BOARD # 172: WIP: Co-Designing Humanitarian Service-Learning Activities: Lessons from Semi-Rural Amazon Communities

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WIP: Co-Designing Humanitarian Service-Learning Activities: Lessons from Semi-Rural Amazon Communities

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Abstract

In Fall 2022, a group of students from Engineers Without Borders student chapter at Universidad San Francisco de Quito USFQ designed a service trip to install water chlorinators in semirural Andean communities in Ecuador. The goal of the trip was to provide clean water by installing water chlorinator in a school of USFQ community, providing maintenance technical training and giving sanitation and hygiene training to the community. The key was to co-design the intervention with the community using Mazzurco and Jesiek principles to co-design such intervention. This study focusses in the lessons learned from the challenges and barriers students faced during the co-designing phase. Such lessons were recorded in a manual of best practices for future interventions in communities with similar contexts. This paper proposes the adaptation of the methodology to co-design humanitarian engineering interventions between students, faculty advisors, interested stake holders and communities. All of these for communities are located in the Andean mountains. The authors discuss the possible factors driving the results, the next steps and explore the avenues academia could take for future co-design service trips to semirural Andean communities. Implications for research and practice are provided.

Introduction

According to the World Health Organization there are billions of people who do not have access to safe water, proper sanitation, and electricity [1]. In the next decades, the demand for energy, food, land, water, public health care and other matters will be critical [1], [2]. For humanity, it is important to fulfill this demands to provide a basic quality of life for people [3]. Engineers are developing sustainable solutions for the lack of access to these basic needs and are applying it in communities around the world [4]. This is known as the Humanitarian Engineering (HE) concept. Today, HE projects are developed as a modern concept of engineering education. HE attempts to develop a new mindset in faculty advisors, students, and partners to achieve both education and practice, while helping students develop their skills and simultaneously address problems in communities [3], [5].

HE programs require technical proficiency; the objective is the implementation of sustainable designed solutions [6], [7]. However, community participation is important. The success of the project is determined by the community's engagement with the project and availability. There is the need for a deep understanding of the community, its social and cultural contexts to develop trust and proper communication to achieve the desired collaboration and partnership. Complementary to the community understanding, students and faculty advisors develop a framework with high ethical standards and professionalism, which may not be applied in every

community [6], [8], [9]. To provide context, and a sense of purpose and clarity, students and faculty advisors have to understand economic, social, environmental, and gender-related factors [6], [10]. Each community should be treated as an individual.

The framework proposed to co-design this HE intervention is based on the five guiding principles of Mazzurco & Jesiek. The goal of this project is to provide a guide to professionals and educators to co-design engineering service trips with Semi-rural Andean Communities. Student organizations like *Engineers without borders* (EWB) and *Society of Women in Engineers* (SWE) will be enrolled. This co-design attempts to provide guidance to faculty members and students and help them succeed. As a result, the HE project will not only address the community matter but also will help students to develop leadership and communication skills, as well as the ability to think critically and to apply knowledge in real life problems within different contexts [6], [11], [12], [13].

Background/Framework

The Andean region of Ecuador are mainly rural areas populated by indigenous people dedicated to agricultural activities [14]. Andean indigenous people have their own form of resources management. Mainly, they focus on water for irrigation and little attention has been paid to drinking water systems [15]. For indigenous people, water is a living, life-giving source from Mother Nature, full of powers[16]. With that mindset, cultural beliefs and practices, there is scarce knowledge and practices in preventing and the consequences of water pollution [17]. However, hygiene and sanitation practices must be taught to community members, especially to children, as a precautionary measure for maintaining good health.[18]. Also water availability, use and quality must be considered [19], [20].

There may be a relationship between poverty and lack of access to safe water in rural areas [21]. This highly problematic issue has become a public health problem of great magnitude for community members, particularly for children and women [22]. According to the World Health Organization, viruses are transmitted through unsafe drinking water. Some of them increase the mortality rate, like Hepatitis E in pregnant women, for example. These viral infections do not only cause severe illnesses but also have a relationship with malnutrition on children and greater morbidity in children under the age of five, pregnant women, and elders [23]. In Ecuador, indigenous populations do not have access to basic services such as running water. Only about the 20.9% of indigenous children have Water, Sanitation and Hygiene (WASH) measures, meaning that the 80% of indigenous children do not have access to safe water, basic sanitation or supplies for handwashing. These percentages do not include women, men, and elderly [24]. Besides the lack of access to safe water, in Ecuador, water contamination by small, medium, or large scale mining is another matter that indigenous people face [25].

In this paper, Humanitarian Engineering (HE) is referred as the design under constraints to directly improve the well-being of under-served populations [26]. Some authors and literature suggest the dangers of not engaging meaningfully with communities when working on humanitarian engineering projects. Considering that the success of the project is related to active

community participation and long-term commitment, the parties enrolled should follow the five principles presented by Mazzurco and Jesiek. These principles facilitate the community participation, planning and management. Therefore, it is important to plan and establish strategies to ensure the success of the project and promote engagement between engineers and community members to achieve the project´s objectives. The literature provides guidelines that enables engineers, educators, and community members to work more effectively.

The Co-Design is "The process of designing with people that will use or deliver a product or service" [27]. In the co-design process there must be interaction between a provider and its customer to provide a high-quality service [28]. The challenge is to identify specific goals of the project to improve efficiency and effectiveness [28]. Due to society issues and for today's humanitarian challenges, some universities and engineering schools around the world have developed HE programs [29]. The aim of these programs is to help engineers embrace real life challenges [5], [30]. Factors as culture, beliefs, history, and geography must be assessed by engineers to inform adaptation options to the program [6], [31].

A framework must be designed not only to enhance the interaction with community members but to include implications for education and training, by outlining key competencies such as humility, self-awareness, cross cultural and listening skills. This research project turns to Mazzurco & Jesiek's work [32] because in each principle of the framework, the authors describe methods to facilitate community participation and explain the dangers of not engaging meaningfully with communities when working on HE projects. Each principle could be seen as a step to follow, to enhance it through local partners, harness local resources, integration of ethics, building trusting relationships and the creation of competent multi or inter disciplinary teams. These guiding principles can be seen as strategies to address technical problems. The following Figure 1 shows Mazzurco & Jesiek 5 guiding principles to enhance community participation in He projects.

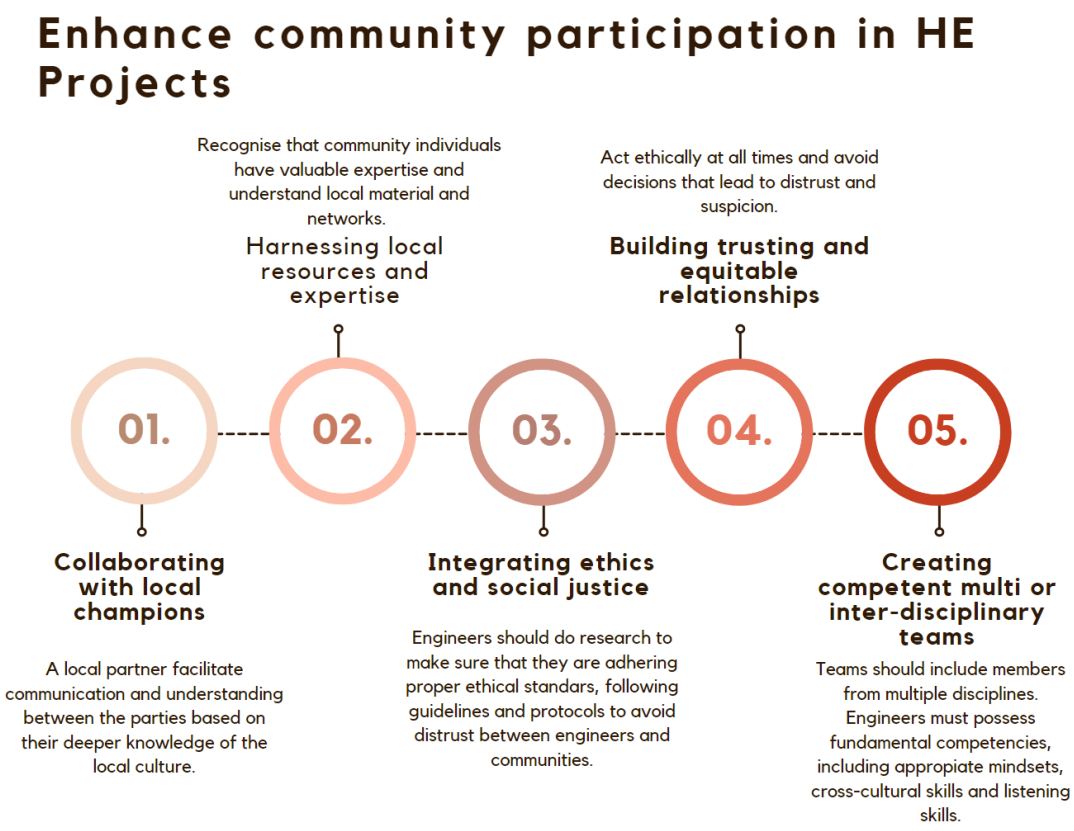

Figure 1. *Mazzurco & Jesiek's 5 guiding principles to enhance community participation*

The first principle is *collaborating with local champions (NGOs and similar).* Local champions should be interested in both the community and the program. The second one is *Harnessing local resources and expertise*. Local resources are referred to physical conditions of the community environment and labor which involves community members. Harnessing the local resources helps to reach sustainable solutions. The third principle is *Interacting ethics and social justice.* When working with people in developing countries, ethical issues should be considered. The objectives of the program should respect human rights, increase opportunities for the community and its members, and harness the collaboration between engineers and the community members in equitable manners.

The fourth one is *building trusting and equitable relationships,* which outlines the importance of promoting trusting relationships between community members and engineers to provide an appropriate distribution of the resources and activities to fulfill the project expectations. To delegate and distribute functions and activities, it is important to consider this. In addition, engineers should handle a humble mindset and adjust to the community mindset to embrace cooperative approaches and enhance community participation [32]. The fifth principle is *Creating competent multi or inter-disciplinary teams.* It is important to have a humble mindset, empathy, and unbiased beliefs regarding other people's knowledge. The project should focus in

promoting the interaction with community members and mitigate differences between community members, engineers and people involved in the project [32].

Understanding that HE projects must focus on empowering communities provides a benchmark in the co-design of HE projects between engineers and community members. HE projects should not only focus on benefiting community members from engineers' solutions, but engineers should also develop or achieve life and interpersonal skills that would let them fit in the community, with its beliefs and the project itself. The community and engineers should work for the same objective. Besides addressing communities' problems and understanding their needs, HE programs offer pedagogical advantages, students can develop intangible qualities such as communication skills and cultural awareness [33]. Contribution to humanitarian engineering and student's engagement with the program also adds motivation for their studies, develop personal and professional skills and help them identify career opportunities [34].

Finally, there is evidence that low humility could put in danger the project. There are some barriers and competencies that should be taken into consideration to improve the interaction between engineers and community members. The five guiding principles should be adapted for each HE projects, as it is important to understand that each project works differently but under the same principles.

Methods

The students of the EWB student chapter at the Universidad San Francisco de Quito USFQ in Quito, followed the Five guiding principles by Mazzurco & Jesiek to co-design a study for humanitarian engineering practices to 4 communities of similar background. The aim was to guide the students and help them to follow several steps to improve their participation in communities and help them succeed in the project. The first step consisted in meeting with 25 students to inquire their interest in being part of a Humanitarian Engineering project. To provide information, there were meetings with students who are part of the EWB and SWE student chapters, as well as faculty advisors. Once the installation of water chlorinators was explained as the project's objective, a leadership group was selected to organize activities between student volunteers, community members, faculty advisors, and student leaders who participated in the installation of water chlorinators previously.

Different activities were assigned to the students according to the five guiding principles they had to follow. One group selected the community, finding a local champion with it. Once the community was selected, students gathered information about the community, such as beliefs and culture. Meetings prior to the installation occurred with students, faculty advisors, the champion, and a leader of the community. Students conducted a plan and organized and scheduled their activities throughout the day of installation. Activities were not only referred to the installation. The first objective was to approach the community, by interacting with them through organized spaces to talk, share and discuss. During this time students established a bond with community members. Alongside community leaders, students then distributed the activities among students and the community. Finally, students created a presentation to explain the importance of safe water, how to use it, and how to give maintenance to the chlorinator in the future to continue providing safe water to the community. For future interventions, students will

maintain communication with the water leader of the community and give them periodic assistance. The analysis for this case study consisted in measuring community members' participation and availability to contribute to the project. Students counted the number of community members that were part of the different activities, and they also conducted conversations that simulated open interviews to find barriers or limitations for the project. Questions made to the community were about collaboration, participation in community events, interactions with other communities, socioeconomic diversity, religious diversity, ethnic diversity, relationships with government (general and local), interactions with legal services, and personal connections to local government, federal government, community service organizations, and volunteer organizations, all the answers were recorded to transcript and analyze. With those answers students determined the impact of the project and how well conducted it was.

Results

The pedagogy of the co-design includes Mazzurco & Jesiek five guiding principles such as collaborating with local champions, harnessing local resources and expertise, integrating ethics and social justice, building trusting relationships and creating competent interdisciplinary teams. Following these guiding principles students were able to address technical problems while engaging with community members and designed different activities that will help them to succeed every step/principle.

Students had meetings with different Local Champions and presented these options in their weekly meetings. Each local champion worked with different communities. However, students had to decide which local champions best suits the aim of the project. Also, they considered characteristics such as the location of the community, travel time, number of people, so they could analyze if the demand of water through the chlorinator could be supplied. Once students decided on the community, they contacted the NGO. It was important to meet the NGO as they provided further information to help students best understand the community. The first step was to contact the community through the local champions and find if they had interest in the project, or otherwise find a new community. Reassuring the community acceptance and availability for the project was the key factor to move forward with the other activities.

Moving to the second principle, students first identified their skills so they could manage time and resources. A board was selected so every group was responsible for a different activity. For example, technical chlorinator assembling, recruiting volunteers, organizing activities with the community and co-designing, and technical training developers were distributed activities. A well organization from the students gave a good presentation to the community. Also, students presented the different activities to the community leaders so they could find their expertise members. Once the community was aware of the project, the different groups were created. It was important that each student and community member felt part of the project and worked in different expertise areas that they felt comfortable in. Besides the labor of the project, other areas had to be considered, like giving capacitation for guaranteeing the proper use of water chlorinators considering that the main objective was to provide safe water to the community, as well as maintenance for future use.

For the third principle, *interactive ethics and social justices*, student had to do prior research about the community. Meeting the local NGO facilitated this for the students. This step was important so they can avoid distrust between engineers and communities. Other important aspect was to mitigate power differentials, so students had to communicate to the community through the community leaders in other to respect their hierarchy. Students had to identify community protocols, so community members collaborated.

Once the community's culture and way of working was understood, students ensured trusting relationships amongst everyone. This is the fourth principle but had to be conducted throughout the entire project. It is fundamental that students promoted a trusting relationship with community members, since it is important that community members can discuss about the vision of the project and make suggestions for it comfortably. A trusting relationship ensures an appropriate distribution of the activities and its contributions. It is essential to have an open mind and an open communication lead with respect and willingness, to adapt to changes suggested by community members. Students must be aware that they may change their original activities and they must be susceptible to change and adapt to the community circumstances.

Finally, creating competent interdisciplinary teams helped to navigate barriers and differences in culture, language, and values. Again, students adapted to the community beliefs and values. This principle is important to reassure community participation and avoid misunderstandings. In this principle, students must develop high level of humility and empathy to collaborate with non-technical experts. For this principle, faculty advisors may suggest students to retire in case they do not share the community's culture, beliefs, or values taking into consideration that these kinds of projects should be an experience that contributes to students professional and personal formation.

Students found barriers during the implementation of the project. One barrier was that community members did not have enough technical knowledge to use, maintain, and supply the water chlorinators. Another barrier was related with gender culture and trust. Approach to women was more difficult for the students, maybe perhaps the team working with the women of the communities had more masculine that feminine population. Finally, other limitations were due to the community's culture and beliefs, and that they did not receive support from any other entities, so they somehow manage this concern through a water board.

Discussion

The findings confirm that there is gap between engineers and community members starting with the difference in culture, values, beliefs and language [32]. Even though this project was conducted in the same region for most students, a lot of implications were taken into consideration. HE programs should consider the interaction of different fields of knowledge to not only address technical problems but to promote other designs and maximize the objective of the project [35], [36].

Despite that HE projects require interdisciplinary work and collaboration, faculty advisor and students should take into consideration that each field has its own approach to design and solve problems, and this may cause delays at work [37], [38], [39], [40]. For instance, HE programs

should not only have a guide principle for the community but for the ones who will provide the benefit. HE programs require effective integration for the success of the project, for which community participation is fundamental [3], [26], [29].

HE program should address many different perspectives starting with students and faculty advisors [41], [42], [43]. The importance of HE program does not only remain in providing sustainable solutions for the communities, it also provides major knowledge and perspectives of work field for students. These programs are designed to help students to improve and use their knowledge in real life context, while developing new skills that cannot be taught through books. HE programs gather every aspect for students' professional preparation. Mazzurco and Jesiek principles provide a guide to help students follow activities and achieve the project objectives. However, further interventions should be taken into consideration regarding to the community's characteristics and other problems regarding to the humanitarian perspective.

Conclusions

Many humanitarian engineering projects fail because the community was not engaged in the project from the early phases. This co-design aims to give a guide for engineering students so they can address community problems and enhance community participation. Each guiding principle is a step to follow through the project. Some considerations must be considered previously, like understanding the community culture, beliefs, and way of working. In Andean communities, there are always leaders, so engineers must work pair to pair with them, so they can enhance their people's participation. Engineers should adjust to the community's mindset and follow their hierarchy, therefore sharing the leadership amongst the community. It is important to understand these aspects to respect the community and enhance everyone's collaboration. Future work includes building the lessons learned manual and incorporating such lessons in the planning and executing for next year's chlorinator installation project to have a better co-design with the community. The lessons learned will serve to be more sensitive to the differences between student volunteers and the community.

For future work, HE projects should have a plan to make sure the correct use of the structure of the service provided. Regular visits to the community throughout the year would help to check the status of the chlorinator, in this study for example, and give maintenance, as well as periodic conversations regarding the proper use and hygiene of the product. Students should have a plan to enhance long term participation. The objective should not only remain on the installation or service provided but focus on how well the community receives, maintain and benefits from it. Also, HE projects should work hand in hand with other fields like medicine, psychology, or educators to approach to vulnerable groups of people in the community for example children, women, and elderly. As engineers, sometimes it may be difficult to have different conversations with certain groups. For example, related to women hygiene, it would be better if a doctor or a psychologist gives support, rather than an engineer.

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