2021 ASEE ANNUAL CONFERENCE
Virtual Meeting | July 26–29, 2021 | Pacific Daylight Time
Paper ID #33049

”The Road Less Travelled”: Engineering With Vulnerable Communities Through NGOs

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“The Road Less Travelled”: Engineering With Vulnerable Communities Through Non-Govermental Organizations (NGOs)

Since the explosion in growth of non-governmental organizations (NGOs) dedicated to community development in the 1990s, these organizations present new possibilities for engineers to serve, work and design with communities without the perils of short-term trips. But how do engineering teams go about identifying NGOs that are effective, responsible, and accountable to the communities they hope to serve? How do engineering students understand how to work in these organizations that historically have not been part of traditional engineering career pathways – “The Road Less Travelled”? This paper presents a conceptual model for understanding, partnering, and building relationships between engineering teams and NGOs, organizations that rarely figure in the employment landscape of engineering. It proposes that sustainable community development (SCD) projects require a level of embeddedness in communities, engagement, continuity and logistical maturity that most engineering schools with community-engagement programs are ill equipped to provide by themselves but that in partnership with properly selected NGOs they might be ready to deliver. Moving beyond the dangers and perils of trips to "save the poor," the Humanitarian Engineering (HE) program at Colorado School of Mines (Mines) is developing new interactions with socially responsible and accountable NGOs to ensure that communities are empowered through engineering projects for sustainable community development. To ensure that these projects can better serve and empower communities, this paper shows 1) how engineers can map their partnerships with NGOs; 2) how to develop engineering design courses where students learn human-centred problem definition and explore design challenges with NGO partners; and 3) how to develop relationships with NGOs so students can have community engagement opportunities even under severe international travel restrictions like those we face today in the midst of a global pandemic.

1. Introduction

NGOs present new possibilities for engineers to co-define and solve problems and co-design with communities without the perils of short-term mission trips. But how can engineers, especially educators and students with little experience in the world of NGOs, identify NGOs that are effective, responsible, and accountable to the communities they hope to serve? This

paper presents a conceptual model for partnering, building relationships, and teaching problem definition/solving and design between engineering student teams and NGOs. I propose that sustainable community development (SCD) projects require a level of embeddedness in communities, community engagement, long-term continuity and logistical maturity that most engineering schools are ill equipped to provide by themselves. Moving beyond the dangers and perils of trips to "save the poor" or "help the needy", the Humanitarian Engineering (HE) program at Colorado School of Mines (Mines) is nurturing interactions with NGOs to ensure that community interests are represented in engineering designs when students work with communities outside their own. We are learning how NGOs can be effective conduits for responsible by translating and co-defining problems between student teams and communities.

This experience also motivated the development of a conceptual model so other engineering schools with similar programs can assess and determine how and when to partner with NGOs to ensure that their projects can better serve communities. First, the paper reviews the literature on NGOs to distil criteria to assess their effectiveness and accountability to communities. Second, it attempts to guide engineers to understand how these criteria can enhance engineering designs to empower communities. Third, it proposes strategies to build relationships with NGOs needed for successful collaboration and community empowerment, including the development and implementation of a three-course sequence where students learn human-centred problem definition (HCPD), explore design challenges with NGOs in Projects for People (PfP), and synthetize these learnings in their Engineering for Community Development (ECD) capstone design course. Instead of focusing on technology development, this sequence challenges students to focus on human needs and concerns, construct and test concepts to foster a strong feedback loop between the students and their partners, and develop design solutions to be implemented by NGOs in the communities where they work.

2. Background

2.1 The Boom of NGOs

The origins of NGOs can be traced to missionary organizations that, from the late 19th century to World War I, played charity roles while promoting American values worldwide.

The role and scale of these organizations changed significantly during the Cold War with the emergence of NGOs related to the promotion of free-enterprise, democratic forms of government, economic development, and modernization as ways to counteract the spread of communism [1].

After the 1980s, NGOs responded to fill the gap in key public services left by diminished governments which, following the ideology of neoliberalism and the policies of structural adjustment, reduced public spending and welfare safety nets while privatizing public services such as water, electricity, and communications in order to receive foreign aid or international development loans. Assumptions behind this "trickle down" development economics (e.g., that a free-market allowed to grow would provide basic services to poor communities better than any government would) have been critically questioned and mostly dismissed [2], [3]. Simply put, most basic public services, now sold for a profit, were out of reach of the poor. This failure of the state and free-market in providing services and opportunities for the poor opened space for NGOs to fulfil these roles, at a scale never before attempted (see Figure 1).

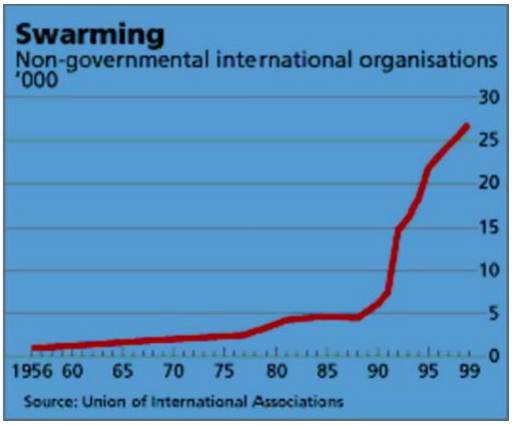

Figure 1. Explosion of NGO creation around the time of the policies of structural adjustment in the 1990s.

Many kinds of NGOs emerged from this boom and can be categorized into 4 groups: 1) relief and welfare NGOs that provide humanitarian relief in times of major emergencies (e.g., Catholic Relief Services); 2) local self-reliance NGOs that provide capacity building projects to communities to meet their needs (e.g., Pact, RETOS, Water for People); 3) NGOs involved in larger institutional and policy formation (e.g., Amnesty International); and 4) NGOs supporting larger social movements such as those against international trades regimes (e.g., Fairtrade Labelling Organizations International – FLO) [4]. This paper focuses mostly in

NGOs that work in community development through technology development and capacity building (Group 2) in which most engineering teams participate, while recognizing that engineers also participate in the three other types of NGOs.

2.2 The Emergence of Engineering To Help (ETH) Initiatives

Also beginning in the late 1980s, engineering education reforms attempted to a) emphasize design education after three decades of dominance by the engineering sciences [5]–[7], b) increase international education for engineers in light of post-Cold War globalization of economic activity [8], and c) provide design opportunities in international settings via "engineering to help" (ETH) activities at the end of the 20th century [9].

By the end of the 1990s the circumstances were set for engineering students, seeking international experiences in ETH projects, to begin working with NGOs. Yet most ETH projects, initiatives, and programs continued to work through their own universities' international programs, service learning offices and/or courses, or through the growing number of EWB student chapters rather than through NGOs. ETH projects present many problems, including being motivated by engineers' desire to help which blinds engineers to social injustices [10], reinforcing a deficiency model where communities are viewed as always lacking and deficient [11], and being technocentric rather than process or people-centric [12]. One way to remedy the perils of this form of ETH is by engaging engineering teams with NGOs who might have deeper understanding of the context and circumstances surrounding communities (e.g., causes of poverty and injustices), communities' assets and capabilities (e.g., local expertise, markets and resources), and ways to engage communities in the definition and solution of their own problems.

3. Partnerships with NGOs

NGO interventions can be problematic, as they can reproduce problems associated with colonialism, international aid and development such as reinforcing racial hierarchies, and creating dependency through relief aid and undermining local autonomy through participatory methods [13], [14]. Even well-intentioned NGO workers can also have biases that shape how they engage people and projects on the ground [15]. It is not the goal of this paper to recount the history of problems and successes of NGOs, but to be keep them present

as we develop criteria for engineers to work effectively with NGOs as partners in community development. What kind of NGO characteristics make partnerships more effective in leveraging engineering student work for community development?

The main goal of a partnership among engineers, NGOs, and communities should be to reduce dependency of communities on foreign expertise while increasing the community's self-reliance to promote social justice, peace, and well-being. Figure 2 shows different kinds of relationships that exist between engineers and communities through NGOs in the complex world of humanitarian relief, international development, and community development. The horizontal axis represents a spectrum with 1) engineers as planners/experts who see communities in terms of what they lack (on the left side), 2) engineers as searchers/partners with communities (in the middle), and 3) autonomous and self-sufficient communities where foreign engineering expertise is minimally or no longer needed (on the right side). The vertical axis represents a spectrum of different states in which communities can find themselves from 1) a state of crisis following a disaster (e.g., earthquake, tsunami) or war (at the bottom); 2) a state of stable economic activity but with injustices and internal conflict still present (in the middle); to 3) an ideal state of social justice and peace (at the top).

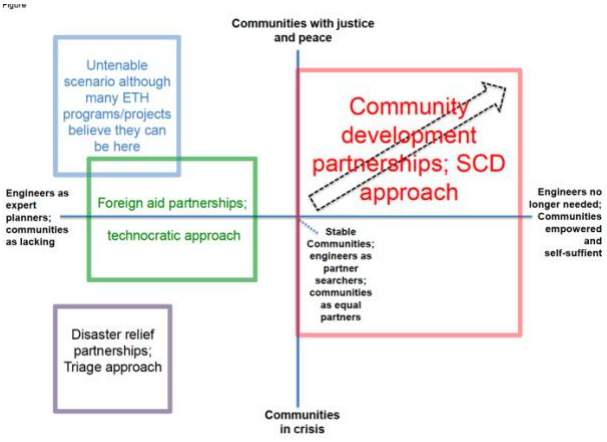

Figure 2. Different kinds of relationships that exist between engineers and communities through NGOs in the complex world of humanitarian relief, international development, and community development.

This paper has the goal of providing a framework to build partnerships where engineers partner with NGOs and communities with the goal of empowering communities to move towards self-sufficiency, autonomy, social justice and peace. The arrow in Figure 2 shows the desired trajectory that these partnerships should promote through projects that move

communities towards the upper-right hand quadrant. Moreover, this paper intends to call attention to untenable scenarios where engineers, seeing themselves as experts who can solve deficient communities' problems, partner with others or simply volunteer, and believe that their efforts will achieve social justice and peace (the unattainable upper left-hand quadrant). Unfortunately, this is often a scenario represented by projects carried out by engineering students who, going at it alone and with the best of intentions, end up doing more harm than good to communities they barely understand [16], [17].

4. What makes a good NGO for engineers to work with?

The two main criteria that NGOs must have to be good partners in engineering projects are legitimacy and effectiveness.

4.1 Legitimacy

Legitimacy is defined as "moral justification for political and social action" or "the right to assert leadership, to organize people, and to allocate resources in the development enterprise." [18] NGO legitimacy to assert leadership and organize people and resources for community development stems from *representativeness of the communities they serve and the kind of values they hold*. Engineering teams can assess how a particular NGO represents the interests of communities they are trying to serve through the NGO's accountability.

4.1.1. Assessing community representation through accountability

Accountability is about power, authority, and ownership that other actors and institutions can exert over the NGO in question. For example, who can call whom to account? Who is required to give explanations and rectifications to who? [19] So to whom, how and why are NGOs accountable? Are they mainly accountable to donors at the expense of being accountable to the communities they are trying to serve? Can they be accountable to both without compromising community interests? If so, how can engineering teams best assess the forms and processes of NGO's accountability to empower, rather than disempower, communities? Let's take a closer look at accountability and its two main targets: values and constituents [19].

4.1.1.1 Accountability to values: Temporal, Terminal, Organizational and Weltanschauung

Temporal values shape temporary decisions important in daily interactions with NGOs. These might be the kind of values that engineering teams first encountered when contacting an NGO. For example, NGOs might express a temporary commitment to work with universities, to allow students as interns, and to work with faculty as advisors. Although not permanent, and not necessarily at the core of NGOs missions, engineers should pay attention to these temporal values. Has your target NGO displayed a commitment to work with universities and their students by sharing space, staff, time and resources? In our experience with NGOs, temporal values can be discerned fairly easy in the way staff responds to emails, are available to meet, or have time to lecture in your classes. These temporal values might be important to start a partnership with NGOs but are not enough.

Terminal values indicate a desired end point of the NGO's development work such as relief of poverty in a particular area, or ending homelessness in a city, or commitment to the UN Sustainable Development Goals. These are often visible in NGOs mission or vision statements such as that of the NGO Build Change that states "Our mission is to greatly reduce deaths, injuries and economic losses caused by housing and school collapses due to earthquakes and typhoons in emerging nations.*"* [https://buildchange.org] Engineering teams should look for alignment between their own goals and NGO's terminal values. Even if a design project has not been defined at the outset, do the engineering team and the NGO both share a commitment to poverty relief? For example, our HE Program partnered with International Development Enterprises (iDE) because of common alignment to one terminal value: increasing the income of poor, rural farmers by developing extremely affordable technologies. Our faculty identified this value in iDE's foundational philosophy [20] and in iDE's methodology for developing and implementing Poverty Reduction through Irrigation and Smallholder Markets (PRISM) Programs. In the present time, we are partnering with RETOS given the alignment between our program's mission and their commitment to "connect challenges of communities with university students to build histories of co-creation."[21]

Organizational values determine how an NGO treats its employees and volunteers, makes internal decisions, communicates with communities, etc. Engineering teams should pay attention to how the intended partner commits to these values and practices them in daily

operations. For example, is the intended NGO committed to flexibility in its staff's work schedules and autonomy in their decision-making so that they can spend time interacting with student groups? This would be important, as it ensures when and how the NGO staff can work with students and communities which usually have very different time scales. For example, a community decision-making process might not align with the fiscal year that often dictates NGOs budgetary decisions. Engineers might want to work with NGOs that have the flexibility to override fiscal year deadlines to benefit community's interests.

Weltanschauung or deeply held values shape a way of seeing the world, e.g., humanism, a religious faith, the power of the market, communities as having strengths and assets instead of lacking assets [19]. It might be dangerous when an NGO pushes its deeply held values to be adopted by communities. So engineering teams need to pay attention to these values and to what extend they drive the NGOs connections with communities.

Table 1 shows how one of our engineering design projects can mapped their values against those of an NGO to identify areas and levels of alignment and potential conflict. We encourage engineers in related projects and/or courses to map their values against potential NGO partners before entering to a partnership as this mapping can reveal fundamental reasons for long-term success or conflict.

NGOs levels of values ⇒ Engineering school hierarchy and values ⇓	***Weltanschauung values*** iDE: "people everywhere have legitimate hopes, dreams and aspirations to improve their standards of living."	**Terminal values** iDE: "to create income and livelihood opportunities for poor rural households through market solutions to get them out of poverty."	**Organizational values** iDE: openness; staff autonomy in decision-making; toolkits	**Temporal values** iDE's key engineering staff shows commitment in mentoring students to learn about design with communities and chart humanitarian careers
College level: CECS: "improving people's lives by attacking fundamental problems facing society."	**strong alignment**		**strong alignment**	
Program level: HE: "Teach students how engineering can contribute to co-creating just and sustainable solutions for communities."	**strong alignment**	**strong alignment**		**strong alignment**
Class /Project level: "empathy for the end user/community for which students are designing...build low cost, physical prototypes of ideas and concepts."		**strong alignment**	**strong alignment with class pedagogy through design and poverty alleviation toolkits**	**strong alignment**

Table 1. Mapping value alignment between an NGO and our [name deleted for blind review] program.

4.1.1.2 Accountability to Constituents

There are three forms of NGO accountability to constituents: downward accountability to intended beneficiaries (e.g., communities), upward accountability to donors and local governments from which NGOs derive their funds and legitimacy, and horizontal accountability to other NGOs [22]. Accountability to beneficiaries is often not required by law yet most NGOs do it to maintain legitimacy, authority, and ability to obtain funding. Donors require upward accountability in different forms and times which can shape downward accountability to beneficiaries, in some cases undermining NGOs decision-making with respect to the communities they serve. So it is ultimately their commitment and accountability to their values (see 4.1.1.1 above) and accountability practices that determine their downward accountability with communities.

Three key variables determine how NGO accountability to communities is reflected in practice: depth, openness and frequency. *Depth* is related to communities' access to NGO management, what knowledge communities have of NGOs, how relevant topics discussed at meetings are to communities, who gets to speak at these meetings, and how controversial issues are handled at these meetings. *Openness* is reflected on meeting's agenda, format and conduct. Can community concerns be formally aired during meetings with them and later reflected in meeting minutes and reports? *Frequency* has to do with when and how often meetings between communities and NGOs are held. Are these regular or discretionary? Are they weekly, monthly, or annual?

In meetings between communities and NGOs, depth, openness and frequency take specific forms. For example, there are *informational meetings* where communities are informed about projects but remain passive recipients of information. Often called "sham rituals", these are low in openness, depth and frequency. In contrast, *negotiating meetings* allow communities to negotiate and bargain, or even hold veto power over a project or some of its features. These are usually higher in depth and openness but less in frequency. Engineering teams should partner with NGOs that hold many negotiating meetings with great depth and openness, and frequency if possible, and minimize informational meetings, and certainly do not resort to "sham rituals" as informational practice.

4.2 Effectiveness

Effectiveness is the ability of an NGO to make a real, lasting impact. There are four dimensions of effectiveness to keep in mind: 1) embeddedness; 2) organizational freedom and flexibility; 3) ability to scale up; and 4) empowerment.

4.2.1 Embeddedness

Embeddedness is related to how geographically close and culturally attuned NGOs are to the communities they serve. Geographic proximity often determines how strong the relationships between communities and NGOs are and how the partnership can find solutions together. Have NGOs been on location long enough to know the community, build trust, and employ community members in their staff and projects? Do NGOs have knowledgeable and committed in-country officers who work with communities often, are accountable to communities, and regularly inform headquarters about this relationship? For example, our HE program partnered with Edge of Seven (EoS), an NGO dedicated to building schools in Nepal [23]. Before starting a project, EoS identifies a local NGO whose staff members are from villages in the region to gain deep understanding of the culture and needs of local residents. Before agreeing to partner on a community project, staff from the local NGO spend several weeks living in the community, working with leaders, school committees, and parents to understand the needs and build strong relationships. When EoS staff arrives, the groundwork for trust has been built for easy transition and collaboration in building a project. Currently, our HE program is partnering with Diversa, an NGO in Colombia who has built an artificial intelligence platform called RETOS (https://www.retos.co) where contextualized challenges defined by communities in Colombia, through embedded interactions between communities and Diversa staff, are paired with engineering student teams to develop community development projects according to mutually defined desires, objectives, and outcomes.

4.2.2 Organizational freedom and flexibility

Often NGOs enjoy freedom and flexibility to work with communities, solve problems, or enter a new geographic location, distinct from the inflexibility of state bureaucracies or for-profit organizations. Is the NGO organized in such a way that allows for processes and projects to be tailored to communities needs and desires? Do organizational practices allow for frequent negotiating meetings with communities with depth and openness? For example, EoS only begins projects when a community approaches them with a need and presents it to EoS and local NGO partners. Once local needs are presented, EoS presents plausible solutions back to the community and then discusses and modifies solutions until one is agreed

upon by all parties. Currently, our partnership with RETOS provides much flexibility during the pandemic when international travel is non-existing, allowing communities and engineering student teams to interact regularly through a virtual platform.

4.2.3 Ability to scale up

Does the NGO have the ability to replicate or repeat successes on a wider scale or in different contexts? Are its processes and technologies adaptable enough to be deployed and carried out in different circumstances? For example, iDE has developed a methodology that considers every locality as a different context that needs to be understood before technologies can be proposed and deployed. Through its PRISM methodology, iDE explores and assesses local actors (distributors, farmers, consumers, restaurants), market conditions, gender dynamics, water conditions and potential for irrigation technologies.

4.2.4 Empowerment

How does an NGO, and the processes and technologies it deploys, facilitate that community members take control over their own lives? NGOs must show commitment to collective decision-making and action but not at the expense of minorities in the communities, i.e., not recreating the rule of the elite in the community. So engineers wanting to partner with NGOs need to ensure that there is no by-passing of existing local entities, committees, and people who can do the job if properly equipped. For example, our NGO partner EoS works with local community development committees (CDC) in the definition and proposal of alternative solutions for schools. CDCs assess and decide on every step of the design process and hire local labor to complete projects.

5. Engineering Design Curricula and Pedagogy to Work with NGOs

Identifying a quality NGO partner using value mapping and the criteria above does not by itself guarantee success in a partnership with engineering students. Curricular spaces and practices are needed that facilitate the partnership. Most engineers are taught to solve technical, tightly defined problems [24] and this training often interferes with successful work on community development projects [25]. NGO's who meet the criteria above will have a deep knowledge of the social, environmental and political context of the areas and communities they work with. Unfortunately, this kind of knowledge is many times dismissed as unimportant by engineers who often focus on the technical aspects of projects, leading to poor outcomes for both partners. Curricular spaces that integrate the social and technical

dimensions of community projects into socio-technical ensembles are essential for the success of a partnership.

Our early efforts at engaging engineering student teams with iDE, through an existing capstone design program without other interventions, led to poor results. There was no clear mission, no common understanding of purpose, and no mapping of values and criteria with iDE. A few years ago, iDE asked two senior design teams to design a low-pressure filtration system. The final outcome of these projects, while meeting the educational objectives of the course, did not lead our students to understand the communities the solution would serve. Similar poor results with other NGOs led our program to re-evaluate how to work responsibly and effectively with NGOs and inspired this paper. Even after mapping values to identify a good NGO partner (see Table 1), we realized that curricular spaces that allow design pedagogy to integrate both partners' values, goals and desires, while keeping the community's interests at heart, are required for a good partnership. This realization was central to the development, in partnership with iDE, of two new design courses: Human-Centred Problem Definition (HCPD) and Projects for People (PfP).

It was advantageous to work with iDE because they had a well-documented set of processes used in the new courses. Part of iDE's organizational values, these design methods and poverty reduction tools are found in The Human Centred Design Toolkit, co-developed by IDEO and iDE to document best practices for applying human-centred design methods for development [26]. The adoption of these toolkits in our courses built strong alignment of values with iDE.

Further discussions with iDE uncovered that they had a documented phase-gate process for technology development. This is a technique for project management that forces work to pass pre-defined quality metrics before proceeding to completion. (see phase-gate process in Fig 4)

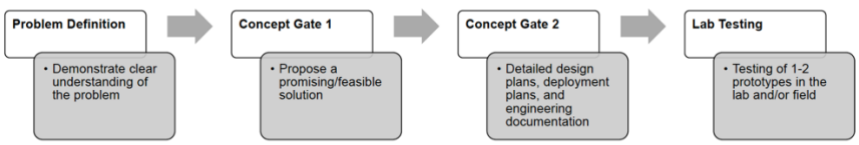

Figure 4. Phase-gate process built into the Projects for People course.

While the phase-gate process is common in technology development, it is a relatively new in engineering for community development [27]. The combination of toolkits with phase-gate process formed the framework for design activities and a basis for clear communication between our design students and iDE staff but it was not sufficient. As part of the HE program, the two new courses needed educational objectives aimed at addressing overarching concerns, namely two key conflicts between traditional engineering education and engineering for community development:

- *Specifically avoiding well-defined problem statements.* Most engineering students struggle with solving open-ended problems even though dealing with these is of critical importance to their future success, especially when working with communities [24], [28].
- *Practicing design as an iterative process which eventually converges on a solution*. Allowing students to constructively fail in the design process, learn from failure, and using design courses to enable "guided mastery" in the midst of an education that tends to value success and punish failures [29].

These educational objectives presented potential conflicts with iDE's needs. In broad terms, these objectives created a level of uncertainty about partnership outcomes. We had to find ways to balance pedagogy with partner desires as the two new courses were developed.

5.1 Course Sequence

The new design course sequence challenges students to 1) focus on human needs and concerns instead of technology development in the course Human-Centred Problem Definition-HCPD; 2) rapidly construct and test concepts to foster a strong feedback loop between students and NGO partners in the course Projects for People-PfP; and 3) develop design solutions that can be implemented by NGOs in the communities where they work through the Engineering for Community Development Capstone Design course.

5.1.1 Human-Centred Problem Definition (HCPD)

HCPD equips students with the knowledge, skills and attitudes to identify, define, and begin solving real problems, for real people, within the socio-technical ambiguity that surrounds all

engineering problems. By the end of the course, students are able to recognize design problems around them, determine whether they are worth solving, and employ design tools to create multiple solutions. First, students are challenged to see themselves as "intended users" and then work in their own community to apply human-centred design techniques. Key exercises include:

- **Bug List** – Students create a list and hand sketches of the things in their surroundings that bug them; intended to encourage them to be observant and think of themselves as having valuable input as users.
- **Extreme Listening** – practice expert interviews and observations to understand human perspectives and problems better.
- **Walk a Mile Internship** – students shadow individuals to practice identifying, defining, and solving problems.

Students' understanding of users, and the ability to act on that understanding, progresses through multiple levels of comprehension with practice [30]. HCPD helps students' thinking to progress from "we must keep the user's needs in mind" toward empathic understanding [31].

5.1.2 Projects for People (PfP)

PfP challenges students to combine human-centred design techniques with technical skills to address community challenges, using iterative problem solving, hands-on testing and prototyping [32] . iDE provided an open-ended problem statement used as the focus of the course. Students split into sub-groups for research and development and work in sprints towards three Phase-Gate Reviews (see Figure 4).

The outcomes of the Phase-Gate Reviews are not predefined in order to allow iteration on each phase of the process as needed. Students are graded on the quality of work completed and several course assignments, not on how many phase-gates their team successfully completes. A student group could spend an entire semester without developing a concept that passes iDE's review and still pass the class.

This decoupling of the grade and the phase-gate reached was, paradoxically, highly motivating to the students. As one student observed "I love this project because we are

allowed to fail. In the beginning we were told that we could succeed in helping poor farmers around the world or we could fail. Our grade does not depend on the outcome. We were told that smart people have tried to come up with solutions before, but they have failed. We were told that this was a hard challenge, but that iDE wanted to see if we could solve it. Having the freedom to fail but the challenge to succeed has shifted my thinking and allowed me to focus on the needs of the final consumer (the farmer) rather than the grade I will receive in the class."

7. Conclusions

ETH programs need to find better ways to ensure that projects are effective, long-lasting, and conducive to community development and empowerment. A key strategy is to partner with NGOs that can demonstrate legitimacy and effectiveness as outlined above. Furthermore, ETH projects need to pay close attention to how NGOs are accountable to values, and map these against theirs, to ensure close alignment with the organizational units (courses, programs, colleges) in which they are embedded.

While ETH programs have little, if any, control of how potential NGO partners develop and enact accountability towards constituents and values, ETH programs can have influence on how NGO partners put effectiveness into practice. For example, ETH design projects can be thought through from the outset with *embeddedness* in mind by ensuring that data-gathering in community only happens after enough trust building has taken place between the community and NGO partners. In doing so, engineering teams can ensure that the quality of the data informing design projects is reliable and trustworthy.

ETH teams can also influence what NGOs do with their organizational flexibility. For example, engineering teams can invite NGO staff to have more involved participation in problem definition/solutions with community involvement, assuming NGO staff has the flexible schedule to do so. ETH teams can also influence how NGOs enact their ability to scale up and empower communities by conceiving designs that communities will be able to maintain, operate, and build in different contexts and at different times.

Once an NGO partner has been chosen, it is important to spend appropriate time developing that partnership through curricula where students and NGOs find a common design language

and a balance between NGO goals and course objectives. Using available design frameworks such as those outlined above, design pedagogy must be carefully crafted in partnership with NGOs to strengthen student learning, NGO effectiveness, and community empowerment.

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