From Service to Engagement: Outcomes from the Implementation of Multiyear Human-centered Design Initiatives Across Engineering Courses to Improve Both Community-Partner and Student Outcomes

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From Service to Engagement: Outcomes from the implementation of multiyear human centered design initiatives across Humanitarian Engineering courses to improve both community partner and student outcomes

Introduction

Engineering service learning or humanitarian engineering in the university setting has only been around since the early 2000s [1]. The many potential benefits of efforts by students and instructors to apply engineering directed at improving the wellbeing of marginalized communities are evident - communities receive valuable contributions while students gain practical hands-on experiences and apply theoretical knowledge to solve real-world problems. However, as pointed out in [2] [3] [4] without careful facilitation and being mindful of historical injustices, patriarchal philosophies, and power dynamics, service learning can unintentionally perpetuate a dynamic of patronization, saviorism, and poverty voyeurism.

The Ohio State University (OSU) has been offering engineering service-learning courses since the early 2000s, that have spanned mostly the international context. These early courses adopted a traditional approach to service-learning which often did not see the community as co-equal partners and overlooked systemic inequalities. Reflecting on this period, the success of many implemented projects (from Honduras to Haiti) remains unclear. To rectify this and transition engineering service learning to a critical paradigm, with the aim to deconstruct systems of power and dismantle the inequalities they perpetuate, a collaborative effort among faculty members, also the authors of this paper, teaching local and international service-learning courses was initiated.

In response to the need for a transformative shift, the authors embarked on a reflective journey to adopt a multiyear Human-Centered Design (HCD) Approach [14][5]. The primary goal was to facilitate authentic relationships in the classroom, redistribute power, and operate from a perspective focused on social change. Over the years, the authors have iteratively modified the original HCD model to accommodate variations in cultures, partnership dynamics, and practical field experiences.

The authors teach courses which involve working with communities in Guatemala, Honduras, Guyana, Ghana, Tanzania and the USA. The next few sections of this paper introduce traditional approaches to service learning and the need for the critical multiyear HCD approach. Following this, a brief overview of the different community-based learning courses at OSU is included. Next, a comprehensive reflection on the journey undertaken by the authors is discussed. It outlines the strategies employed, the successful interventions, challenges faced, and the subsequent modifications made to the HCD model. The authors aim to provide insights into what worked and what didn't during the evolution of engineering service learning at OSU. In the outcomes section, the authors make the case for using the Intercultural Development Inventory

(IDI) as a tool to assess impact on student intercultural competence and provides data from one of the courses.

Challenges with the traditional service-learning model

Traditional service learning in the university setting, typically involves, students learning about community, their problems, and identifying a problem that the students can 'solve'. The project is usually identified directly with a community, by a community partner or by the instructor. Students then work on developing a solution through an iterative engineering design process and come up with prototypes which they may share with the community or the community partner to receive their feedback. Students then travel to the community and deploy the prototype. In some instances, a 'one and done' approach could also be taken where the course moves on from the community or non-profit partner to a different one after just one or a few instances of working with them.

From the perspective of the instructor, the course is often treated like a typical engineering course, where the instructor focusses on the course mainly in the semester that the course is offered. The course can be structured with homework assignments, projects and exams. Any relationship with the community or community partner fizzles off during the off semester and is picked back again the semester the course is offered. From the perspective of the student, it can be viewed as a typical engineering course with some offsite travel to collect data and implement a project.

In these courses, the focus is usually not on the inherent power differences between the community and the students or the historical ways in which humanitarian engineering efforts have failed but rather the focus is on the engineering design process to solve an 'identified' problem.

While the current 'preferred' service-learning approach in the literature [6] [7] is critical service learning, a lot of early literature pointed to the many positive student outcomes that could arise from the traditional approach. Astin and Sax pointed out that traditional SL approaches lead to more tolerant, altruistic, and culturally aware students [4]. Densmore (2000) talked about the many communication and leadership skills that students who participate in traditional service-learning gain. A common theme that could be seen with projects that involved traditional service learning was the extreme focus on student outcomes often at the expense of community outcomes.

The Human Centered Design Approach – Efforts at a "new" model

As it relates to HE, Human Centered Design is an approach for problem solving that puts people who experience problems of poverty, access to resources like water, sanitation and health (WASH) etc. front and center in any attempt to help address the problems. It does this by placing those who will end up using the designed products or services at the fore front of the design process.

One pain point of aligning community engagement work with the typical U.S. academic schedule is the need to fit within predefined semesters, quarters, summer terms, etc. Having a student team, work from conception to completion of a design deliverable in that timeframe is difficult even when the context is well understood, and the scope is clearly defined [8]. Add in the challenge of an unfamiliar context and morphing scope inherent in community engaged work and the process becomes infeasible [9]. This can result in inappropriate, ineffective and/or insufficiently tested designs. This poses a risk directly to the community partners and can imbue students with an unrealistic sense of competence and impact.

The three-year version of the HCD model that we used was a modified version of what was proposed by IDEO [14]. This modification was done to accommodate existing course structure limitations such as this model being adopted in an engineering course which is offered one semester in an academic year with a new group of students every time. The original IDEO proposed model was meant for groups working on design projects to go through the next HCD step immediately after the conclusion of the previous step. This is more challenging to implement with existing university course logistics for typical engineering courses. These logistics can include variability in course offering, timeline of potential travel opportunity, and turnover of faculty and students. This modified structure is shown in Figure 1.

Figure 1: The Three-Year HCD Model

Inspiration – During this year, the goal is to collect as much information, both through interviews and other methods of data collection, about a particular problem in a community. It gives designers an opportunity to clearly articulate the design challenge by talking to different people about their hopes and dreams for their community. A key part of this is to keep an open mind and being willing to go in the direction that the data points to.

Ideation – During this year, the goal is to make meaning from the data collected in the Inspiration phase. Following this, an idea generation process is initiated, and the good ideas are identified through stakeholder feedback. Then prototypes based on the idea are created and shared with the community and their feedback is incorporated through an iterative process. At the end of this year, a solution to be implemented is ready.

Implementation – During this year, the goal is to iteratively incorporate feedback, construct and deploy the final prototype in the community. This step also involves, monitoring and evaluating the effectiveness of the implementation and make any necessary changes.

An overview of the Community Based Learning courses at OSU is discussed in the next section.

Background on Community Based Learning Courses at The Ohio State University

The Ohio State University has established community-based learning courses in Guatemala, Ghana, Tanzania, Guyana, Honduras and Columbus as shown in Figure 2 below. Each of the courses have different degrees of implementation of the HCD model.

Figure 2: Community Based Learning Courses at OSU – Partner locations

Guatemala

The Ohio State University has a well-established relationship with an indigenous led non-profit partner in Panajachel, Guatemala. Since 2015, an engineering community-based learning course has been offered which gives students an opportunity to work with the community partner and with Maya communities in the region. Over the years, students have worked with the community in the region on various projects relating to water, sanitation, effective cookstove design and energy. Between 2015 and 2017, the course tried to implement multiple projects in the community each year with no guarantee that the course will be offered the next year. This meant that an attempt was made to tie up all loose ends during the single semester that the course was offered. This usually involved interacting with the community partner who identified suitable engineering projects for students to work on, students who then worked on the projects and travelled to Guatemala to try to implement the projects. The course adopted a multi-year HCD model in 2019.

Ghana

Since 2017, OSU has collaborated with United, a Ghanian led NGO that focus on community livelihood projects, specifically in WaSH and Agriculture domain. Students collaborate with this partner through a community-based learning engineering course, that is designed to introduce students to the concepts of humanitarian engineering through a practical, meaningful, authentic, real-world, international engineering experience. Students in this course collaborate with the NGO and community partners of the NGO to co-define, research and co-implement useful,

sustainable technologies. While working with the in-country partner, student projects have focused on the evaluation of various project aspects such as cost, sustainability, and local ownership. Student teams along with the NGO partner garner feedback on design and ideas from the community and identify potential opportunities that could be developed for the local community. Students have worked on projects within the water, sanitation, and hygiene domain and small-scale agricultural projects. Students focused on the human centered design process, as well as the history, culture, politics, socioeconomics, languages of Ghana. The course adopted a multi-year HCD model in 2019.

Tanzania

Starting in 2015, OSU has had community-based programing in Tanzania. Specifically, the Tanzania Maji Marwa project, an effort focused on water access for rural communities was introduced to students first as a capstone project option in the undergraduate civil engineering program with a travel component course where students learn Kiswahili, historical and cultural context and then travel for experiential learning. The engagement typically spans as yearlong capstone projects (AU and SP) with the complementary travel preparation course. Students have engaged with nonprofit Kilimanjaro Hope Organization and the rural Masaii community of Marwa to access their water related challenges. The first implementation of student driven projects related to rainwater harvesting, the initiative's goal was to collaborate with in-country partners to co-implement three rainwater harvesting (RWH) systems on locations designated by the community. The phasing of the rainwater harvesting initiative starting in 2017 followed the HCD model with a three-year process. Year One (2017) focused on relationship building, observation and interviews, and analysis of local construction practice. Year two (2018) focused on adapting a water storage tank design, co-implementing the design, and an intentional focus on community capacity building through the engagement and seeding of a local contractor. With (2019) focused on improvements to the design and the implementation process of the tank and worked towards full community autonomy. Efforts to continue to address water challenges in the region have continued with student projects related to water wells and water distribution networks.

Guyana

The community-based learning course in Guyana was started in 2019, with the HCD model from the outset. The course is the newest of all the courses mentioned in the paper and has many unique attributes. Unlike the other courses, one of the instructors of the course is Guyanese and this autumn semester course with winter break travel involves working directly with the community with no non-profit partner. Through the inspiration phase it was determined by the community that immediate needs were centered around small-scale solar generator systems to power individual households. Students, with input from the community produced designs and prototypes of the system in 2021. In December 2023, students from the course implemented 10 solar generator systems in two communities on the Essequibo River.

Columbus

A partnership between a local community garden and a College of Engineering lecturer began in 2017, when their paths crossed at university programming around food security and urban

agriculture. The lecturer began volunteering at the garden, and soon proposed a partnership in which a service-learning class would carry out projects at the garden. The class has been held once annually since then, with students implementing a solar electric generator, an automated farming robotics system, a rainwater collection system, a hydroponics system, two three-bin composting units, and high tunnel automation. In addition to the class, research faculty, student organizations, and another community food security organization have become involved.

The garden is located on the grounds of one of the oldest black congregations in the city, 4 miles from the university campus. Its mission involves food access, cultural connections of farming and gardening to black and brown communities, STEM education access for youth, and increasing economic self-sufficiency of its community. The garden hosts a weekly farmer's market in the summer, a free summer STEAM camp for community youth in the summer, and various pop-up mini camps throughout the year.

Lesson Learned: Reflections on the multiyear HCD approach

The authors recognized that over the years, the original multi-year HCD approach had evolved differently across the different courses due to logistical, structural, and cultural differences. The authors came together and reflected on these changes that they needed to make to the original approach and the lessons they learned along the way. These lessons learned were grouped into to two categories for international collaborations, role of the class and the role of the community, which are outlined and further elaborated below. The unique lessons learned from local collaborations follows the international collaborations section.

1. Role of the class
    a. Interviewing community members
    b. Unguided student interactions
    c. Students travelling to the community
    d. Perception of students as experts
    e. Students participating in construction
    f. Project continuity and sustainability
    g. A never-ending course for the faculty
2. Role of the community
    a. Larger community
    b. The need for an effective community partner
    c. Power dynamic with community partners
    d. Flexibility in the HCD process
    e. The role of involving local universities and colleges

1. Role of the class

The class here refers to the entire classroom ecosystem which involves a series of interacting stakeholders with complex motivations. Figure 3 shows this complex classroom. The type of student who typically participates in community-based learning engineering courses are those who want to make a difference in the world by utilizing their engineering skills. In the

student's mind this might mean jumping in, taking the lead, developing solutions, and implementing them in the community. The authors have observed the many ways in which the student can negatively impact the community and the community partner, and thus their role should be carefully facilitated.

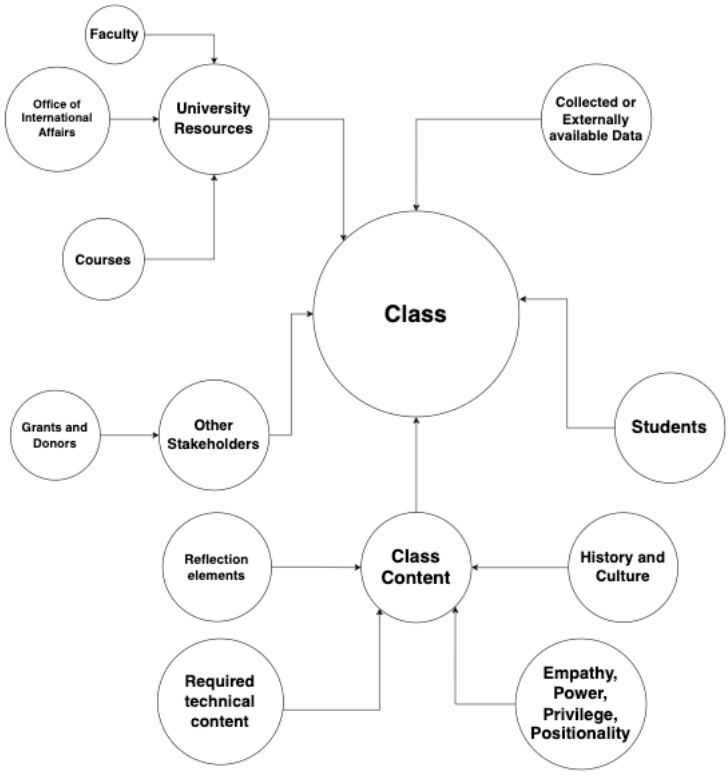

Figure 3: The complex classroom

a. **Interviewing community members –** The authors have observed the negative impact of having students directly interview members of the community. For example, in the case of the Guatemala course, even when adopting best practices from sociology for the construction of interview questions and getting them vetted from the community partner, the underlying power dynamic between the students and members of the community was evident. This led to questions about the validity of the feedback from the community. Additionally, a translation from English to Spanish to Kakchiquel or Kiche was needed when the questions were asked, and this seemed to add to the artificiality of the process.

b. **Unguided student interactions -** While it can be extraordinarily positive for students to form relationships/partnerships with community organizations outside of instructor oversight, this can lead to problems. In some cases, students may be over-ambitious and make promises that they may not be able to follow through on. This could potentially tarnish the overall relationship between the community and the institution. Additionally, the community partner may become overburdened dealing with multiple student interactions. So, it might be needed for faculty to serve as gate keepers to the community. For example, in 2019 in the Guatemala

course, and 2018 in the Tanzania course, the instructors wanted to democratize access to the community partner, so they provided access in the form of email addresses of folks who work in the organization. This ended up overwhelming the community partner who requested that the student questions be filtered through the instructor.

c. **Students travelling to the community –** Students travelling to the communities and interacting with community members that they are working with in controlled settings can be an extraordinary experience for them. However, there can be complications. For example, in Tanzania, challenges arose from the community perceived optics related to how fiscal aspects of the projects were managed. The community leaders questioned how there was funding to bring students to the community but not sufficient funding for the projects themselves. While it was conveyed that OSU was not a funding organization and students had to pay to be able to travel and that the project cost was far greater than the cost to bring students to the community, tensions still arose.

d. **Perception of students as experts –** In all the courses, the authors faced challenges related to students being perceived by the community as experts even though many were early in their educational career. This led to ineffective feedback and dialogue amongst collaborators. Indeed, we have noticed that there are inconsistencies between community partners' perceptions of engineering students' skills and abilities and the reality that they are young learners who may be novices when it comes to project deployment and partnership/relationship development. This can result in community partners requesting assistance in projects outside of student expertise and putting too much stock in student recommendations.

e. **Students participating in construction –** In traditional engineering service-learning courses it is common for students to partake in construction or assembly of their prototype in the country. But in the HCD model, depending on the year, student role in the community may involve no construction at all. For example, in 2019, the Guatemala course was offered under the framework of HCD which involved the Inspiration Phase (Year 1), Ideation Phase (Year 2) and Implementation Phase (Year 3). The authors were nervous about how the Year 1 students who were part of the Inspiration phase would react to the realization that they were not going to be designing a prototype or building anything in country. But to their pleasant surprise, the students seemed to be supportive of the framework and understood their role of setting the foundation to implement the project a couple of years later. The outcome of this effort was the constructions of two rainwater harvesting systems in the two Maya communities of Pena Blanca and Tierra Linda in 2022. The COVID pandemic delayed the implementation by a year and the system which was designed by the students based on input and feedback from the community and community partner, was constructed by members of the community and managed by the non-profit partner. While this seemed less than ideal at the time, the overall quality of the construction by professional builders in the community was superior to what the students would likely have built. Learning this lesson, in subsequent implementations of projects, students have played second fiddle to the implementation led by professionals in the community. But, during the 2017,18,19 project implementations in Tanzania there was observed student frustration that their exact project design wasn't being implemented and that they weren't the ones that were doing the physical building. One

observation from the contrasting observation is that students are not a monolith and have a varied level of emotional maturity, technical competence, and socio-cultural skills.

f. **Project continuity and sustainability –** After implementation of the project, the role of the class and the instructor with the project is nebulous. On the one hand it is impossible to be responsible for a for multiple implemented projects in the community for ever but on the other not having a long-term plan for the implemented systems can lead to non-functional systems and take on a more traditional service-learning approach. Also, having students work on projects for only 1 semester during the year is not ideal. At OSU an attempt is currently being made to involve capstone students who are part of the global capstone program who have more time to start working on these projects in the previous semester and thus offering some continuity.

g. **A never-ending course for the faculty -** While community-based learning courses are typically only offered for a semester, effectively maintaining the relationship and the projects is a yearlong commitment. The off-semester work is often not compensated.

2. Role of the Community

The community is a complex set of stakeholders which can comprise of members and leaders of the community, the community partner, supporters of the community like the government, local universities etc. The complex nature of the community is shown in Figure 4 below:

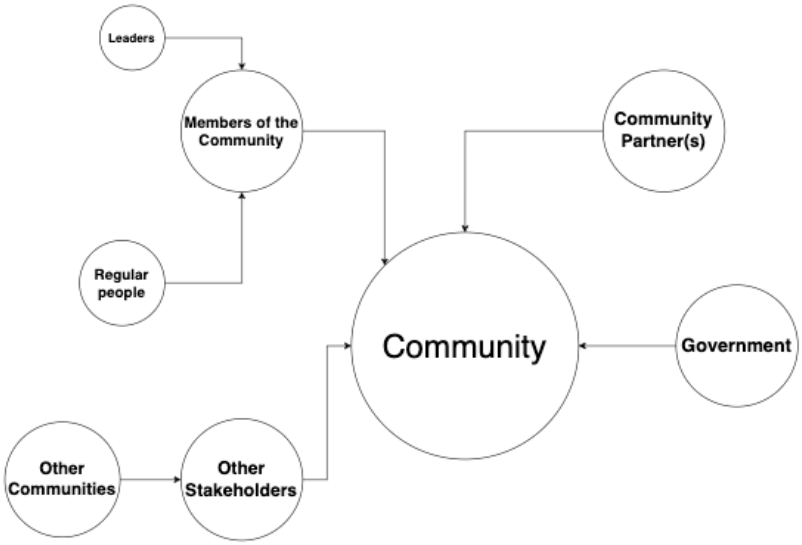

Figure 4: The complex community

a. **The Larger Community –** The community is a complex entity with multiple stakeholders, and it is important to take the time to consider all stakeholders and the project's potential impact on all of them. For example, in 2017, before the HCD model was adopted in the Guatemala course, a rainwater harvesting system was installed in a local pre-school in a

community around Lake Atitlan. The system was requested by the community and was designed in collaboration with the community partner and the community. During the semester, feedback from the teachers who were going to be using the system was incorporated into the final design. The students and the instructors then travelled to the community and built the system. However, shortly after implementation, conflict arose with a neighboring community, who claimed the pre-school was a part of their community and despite many attempts to resolve the conflict, it is currently not in use by either community. One outcome of this experience was the realization that the community is far more complex than the small minority of people that one typically tends to interact with and effort needs to be put towards carefully identifying stakeholders and ensuring that no harm comes from well-intentioned actions. Another example from Tanzania was when a leadership change in the community lead to information not being shared and expectations needed to be re-established with the new leadership.

b. **The need for an effective community partner –** A effective community partner can play a vital role to facilitate interactions with the community. So, identifying a partner organization which is run by locals in the community, with shared motivations is preferable. In the courses outlined above, only the Guyana course doesn't utilize a community partner and work is done directly with the communities. This was only possible because of the instructors of the course is Guyanese and a close working relationship was established with the leaders and members of the community.

c. **Power dynamic with community partners –** The community partners are typically non-profit organizations who are working to address the needs of the community. If not carefully managed, the community partners could end up working to support the needs of the class rather than work with the class to help address the needs of the community. For example, in Guatemala, Ghana and Tanzania, the instructors noticed that the community partners interest in working on an identified project was primarily during the semester when the class was offered, and it often fizzled away during the off semesters. This was something that needed to be expressly addressed with the community partners.

d. **Flexibility in the HCD process –** In all the courses listed above, the instructors found that the HCD process of Inspiration, Ideation and Implementation needed to be flexible. The inspiration phase, which often involves interviewing members of the community was determined to be unnecessary in certain circumstances. For example, communities and community partners expressed interview fatigue. In a few instances these stakeholders have mentioned that their needs hadn't changed from the last time an interview was conducted. The authors do feel however, community input in the ideation and implementation phase is crucial.

e. **The role of involving local universities and colleges -** Community engaged courses at OSU have varied partnerships with local universities. Four forms this has taken are as follows:

    1. There is no partnership with local universities.
    2. Local university students take a full semester class and work on projects virtually, in teams with OSU students.

3. Local university students travel to the community partner with OSU students.
4. The project is local, so the students are the local university students.

For example, students in the Tanzania course can engage with counterparts from a Tanzanian University which allows for rich cultural exchange while also providing students with the perspective of the range of lifestyles and nuance of Tanzanian culture. Anecdotally, the authors have observed that when OSU students work with local university students, it broadens their perspective and counters misconceptions that the entire region being visited is represented by the communities with which they partner.

Reflections from local community-based learning in Columbus

Local community-based learning presents unique opportunities and challenges. The proximity of locally community-based learning projects in engineering offers several advantages:

a. **Cost -** Local partnerships avoid the high expense of travel, which can be an obstacle for students who may not have the necessary disposable income.

b. **Informal relationship-building -** Proximity also allows for more opportunities throughout the calendar year for relationship building and in-person interactions between faculty/staff and community partners. Faculty can show up for informal volunteer sessions, they can bring their family, and develop friendships beyond the work.

c. **Expanded opportunity for students -** For students, it means that they can be involved with community groups outside of their course work. We have seen student organizations raise money for community groups, establish hands-on projects through their student organizations, and carry out internships and other informal learning experiences with the local community partner. In the past, students have developed meaningful mentor/mentee relationships with community partners, received recommendation letters, and received valuable hands-on project experience.

d. **Expanded professional opportunities -** There may be many opportunities for collaboration on a variety of fronts, including collaborative journal publications. It becomes possible to build an ecosystem that can create an overlap between the academic institution and the community. Various units and offices from the university can become involved, various student organizations, funding avenues can all come to bear on the joint mission. Where an international class might see a couple dozen students for two weeks in a year, a local project can see many dozens of students and faculty/staff throughout the year.

It's a double-edged sword, however, as the proximity also creates new challenges:

a. **Project upkeep -** With faculty and students being close by, community partners can feel that they can count on continued engagement for project upkeep. Even with clear communication around project handoff and ownership, unexpected issues that arise with projects after the service-learning experience has ended can become additional work for faculty. Faculty feel a responsibility to help and can end up putting in hours outside of

their paid duties. As the partnership ages, there can be many such projects that the faculty feel a responsibility to help keep up. Without the clear delineation of project start and hand-off, instructors can feel that they are forever "on-call" to assist with projects well beyond the hand-off date.

b. **Classroom culture -** Without a trip and the corresponding informal conversations, meals, reflections, and time together, the instructors and students may not develop the same level of understanding and trust that often develops during international experiences.

c. **Scheduling activities -** The project work itself doesn't get the one- to two-week intensive attention that is received in an international trip. Instructors must find time to be on-site with students around their busy schedules, and often the projects don't receive the same total number of hours that they might in a longer dedicated trip.

d. **More complex partnerships -** When multiple student organizations, academic units, and a span of personalities get involved, it can become complicated and community partners, delighted at the opportunities for more partnership and access to resources, can become stretched thin. The 'hard to say no' problem persists in local community-based learning.

Outcomes: Making sense of our observations and reflections

To understand the efficacy of the multiyear HCD model on students, quantitative data to help assess intercultural competence was collected and analyzed. Intercultural competence involves the development of attitudes, knowledge, skill and qualities that let an individual to function effectively across cultures [24]. The Intercultural Development Inventory is a widely used tool for this purpose.

Intercultural Development Inventory (IDI) data was collected to establish insight into student mindset related to intercultural competence as part of a larger ongoing research effort in several HE related courses. The IDI has been widely used in educational institutions to assess intercultural competency and has been recommended by higher education organizations such as the American Council on Education (Delmas, 2013). The IDI, a 50-question survey, was implemented as a pre and post assessment in various courses. IDI scores range from 0 to 150 and provide students with insight into their Development Orientation (DO) stages, correlated to the Intercultural Development Continuum (IDC). The IDC is a continuum that starts at Monocultural/ Ethnocentric Mindset and moves towards an Intercultural Mindset. The phases are Denial, Polarization, Minimization, Acceptance, and Adaptions as mapped and described further in Figure 5.

For example, the data in Table 1 show the results from pre and post IDI surveys administered on students who took the Engineering Service Learning in Guatemala course in the Spring semester 2021. It can be observed that of the ten students in the course, there were eight students who had significant gains in their Development Orientation (DO) scores (i.e. at least a 7- point increase) from pre (T1) to post (T2) with a mean gain of 11.31.

Student	T1 DO	T2 DO	IDI Gain	T1 Orientation	T2 Orientation
Sp22EngT211	105.39	95.5	-9.89	Minimization	Minimization
Sp22EngT210	75.74	78.42	2.68	Polarization	Polarization
Sp22EngT28	91.28	99.6	8.32	Minimization	Minimization
Sp22EngT217	109.01	118.7	9.69	Minimization	Acceptance
Sp22EngT29	88.72	99.23	10.51	Minimization	Minimization
Sp22EngT213	80.18	91.04	10.86	Polarization	Minimization
Sp22EngT212	88.54	102.94	14.4	Minimization	Minimization
Sp22EngT214	77.66	93.22	15.56	Polarization	Minimization
Sp22EngT215	96.32	113.4	17.08	Minimization	Minimization
Sp22EngT216	86.15	120.06	33.91	Minimization	Acceptance

Table 1: Spring 2021 Guatemala IDI Scores

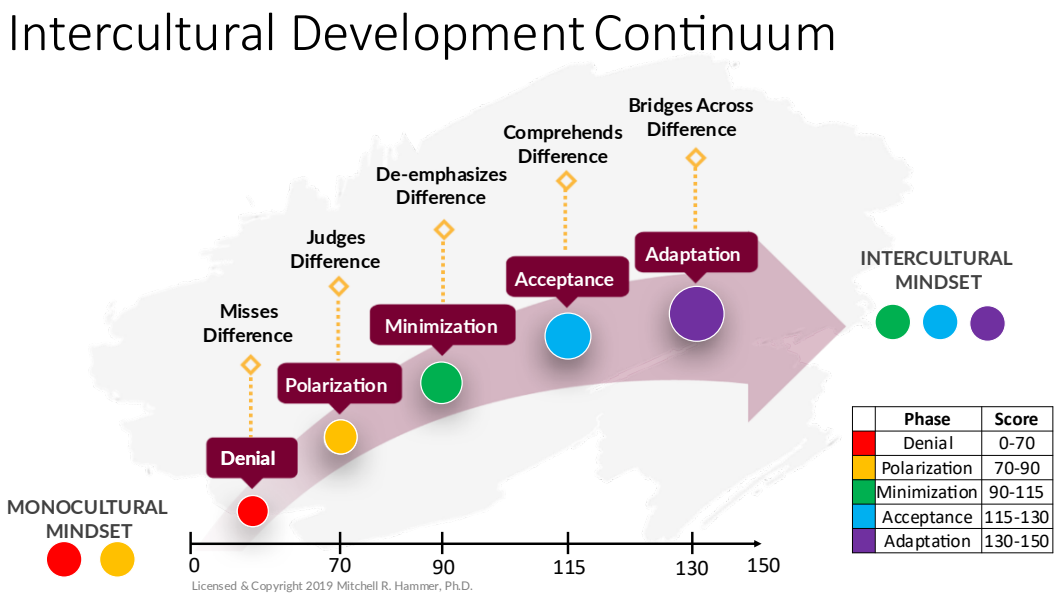

Figure 5: Intercultural Development Continuum with IDI Scoring (modified from Hammer 2011)

Qualitative data in the form of anecdotal evidence such as conversations with teachers in Guatemala and Tanzania, student participation in school and community garden activities in Tanzania and Columbus seems to suggest that there have been some positive impacts on the community. But the process of understanding community impact is complicated and laborious, and more evidence is needed to estimate the impact on the community.

Conclusion and Future Work

The integration of the multiyear HCD model into community-based learning courses has resulted in varied outcomes and the authors acknowledge that there will be need for continued iterative design and modifications to this model. The transition away from ‘tech to the rescue’ projects has allowed for long term partnerships and relationships to grow. In addition, the IDI data on the impact on student intercultural competence is promising with some results from this investigation indicating growth related to intercultural competence for a majority of students that partook in community-based learning courses. IDI data was not collected prior to 2021.

The authors of this study plan to expand the IDI assessment for more community-based learning courses and investigate longitudinal data from students taking the assessments multiple times over their time in the university setting. Additionally, a formal way to assess the community perception of the work is being developed.

Acknowledgment

The authors would like to thank the following people who were instrumental in supporting the courses mentioned in this paper over a period of time: Dr. Rachel Tuttle, Dr. Michael Hagenberger, Dr. Kevin Passino, Dr. Gregory Bixler, Mr. Raymond Brooks, Ms. Elizabeth Ritter.

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