Alum Perspective Changes on Engineering Community-Engagement Experiences in EWB-USA

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Abstract

Community-engaged learning has grown rapidly in the past decades within the engineering disciplines. A large U.S.-based program in this space is Engineers Without Borders USA (EWB-USA). Studies have shown positive impacts on student motivation and learning while participating in these types of programs. However, previous studies have not specifically presented the views of this organization's alums. As part of a larger QUAN QUAL explanatory sequential mixed-methods study, semi-structured interviews were conducted with twenty-nine alums of EWB-USA. This paper focuses on the results found from inductive thematic analysis on the interview transcripts related to the changes in perspectives the alums experienced between their time as a student and that of their interview while in professional practice. The findings report a greater perception of benefits accrued by the alums, with specific elements of the EWB-USA experience that they value more now as well as some increased concerns related to models of international development, including a few thoughts on white saviorism. This work illustrates the importance of gathering alumni perspectives for more comprehensive educational program assessments and of providing support in community engagement programs for understanding the value proposition for each stakeholder group. Such investigations can help researchers and practitioners better optimize programs to more closely meet their full potential.

Introduction

Leading institutions in engineering education have been focusing on integrating experiential learning into the undergraduate experience in recent years [1], which is a pedagogy that involves educators purposefully engaging learners in direct experience and focused reflection [2]. One subset of the experiential learning approach is community-engaged learning, which is intended to incorporate the five elements of engagement, academic connection, reciprocal partnerships, mutual learning, and reflection [3]. In engineering, this pedagogy often takes a form illustrated by a *Model of Project-Based Community Engagement* [4] and has been growing in popularity for capstone design courses and other applications [5,6]. Previous findings have shown significant benefits from community-engaged learning experiences in developing a broad range of skills that are critical for engineers [7], including teamwork and communication [8], becoming self-directed and life-long learners [9], and developing design skills [10]. However, there have also been calls for additional research on the perspectives of community partners as well as holistic assessments of programs [11].

Within this space, Engineers Without Borders USA (EWB-USA) is one of the largest players, with 5,600 student participants, over 40% of whom are female, spread across 165 university/college chapters [12]. Studies have found that participating in this organization supports the development of professional skills such as teamwork, leadership [13], project management [14], appreciation for other cultures, and increased awareness of the role of ethics in engineering [15], while not diminishing any technical competencies [16]. EWB-USA has also been found to serve as a multi-faceted retention tool for engineering students, particularly women [14]. However, previous

studies have not specifically investigated the views of the program's alums, and a study of another community engagement program called EPICS found that alums of that program often developed significant new insights into how the program helped them grow only once they entered the workforce and had the opportunity to apply their learning in practice [17]. That suggests that studying such undergraduate programs from the perspective of those with professional experience can be extremely important as part of a holistic program assessment. This paper addressed this literature gap by documenting the perception changes of EWB-USA alums reported between their time as students and when they were interviewed as working professionals.

Methods

This paper is part of a larger NSF-funded QUAN QUAL (Quantitative and Qualitative) explanatory sequential mixed-methods study [18] that included participants who were EWB-USA alums [19] as well as third parties who were professionally connected with EWB-USA alums in some way. Alums were defined for this study as people who participated in EWB-USA as an undergraduate, completed their undergraduate degree, and have worked in professional practice after graduation. Participation was defined as being a member of the EWB-USA organization on their campus, being part of a design team, having a leadership position, and/or being a member of a travel team. The broader investigation included the design and distribution of a survey instrument [20] completed by 268 alums followed by semi-structured interviews. Interview participants were purposefully sampled from the survey respondents to represent the different self-reported populations and voices in the survey pool among those who volunteered to be interviewed per the approved human subject protocol. While multiracial participants were interviewed, there were no African American participants who were able to be interviewed despite significant efforts by the research team. Similarly, there are no non-binary participants interviewed. The interview transcripts were analyzed with inductive thematic analysis [21].

This paper focuses on emergent themes from the alums' interview transcripts related to changes in perceptions the participants reported between the time they were active in EWB-USA as a student and when they had become graduates in the professional space. Some of these findings are outside the scope of the larger study's original research questions of:

1. What professional competencies do alums identify as most developed through their EWB-USA experiences as undergraduates?
2. What is the nature of how undergraduate participation in EWB-USA may bridge the experiences of formal post-secondary engineering education and professional practice?
3. How do variations in the nature of involvement with and/or the structure of EWB-USA programs impact the above elements?
4. How are Alums of EWB-USA perceived by other members of industry?
5. How do the above elements vary between female versus male students, among students of different races and ethnicities, and for first-generation college students?

Interview respondents were prioritized for sampling in the interviews based on their ability to add viewpoints or voices to the sample, in a form of both extreme case and maximum variation sampling [22], and to speak to intriguing information gathered in the survey phase. The final list of 29 interview participants is provided in Table 1.

Table 1: Interview Participants by Pseudonym

Pseudonym	Gender	Race	Hispanic, Latino, Spanish	First Gen. Student	Months in EWB-USA as an Undergraduate	Undergrad Major
Lisa	Female	W	No	No	60	Civil
Kimberly	Female	W	No	Yes	36	Civil
Robert	Male	W	No	No	51	Civil
Crystal	Female	B	Yes	No	42	Social Service
John	Male	W	No	No	48	Civil
Diego	Male	N	Yes	Yes	45	Mechanical
Oski	Male	W	No	No	48	Environmental
Rebecca	Female	W	No	No	45	Environmental
Daniel	Male	W	No	No	48	Electrical
Brittany	Female	B	No	No	50	Environmental
LeBron	Male	W	No	No	36	Biomedical
Gabriela	Female	B	No	Yes	40	Mechanical
Matthew	Male	W	No	Yes	9	Architectural
Natasha	Female	W	No	No	40	Civil
Sofia	Female	W	Yes	No	45	Materials
Brandon	Male	W	No	No	46	Mechanical
Nicholas	Male	B	No	No	50	Architectural
Ann	Female	W	No	Yes	36	Environmental
Jessica	Female	W	No	No	45	Civil
Erin	Female	W	No	No	28	Chemical
Chris	Male	W	No	No	30	Science
Naomi	Female	A	No	No	40	Civil
Edward	Male	W	No	Yes	30	Civil
Adam	Male	W	No	No	48	Civil
Sarah	Female	W	No	No	33	Civil
Amanda	Female	W	Yes	No	25	Environmental
James	Male	W	No	No	36	Chemical
Malissa	Female	W	No	No	20	Civil
Laura	Female	W	Yes	Yes	54	Civil

Note: for Race: A indicates Asian; B indicates Multiracial or Biracial; N indicates a race/ethnicity not listed here; W indicates White or Caucasian

Interviews were conducted and recorded over video conferencing with a target duration of 60 to 75 minutes. The interviews were transcribed using a professional service, the researchers cleaned the transcripts, the recordings were deleted, and the transcripts were entered into NVivo. The analysis involved iterative category construction (coding), sorting, naming, and refining [23].

Relevant and representative quotes were collected for presentation, including variations of voices across the interview pool.

Results

The two primary themes related to alums' perception changes that emerged centered around gaining a greater perception of benefits to the alums, including valuing parts of the EWB-USA student experience more, as well as developing concerns related to international development and White saviorism. At least one of these themes was discussed by each of the 29 interview participants. Crystal summarized this by saying:

> I think the biggest thing I learned postgrad […] is that part of the Engineers Without Borders experience is we were part of the mission as a student and our learning was a part of the mission. I think if we really wanted to just do the singular mission of helping people, which is why I joined, I think, originally, there are a lot more efficient ways of doing that, and I think I'm aware of that completely. But I definitely was not aware of that as a student. (Crystal)

Erin expressed the sentiment by saying:

> So, at the time, I felt like I was doing this tremendous service. And now, when I look back, really, instead of providing this tremendous service, I was doing a lot of learning. So, I consider it a really valuable learning experience now. Whereas, at the time, I thought I was giving a lot to this community, but really in the end they gave a lot to me. (Erin)

The following sections explore these two primary themes further, providing illustrative quotes from the interview transcripts.

Greater Perception of Alumni Benefit

Many participants conveyed a greater understanding of the value they received from their EWB-USA experience that only became apartment after joining the workforce and having this prompt their reflection. The importance of this reflection was noted by Oski when he said "reflecting on it after the fact gives you additional perspective and gratitude for the experiences you had, and it also influences you to take those lessons and to learn from them and integrate them into your professional practice." And others highlighted how the act of working professional was important to their shift in thinking. Melissa shared that "other alumni or professors or whatever would tell me that it was a valuable experience, but I didn't know for sure until I actually started working," and Gabriela mentioned "I didn't realize how much it really would help me once I started working. […] But actually, when I started working, I was like, EWB actually did kind of parallel what I see day-to-day at work." Adam tied his reflection to a particular type of work experience, noting that "I think the more you are involved in specifically consulting engineering, the more things come up where I can look back and be like, I did some of that at EWB, it's nice that I have that experience." Others noted a lack of clarity or appreciation for what would be valued after graduation as one element impacting their change in view.

> [T]his experience is a differentiating factor, and, at the time, I didn't really know that other people weren't developing those skills, and also didn't realize the value that those soft skills have in a professional environment. In engineering school, you spend all this time learning the math and science, and then when you get to a real job, that's maybe 50% of your work. And the other 50% is working with people and resolving conflict. […] So, I consider it a really valuable learning experience now. (Erin)

Along the same lines, Chris shared:

> I don't think I realized at the time essentially most of what I'm saying now in terms of the benefit of stakeholder involvement, of customer discovery interviews, of really having a partner in development. I think that was something that we did that was driven by the team, but it was maybe something that I didn't even realize we were doing that was special and unique until I got out into industry […] So, certainly, I think the time to reflect on that and have discussions has certainly made me more appreciative of the positive experience that I had as an undergrad. (Chris)

Daniel similarly indicated:

> I think at the time I didn't fully appreciate the skillset that came with it. I liked being able to work in those cross-functional teams. […] But I didn't really fully appreciate how much it would prepare me to enter the workforce afterwards until I kind of left and actually got into the workforce and I noticed all these parallels to the things that I had been doing. (Daniel)

In addition to these general increases in perceived value of the EWB-USA student experience, interview participants discussed an increased appreciation for a wide range of different specific elements of the program. For example, Danial indicated "I look back and really appreciate more of the kind of overhead project management parts of this, more so than the technical design aspect." Others discussed various elements of their EWB-USA experiences that came to stand out once they began their career.

Crystal spoke about communication skill building through practice in EWB-USA.

> [N]ow that I've been in a job for a year or so, I think I've also realized the different aspects that are directly applicable to professional work such as writing emails, making valuable presentations, presenting data in an easy way so people can understand it. Little things that I constantly practiced in my EWB undergraduate career that I didn't necessarily know would be valuable in my career. I think those day-to-day activities, the leadership component. I don't think the people skills I learned I thought would be as valuable until post-grad. (Crystal)

Communication was also pointed out by James.

> I think I do value the communication and how some of our meetings went, because I can kind of see that when I'm in meetings now, I know how to lead a meeting better. I'd never really done that before EWB. I had really no reason to lead a meeting before it and so I'm much more comfortable with video meeting and sharing my ideas and being able to facilitate through other people's ideas. I don't think I realized that while it was happening. (James)

Robert focused on a different area, technical review.

> So, at the time, I wasn't always excited to go to an EWB technical review. Of course, I understand why it's necessary. You need to make sure the designs that are being implemented are sound designs. But as a student, I was a little bit at times like, man, this is kind of a pain. So, looking on that now, I mean, that's just been, of course, part of my profession, and it's just obviously part of engineering integrally. It has to be this design review thing. So, I think my perception on the necessity of those design reviews has changed and even just having the process of assembling calculations and putting together a presentation. I think I look back at that piece of it as more valuable than I thought it to be at the time. (Robert)

Finaly, Erin emphasized learning from failure in her EWB-USA experience.

> I would say just going back to that experiencing failure, which really, in a more positive way to say it, is experiencing a realistic engineering project. So, at the time, it was pretty painful and miserable to put a lot of work into something and see it fail. But then in hindsight, the way [we] reacted to that and saw it as an opportunity to learn from and implement improvements going forward, those sorts of things are really, really valuable now. (Erin)

Greater International Development Concerns

EWB-USA alums expressed a growth in discomfort with some notions related to the program's model and international development more generally. Sarah said "I do think, looking back, it just strikes me as a little crazy that another country would just let some students in to build water infrastructure." And going on to say "I hope whatever issues this region's dealing with, they get their bureaucratic ducks in a row and then don't let us in anymore because they're doing a great job themselves." Naomi also expressed growing skepticism towards EWB-USA's model.

> I think while I was in it, I was very adamant that this was the best thing that anyone could possibly do in undergrad, and that it was unflawed. And now that I'm learning more about the discourse of development as a whole […] and understanding the different power dynamics that come into play, I think I'm a little bit more skeptical of the ideology that EWB is the gold standard in development. (Naomi)

The limited time onsite and ability this gives students to understand the local context was the focus of Natasha, who indicated "I'm seeing even more the limitations of the model that EWB has, because people are only in country for such a short amount of time. There's only so much

you can do to engage really well culturally, or even to do a proper needs assessment." This same topic was addressed by Rebecca.

> [T]he whole what is our theory of development conversation and kind of how important is the cultural and social context of implementing a design I think that that has become more forefront in the last few years as I reflect on my student experience, you know, just wondering if we as students had kind of learned enough or spend enough time on understanding the context within which the engineering project was placed. (Rebecca)

Brandon focused on how this timeline structure impacts the efficiency of different parts of the organization's mission.

> [Y]ou raise a bunch of money to send a bunch of teenagers, or young adults and a professional mentor, over to a country, to be there for a couple of weeks. And then, to come back a few times over the course of X number of years, do projects. It's, I perceive, a very inefficient way to actually do development work, and not necessarily the most effective. However, it's very effective at developing those people who are doing it, the students that are going. But to actually go and implement projects is just, there is much better ways to do it. (Brandon)

Concerns about the international development model are tied to the ideas of reciprocity by Brittany.

> So, it's not as clear cut as it was in EWB to say that they applied for this project and you're going to go and do it. Life is not that easy. I think I have gotten a broader perspective on how simplistic that is. In terms of just international development in general, I have a better sense of the challenges involved than I did as a student, and also an understanding of really what the relationship is between EWB chapters and the communities where they are in terms of how maybe the EWB teams are not really as necessary as we used to think that they were when I was involved as a student, right? The community doesn't really need a bunch of college students with minimal experience and knowledge to come in and do stuff for them. It is very much a two-way street, right? It is an opportunity for the communities to get some technical expertise on their problem. It is also a great opportunity for them to get funding where otherwise they wouldn't. That's not to say that what EWB does is ineffective or purely monetarily driven, but that's a part that you forget a lot of the time as a student and maybe need to be reminded about that you are there not only to help the people you're supposed to be helping, but also because it is really helping you as a student, as a citizen, as a future professional. These are all things that are going to benefit you, and if the community also gets benefit from it, that's great, but I guess I've gotten a little more cynical about it. (Brittany)

Lastly, Ann described a shift in interest away from international development toward more local engagement.

> So, I feel like I'm less driven towards international development than I was when I was in my undergraduate. But I think I'm just realizing the most impact that I can make is in my community. So, not to say that the work that EWB does isn't important, but I think I need to apply my skills to my home. So, I think that perception has definitely changed. I thought I would be working international development when I graduated, but I realized I wanted to focus on the city that I grew up in. (Ann)

Beyond these feelings about international development more generally, four of the women in the interview pool spoke specifically about the topic of White saviorism. Personally, Crystal shared that "I just didn't realize in some sense I was maybe a little selfish in being like, 'Oh, I want to help them. I can help them.' Little White saviorism." Sofia noted at the organizational level that "I think it's a really good program if executed correctly and responsibly […] I sometimes worry that it might fall into that trap of White savior complex sometimes, again, if not executed properly, responsibly." Similarly, Jessica identified the risk of EWB-USA projects falling into this trap.

> I feel like I've learned more and read more about how sometimes even projects like those that EWB does, even with the focus on making them sustainable and engaging stakeholders, I think just looking at the development field in general, I've learned more about how even with the focus on sustainability, sometimes projects don't work and the philosophy in the field is evolving constantly and there's a risk of sometimes like the White savior complex that I feel like sometimes EWB can maybe have or seem like it has. (Jessica)

Kimberly expressed a desire for more guidance around this subject as part of the program.

> I think looking back on it now and thinking of how I was as a student, I mentioned this a little bit earlier, but I think there was an element of White saviorism, and I wish I had been educated on that a little bit more and just had a different mindset going into my, especially my travels. I think that that's the biggest difference between my perspective as an undergrad being in it and my perspective looking back now. All the positives are still all there, absolutely, but I do wish that I had a better outlook on what the perception of me as a white young engineer, who's super fresh, is actually looks like going into a community and attempting to solve these problems. (Kimberly)

Discussion, Conclusions, and Future work

The interview transcripts make it clear that the EWB-USA alums saw significant shifts in their perceptions of the value of their EWB-USA experience after they graduated. The alums generally went from seeing their EWB-USA efforts as something done primarily for the benefit of the community partner to viewing it more as something that significantly benefited them as student participants. This suggests a need for additional focus on the reciprocal nature of partnerships within community engagement programs such as EWB-USA. We recommend more explicitly addressing the benefits across professional career paths of working on real design projects with real people within community engagement programs. This may include facilitating structured

reflection activities and bringing alums back to the students to provide their reflections, perspectives, and experiences.

Such a push to focus more on the dual and reciprocal nature of the experiences that benefit multiple stakeholders aligns with the recent finding from Delaine et al., [24], that "to enact more equitable [service learning and community engagement (SLCE)], researchers and practitioners must intentionally conceptualize reciprocity, translate it into practice, and make visible the ways in which reciprocity is enacted within their SLCE efforts" (p. 1). This can be done with tools that scaffold thinking about and documentation of what each stakeholder group contributes and gains from a project or program, as used by organizations such as Engineers Without Borders Guatemala [25], diverse programs at Purdue University [26], and the NGO ACCMARI [27].

Future work opportunities include more programs implementing and continuously improving the tools to scaffold reflection and reciprocity in experiential learning. Additional studies focused on the perspective of other stakeholders beyond student participants in community engagement are also called for. And finally, more holistic program assessments that employ the perspectives of alums can better show their value to university/college officials, funders, and employers. To support this process, it may be helpful to find ways to better inform faculty and students of the skills valued in the professional engineering workforce, to clarify the nature of benefits the student participants are accumulating while participating in community-engaged learning. Such investigations can help researchers and practitioners better optimize programs to more closely meet their full potential.

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References

1. Graham, R. (2018). *The global state of the art in engineering education*. MIT school of engineering. https://jwel.mit.edu/assets/document/global-state-art-engineering-education
2. Brumm, T. J., Hanneman, L. F., & Mickelson, S. K. (2005). The data are in: Student workplace competencies in the experiential workplace. *American Society for Engineering Education Annual Conference*.
3. Lima, M. & Oakes, W. (2014). *Service learning: Engineering in your community (2nd ed.).* Oxford Press.
4. Leidig, P. A. & Oakes, W. C. (2021-a). Model for Project-Based Community Engagement. *International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship, 16*(2), 1-13. https://doi.org/10.24908/ijsle.v16i2.14809
5. Howe, S., and J. Goldberg. (2019). Engineering capstone design education: Current practices, emerging trends, and success strategies. In *Design education today: Technical*

contexts, programs and best practices, edited by D. Schaefer, G. Coates, and C. Eckert. Springer.
6. Leidig, P. A., Khalifah, S. M. & Oakes, W. C. (2023). Capstone design in engineering community engagement course. *Journal of Civil Engineering Education*, 149(2). https://doi.org/10.1061/(ASCE)EI.2643-9115.0000071
7. Bielefeldt, A. R., Paterson, K., & Swan, C. (2010). Measuring the value added from service learning in project-based engineering education. *International Journal of Engineering Education, 26*(3), 535-546.
8. Coyle, E. J., Jamieson, L. H, & Oakes, W. C. (2005). EPICS: Engineering projects in community service. *International Journal of Engineering Education, 21*(1), 139-150.
9. Jiusto, S. & Dibiasio, D. (2006). Experiential learning environments: Do they prepare our students to be self-directed, life-long learners? *Journal of Engineering Education, 95*(3), 195-205.
10. Zoltowski, C., Oakes, W., & Cardella, M. (2012). Students' Ways of Experiencing Human-Centered Design. *Journal of Engineering Education, 101*(1), 28-59.
11. Natarajarathinam, M., Qiu, S., Lu, W. (2021). Community engagement in engineering education: A systematic literature review. *Journal of Engineering Education*, 110(4). https://doi.org/10.1002/jee.20424
12. Engineers Without Borders USA (EWB-USA). (2020). 2019 Annual Report. https://www.ewb-usa.org/wp-content/uploads/ewb-ar2019-final.pdf
13. Savage, S. and Knight, D. (2018). An ethnographic investigation into the development of engineers without borders USA students during the monitoring and maintenance of a potable water system in Peru. *IEEE Frontiers in Education Conference (FIE).* http://dx.doi.org/10.1109/FIE.2018.8658676.
14. Litchfield, K., & Javernick-Will, A. (2014). Investigating Gains from EWB-USA Involvement, *Journal of Professional Issues in Engineering Education and Practice, 140*(1), 4013008.
15. Jaeger, B., & LaRochelle, E. (2009). Ewb^2 engineers without borders: Educationally, a world of benefits. *ASEE Annual Conference & Exposition*. http://dx.doi.org/10.18260/1-2--4961
16. Litchfield, K., Javernick-Will, A., & Maul, A. (2016). Technical and Professional Skills of Engineers Involved and Not Involved in Engineering Service. *Journal of Engineering Education, 105*(1), 70-92.
17. Huff, James L, Zoltowski, Carla B, & Oakes, William C. (2016). Preparing engineers for the workplace through service learning: Perceptions of EPICS alumni. *Journal of Engineering Education*, *105*(1), 43-69.
18. Borrego, M., Douglas, E. P., & Amelink, C. T. (2009). Quantitative, qualitative, and mixed research methods in engineering education. *Journal of Engineering Education, 98*(1), 53-66. https://doi.org/10.1002/j.2168-9830.2009.tb01005.x
19. Leidig. P. A. (2023) *Impact of Engineers Without Borders USA Experiences on Professional Preparation*. [Doctoral dissertation, Purdue University] Purdue e-Pubs.
20. Leidig, P. A., Holloway, E. & Oakes, W. C. (2022). Designing the Engineers Without Borders USA professional preparation study surveys. *ASEE Annual Conference & Exposition.*
21. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. http://dx.doi.org/10.1191/1478088706qp063oa

22. Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219- 245.
23. Merriam, S. B. & Tisdell, E. J. (2016). *Qualitative research: A guide to design and Implementation* (4th ed.). Jossey-Bass.
24. Delaine, D. A., Redick, S., Radhakrishnan, D., Shermadou, A., Smith, M. M., Kandakatla, R., Wang, L., Freitas, C., Dalton C. L., Dostilio, L. D., DeBoer, J. (2023). A systematic literature review of reciprocity in engineering service-learning/community engagement. *Journal of Engineering Education*. https://doi.org/10.1002/jee.20561
25. Leidig, P. A., Crowe, s. & Oakes, W. C. (2022). Engagement in practice: Model for project-based community engagement Engineers Without Borders Guatemala case study. *ASEE Annual Conference & Exposition.*
26. Leidig, P. A. & Oakes, W. C. (2021). Engagement in practice: Project-based community engagement model preliminary case studies. *ASEE Annual Conference & Exposition.*
27. ACCMARI (2019). *Growth of communities through capacity building*. Asociación de Comités Comunitarios Medioambiental Región (The Association of Community Natural Environment Committee Leaders Ixil Region).