impact of global engineering education for sustainable development (GEESD) projects and partnerships not only on student learning, which has received ample attention (e.g. Smith *et al*. 2016; Budny and Gradoville 2011; Budny 2016; Litchfield and Javernick-Will 2013; Borg and Zitomer 2008; Johnson 2009; Bielefeldt, Paterson, and Swan 2009), but also on off-campus global partners (including for-profit enterprises) and the communities they serve.

We provide a framework for engineering faculty and practitioners to inform their own GEESD program design to work towards overall project success, sustained social outcomes, and positive long-term impact. Our framework draws on the research and principles of Fair Trade Learning (FTL), introduced in the community-based global learning (CBGL) field, to evaluate university-community partnerships (Hartman, Paris, and Blache-Cohen 2014). FTL was designed to adapt to different partnership contexts and disciplines; it provides a framework to spark dialogue and raise critical questions that are often systematically ignored. By engaging these questions methodically, the FTL process increases the likelihood of diffuse stakeholder commitment and, ultimately, increases the likelihood that our work will lead to intended and even tangential, positive social impacts. Herein we apply FTL for the design, implementation and evaluation of university- and off-campus partnerships in global **engineering** education for sustainable development (GEESD) programs. Use of the FTL framework can help ensure that sufficient attention is paid to long-term social impacts and the ethics of engagement between the university and off-campus partner.

In this article, we first review the relevant literature in order to demonstrate the need for intentional program and partnership design in GEESD towards positive social outcomes and long-term impact. Second, we interrogate and define the terms “off-campus partner,” “community,” and “impact” by drawing from the fields of CBGL, global development, and program evaluation. Next, we describe the Fair Trade Learning (FTL) framework, and justify our focus on the first two core principles (community voice and direction and dual purposes) because they are foundational throughout all stages of the project, including early project planning stages, and partnership development in GEESD. We describe a long-term university and off-campus partnership and its associated projects that have been the subject of a research study on community/ partner perspectives and outcomes (Cases #1

and #2), including a water systems partnership that has affected more than 7,000 families. The research findings from these cases demonstrate how closer adherence to FTL principles by the project and partnership led to greater long-term social impact. We then analyze two case studies (Cases #3 and #4) from active GEESD practitioners applying the FTL framework to their own work. Drawing from these GEESD cases, we distill practical implications for GEESD project planning, partnerships, and practice, and propose several adaptations to FTL to improve relevance for GEESD. We argue that a focus on technical deliverables absent prioritization of how and with whom our partnerships happen is less likely to actually lead to desired longer-term social impacts. Integrating FTL principles improves the likelihood of achieving desired results.

BACKGROUND: UNIVERSITY AND OFF-CAMPUS PARTNERSHIPS IN ENGINEERING EDUCATION

There is a well-documented and increasing demand for internationalization in higher education (Gao 2014) and engineering education to prepare students for 21st century engineering practice (Duderstadt 2008, 44; Lucena et al 2008; American Society for Engineering Education 2013; ABET 2019). In response to these demands, there has been a proliferation of global engineering education for sustainable development (GEESD) programs. For example, from its founding in 2000 to 2010, Engineers Without Borders-USA (EWB-USA) grew to a professional and student membership of 12,000 in almost 300 chapters working on more than 400 projects around the globe (Amadei and Sandekian 2010). There is substantial variation in the terms used to describe this work such as "engineering-for-development, community development engineering, humanitarian engineering, and appropriate technology" (Nieusma and Riley 2010, 29) and the ways in which engineering students are involved, such as course based experiential learning, co-curricular experiences, and extracurricular experiences (Carberry, Lee, and Swan 2013). Whether course-based, co-curricular, or extracurricular, many university-based programs directly involve engineering students and faculty members in global development initiatives and projects on the ground. Many of these programs offer educational or research opportunities to support the creation of technology-driven solutions to global development challenges. We utilize the term global engineering education for sustainable development (GEESD) in this article to emphasize programs and projects that focus on technologies, that include engineering students, and that often have technical deliverables such as devices, systems (e.g. water systems), or designs for devices, systems, or processes.

After decades and a substantial investment of resources in engineering-for-development projects, there is still a gap between invested resources and "successful, sustained outcomes" (Nieusma and Riley 2010, 33). The history of engineering-for-development, similar to international

development more broadly, contains many examples of failed and unsustainable projects (Engineers without Borders Canada 2009; Mazzurco and Jesiek 2014). Leydens, Lucena and collaborators have been particularly prolific on the implications of GEESD efforts with off-campus partners (Lucena, Schneider and Leydens 2010; Schneider, Leydens and Lucena 2008; Lucena and Dean 2014; Leydens and Lucena 2018; Leydens 2012). Lucena and Dean (2014) describe characteristics of a project partner most likely to lead to project "success," which they define as overall positive impact on the partner/community and the avoidance of unintended negative consequences. Lucena, Schneider, and Leydens (2010) carefully dissect process and outcomes of previous GEESD projects.

There is a nascent but growing literature on the role of the off-campus partners, analysis of university and off-campus partner relationships, and, most recently, guidance on ethical and just program design (Mazzurco and Jesiek 2017; Thompson and Jesiek 2017; Reynolds 2014; Reynolds 2016; Mazzurco 2016; Lucena and Dean 2014; Leydens and Lucena 2018). The most relevant research on social impact focuses on one or more specific case studies (Reynolds 2014; Reynolds 2016; Nieusma and Riley 2010; Dickey 2008), or otherwise lays groundwork for methods and approaches of analyzing power dynamics in university and off-campus partnerships in engineering education (Mazzurco and Jesiek 2017; Thompson and Jesiek 2017; Lucena, Schneider and Leydens 2010; Schneider, Leydens and Lucena 2008; Reynolds 2014; Reynolds 2016; Mazzurco 2016; Leydens and Lucena 2018).

Nieusma & Riley (2010) highlight the problematic ways that engineering-for-development projects often handle participation. They write,

> Community involvement morphed into a narrow form of market research, where students first conducted a community needs survey, then carried out brainstorming and idea evaluation without participation from community members, and returned with a second community survey to elicit feedback on final design concept…community participation was superficial over the entire duration of the project [which] calls into question the priorities of the partners in determining what (and whose) involvement was essential to the project and what (and who) could essentially be left out (p. 39).

The focus on technology in engineering all too often leads to a narrow definition of outcomes that only includes functional sustainability of projects. Nieusma and Riley (2010) draw attention to non-technical dimensions of projects that are crucial to successful, sustainable projects. George and Shams (2007) propose questions that must be addressed related to whether the customers' needs have been met and whether the project is sustainable and maintainable by the customer. If we aspire for GEESD

to lead to positive long-term social impact, we must draw from other fields to interrogate and inform our work and the design of our projects, programs and partnerships beyond functional sustainability.

DEFINING TERMS: PARTNER, COMMUNITY, AND IMPACT

In this article, we draw upon the literature in community-based global learning (CBGL), global development, and program evaluation to further interrogate the meaning and use of the terms "community" and "impact." We further delineate between direct project partners and the broader set of project stakeholders.

In CBGL, "community" can be location-based or interest oriented (Hartman, Kiely, Friedrichs, & Boettcher 2018). In global development, Cannon (2004) concludes that community has simply come to mean "where we work" echoing the location-based definition in CBGL literature. In this article, we focus on the question: "Who are your partners and stakeholders?" Hartman, Kiely, Friedrichs, and Boettcher (2018) pose this question and list a suite of potential off-campus partners and stakeholders including: businesses, community organizations, foundations, government leaders, peer colleagues, and social staff members among others (p. 155).

Herein, we use:

- (off-campus) partner when we refer to direct project partners ("who we work with").
- community to encompass *both* the direct off-campus project partners and the broader set of project stakeholders including community members ("where we work"), drawing from the fields of CBGL and global development.

Explicitly recognizing that off-campus partners can be for-profit entities and ensuring that all types of partners are included in the definition of community improves the relevancy of prior CBGL and global development frameworks for application to engineering education, social enterprise, impact investing, and interest- or problem-based collaborations. For example, ensuring sustainable access to clean water and sanitation in a municipality does not occur through one capstone design project or one engineering education partnership between a university and a local non-governmental organization. Instead, sustainable access to water and sanitation necessarily includes government entities, community groups, and possibly for-profit businesses to advance towards such goals and, eventually, to fix the problem.

The term "impact" is used frequently with different meanings and absent clear definition. We draw from program evaluation (Kellogg 2004) to define not only impact, but also to distinguish between activities, outputs, outcomes, and impacts in our work. Logic models differentiate between the planned work (resources and activities) and the intended results (outputs, outcomes, and impacts). The table below displays a simple logic model template.

Table 1. Simple logic model.

Resources	Activities	Outputs	Outcomes	Impact
In order to accomplish our set of activities we will need the following:	In order to address our problem or asset we will conduct the following activities:	We expect that once completed or under way these activities will produce the following evidence of service delivery:	We expect that if completed or ongoing these activities will lead to the following changes in **1–3 then 4–6 years**:	We expect that if completed these activities will lead to the following changes in **7–10 years**:

(Kellogg 2004, 17)

Too often, outputs are reported as and confused with impacts. For example, if a water and sanitation nonprofit reports health, wellness, or longevity impacts based on installation of physical infrastructure in rural villages, they are confusing outputs with eventual intended impact. Instead, the water and sanitation nonprofit can report that they built three hand-washing stations at a village school (output) and have improved student knowledge about the importance of hand-washing for health and increased the rate of hand-washing in school students in the first year (short-term outcomes) leading to decreased diarrhea reported in the local health clinic and/or improved school attendance (long-term outcomes). The organization's planning assumes that those outputs and outcomes will lead to community impact of improved health and educational attainment in this village 7–10 years later. Defining impact as necessarily taking 7–10 years calls us to shift how university and off-campus partnerships report on and understand our work - water system designs or a prototype delivered through an engineering education partnership always begins at the output rather than the impact stage.

FAIR TRADE LEARNING (FTL)

(3 minute video intro to FTL)

Fair Trade Learning (FTL) provides a set of standards, a rubric, and queries to explore and understand university-community partnerships (Hartman, Paris, and Blache-Cohen 2014). FTL may be useful for universities, NGOs, ethical business, and faith institutions as they work to improve the quality of their partnerships. A set of FTL queries that can be used towards program design and evaluation are included in Table 2 (for the principles we focus on in this article) and the Appendix (the full set of queries from the FTL literature). FTL asserts that "student learning and community goals must reinforce and inform one another. Either is undermined by the absence of the other." (Hartman, Paris, and Blache-Cohen 2014, 112).

Validation

These standards have emerged through a collaborative and on-going process over several years with feedback from educators, nonprofit practitioners, and community members including in-person

input at the International Association for Research on Service Learning and Community Engagement, The Forum on Education Abroad, the Cornell University–New York Campus Compact Global Service-Learning Institute, and the Building Bridges Coalition's International Service-Learning Summit, that has been incorporated into the standards (Hartman, Paris, and Blache-Cohen 2014, 112). To date, "numerous institutions and organizations, including Amizade, Dartmouth College, the University of Dayton, the Foundation for Sustainable Development, Haverford College, Northwestern University, Water for Waslala, and many more, have employed FTL principles, rubrics, and queries to guide conversations through stakeholder networks, encouraging shared meaning making, critical review, and commitment to ethical practice" (Hartman, Kiely, Friedrichs, and Boettcher 2018, 128).

Core Principles

FTL provides eight core principles: (1) community voice and direction, (2) dual purposes, (3) commitment and sustainability, (4) transparency, (5) environmental sustainability and footprint reduction, (6) economic sustainability, (7) deliberate diversity, intercultural contact, and reflection, and (8) global community building.

We focus specifically on two core principles of FTL - (1) community voice and direction and (2) dual purposes - because these principles are critical considerations in every phase of the design process for both the technical project and the partner relationship. In other words, soliciting community feedback or voice in a survey during only one project phase might undermine the pursuit of long-term impact without continued attention to that principle in all other phases of the design process. Further, the implications derived from the analysis of the case studies' alignment with these two principles provide specific insights to go along with specific tools (the queries) that can empower university-based engineering teams and their partners towards greater success in achieving long-term social impact.

- Community voice and direction – "Drawing on best practices in community development, service learning, and public health, community-based efforts must be community driven. Community engagement, learning, program design, and budgeting should all include significant community direction, feedback, and opportunities for iterative improvements. Attention to the best practices referenced above suggests practitioners should triangulate community voice, actively seek the voices of the marginalized, and otherwise be systematic about inclusion of broad community perspective and multiple stakeholders regarding direction and goals. While student outcomes are certainly important and we point to dual purposes above, the typical bias of universities to serving students and organizations to serving customers requires a special focus on and attention to community voice and direction" (Hartman, Kiely, Friedrichs, and Boettcher 2018, 130–131).

- Dual purposes: "Programs are organized with community and student outcomes in mind. The ethics of integrating community development with student learning necessitates that as much attention is paid to community outcomes as to student learning. One purpose is therefore never primary. Rather, community-driven outcomes and student learning about ethical global engagement must be held in balance with one another." (Hartman, Kiely, Friedrichs, and Boettcher 2018, 130).

The FTL core principles, queries, and rubric provide tools for self-study, reflection, and co-planning for all stakeholders in a university and off-campus partnership. In Table 2, queries (a)–(c) explore Principle 1 (community voice and direction) and queries (d)–(f) explore Principle 2 (dual purposes). In effect, the FTL queries (Table 2 and Appendix) allow program designers or partners to analyze their program design and implementation relative to the core principles.

FTL APPLIED TO PARTNERSHIPS IN GLOBAL ENGINEERING EDUCATION FOR SUSTAINABLE DEVELOPMENT (GEESD)

In this section, we utilize the FTL framework to examine the adherence to the aforementioned two core principles for four different cases in university and off-campus partnerships in engineering education: (1) Villanova University's College of Engineering and Waslala, Nicaragua - Water, (2) Villanova University's College of Engineering and Waslala, Nicaragua - Telehealth, (3) Oregon State University (OSU) Humanitarian Engineering Program's faculty-led study abroad in Guatemala, and (4) OSU Humanitarian Engineering Program's international senior capstone design projects.

The first two cases served as the basis for research on the outcomes and impact from a long-term (10+ years) GEESD partnership (Reynolds, 2014, 2016). Analysis of these cases demonstrates how

Table 2. Fair Trade Learning Queries (Hartman, 2015).

FTL Principle	FTL Queries
#1 – Community voice and direction	a. Do stakeholders, including several and diverse community members, agree on long-term mutuality of goals and aspirations? b. Do all stakeholders understand the nature of partnership commitments, including whether the partnership is ongoing or time-bound and under what conditions or processes it might end? c. Do community members have clear teaching and leadership roles as well as clear roles in driving research direction, process, and publication, with fair authorship rights?
#2 – Dual purposes	d. Do students' same-age-peers from the community have financially underwritten opportunities to participate in programming (in an accredited way)? e. In terms of community impact, are the reasons for the partnership understood and embraced by multiple and diverse stakeholders? f. In terms of student learning, are the reasons for the partnership understood and embraced by multiple and diverse stakeholders?

better alignment with the two FTL principles we focus on (community voice and direction, and dual purposes) leads to greater long-term impact.

The second two cases were initiated by engineering education practitioners within the last five years, and are ongoing. Analysis of these cases shows how the FTL tools and queries can be used to identify concrete ways to modify project and partnership practices to increase the likelihood of long-term social impact.

Because these cases have different on-campus partners, off-campus partners, length of partnership, and program components, they provide an opportunity for comparisons in order to distill learning and implications for practice and planning in university and off-campus partnerships in engineering education (see Table 3 below for descriptions of each partnership).

Case #1 & #2 - Villanova - Waslala - Water & Telehealth

Although Villanova's College of Engineering (CoE) has numerous partners, they describe their partnership with Waslala, Nicaragua as their "most successful partnership." It is their longest continuous partnership (initiated in 2002) and over 300 CoE students and faculty have travelled to Waslala, Nicaragua. In this case, the "community" is composed of multiple off-campus partners including several community-based organizations (NGOs), local and national government offices/representatives, in-country educational institutions and in-country businesses. Over the past 16 years, Villanova Engineering Service Learning (VESL) has sent engineering students and faculty on trips to Waslala, Nicaragua to work in projects related to water distribution, mobile healthcare, and micro-hydro electrification (Reynolds and Ermilio 2015). Student participation ranges from one-week immersion trips to senior capstones to graduate field placements for 6+ months. The partnership includes several different departments in the CoE, local community organizations in Waslala, and types of projects. As a result, it does not depend too heavily on one person and it allows intra-case comparisons.

Case #3 - OSU Faculty-Led Study Abroad in Guatemala

OSU's short-term study abroad course called "Household Energy in Guatemala: Background and Applications" is a two-part course series offered in both 2016 and 2018 (cancelled in 2020 due to coronavirus) with 12–20 student participants each year. The interdisciplinary course provides an introduction to the technical, social, environmental, and economic issues pertaining to global household energy poverty. Students from any major are introduced to household energy technologies, global development, needs assessment and co-design, and qualitative and quantitative impact evaluation through discussion, activities, and guest lectures from across campus and external organizations followed by an immersive service-learning-research trip. The course is structured as a 1-credit background course on campus, followed by a 12-day faculty-led 3-credit course in rural Guatemala. The field components

Table 3. Partnership and program overview.

	Case #1: Villanova & Waslala - Water	**Case #2: Villanova & Waslala - Telehealth**	**Case #3: OSU Study Abroad**	**Case #4: OSU Senior Capstone Design**
On-campus partners	Mechanical Engineering, Civil Engineering, Sustainable Engineering	Electrical & Computer Engineering, College of Nursing, College of Business	Humanitarian Engineering – interdisciplinary program across the College of Engineering with anthropology, public policy, economics, and education	Mechanical Engineering, Electrical Engineering & Computer Science
Off-campus partners	Water for Waslala (WfW), Immaculate Conception Parish (Parroquia) Associación de Desarrollo Integral y Sostenible (ADIS)	Ministry of Health of Nicaragua (MINSA) Telehealth (Telesalud) Immaculate Conception Parish (Parroquia) Associación de Desarrollo Integral y Sostenible (ADIS) Claro (subsidiary of America Móvil, a telecom group)	StoveTeam International (non-profit program implementers), EcoComal Cookstove Factory (for-profit technology manufacturing business), Link4 (non-profit design firm), product users, homestay communities	Partner for-profit businesses; interactions with broader community members are typically through the business owners/ staff
Off-campus partners represent:				
• **Private sector**	–	✔	✔	✔
• **Nonprofit**	✔	✔	✔	–
• **Government**	✔	✔	–	–
Projects & Initiation dates	Water supply system design (2002) Micro-hydro electrification (2009)	Telehealth project (2010)	Spring 2016 Spring + Summer 2018 Spring + Summer 2020 (cancelled due to coronavirus)	Fall 2016, annually thereafter; (2020 prototyping and travel cancelled due to coronavirus)
Components	Coursework and capstone projects Multiple student trips to Waslala each year Ongoing research projects	Coursework and capstone projects Multiple student trips to Waslala each year Ongoing research projects	On-campus 1-credit background course plus 12-day study abroad in Guatemala	6- to 9-month capstone design course, some field travel
Deliverables	Water system designs Feasibility studies Water quality testing results	Local data gathering, software design	Technology manufacture, distribution, and socio-technical evaluation; household surveys and mapping; local data-gathering; co-design activities	Background research, design concepts, evaluation metrics, final project report/ poster, physical prototype (or drawings), prototype testing results

are provided in conjunction with several partner organizations including 1) StoveTeam International, a non-profit cookstove implementation and local partner capacity building support organization out of Eugene, Oregon, 2) the EcoComal cookstove factory in Guatemala that StoveTeam International supports, and 3) Link4, a co-design education firm in Guatemala City, with links to MIT's D-Lab, that "fosters local innovation and development through product design, capacity building and cross-learning experiences across the corporate, international development and educational sectors" (https://www.link4.gt/). During the background course, students work closely with faculty and graduate researchers in humanitarian engineering as well as the field partners to develop relevant field research questions that support the ongoing work of the partners. They then implement this research via various forms of field testing, observations, user surveys, stakeholder interviews, and co-design activities in country. In addition to team research projects, during each trip students help to finance, manufacture, and distribute clean cookstoves made by the EcoComal factory for nearby families.

Case #4 - OSU International Senior Capstone Design Projects

OSU Humanitarian Engineering capstone design projects pair teams of engineering students with an off-campus partner, typically an internationally-based entrepreneur. For curricular reasons, these engineering capstone design projects must have a significant technical component and typically require both creation and testing of the prototype during the course. The off-campus partners largely drive the project framing, which is modified collaboratively as needed to accommodate available budget, time, and curricular needs. The students typically meet weekly or bi-weekly with the faculty adviser during the first half of the project, and communicate with the partner with similar frequency. During the second half of the project, students are prototyping and testing, and as such, meet and/or communicate less often with the faculty technical adviser and off-campus partner. The faculty adviser may attend project meetings between the students and the partner and occasionally checks in with the partner. The projects are funded largely by program funds and gifts. To date, students from four student design teams have traveled internationally to their partner for project research, implementation, installation, and/or testing. All final report and presentation material for the course, as well as any other resources (e.g. references, computer-aided design (CAD) models, product manuals, test results) requested by the off-campus partner, are provided to them.

ANALYSIS

Drawing from the four cases of university-community partnerships in engineering education, we distill implications for engineering education partnership planning and practice and propose several

adaptations to FTL to improve relevancy for engineering education in particular. We argue that a focus on technical deliverables absent prioritization of how and with whom our partnerships happen is less likely to actually lead to our desired social outcomes and longer-term impacts. Integrating FTL principles improves the likelihood of achieving desired results and social impact.

Villanova University College of Engineering & Waslala, Nicaragua

In the case of Villanova – Waslala partnership, these FTL core principles, related indicators, and questions catalyzed a research study (Reynolds, 2016) that explored multiple stakeholder perspectives (university administrators, faculty, and students and community organization representatives and residents) about the outcomes of a 10+ year university and off-campus partnership. As a result, we analyze this case in more depth to demonstrate how FTL served as a tool to better understand this partnership and how partnership quality and process – dual purposes and community voice and direction - determined if and how projects led to sustainable social outcomes and impact in Waslala, Nicaragua.

The Dean of Villanova's CoE commented,

> It's hard for me to assess what Waslala has gotten out of it. I guess that's kind of one of the things I don't know and am a little uneasy about: have they gotten what we'd like to say they've gotten out of it?

In the case of the partnership between Villanova's CoE and Waslala, Nicaragua the university administration and faculty were confident that the university and the students were benefiting from the partnership, but wanted to understand more about whether and how the community in Waslala, Nicaragua was benefiting.

Through several years of systematic conversations, focus groups, and observation, Reynolds (2016) explored that question raised by the Dean of the CoE. She found that the community participants in Waslala described outcomes much more broadly than the university administrators, faculty and students. In addition to tangible project outcomes such as improved access to health care, water and electricity, the community participants also described trust, a sense of community pride, and the creation of transnational networks for advocacy as positive community outcomes from their partnership with Villanova's CoE (Reynolds 2014). Community participants drew attention away from *what* (specific tangible project outputs) and instead focused on *who* drove decision-making and *how* the partnership was enacted as the characteristics that led to achievement of community outcomes (and longer-term social impacts) (Reynolds 2016).

Comparing community participant perspectives about two different projects within this partnership - water projects and a telehealth project - Reynolds (2016) demonstrated that while outputs

were achieved in both projects, community outcomes and eventual social impacts are more likely through partnerships with "dual purposes" and "community voice and direction." In other words, if we want our projects and partnerships to lead to sustainable social outcomes and impacts, we must focus on how our partnerships happen.

Case #1 - Water projects

A trip to Waslala in 2002 led to the creation of Water for Waslala (WfW) and through WfW, the connection between Villanova and Waslala. During a two-week trip, community residents asked to meet with the group of recent Villanova graduates. The community residents proposed that the group support them in building a water system to serve their children's school (Reynolds 2017). The moment that the group said "yes" was the start of WfW. Over the next 13 years, WfW raised over $600,000, built 18 water systems, and reached 7,000 residents in Waslala (outputs).

When Reynolds (2016) explored community perspectives about these two projects, one community organization representative described the water projects and the approach to work,

> It was always focused in the [rural villages] and in what the people really need. We have to remember that many projects arrive to places, not just Waslala, and many of these projects do not originate from the needs of the, they don't respond to what the people need and want.

UNICEF estimates that 30 to 50 percent of water, sanitation, and hygiene (WASH) projects fail within two to five years (UNDP Water Governance Facility/UNICEF 2015, 4). In comparison with high failure rates in the water and sanitation (WASH) sector, when WfW pursued acquisition in 2015, 90% of the people who benefitted from those water systems continued to do so over time. Without functional and financial sustainability, water systems will not lead to planned outcomes (e.g. decreased rates of diarrhea or increased school attendance) and impact (e.g. improved health and educational attainment in the village). As a result of acquisition, even in the current Nicaragua political context, the water projects continue - there are new projects under construction and community residents continue to benefit from the existing water projects demonstrating both functional and financial sustainability over time.

Case #2 - Mobile health care project

The Telehealth program aimed to improve communication between the rural villages and community health leaders (CHLs) in the villages and the health care system in Waslala. It is a multidisciplinary program involving Electrical and Computer Engineering, Nursing, and Business at Villanova. In May 2010, a group representing the colleges of engineering, nursing, and business travelled to Waslala

for an assessment trip. During that trip, the group assessed the health and resource challenges in the rural villages (McDermott–Levy 2012 details that assessment). Almost immediately following that trip, an engineering faculty member was invited to attend a conference focused on communication technologies related to health care. By October 2010, the CoE and the College of Nursing had compiled and submitted a proposal for the Telehealth program and by January they found out they were funded.

During a trip to Waslala in 2011, Reynolds was sitting with an old friend who leads one of the community based organizations in Waslala that works in partnership with Villanova's CoE. The excerpt from her research journal below describes the conversation that sparked the research study (Reynolds, 2016):

> As we sipped our afternoon coffee, [we] chatted about a new project. [The community organization representative] told me that a university project initiator had won a grant to pilot a new technology and had come to [him/ her] with funding and asked [him/her] if [s/he] could write up a proposal about potential uses for this new technology. So…[s/he] did.

The telehealth project team has presented both the progress and the challenges they have confronted at several conferences (see Singh et al, 2011 and Singh et al, 2013). In one conference paper, Singh et al (2011) describe one of the main challenges the Telehealth program was struggling with - financial sustainability. Explicitly linking their work to that of WfW (but not mentioning WfW by name), they describe how they based their initial business model on WfW's methodology. They wrote,

> This model was pioneered in the region by an NGO that funds and installs gravity-fed clean-water-distribution systems in Waslala. Each household benefitting from the water system (either through water coming directly to their home or to a stand-pipe by a local school) would contribute monthly to a reserve fund to cover operation and maintenance costs. The initial cost of the installation was based on a mix of philanthropy from the funds raised by the NGO, government funds where available, and "investment" from the villages – both money and "sweat equity" – labor in digging the trenches necessary to bury the pipe(s) (p. 198).

The Telehealth program found that this model did not work for them.

During data collection (Reynolds, 2016), the community participants described "differences" that influenced the success and challenges encountered by the Telehealth program related to sustainability. Comments described the origin of the program in the university instead of in the community

(counter to the FTL principle of community voice and direction). One community organization representative commented,

> They had the idea…my personal feeling is that it was lacking a goal. It is a tool not a goal…so collect information on blood pressure and on temperatures, but that doesn't excite people in the community…there's no use to the community, directly.

At the time of data collection, the telehealth project was still in its nascent phases and community representatives commented that objectives were becoming clearer and communication was improving; however, the community participants' comments illuminated a lack of community voice and direction in the origin or initiation of the project. In the current Nicaraguan political context, which has forced most international organizations out of the country, the telehealth project has stopped. Unfortunately, despite substantial investment of resources in this project, there may not be functional or financial sustainability that would lead to community outcomes or longer-term social impacts.

Take-away: For long-term social impact, prioritize community voice and direction

Although both the projects - the water projects and the mobile healthcare projects - achieved outputs, the purpose of the projects/partnership and community voice and direction determined functional and financial sustainability (or lack thereof) – the characteristics that lead to outcomes and long-term social impact over time. If we hope that university and off-campus partnerships in engineering education lead to social impacts (necessarily 7–10 years later), these cases demonstrate that an intentional focus on community voice and direction driving project initiation, planning, and decision-making is critical. FTL and the associated queries can serve as a tool to explore partnerships to ensure that multiple stakeholders - including those who may be off-campus partners – are active in driving why and how our partnerships happen.

Case #3 - OSU Faculty-Led Study Abroad in Guatemala

Partner/Community Voice and Direction (Queries a-c)

This partnership responds to query c in three ways: (1) using technology, partner representatives teach in the background course, (2) co-publishing in ways that was useful for off-campus partner fundraising goals, and (3) co-design processes with homestay families.

To assure partner/community voice and direction, three to nine months prior to each trip, discussions between the on- and off-campus partners work to identify overlapping research and development goals on which to focus the course. These goals are then introduced to students as options for research topics for them to focus on during the time in-country. This both enables students to

select the topic of interest to them, and allows instructors to tailor the background coursework to center on the methods and tools needed to successfully implement the field research. During the background course, representatives of the non-profit provide a lecture on campus about the context of their work, while Guatemala-based partners Link4 also provide a lecture via Skype. This balancing of research objectives and teaching duties assures that the community members have a clear teaching and leadership role while driving research direction (FTL query c).

In 2016, some specific priorities for the non-profit StoveTeam included: (1) assistance with gathering data in communities for four days in conjunction with a project sponsored by an external funding organization and (2) laying the groundwork for data gathering for an externally-funded research project by the faculty partner. While the students did not participate in analysis or publication of data from the former which was led by the non-profit, the latter was the subject of a doctoral thesis that was reviewed and an article that was co-authored by the director of the non-profit (Pakravan and MacCarty, 2018; Pakravan, Laughlin, and MacCarty, 2018). These data contributed to results reporting for the organization's donors and were highlighted in their publicity materials. This community engagement in publication and authorship also helped to fulfill query c.

The second half of the trip in 2018 with partner Link4 centered on co-design with communities, a method that is inherently designed to solicit community voice in the design process. Herein, we use "co-design" to refer to the "creativity of designers and people not trained in design working together in the design development process" (Sanders and Stapper 2013, 25). Students and faculty participated in homestays with families in a small rural community, and the cooks in those families ranging in age from late teens to well into their 60s spent good portions of each day (and were compensated for) providing design ideation and feedback to students in the context of a specific cooking technology-related design challenge. By nature, co-design is focused on providing end users a stronger teaching and leadership role in the design process, fulfilling query c as well.

Dual purposes (Queries d-f)

The jointly-created research projects discussed above also relate to the dual purposes aspect of FTL. In 2016, priorities for the 5-day visit to the cookstove factory included standard testing of performance, emissions, and safety of the factory's new model of cookstove, as well as evaluating the layout and flow of the factory to optimize time and effort according to principles from industrial engineering. With these projects in mind, students were able to prepare to execute these detailed engineering analyses prior to the trip to Guatemala by familiarizing themselves with the standard experimental protocol and required tools. After executing these methods in the field, several students noted how much more difficult it was to implement the tests in a real-world context than it sounded on paper, indicating valuable learnings regarding engineering in practice.

At the conclusion of the 2016 trip, each student team then completed a detailed report following templates and standard practice in the sector to share with the non-profit and factory partners. The reports included recommendations for improvement and were delivered to the partners several weeks after the conclusion of the trip. Because the reports were in English, they were shared with the Spanish-speaking factory owner verbally by the non-profit partner. However, no follow-up occurred with the students or faculty to determine if or how these findings were implemented after the conclusion of the course, illustrating the importance of regular communication between partners as highlighted by additional FTL principles shown in the appendix. This example of class reports in English not getting back to the factory floor partner in Spanish highlights an explicit example of how student-focused work and thinking sometimes misses on community impact aspirations, with curricular goals and timelines in tension with partner goals. Without intentionality or a guiding set of principles suggesting that structure must be reimagined, it's not likely to change. It also highlights the inadequacy or omission of sharing research findings and feedback with community participants at the conclusion of research in a format and language accessible to them. As discussed in (Reynolds 2019), appropriate feedback loops should be built into the research process and expectations, possibly even included in IRB protocols.

The second course in 2018 spent only three days at the factory and two days in communities, with the remaining days at a second location with a different set of partners. Even though the factory was again asked in advance if there were research projects that students could assist with, nothing materialized. This may have been due to the challenge of accomplishing much in such a short time, but at that time the owners of the family-run factory were facing some upheaval in their family. It should also be noted that the non-profit often brings voluntourism groups to the factory to take immersion language classes in the mornings and manufacture cookstoves in the afternoons, so this was the model the factory had grown accustomed to. As a result, the students contributed to the factory by manufacturing a batch of cookstoves, but when that work was complete some student teams were left only with the opportunity to paint walls and missed out on any engineering curricular opportunities for that day. In this case it was likely the partner was satisfied but some of the students were not. Contributions to the non-profit's goals were also less pronounced since there was less active ongoing research during that visit, focusing on the goal of mapping the potential market in a new semi-urban community. Students helped to co-create and conduct surveys and use geotags to map the location, demographic, and cooking technology aspects of households for the non-profit. However; a half day of surveying opportunity was lost because the community liaison was unexpectedly unavailable, highlighting the need for flexibility and challenges of implementing curriculum in the field and tensions between curricular and partner goals. Thus, due to constraints regarding time and the needs of the community, the achievement of student learning objectives was reduced (query f).

In contrast, while the co-design activity in 2018 (described under partner/community voice and direction) had no tangible long-term deliverables and was presented as such, it still worked towards the FTL objectives and dual purposes principle. This was due to the balance of a clear engineering focus of activities in a way that directly engaged the community in a meaningful way. It also developed capacity in the community to host similar activities in the future, thus supporting a key goal of the partner Link4. This specific example illustrates integration of community voice, community remuneration, community direction, AND student learning.

Case #4 - OSU International Senior Capstone Design Projects

To date, OSU has run approximately 16 humanitarian engineering capstone design projects. Herein, we refer primarily to those run with off-campus partners Raitong Organics Farm in Thailand (2018/19) and Burro in Ghana (2018/19).

Partner/Community Voice and Direction (Queries a-c):

With both off-campus partners, small enterprises Raitong Organics Farm in Thailand and Burro in Ghana, there were discussions about long-term goals and aspirations. The scope of these discussions has gone briefly beyond the current project to ask what long-term success looks like. Narrowly, the success of a given project may include researching, prototyping and testing a specific version of a device/product, and providing full research and design documentation to the partner. However, it would be unusual for a device/product design cycle to end with a single capstone team. From the university perspective, it has been useful to understand the partner's motivation for the project framing itself[1].

Our project concepts are chiefly driven by the off-campus partner, attending to query c (clear role in driving direction). The faculty adviser then provides input on resources and expertise available in an effort to define a project that can be reasonably completed within the capstone time frame.

Project Partner #1: Raitong Organics Farm

Bryan Hugill, of Raitong Organics Farm, for example, maintains a shared document with project concepts. In the academic year 2018–2019, we selected three project concepts, including weather

[1] Guiding questions that we have found helpful include: Is this device/product an iteration on a previous device/product, and why? Was the previous one not suitable for market? Why/why not? What is the partner's motivation for wanting the device or product? For example, for a sensor project, does the partner anticipate using information gathered by the sensor to aid decision-making about practices, educational approaches or policies? It is also helpful to have a sense of the partner's anticipated scale and timeline. Is the partner hoping for a design that can be immediately adopted, marketed and sold? Or is the partner at the stage where they want a design to prototype and test themselves, not with the intent of becoming a seller and/or distributor but rather to use in their own business (e.g. agricultural food processing)? What are the partner's long-term hopes and ambitions for their business?

station sensors and accompanying relay, a second-round integrated sensor for a piggery, and a prototype-scale microbial fuel cell using wastewater. Based on resources available in this project cycle, we selected projects that could be completed with <$1,000 in materials and supplies. We deferred a heavy-payload drone for agriculture project to the academic year 2019–2020 when we would have more resources for materials and supplies, since the commercial product we'd be looking to mimic (albeit with a smaller price tag) is ~$8,000 USD.

Hugill is also interested in the development of a microfluidics device for testing and identification of pesticides. OSU, and the faculty adviser, have extensive microfluidics expertise, however, the development of a functional device can require relatively time-intensive training on fabrication techniques even before concepts can be properly formulated. Device design also requires a strong working knowledge of chemistries and detection methods. This type of project is better suited for a graduate student research project.

In the future, unselected project concepts may be more feasible based on our available expertise, personnel and funding. Alternatively, if appropriate funding opportunities arise for pursuing such concepts as graduate research projects, OSU can take the lead on collaborative proposals. One of the real strengths of OSU's partnership with Hugill of Raitong Organics Farm is that Hugill has a wealth of potential project concept ideas, allowing us to select the ones that seem most feasible in each cycle.

Project Partner #2: Burro

One of our partners, Burro Business was founded by entrepreneur Whit Alexander. Over a number of years, Burro worked with U.S.-based student design teams (not just from OSU), and also hosted interns or fellows in their Koforidua office, including some from the U.S. These project framings were very much driven by Burro, and allowed the teams to contribute to different phases of Burro's product development cycle depending upon the project; in some cases, our team was building on work done by prior design teams, interns, or fellows.

Dual Purposes (Queries d-f)

FTL queries d-f (Table 2) offer language that we can use at the outset of the project and in post-project communication after each design team cycle. Typically, the faculty member connects with the partner for a post-mortem analysis of both the technical deliverable and other factors contributing to project progress (communication, expectations, student selection, etc.).

There is an inherent tension between curricular constraints and technical project progress when capstone design teams are working with off-campus partners. The tensions relate to:

- Curricular elements being perceived as distracting from technical progress;
- Little room for iteration, and need to freeze design requirements mid-project; and,
- Overall timeline.

OSU's capstone design course series fills one of the accreditation needs as a writing-intensive course. While the curricular writing requirements help to ensure proper documentation of the design process and outcomes, they can also be perceived by students, faculty advisors and even partners as onerous and distracting from the technical design effort.

A criticism of our capstone design curriculum is that there is little room for iteration — effectively, the student team goes through only a single design cycle. This limitation is justified because students need to be able to build and test a prototype, thus we have to freeze our design requirements at some point during the design cycle. However, a longer capstone design experience, namely one that allows prototyping, testing, and iterating on the design at least once, would better replicate an actual industrial product design cycle and may better respond to off-campus partner goals. Discussions of curriculum requirements (and student learning) have loosely occurred at the outset between OSU and the partner. They have been revisited at later times during the project so the partner understands why it is difficult to continue to iterate on design requirements after a certain point in the project timeline, but this does remain a tension.

For about half of our projects, particularly the ones that involve delivery of a physical prototype or other follow-on travel, students can continue to work on the projects beyond the end of the capstone design course sequence, often but not always on a volunteer basis. Students are needed for any field implementation and testing of the final prototype, but they may not be able to commit to field travel or post-capstone availability, especially post-graduation, and the logistics of field implementation can fall apart. Usually the opportunity for field travel is a significant incentive for students continuing to work on projects beyond the course conclusion. Students may build additional products/devices (e.g. building additional weather sensors), modify products/devices prior to delivery (e.g. adding additional sensors), conduct field testing, or otherwise continue to develop the project after the course but prior to the field travel.

Partner #1: Raitong Organics Farm

The tension regarding the need to freeze design requirements has been felt in several of our joint projects. Our mitigation strategy has been to try to continue the projects into the following year, but there is some dependence on resources and access to students with the right expertise for that specific project, especially when expertise from multiple engineering programs is preferred for a single team. (Our curricular structure has not easily allowed students from different majors to join a single team, however, changes are currently underway to more readily permit multi-disciplinary teams in the future).

Partner #2: Burro

Because of Burro's prior experience working with student design teams (not just from OSU), founder Alexander understands the competing demands of curricular requirements and company

needs, and also understands the value of this type of experience for U.S. student and competency development. Carol Brown, Burro's long-time Country Manager operations manager, often coordinated Burro's on-site interns, on-site fellows, and at least the initial communication with campus-based student design teams. Brown also understood the balance of curricular requirements versus company needs, and helped standardize and streamline the documentation templates and processes such that, from the university perspective, students on Burro's design teams had an unusual chance to see "inside" a small company. The student teams did not typically complain to the faculty adviser about having to put their research and design progress into these two differing forms of reporting.

At OSU, we tried to be flexible to mitigate extra unnecessary work while still fulfilling curricular requirements (assessments, format, etc.). Even so, the tension between curriculum requirements and partner requirements was apparent and the students had an underlying sense of having to satisfy two masters. From a faculty perspective, the need for students to balance these two sets of requirements directly supports the development of both professionalism and leadership/management competencies. Students must build project-management skills, especially with regards to collaboration and teamwork, and must also build resilience skills in these unfamiliar and challenging situations.

A strength of the Burro partnership, in terms of dual purposes, was that Burro staff typically partnered their U.S. student teams with on-site Ghanaian staff teams. These Ghanaian-based teams sometimes included a U.S. intern or fellow living in Koforidua. From the university side, this type of partnering of students with junior staff provides a rich educational opportunity for cross-cultural learning, and attends to FTL query e. Brown also explained that from Burro's side, the partnering offered project management experience for their junior staff. We note that this type of outcome (professional development for off-campus partners) does not require a significant amount of additional financial resources, so it may be possible in other partnerships.

Take-Aways From OSU Cases (case 3 and 4)

FTL Principle #1 - Partner/Community Voice and Direction

- Technology can enable clear teaching roles for off-campus partners (even from a distance). For example, in the Cookstoves partnership the off-campus partners taught sessions via Skype in the background course as part of preparation for the trip experience.
- Be prepared to dedicate significant time to ensure community voice and direction. For example, in case 3, the university and off-campus partners started conversations six to nine months ahead of time to allow time for planning together. Additionally, because the selected projects determine needed content in the background course, the faculty member needs to dedicate time to course planning and adjustments even if they have taught the course during a previous semester.

- Long-term (direct) social impact has not been a driving criterion for project selection. For example, for Raitong Organics Farm, OSU serves as a research and development partner to prototype and test innovative concepts that could contribute to modernizing or changing agricultural practices in Northeast Thailand towards increased sustainability and healthier agricultural production. Raitong Organics Farm already supports agricultural training, so there is a potential route for dissemination of innovations. Serving as a research and development partner has been an explicit choice, but one we feel is justified because of the partner's profile, positioning, and potential long-term impact on the broader community through the dissemination of innovation. University programs, faculty, or students seeking more direct routes of impact or market-based routes of impact may want to prioritize opportunities to partner on shorter-term product development projects with a more direct path to market, such as the projects we worked on with Burro.
- The project selection process is critical. In both cases, the sequence of stakeholder participation in the project selection process was important to ensure community voice and direction.
- It is all too easy to neglect to revisit expectations about the partnership and project continuity in-between active project cycle (e.g. from one year to the next, or in-between field courses).
- Capstone design project and teaming process can make it difficult to achieve project continuity from year-to-year.

FTL Principle #2 - Dual purposes

- The discussions on long-term goals and aspirations attend to queries a and b (Table 2), but FTL principles suggest that these queries should be periodically revisited. In OSU's own structure and process for identifying, initiating/renewing, and advising of projects, we can more consistently integrate the discussion of long-term goals, aspirations, and expectations for the duration of partnership commitment into our regular process.
- Curricular requirements can be in tension with off-campus goals.
- Sharing research findings with community/off-campus partners in a language and form accessible to them should become more the rule rather than the exception. Participants are often expected to share their time and expertise toward achieving research goals, but less frequently feedback about results are provided to them.
- There is little room for iteration in the typical capstone design curriculum.
- Find benefits outside of the specific technical project for the off-campus partner. Look for additional benefits such as providing project management experience for local (partner) staff or volunteers who serve as liaisons with university students/teams, offer reverse exchange opportunities if available, etc.

IMPLICATIONS

Implications For Theory: For Social Impact, Community Voice and Direction are Critical

We draw from the fields of CBGL, global development, and program evaluation to provide tools and insights for university-based engineering teams and off-campus partners to improve their long-term outcomes and impact. In particular, we draw on the fair-trade-learning (FTL) framework and core principles. We suggest adaptations to the FTL framework for engineering education:

- *Community* - Explicitly recognizing that off-campus partners can be for-profit entities and ensuring that all types of partners are included in the definition of community improves the relevancy of prior CBGL and global development frameworks for application to engineering education, social enterprise, impact investing, and interest- or problem-based collaborations.
- *Social impact* - Drawing from program evaluation, we distinguished between outputs (e.g. deliverables) and community outcomes and longer-term impacts. Impact is 7-10 years later so, therefore, requires sustainability. Constructing something or delivering a prototype is an output, not an impact. If we seek to move beyond project outputs in order to ensure community outcomes and longer-term impacts, we must prioritize project and partnership components that go beyond technology; in effect, it is not just about what work we do but also how and with whom we do the work.

Our analysis suggests integration of the FTL core principles of partner/community voice and direction and dual purposes increases the likelihood of achieving the desired social impact. If we hope that university and off-campus partnerships in engineering education can lead to long-term social impact, the Villanova University cases demonstrate that an intentional focus on community voice and direction driving project initiation, planning, and decision-making is critical. Community voice and direction must be considered at every phase of the design cycle to pursue long-term social impact.

Implications For Practice: Project Selection, Phases of the Design Cycle

If we focus on technology that prioritizes completion of deliverables, it is less likely to lead to social outcomes and impact. Yet in GEESD we often need to retain a substantial focus on technical content to fulfill course and program learning outcomes dictated by accreditation processes. While our conclusion that we must focus on more than technology seems intuitive and obvious, in practice, it is not always easy to ensure a broader focus. Analyzing the two OSU cases (3 and 4) together, we identified lessons learned and recommendations for practice to improve the ethics of engagement specifically in GEESD.

Lesson learned #1 - The project selection process is critical to ensuring community voice and direction and dual purposes.

Recommendations

- The following sequence of stakeholder participation in project selection processes works to ensure dual purposes and community voice and direction:
  1. From the off-campus partner's perspective, what are possible projects?
  2. Then, from the university or faculty member's perspective, which of the possible projects identified by the off-campus partner are realistic in terms of timeline and engineering experience and curricular requirements?
     - Timeline - is there fit between the timeline for the proposed project and the semester/ capstone project?
     - Alignment with engineering expertise/ experience and curricular requirements - is there fit between the proposed project and the university-based engineering team's areas of expertise and experience? Is there fit between the proposed project and the engineering curricula requirements?
  3. Then, from the student(s)' perspectives, which proposed projects are interesting?

Lesson learned #2

While community/off-campus partner participation may happen; it often falls into only one phase of the planning process. All too often, this participation is in providing survey feedback, but it should also be a priority in project initiation and planning, creating the questions on the survey for feedback, analysis and all the way through to dissemination. It is critical to intentionally prioritize these two FTL principles - dual purposes and community voice and direction - in every phase of the project and partnership planning process.

Recommendations

- It is all too easy to neglect to revisit expectations about the partnership and project continuity in-between active project cycles (e.g. from one year to the next, or in-between field courses). In university processes for identifying, initiating/renewing, and advising of projects, consistently integrate the discussion of long-term goals, aspirations, and expectations for the duration of partnership commitment into our regular planning process.
- Look for additional benefits such as providing project management experience for local (partner) staff or volunteers who serve as liaisons with university students/teams, offer reverse exchange opportunities if available, etc.
- Co-publication opportunities are concrete pathways to pursue off-campus partner participation in dissemination.

Lesson learned #3

If impact necessarily requires long-term sustainability after 7–10 years, plan for partnership instead of project.

Recommendations

- Long-term social impact can happen via multiple paths, some via products brought to market, and others via building capacity in an off-campus partner.
- Capstone design project and the teaming process can make it difficult to achieve project continuity from year-to-year. Collaborate with capstone design program leaders to plan appropriately to match expectations for length of project (and number of design iterations) with project allocation and the teaming process. There is little room for iteration in the typical capstone design curriculum.
    - Plan for project continuity at the outset if it is likely that multiple large iterations and year-to-year continuity will be needed.
    - Consider breaking down a complex project into multiple teams, if viable. This allows more redundancy and flexibility in terms of student availability for travel or implementation post-project.
    - Work with students who want to volunteer or be paid (if resourcesare available) to continue on the project after the capstone design course, equip them to iterate on the design.

Lesson learned #4

There is a tension between curricular requirements and off-campus partner goals. For example, the timeline of the university semester and capstone projects only allows for one design cycle while an off-campus partner may want to iterate multiple times before moving forward with the design cycle or before taking delivery of a material prototype or plans (e.g. CAD drawings) for a material prototype that can be fabricated by the off-campus partner.

Recommendations

- Remain flexible in how the course learning outcomes are met if it better accommodates the needs of the off-campus partner.
- Set an early expectation with both the students (team) and off-campus partner that certain elements are required to meet curricular requirements.
- Recognize that written documentation can be valuable for the off-campus partner, especially if it includes background research on prior project concepts or alternative solutions.
- If curriculum change is viable, consider extending the capstone design project to at least a 9-month if not multi-year timeline.
- Ensure feedback loops to share research findings, initial designs, etc. with off-campus partners in appropriate format and language (Reynolds, Hunt, and Munoz 2019).

The FTL queries provide a tool to illuminate these tensions so that all stakeholders understand those pressures and can create a plan to address them (or try to) that works for their partnership.

While we have included a set of FTL guiding queries for program and partnership design and implementation, we also recommend practitioners refer to the FTL rubric and related resources for self-assessment (Campus Compact, 2019). FTL was designed to adapt to different partnership contexts and disciplines; it provides a framework to spark dialogue and raise critical questions that are often systematically ignored. By engaging these questions methodically, the FTL process increases the likelihood of diffuse stakeholder commitment and, ultimately, increases the likelihood that our work will lead to intended positive social impacts.

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AUTHORS

Nora Pillard Reynolds serves as Director of the Community-based Global Learning Collaborative and Fellow for Ethical Global Learning and Visiting Assistant Professor at Haverford College. Following her graduation from Villanova University in 2002, Nora co-founded Water for Waslala, an NGO that worked for access to water and sanitation in rural Nicaragua. On April 1, 2016, Water for Waslala was acquired by Water-Aid. She earned her MA in International Development at La Univerisidad Complutense de Madrid, MS in Elementary Education from St. Joseph's University, and her PhD in Urban Education at Temple University. In her research, Nora utilizes participatory methods to explore multiple perspectives in civic engagement and community campus partnerships.

Nordica MacCarty is an Associate Professor of Mechanical Engineering and Richard & Gretchen Evans Scholar of Humanitarian Engineering at Oregon State University, and Executive Director of Aprovecho Research Center. Her research is focused on co-design and impact evaluation for household energy project. She was recently recognized with OSU's International Service Award and the Elevating Impact Award for social entrepreneurship from the Lemelson Foundation. Her work is funded by the US Department of Energy, US Environmental Protection Agency, National Science Foundation, VentureWell program, and other private foundations. She also serves as faculty co-advisor for OSU's Engineers Without Borders chapter and Associate Editor for Energy for Sustainable Development. Prior to joining the OSU faculty in 2015, she spent nearly 10 years as an international consultant building capacity at projects and universities in developing countries.

Kendra Sharp is Senior Advisor for Global Affairs, Associate Vice Provost for Faculty Development, and Professor of Mechanical Engineering at Oregon State University (OSU). Currently, she provides leadership for the development and implementation of OSU's university-wide internationalization and global engagement strategy. She also founded OSU's Humanitarian Engineering Program, holding the Richard and Gretchen Evans Professorship of Humanitarian Engineering from 2015–2020. In collaboration with faculty, students, NGOs, and social entrepreneurs, she works to address global issues in poverty, energy, and water through engineering design and international education. Recent awards include an Erskine Fellowship at the University of Canterbury and the American Society of Mechanical Engineering's Edwin F. Church Medal. Dr. Sharp received her Ph.D. and B.S. degrees from the University of Illinois at Urbana-Champaign, and Masters' degrees from the University of Cambridge and the University of California-Berkeley.

Eric Hartman is executive director of the Haverford College Center for Peace and Global Citizenship, lead author of *Community-Based Global Learning: The Theory and Practice of Ethical Engagement at Home and Abroad* (2018), and co-founder and executive committee member of the Community-Based Global Learning Collaborative. He served as executive director of a community-driven global nonprofit organization, Amizade, and taught human rights, transdisciplinary research methods, and globalization in global studies programs at a number of institutions before arriving at Haverford College. Eric also serves as a Lecturer in the University of Pennsylvania Graduate School of Education, where he teaches Seeking Global Citizenship at Home and Abroad: The Role for Higher Education.

APPENDIX: FAIR TRADE LEARNING QUERIES (HARTMAN, 2015)

Fair Trade Learning (FTL) Queries
Do stakeholders, including several and diverse community members, agree on long-term mutuality of goals and aspirations?
Do all stakeholders understand the nature of partnership commitments, including whether the partnership is ongoing or time-bound and under what conditions or processes it might end?
Do community members have clear teaching and leadership roles as well as clear roles in driving research direction, process, and publication, with fair authorship rights?
Are vulnerable populations, such as children, clearly protected through appropriate safeguards and relevant training for all individuals involved in the partnership?
Do students' same-age-peers from the community have financially underwritten opportunities to participate in programming (in an accredited way)?
In terms of community impact, are the reasons for the partnership understood and embraced by multiple and diverse stakeholders?
In terms of student learning, are the reasons for the partnership understood and embraced by multiple and diverse stakeholders?
Do recruitment and any other outreach materials serve an educative function, shaping expectations for ethical engagement?
Do all stakeholders know whom to communicate with about what, through what channels, at all times?
For all interested community members and students, does carefully selected text and facilitated discussion support learning about responsible engagement, cross-cultural cooperation, and growth in global community before, during, and after community-campus engagements?
Is the economic impact of the partnership deliberately distributed among multiple stakeholders (such as community organization buildings where classroom space is secured, local restaurants that host students and community partners, and/or host families working with overnight programs)?
Do all stakeholders have access to information regarding financial commitments and disbursements that support the partnership, along with opportunities to openly and critically discuss those commitments with the other stakeholders?