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Engineering to Help Communities or Students' Development? An Ethnographic Case Study of an Engineering-to-Help Student Organization

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***Abstract* – This article offers a critical ethnographic analysis of the organization Mines Without Borders (MWB), a student group at Colorado School of Mines. It evaluates the impact the group's institutional culture has on its effectiveness as a student-led engineering-to-help organization. Through ethnographic and participatory research methods, we sought to understand members' motivations for joining the organization, their prior knowledge of engineering-to-help, their assessment of the organization, and how well MWB balances service learning for their members and impact on the communities they seek to serve. A participatory photo essay was used to illustrate the perspective of the community members in Nicaragua, and vice versa. The researchers found that members are primarily motivated by a desire to help disadvantaged populations, have little background knowledge on principles of engineering-to-help, see the organization as socially exclusive, and that MWB places a greater emphasis on student experience than community impact. The participative photo essay suggests that MWB members and community members have different perceptions of what constitutes collaboration. This evaluation advances current research on engineering-to-help organizations with the growth of humanitarian engineering programs throughout the world. The results of this study have been used within the organization to enhance its potential effectiveness to benefit students and community members alike.**

Index Terms - Critique in service learning, ethnographic research, humanitarian engineering, participatory research, engineering to help

INTRODUCTION

Since the early 2000s, engineers involved in humanitarian and community development activities have increased at an astounding rate.[1] One of the largest student engineering-to-help (ETH) organizations, Engineers Without Borders – USA (known as EWB), has 16,800 members who are working on 686 projects in 42 countries.[2] Yet this rapid growth in ETH has been accompanied by strident critique of programs that send college students for short volunteer trips

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to communities in the "developing world." These programs come under fire for helping already privileged college students more so than the communities they seek to serve. This is because most volunteer tourism is "premised on the idea that one person's impoverishment or environmental degradation is another's opportunity for adventure and personal growth, rendering the structural inequalities that characterize many host/guest encounters a fundamental and necessary feature of this sort of tourism."[3]

In this article, we share our ethnographic program evaluation of an ETH organization at a US university that specializes in engineering and applied science. The first author was a member of an EWB student chapter for two years as an undergraduate, and the leader of a project of an independent student-led ETH organization for one year. At Colorado School of Mines, the setting of this program evaluation, he was involved with the organization evaluated in this study as a graduate student, before and throughout this research. The second author was an undergraduate not directly involved in the organization, and the third author was an anthropology faculty member who supervised the ethnographic project as part of the students' coursework. The evaluation was motivated by ongoing concerns within the student group about their relationships with the communities they sought to serve. In our evaluation, we investigated if and how scholarly critiques of ETH organizations were applicable to this organization, which has an ongoing but uneven relationship with an academic program that critiques dominant ETH orientations by focusing on local, community-centric sustainable development. In this case, we suggest that the ETH organization's student culture, structure, and model of conducting ETH projects are sometimes inhibitive to creating positive change in the communities they serve.

Engineering to Help

The programs and organizations that conduct such work call it many different names, such as sustainable community development, humanitarian engineering, community service, and service learning in engineering. Schneider and coauthors use the umbrella term "engineering-to-help," or ETH, to encompass all of such organizations engaged in development work.[4] Most ETH programs and organizations are based in countries considered part of the global "North,"[5] or "developed" countries.[6] Consistent with studies of other ETH organizations,[7,8] we observed that students involved in an ETH organization contrast with the stereotypical engineer, most often a technical-minded male. Litchfield uses the term "socially engaged engineers" to describe this unique subset of engineers who are attracted to ETH organizations. These engineers, she claims, are more diverse than the average engineer, and more capable of "interfacing between the social and technical dimensions of engineering which are needed to better address critical engineering challenges facing society."[9] Students in ETH organizations gain desirable qualities such as global competency, intercultural communication and management skills and real-world engineering experience.[10,11,12,13] This article builds on that literature by examining the motivations of the students involved in an ETH organization and the extent to which these motivations facilitate or hinder the organization's ability to serve communities.

Critiques of ETH

The recent growth in ETH programs and projects has also led to research on the impacts of ETH organizations. Volunteer tourism for college students, in particular, may offer more to the students than the communities they seek to serve, since these programs frequently "build upon and reinforce existing inequalities, preconceptions and stereotypes."[14] Although members of

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ETH initiatives are driven by a desire to help, as are many engineers,[15] the structure of such organizations reinforce the problematic "need/help" paradigm and place student experience above project effectiveness, longevity, and community impact. Engineers more than other professionals involved in development work view themselves as problem-solvers, which lends itself to approaching ETH through the deficiency model.[16] The engineers from the North solve problems to help communities in the South. Despite engineers' best intentions, their work is done in a complicated context of the historical legacy of colonization and racial hierarchies that persist today. Donna Riley claims that "critical thinking about adverse impacts or the social context and cultural impacts of projects is often lacking" in ETH projects.[17] More understanding of the context of ETH projects, and the culture of the communities who are impacted by them, is integrating into the education of socially-engaged engineers, but does not always translate to more thoughtful practitioners, as seen in this research.

BACKGROUND

Mines Without Borders

Mines Without Borders (MWB) is a student-led, on-campus engineering-to-help organization at Colorado School of Mines (CSM). MWB is a fairly large student group for CSM, with around 100 members, about half of whom participate actively, according to the organization's student leadership. Active participation includes attending meetings regularly and being consistently involved in some component of a project. The organization is part of the unprecedented growth of ETH organizations in the past two decades. It is composed of chapters of two larger organizations: Engineers Without Borders – USA (EWB) and Bridges to Prosperity (B2P). EWB is a nonprofit humanitarian organization that partners with developing communities to implement sustainable development projects.[18] B2P is an organization with a similar mission, but a more specific scope of projects – constructing footbridges in developing communities. Each MWB project is conducted under the guidelines of one of these two organizations, which aim to curb potential negative effects of projects. MWB describes its mission as the following: "Mines Without Borders (MWB) partners with communities to design and implement sustainable engineering projects, while creating transformative experiences and responsible leaders."[19] This is similar to that of EWB's national organization's mission, which "builds a better world through engineering projects that *empower communities* to meet their basic human needs and *equip leaders* to solve the world's most pressing challenges."[20] The common thread between the mission statements is that the organizations seek to benefit both the engineering students and the communities, which will be explored more in this article. In the 2015-2016 academic year, MWB was working on a B2P bridge and an EWB water distribution and treatment project, both in the Carazo department of Nicaragua.

Humanitarian Engineering at Colorado School of Mines

The setting of the study is at Colorado School of Mines (CSM), a selective public university with a focus on STEM industries. It hosts a Humanitarian Engineering (HE) program, which offered the country's first HE undergraduate minor. Its founders sought to educate "a new cadre of engineers, sensitive to social context, committed and qualified to serve humanity by positively contributing to the solution of the complex problems of the underserved at regional, national, and

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international locations around the world."[21] The program now revolves around engineering for sustainable community development and social justice.[22,23] Many of the courses are critical of the top-down approaches to community development characteristic of the ETH organizations and projects described above, and instead train students to work with communities to co-create solutions that are socially just and sustainable. Many, but not all members of MWB are involved in the HE program in some capacity, through enrolling in the minor or taking a few courses. In our study, we sought to understand if and how the presence of the HE program influences MWB in the themes commonly associated with ETH organizations.

RESEARCH QUESTIONS AND METHODS

This program evaluation was motivated by concerns within MWB about the potential negative impact organizational culture can have on community projects. Although the first author was a relatively new member of MWB at the time that long-time members shared their concerns, his prior experience in other ETH organizations had led him to see many of the critiques of ETH in action. The goal of this program evaluation was to support existing internal efforts within MWB to understand if common critiques of ETH in general and MWB in particular were indeed present in the organization, and if and how they were being actively managed. In the spirit of constructive critique, the first author shared the team's findings with MWB's leadership throughout the research process. At the end of the evaluation, the first author gave a formal presentation of the findings open to all members of MWB, which initiated a productive dialogue within the organization, discussed further in the "MWB Moving Forward" section, below. Potential sources of bias exist in the first and third authors' positive experiences in the HE program, which inspired the research questions about the influence of that program on MWB.

Because of this specific history, the co-authors chose to critically study MWB to investigate it in relation to the growing critiques of ETH organizations. To do so, the authors analyzed four major research questions:

- What are members' motivations for joining MWB?
- What prior knowledge and critiques do members have on engineering-to-help?
- What critiques and/or praise do members have of MWB?
- How does MWB weigh importance on service learning for students versus positive impact on the community served?

This ethnographic program evaluation of MWB took place within the context of a Community-Based Research course taught by the third author. In the course, students learned anthropological and participatory fieldwork methods through a combination of seminar-style discussion of peer-reviewed research, traditional academic paper writing assignments, and work on a semester-long research project of their own choosing. The course emphasizes the importance of valuing the knowledge and perspectives of the people forming the basis of the study. As students in the course, the first two authors learned how to see MWB through the lens of ethnographic research, shaping the way they approached the evaluation to focus on the study's participants.

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The study analyzed here was the project undertaken by the first and second authors. The team conducted participant observations, interviews, and a participatory research activity. We observed the organization during formal weekly water and bridge committee meetings over the course of a semester, and attended informal social events held by members of the organization, such as weekend parties. The participant observations sought to build rapport with MWB members and gain insight into the day-to-day happenings of the organization, such as patterns in social practices and the underlying values and motivations of the members. These observations were documented with notes, specifically concentrating on social interactions between members of MWB, and how the organization operates.

We interviewed a total of 14 MWB members. The team chose four members within MWB to participate in in-depth interviews, which were recorded and transcribed so that we could identify themes in the interviews and best represent the perspectives of the interviewees in our analysis. These interviewees were specifically chosen to represent the diversity of students within MWB, as outlined in Table 1. Although these interviewees form a small portion of the larger organization, they represent a wide diversity of perspectives that were not as visible during the meetings and social events, complementing the data we collected through participant observation. An additional ten MWB members, selected to represent a wider swath of the organization, were informally interviewed, focusing on whether the critiques of ETH organizations held true for MWB, or if the organization had mitigated them. In this way, the researchers could gauge members' perspectives and experience without the hour-long interview process. We took extensive notes during these informal interviews, but they were not recorded and transcribed. We shared the purposes of the study with all of the MWB members involved, obtained informed consent from interviewees, and assigned a pseudonym to each of the members quoted in this article to retain anonymity. Because the study was limited to a semester, time was a limiting factor in data collection.

TABLE I
PROFILE OF IN-DEPTH INTERVIEWEES

Team	2 Bridge Members	2 Water Members
Gender	3 Females	1 Male
Class	3 Undergraduates	1 Master's
Ethnicity	3 Minorities	1 Majority
Travel Experience	3 Travelers	1 Non-traveler
Leadership Position	3 Not in Leadership	1 in Leadership

To complement these more traditional ethnographic research methods, the team implemented a participatory research activity to gain another perspective on MWB as an ETH organization. Community-based participatory research turns traditional "subjects" of research into active participants in it, providing a suite of methodologies that empower community members to co-define research questions, gather data, analyze results, and identify paths forward.[24] In particular, the research team took inspiration from PhotoVoice research methodologies, in which participants take photos responding to a prompt or theme.[25] PhotoVoice enables people to investigate and document crucial aspects of their communities, as well as to promote dialogue through the process of reflecting on the collected photographs.[26]

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In our case, we sought to understand the difference in the perception of the word "collaboration" by different stakeholders in an MWB project. Disposable cameras were given to two active community members who were involved in the water project and accompanied the MWB students on the trip. The community members were asked to take pictures of what they consider "collaboration between their community and the MWB travel team." To see the other side, MWB members were also encouraged to take pictures of what *they* consider to be "collaboration between the MWB travel team and the local community." In this way, the researchers were able to gain insight into the relationship between MWB and the community without asking straightforward questions about collaboration or their relationship. None of the four in-depth interviewees were photographers for this part of the research. The method was modeled from PhotoVoice projects in other ethnographic studies,[27] which mitigate language, literacy and cultural barriers while opening space for in the community's role in the ethnographic research of MWB. Some limitations to this activity include the small group of community members who were involved, and their preconceived notions of MWB and the project, which were unknown to the authors.

FINDINGS

The research findings are organized by their relation to the four research questions summarized above.

Members' Motivations:

Desire to help: All four of the in-depth interviewees explained that members of MWB, including themselves, are motivated to join the organization by their desire to help, a common motivation in development work[28] that is also a core mindset of many engineers.[29] Jorge, a non-traditional Latino student, said, "I like the fact that we are using our knowledge to help promote living stability among communities." He was very positive about the motivations of his fellow members. Jan, a graduate student who has traveled with MWB, was also very positive about members' motivations, saying, "It's nice to know the world's not going to shit." She thinks the undergraduate student members have hearts, and are doing good things for humanity. In another study, Litchfield and Javernick-Will concluded "that EWB-USA helps to recruit a unique subset of engineers […] with strong interests in the social side of engineering, with strong desires to help others and benefit society," which aligns with our research on MWB.[30]

Hands-on engineering experience: Another motivator was applicable hands-on engineering experience. Julie, a traditional undergraduate student, stressed the importance of the practical engineering experience one gets from MWB involvement: "It gets you hands-on experience that you otherwise wouldn't have gotten. You get to see what you're working towards instead of numbers or drawings on a page." In a recent study of EWB members from across the US, the practicality of solving real-world problems was one of the top few gains of participants in EWB.[31]

Cross-cultural opportunity: Another major motivator is the allure of cross-cultural experiences in which members can take part. A study of the benefits of EWB found that "80% of respondents reported that they developed a greater appreciation for other cultures" from their involvement with their EWB chapter.[32] We found similar results while researching MWB. Julie looked forward to the prospect of "practicing some language skills," since she is learning Spanish. Jan also thought members are motivated by attaining a more global perspective, but was

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more cynical about it than Julie. She said that leadership advertises the trips by "showing all the fancy pictures of gringos in [a] developing country… That doesn't inspire me." Analyzing this response, it seems that cross-cultural exchange is not always a selfless motivation, but can be desired because of the positive image humanitarians have in North American culture, as noted by MWB members in informal interviews.

Free travel: Julie treated the cost-free travel as an equal opportunity for all members: "We do want everybody to have an opportunity to travel. We have different sections: media, logistics, water and bridge. Even if you just go to solely media things you are still equally eligible to travel. It's definitely an important part." Julie described the bridge implementation trips as the very last stage of a project where "you're basically done with the bridge." She described the trips as a way to reward students who have worked hard on the project and want to see it implemented in the community. Jan described traveling to Nicaragua in this way: "That trip is more or less vacation for me." The culture of the organization is affected by what emphasis is placed on a trip: as an opportunity to travel or an opportunity to empower vulnerable communities.

Career benefits: Jaeger and La Rochelle claim that "by affiliated with EWB, student participants are becoming better prepared for leadership positions […] for their entry into the workplace while also instilling a sense of humanitarian service."[33] Some students in MWB agreed with that, and considered it a motivating factor. Jorge expressed concern that joining for potential career benefits was a very personal motivation. He thinks that personal motivations can inhibit collaboration with communities.

Members are dedicated to their projects and desire to help underserved communities. This represents some of the positive ways that ETH is transforming engineering and engineering education. ETH projects have opened doors for students to think about who engineering should benefit, and how engineers can contribute to a more just global society. Given the scholarly critiques summarized above that even well intentioned ETH organizations can inadvertently perpetuate stereotypes and inequalities, however, we caution that organizations consider motivating members in ways that also foster empathy and collaboration.

Knowledge of ETH

In the formal and informal interviews we explored MWB members' knowledge of engineering-to-help and their familiarity with critiques of development, in order to evaluate how much these critical scholarly perspectives inform the organization and its activities. These interviews, along with our observations of meetings and social events, suggests that new members tend to know very little about sustainable community development projects when they join the organization. In part this is due to the lack of focus on this area in the mainstream engineering curricula they experience as students. CSM does offer elective courses in humanitarian engineering that explicitly address sustainable community development and encourage students to "reflect critically on the practices of engineering."[34] The lack of knowledge and critique of humanitarian engineering projects in the overall MWB organization suggests a lack of collaboration between MWB and the HE program at CSM. Many CSM HE minors are in MWB, but do not necessarily incorporate those themes into their work or share that knowledge with other members. Our observations also revealed that the basic principles of ETH are not directly addressed during water or bridge meetings. This affects the ability of MWB members to be constructively critical of current MWB projects, and development work in general.

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Julie had not taken any HE classes before or during her involvement with MWB. When asked to define humanitarian engineering, she replied "I think it is engineering with the purpose of helping people, making sure that the people are okay with how everything is being implemented and making sure that we are using correct moral practices. Engineering is for people." This definition of humanitarian engineering was self-informed by the participant after she traveled to Nicaragua with MWB. Julie admitted that humanitarian engineering principles were not defined for her directly by MWB. "I think that I knew a little bit of [what humanitarian engineering means] but I didn't realize the extent of it until I actually went to Nicaragua." This means that Julie was an active working member of an MWB project for two semesters until she began to learn the principles of ETH and their importance to her work in MWB. Jan claimed that student leadership sometimes lacks knowledge of some ETH principles such as the importance of a project's history and context, saying, "Officers don't know about past projects." Knowledge of past projects of ETH organizations, along with their relative success, can be critical to the success of current projects.

Minh, who holds a leadership position, cited that a lack of cultural knowledge sometimes acts as a blinder in their projects. "We need to be asking the community 'Why?' more often." A strong background and critique of ETH could help MWB students not make those kinds of mistakes. Jorge outlined what he wished training would look like for working with communities: "I think we need to impart to our members three big things before they can travel: culture, environment, and, like, reasons to help." He expounded by describing that cultural knowledge includes understanding and valuing the community's ethics and lifestyle, that it's "totally different than what [MWB members] know."

MWB members who lack foundational knowledge of ETH and sustainable development are not well-prepared to evaluate their projects as successes or failures, or to reflect critically on their implications to communities. Although there is some critique of their own projects, MWB does not specifically assess their projects' impacts. This holds true with larger critiques of the lack of accountability in ETH projects that also point to the value of this activity for student learning and development outcomes: "students could learn from failures as well as successes, and use rigorously researched information to improve future projects."[35]

The investigators thus found that new members have very little background knowledge on ETH, especially compared with veteran members who had much more experiential knowledge that helped them be more constructively critical of projects. MWB's leadership does not prioritize this knowledge in incorporating new members into the organization, missing an opportunity to expose new members to the value of critique and the importance of history in ETH projects. Based on participant observation and interviews, there does not seem to be a smooth transition of information from HE courses to MWB projects. There are HE minors in MWB, but they are not necessarily sharing the knowledge they have acquired in HE courses, or fully implementing that knowledge in their projects. This relationship between HE and MWB could be strengthened to empower MWB's critical reflection of their projects' implications, evaluation of the relationship between MWB and communities, and defining success from the viewpoints of different stakeholders. Moreover, a closer relationship would allow HE students to learn from the successes and failures of MWB projects.

Members' Evaluation of MWB

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Socially exclusive: Jan was critical of MWB, citing that the organization is not structured efficiently, and that only the core group of people, or clique, moves forward and has the opportunity to be heavily involved. The student leadership decides who gets to travel to Nicaragua and who does not. "The only reason I got to travel was because I am a girl and a grad student. They needed a chaperone," she said. Julie insisted that leadership does very little to motivate younger members, especially those different than them. "They still need to work on inspiring younger members. No one has inspired me to be in the club or shoot for an officer position." The interviewer noted that Jorge consistently used the pronoun "they" instead of "we" to describe the organization, which could be because he feels socially distant from the group as a non-traditional student, much older, and from a different cultural and socio-economic background than most members, based on his own estimation. Jorge laments that people do not talk to each other enough, which would make a more cohesive group.

Defining roles: Jorge, who considers his cultural and language knowledge valuable to MWB, said, "They don't always think of me," referring to the fact that the leadership does not respect his skill set as much as they should. "They need to help tailor members' skills and interests to put them to best use." Jan thinks that the leadership does not value the average members' opinions. "They mostly have the attitude of 'figure it out by yourself.' They unintentionally keep things in the dark because they overestimate what people know." The structure of the organization seems to inhibit connecting leadership with average members. Those average members expressed concern that their opinions are not always valued by leadership.

Diversity: A common theme that came up in interviews was that the organization's lack of diversity made everyone think in a similar way, and not necessarily listen to other points of view. Minh claims that, "The officers are just a clique. They don't even realize that they all think the same." She wishes that diversity in ways of thinking were valued more in the organization. Jorge argues that "diversity gets people out of their comfort zone, and it builds character." Jan explained that "[MWB] is mostly privileged, immature kids who have time to go on trips because they don't have to work." With the current model, Jan thinks that it is not conducive to promoting diversity within the organization. In reference to the student leaders' awareness of their cultural and social background, she said, "I don't think they think about it. They just aren't aware. This is what is normal to them." Members like Jan and Jorge feel excluded, which may be because the core groups of members expect other members to be "normal" like them. Other studies suggest that ETH organizations attract a more diverse group of students than the engineering profession as a whole,[36] but some MWB members do not think diversity of opinion is valued enough by an organization that collaborates across cultural divides.

These observations suggest that structures and regulations might present obstacles and inhibit members from implementing effective and sustainable projects for the communities they seek to serve.

Service Learning vs. Community Impact

Understanding community: Jorge thinks that MWB does not think enough about potential implications to the community, and often do not have a "plan B" for solutions to potential problems, which he thinks stems from lack of cultural understanding. He illustrated that fact with an example of finding out about the community trash-burning habits over a phone call, which surprised MWB's leadership. "I thought, 'why are they surprised?' Aren't they supposed to be aware of standard practices in the area we're working?" He thinks MWB often approaches their

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projects with assumptions about the culture and lifestyle of the community, which are often "way off" the truth. How MWB deals with and assesses misunderstandings and miscommunications highlights the emphasis they place on student experience. Jorge was positive about their attempts to engage the community for a positive impact, but thought their ignorance of some things acted as blinders. "They get the community involved in the project, especially on the labor side of things. They sometimes get community members' opinions on parts of the project, but communication definitely needs to improve." Minh reiterated what Jorge thought about engaging the community. saying, "People's hearts are in it, but we don't always incorporate the community's perspective into decisions." She also brought up listening as an important component of working with communities: "We need to listen. That's what we really need to do. We have our own ideas of what the community needs, but we aren't them. On the trips I have been on, I just like to sit and listen to community leaders about their thoughts, but I don't think that is valued enough [in MWB]." The first criterion for social justice, is listening contextually,[37] which is desired from some interviewees in this research.

Evaluating projects: To assess how MWB evaluates the success and failures of their projects, Julie was asked to describe the long-term project assessment methods of the bridge committee. She was confident in her belief that the community would approach MWB if anything were to go wrong with the bridge. "I know that part of the necessary components of our technical document includes how we think it will affect the community as a whole. We've maintained contact with an in-country engineer contractor so we know where [the project] is and he can keep us in contact with the community." MWB maintains in-country contacts, but have not evaluated whether or not a passive approach to ensuring a project's sustainability is effective. Julie was unsure of who exactly inherited the responsibility of maintaining the bridges once they were implemented, but guessed that the responsibility would fall on the communities. "If we do need to make changes, our in-country contact will tell us. He's been certified by B2P to help with that and be knowledgeable on what is best." Julie left the impression that the bridge committee moves on quickly from finished projects without outlining a comprehensive plan to follow up on long-term success. The bridge implementation trips, as the name implies, occur at the end of the project's timeline. This would suggest that these trips are planned largely for the benefit of the students instead of facilitating community engagement, limiting the opportunity for a bilateral exchange of knowledge between students and community members. Because of the lack of communication and contact with the communities, the implementation trips have the potential of reinforcing problematic assumptions in the members' approaches to development work, as critiqued in the introduction of this article.

On the balance of "equipping leaders" and "empowering communities"[38] the study concludes that MWB does both, but places a greater emphasis on equipping student leaders. Members feel that the communities where they work are positively impacted, but that student experience and learning is prioritized. Many members desire more time to build personal relationship and trust with communities, but are limited by the length of trips and the models of EWB and B2P. This may limit opportunity for bilateral exchange of knowledge with community and reinforce common assumptions in development work.

PARTICIPATORY RESEARCH: PHOTO ESSAY

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In addition to conducting ethnographic research with the MWB members, the researchers sought to understand how the organization was perceived by the community members its members sought to serve. We therefore designed a photographic participatory activity when MWB students traveled to Nicaragua for an assessment trip as part of their EWB-affiliated water project. Although outside the primary scope of evaluating MWB, it provided the team with insight into the final research question of weighing service learning and community impact. It also sheds light on the differences in the perception of this relationship from different stakeholders' points of view. Because of the semester-long timeline of this research, the team did not have the opportunity to interview the community member photographers, and therefore cannot make assumptions about their intentions, or use the photos as conclusive evidence to support our thesis. Nevertheless, the small set of photos taken as part of this evaluation merit mentioning in this work. Due to the preliminary nature of this research activity, the photographs are not included here, but our initial readings of them are summarized below.

In the photos that community members captured, community members can be seen actively communicating to MWB members, often seeming to be in charge of the interaction. The photos suggest that the community's perception of collaboration most often involves their community imparting knowledge to the visiting MWB members. For example, one photo depicts a young community member demonstrating to an MWB member how to pump water from a well. The common theme among them is that the roles of "giver" and "receiver" perceived by the community are different than what appear in many ETH projects that privilege engineers as the primary source of knowledge. In contrast with the photos taken by the community members, the photos taken by MWB members to illustrate "collaboration" involved MWB informing the community. For example, one picture shows an MWB member explaining a technical component of the project to a community member, with the aid of a diagram. There were exceptions to this general trend, but the major thread through these photos is that MWB's version of collaboration involves more unidirectional flow of communication from MWB to the community, rather than an exchange of communication in which MWB students are learning from the community members.

The photographs taken by community members and MWB students thus depicted different views of collaboration in interactions between them. In future research we would like to discuss the photos with all of the photographers to identify their intentions in taking them, and better understand the context of each. Yet even a preliminary analysis of the photos suggests that both the community and MWB are positive about collaboration, but perceive it through their own cultural lens. The community member who holds the camera takes pictures in which the same community member is in control of the information being communicated. In this sense, MWB may be practicing a more paternalistic style of ETH that is critiqued in HE courses, which supports our main argument.

DISCUSSION

Shortcomings

There are some shortcomings in this program evaluation. For example, the research was very small-scale, with few interviews conducted, which restricts the validity of some generalizations of such a large organization. The researchers were not able to travel to Nicaragua to see MWB members interact with the community there. Although the photo essay captured some

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community members' perceptions, it was limited by the number of community members involved and because it was the only community connection in this research. The research group also engaged in this research with a critique of the organization based on their experiences with ETH and MWB, described above. Through the ethnographic research methods of participant observation and interviewing, the researchers analyzed their data methodically to answer the research questions for the benefit of MWB. Despite these shortcomings, the findings revealed strong patterns in the way MWB members regarded their work, their organization, and the communities with whom they work. This ethnographic study is critical yet valuable to MWB and the engineering-to-help body of literature.

Recommendations

To address the research findings that MWB's culture has a potential negative impact on their projects, we proposed some recommendations to the organization. They would benefit from more community engagement training and ETH education to more positively impact communities. This would challenge members to think critically about ETH, be more cognizant of their motivations for joining MWB, and help outline ways to be more effective in their goals. Collaboration with the HE program's classes, projects and initiatives would be beneficial to more knowledge and critique of ETH, as well as collaborating with other local resources for development work, such as the Posner Center for International Development in nearby Denver. Increasing and welcoming diversity of thoughts and backgrounds within the organization could come for cooperating with the CSM chapter of the Society of Hispanic Professional Engineers and diversifying campus events with which they use to attract members. To address members' critique of defining roles, MWB could better utilize the skill sets of their member base by matching them with effective roles in the organization. Listening to the entire member base could also foster a more welcoming environment for all involved students. To balance benefits to students and communities, Amadei and coauthors propose a "shared vision" approach to projects[39], which the CSM HE program calls "co-creating,"[40] where all project stakeholders buy in to the goals and outcomes of projects. This is already done to some degree in MWB projects, but we recommend that they are more empathetic, listen contextually, and be prepared to assess projects throughout their timeline.

MWB Moving Forward

These research findings were presented at an EWB regional conference, and also directly to MWB, as an open presentation to all members. This research and data were shared with the group's student leadership as a way to start a constructive conversation about how things can be changed in the organization. MWB was very open to discussion about the findings, and were already aware of many of the potentially inhibitive aspects of their organization's culture. In fact, MWB had already proactively addressed some of them. For example, they have offered many free outings for members to attend Posner Center events. They have also started a program of weekly presentations and discussions about ETH and development work in general. These events are advertised to the entire CSM community. Since this research was shared with MWB, the student leaders have gone even further in encouraging a culture that fosters less paternalistic projects. They have recently launched a program called "MWB Buddies," in which seasoned members of the organization are paired with new members to encourage transmission of knowledge between different generations of members, as well as create a more inclusive

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environment for new members who may not feel that their opinions are heard. MWB has also started a book club, reading books on "engineering and community development" and related ETH topics. This book club will both foster inclusion in the MWB community while training members on the history and context of ETH projects. With such a thoughtful and positive response to the research, MWB is moving forward with understanding how their culture affects projects, and what they can do about it.

CONCLUSION

Based on the ethnographic data presented in this article, we conclude that MWB's culture and their model for conducting ETH projects can inhibit their goal of empowering communities. In the larger context of the recent growth of ETH programs, student organizations should continue to be critically evaluated to understand the impact of organizational culture on their goals. In the case of MWB, most of their motivations are positive, such as a desire to help, but can reinforce paternalistic development practices where communities are "in need" of their help. Hands-on engineering experience and career benefits are valid motivations to be involved in MWB, but may overlook the role of community. Concerned with members' backgrounds in the history of ETH initiatives, we found that most members have little knowledge, and those with such knowledge do not necessarily share it well with the organization as a whole. On MWB's balance of student experience and community impact, we found that there is a greater emphasis on students. Members' assessment of the organization as socially exclusive may play into the fact that MWB's projects are not ideal case studies for HE courses that are taught at CSM.

To these ends, it should be reinforced that critique is invaluable in engineering service work, and MWB should be aware of their role in ETH projects, with development work's long and complex history. To empower communities, their projects should be assessed by both MWB and the local community. This article is not meant to discourage MWB or other ETH organizations from engaging in projects, but to bring to light that organizational self-reflection is key to growing and adapting to solve the world's challenges. Baillie and coauthors exemplify our call to ETH organizations: "We must listen, we must observe and we must learn to see what our technical knowledge can bring to the community, in ways that will support positive, life-giving structures as well as independence from unsympathetic political systems."[41]

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