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2024

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Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA
SANTA CRUZ

**BARRIERS TO COMMUNITY-ENGAGED STUDENT PROJECTS
FROM THE PERSPECTIVE OF COMMUNITY MEMBERS
EXPLORING COLLABORATIONS WITH ENGINEERING
PROGRAMS**

A thesis submitted in partial satisfaction of the
requirements for the degree of

Master of Science

in

COMPUTATIONAL MEDIA

by

Amelia Wang

June 2024

The Thesis of Amelia Wang
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2024

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Abstract

Barriers to community-engaged student projects from the perspective of community members exploring collaborations with engineering programs

by

Amelia Wang

The growing role of technology in society has led to calls for more experiential, community-engaged learning to equip students with the skills and qualities needed for developing technology for the public interest. Despite the growing number of initiatives that seek to provide such experiences, there is still limited research on the barriers that make it challenging to do so. To better understand these challenges, we ran a matchmaking program to help community members connect with potential campus partners and conducted a series of interviews with 8 community stakeholders (nonprofits, government programs, and small tech consultancies) to understand potential project needs, expectations for collaboration, and views on connecting community needs to student learning. We analyzed these interviews to understand barriers and identified three themes around the central concept of misalignments: misalignments between the professional and non-profit world versus the educational system, misalignments between the goal of delivering project impact versus the goal of completing a course or developing a career, and misalignments between expectations of professionalism versus the reality of volunteers and learners. We conclude by reflecting on approaches to overcoming these misalignments

and implications for designing computational ecosystems that support educational experiences more integrated with the community.

Many thanks to my advisor Professor David Lee, for his endless patience and unwavering optimism. We've run into countless issues during my time here and I am not only a better researcher, but also a better mentor, and kinder leader

To my family, for always reminding me that things will be okay

And to my friends, for making sure I always have a smile on my face

Part I

Barriers to community-engaged student projects from the perspective of community members exploring collaborations with engineering programs

1 Introduction

Digital tools today are playing increasing roles in society in contexts as wide-ranging as education, work, and community engagement [35], leading to calls for more experiential, community-engaged learning to equip students with the skills and qualities needed for developing technology for the public interest [17]. In the social sciences, service learning and community-engaged learning are prevalent, with students learning through projects developed in partnership with and in support of community organizations [40]. Studies have shown that service learning not only has a positive effect on academic performance, but also on leadership qualities, prosocial values, and civic responsibility [5]. However, service learning is not as common in engineering contexts. Unlike the social sciences, where teaching methods, styles, and content are closely aligned to service learning's roots in critical pedagogy [25], engineering programs tend to focus on technical skills. This means that there are significant barriers to defining community-engaged projects that take into account the complex context of real needs and that produce sustainable outcomes [10].

Understanding barriers to community-engaged learning in engineering is an important step towards tackling this challenge, but there is limited qualitative research providing a richer picture of community perspectives that could help inform new angles for design, especially for community members *not currently engaged in campus partnerships but looking to do so*. We are particularly interested in this from the perspective of the growing research in Computer-Supported Cooperative Work (CSCW) and social

computing focused on designing computational ecosystems to support learning or community engagement [47, 51]. If one can more richly understand the context to barriers, including barriers for those who have interest in getting involved, this may help provide insight into designing tools that can support a more integrated campus and community ecosystem.

In this paper, we seek to fill this gap through a qualitative study rooted in a matchmaking program we ran to help community members connect with potential campus partners. We conducted a series of intake interviews with 7 community stakeholders (nonprofits, government programs, and small tech consultancies) to understand potential project needs, expectations for collaboration, and views on connecting community needs to student learning. We analyzed these interviews to understand barriers from the lens of misalignments at the level of systems, goals, and expectations (drawing from an analysis of barriers to undergraduate research from the lens of misalignments [44]).

First, we found that many barriers stem from system-level misalignments between the professional/non-profit world and the educational system, due to a mismatch between educational content and timelines with that of real-world projects, a lack of centralized and accessible ways for the community to engage with the university, and the limited resources non-profits have to engage in student work. Second, these system-level misalignments are further compounded by misalignments in goals, with community stakeholders focused on delivering project impact and students focused on experiential learning and resume-building. Third, these system and goal-level misalignments are reflected in misalignments in expectations, with nonprofits expecting that students can

make meaningful contributions without mentorship, organizations expecting students to be more reliable or communicative than they sometimes are, and students not realizing that some contributions require longer-term understanding and involvement.

In what follows, we discuss related work and our methods (**Sections 2-3**), detail the findings on misalignments in systems, goals, and expectations (**Sections 4-6**), and conclude by discussing the complex nature of misalignments in this context, approaches to overcoming misalignments, and implications for designing computational ecosystems that support deeply community-engaged educational experiences

2 Related Work

2.1 Service-Learning and Barriers to Collaboration

Service-learning is one of several pedagogies emphasizing ‘experience’ as a critical part of the learning process. It was a social movement that started in the 1970s as a way to bridge academic achievement and volunteerism primarily in the field of social studies [25]. Today, service-learning is prevalent in the social sciences and typically follows an educational structure in which students gain real-world skills and work experience by supporting local community organizations through service activities that meet community needs or advance their mission [41].

Themes	Subthemes	Representative Quote
Misaligned systems	Educational content and timeline mismatch	"It is based on just their classwork, what they're learning, they need to apply that towards whatever the project, so it was very specific...And, by the time they learn and do it, is satisfying the coursework, but it is not adding much value to me" -Nonprofit 2
	Lack of centralized community engagement	"I think the challenge there is that each university or Community College has their own system and their own way of doing things and they're not really talking to each other." -Umbrella organization 1
	Nonprofits lacking resources for student work	"I think the second thing that I think a lot of nonprofits struggle with is just funding...it really depends on the season, the fate of the, the fate of the county, education, state funding all of that" -Nonprofit 1
Misaligned goals	Community orgs prioritizing student learning	"[we can] easily look in our portal and see. Yeah, who's asking for a social media intern? And I would be, you know, 99% sure they're asking for that because they don't know how to do it themselves" -Umbrella organization 1
	Students focusing on professional roles	"The biggest thing that we look for is that their goal aligns with the internship goal...we look for someone who's like, I want to engage with the community, and I want to contact people and want to learn that skill." -Nonprofit 1
Misaligned expectations	Nonprofits expecting meaningful contributions	"Employers want to hire an intern to do work they don't know how to do and I have to tell them, that's not how an internship works. You are mentoring and training a student, you're not hiring them to do things you don't know how to do...they want a student to do it because they don't know how" -Umbrella organization 1
	Expectations of professionalism in student reliability	"If people ultimately have difficulty managing their time, and being able to focus on the project. . . like I said, they have to go to school, I get that. But you know, they'll need to be able to set aside time to work on the project and to make strides" -Small tech consultancy 2
	Students unaware of long-term involvement needs	"It's coming from a really good place...that can be something that you really have to be very clear that when you're standing in a public position in that regard, say giving you three minutes on record, that you have to be very cognizant that you're representing an organization and not yourself." -Umbrella organization 1

Table 0.1: **Themes and Subthemes from qualitative analysis, represented with illustrative quotes**

2.1.1 Service learning benefits and challenges

Studies have shown that service-learning positively impacts academic achievement by fostering critical thinking, problem-solving, and content mastery [25, 37]. It enhances students' understanding of course material by applying concepts to real-world situations and furthermore promotes interpersonal and activist traits [7]. In a longitudinal study that followed over 22,000 undergraduates from their freshman year to their graduation, service-learning was found to have a positive effect on every measured outcome, including: 1) Academic performance (GPA, writing skills, critical thinking skills); 2) Commitment to activism and to promoting racial understanding; 3) Self efficacy; 4) Leadership (leadership activities, self-rated leadership ability, interpersonal skills); 5) Choice of a service career; and 6) Plans to participate in service after college [5].

However, despite the many benefits of service learning, a major challenge is finding alignment between the needs and contexts of students, educators, and community organizations [36, 1]. Building meaningful partnerships with community organizations requires time, effort, and ongoing collaboration. Challenges in identifying suitable community partners, coordinating logistics, and aligning community needs with learning goals can hinder the successful implementation of service learning [9]. Issues related to student conduct, poor fit between course and organizational objectives, and lack of communication between instructors and organizations can result in partnerships that provide benefits for students but not for community organizations [8]. Cultivating meaningful and reciprocal collaborations with community organizations based on

strong relationships is crucial for the success and sustainability of service-learning efforts [52]. Studies highlight the importance of including community partners in decision-making processes and identified four key insights for enhancing relationships between colleges/universities and community partners: 1) Reciprocity drives community partners' outcomes, 2) Community partners value students' learning outcomes, 3) Institutionalization of service-learning is significant to community partners, 4) Community partners want to contribute [36].

2.1.2 Service learning in engineering and design

Challenges to service learning can be even more pronounced in particular disciplines such as engineering, where service learning is still in its infancy. Salam et al.'s literature review from 2019 looked at 80 studies of service learning in different academic pedagogies and found the most reported studies in medical and nursing and the least in engineering [40], with some remarking that this is "*a consequence of either poorly marketing what service-learning can offer the hard sciences...or the inability of the hard sciences to transform themselves into useful public disciplines*" [10]. Similarly, applications of service learning in CS and (ICT), although well-documented as beneficial in HCI spaces, are still facing many challenges to this day. [32, 46, 38]

Furthermore, many of the studies that do focus on these technologies note that it is a challenge to be able to enact service learning in classes without requiring both students and teachers to take on significantly increased workloads to be able to communicate, reflect, manage expectations. [32]

Service learning has many benefits for engineering too for bridging the gap between theory and practice, fostering civic responsibility, and turning students into well-rounded engineers. Employers often highlight a gap in essential soft skills among graduates, including communication, teamwork, problem-solving, and cultural competence [28]. Service learning is shown to enhance engineering competencies beyond technical skills. It helps students cultivate ideal professional skills such as teamwork, communication, project management, and bridging theory and practice; these are essential for successful engineering practice [28, 7, 16, 5].

This is important for engineering and design fields as the proliferation of tech to address and solve social issues has been shown to be consequential due to the innovation-driven nature of science/technology/our economy. Tech-driven solutions to societal issues have resulted in outcomes that are “unnerving, unfair, unsafe, unpredictable, and unaccountable” for the users/communities that are affected. [42] As a result, issues such as implicit bias, invasive monitoring, and unbalanced accountability now serve as cautionary tales against the involvement of outside solutions to communities. There is growing research in ICT that focuses on ‘care’ as one of the integral perspectives students acquire and demonstrate through service learning. [39] “Its “slowness” nourishes co-existing ecologies not running at the speed of innovation-driven capitalist economies.” “By foregrounding involvement, affect, interdependence, care time, relationality, and repetitive adjustment, nurturant relationalities can emerge as alternatives to the aggressive temporality of profit-driven techno-scientific innovation” [39]

2.1.3 Our contribution

Our work contributes to the literature on challenges to service learning in several ways. First, while there have been many studies on the student perspective, there is less research that focuses on the community perspective, important for ensuring mutually beneficial collaborations [31, 50]. Second, while there are many case studies on existing programs and collaborations, there is less research that focuses on those who are *not* currently in a collaboration but that are interested in developing one. Third, there are relatively few studies that focus specifically on challenges for service learning in engineering contexts.

Our approach of interviewing community members looking to establish collaborations with engineering programs fills all three of these gaps, and does so in an authentic context through running a pilot matchmaking service. Additionally, the lens of misalignments at the level of systems, goals, and expectations also provides a novel high-level view of barriers useful for considering how one might design ecosystems to support service-learning and for institutionalizing service-learning in ways that bridge universities and their local community.

2.2 Computational ecosystems, digital civics, and designing for alignment

As mentioned earlier, we are particularly interested in understanding challenges and barriers to service learning for designing computational ecosystems that help address these challenges. In this section, we describe some of the relevant literature in

Computer-Supported Cooperative Work (CSCW) and social computing in digital civics, computational ecosystems, and designing for alignment.

2.2.1 Computational ecosystems and crowd computing

Crowd computing has transitioned from micro-tasking to the development of sophisticated team structures, organizational frameworks, and the emergence of computational ecosystems. By breaking down objectives into simpler computational tasks, micro-tasking empowers novices to work together and complete more complex tasks that are interdependent of one another. Over time, these findings have helped inform the design of computational tools and social structures that also include both physical and online interactions. More specifically, this has been shown to be beneficial in educational ecosystems (Agile Research Studios, Crowd Research.)

Computational ecosystems represent the idea that advancing human values and problem-solving require not only technology as tools, but as integrative systems that also necessarily include community processes, social structures, and intelligent systems. In asking how we can support students and the community to come together, we have to take inventory of the current system and treat our contribution not as a product, but an adjustment to the current system. The author uses taking care of living soil as an analogy to techno-innovation. “a community right underneath us, lively, vibrant, and teeming with life” [39] Understanding the systems we’re trying to improve is integral in creating solutions that are sustainable and work with what already exists/functions.

Recent studies in social computing have explored creating environments where

digital tools work together with social structures to address complex challenges. Our work is influenced by existing research in crowdsourcing and social computing, particularly in the design of computational ecosystems [51]. We draw on technology used to coordinate individuals, groups, organizations, or communities in democratic and civic engagement [30] (Lee et al., 2021; Okolloh, 2009). Additionally, we incorporate insights from research on collaborative efforts for complex tasks (Retelny et al., 2014; Valentine et al., 2017) and on supporting experiential learning (Zhang et al., 2017; Vaish et al., 2017; Lee et al., 2019).

2.2.2 Digital civics and designing for relationships and alignment

Digital civics is an interdisciplinary field that studies how digital technologies can support civic engagement. More specifically, the field focuses on supporting citizens in becoming agents of democracy with and through technology and putting them in dialogue with the institutions that can actualize public will. Researchers believe in the potential of these models to reconfigure power relations between citizens, communities, and the state [3, 12, 4].

While much of the work in digital civics centers on developing digital tools to meet various needs, there is a growing body of research emphasizing the importance of going beyond tool-building to critically examining the social, cultural, and political implications of digital technologies and their impact on civic engagement. This includes, for example, issues of power, inequality, privacy, and ethics within digital civics, and the need for inclusive and ethical co-design and co-creation processes [34] to meaning-

fully engage marginalized communities and avoid exacerbating existing inequalities [2]. Researchers and practitioners need to work closely with communities and stakeholders to develop technology solutions that address their specific needs and aspirations [3, 20]. The clear implication is that we need to develop educational experiences that teach technologists and designers how to develop technologies through community-engaged projects that are inclusive and equitable.

But literature in digital civics doesn't only motivate the need for experiential, community-engaged learning, it also informs how we should begin working towards designing ecosystems that support experiential, community-engaged learning. One thread of work particularly relevant to us centers on the importance of designing for relationships and alignment in digital civics. Researchers argue for a shift "*from transactional to relational interaction*" [3] and that the common "*transactional, data-driven approach to designing civic tech does not support relationship-building between city governments and communities*" [19]. Implementing technology in a community that lacks the necessary but complex social infrastructure to support it can be dangerous. One needs to go beyond a focus on 'users' to all stakeholders in a community who may not be directly engaging with the system [22]. Designing solutions for communities needs to go beyond technologies/apps that provide services, and requires awareness and prioritization of the intricacies of community needs and the relationships that support them [21, 14, 3].

While traditional APIs primarily focus on technical functionalities and data exchange, communities require a "sociotechnical API" that accounts for the social and human aspects of system interactions [3] and incorporates social, cultural, and ethical

considerations. More nuanced concepts are needed. For example, rather than viewing the goal as teaching participants how to civically engage, one should consider how to develop empathy and understanding, key building blocks to addressing many issues within civic engagement.

We specifically build on the work of Asad et al. in their emphasis on the importance of supporting “the work of alignment” in which they argue that the “user experience” of a community centers on the relationships in it [3]. In the context of digital civics studies, the work of alignment refers to the process of bringing together various stakeholders, such as government agencies, community organizations, and citizens, to collectively address social and civic issues using digital technologies. Alignment involves fostering collaboration and cooperation among these stakeholders to achieve common goals and maximize the impact of digital civic initiatives [29]. By better aligning the practices and expectations of multiple stakeholders around common goals, it reduces some of the work necessary to collaborate across issues and community groups and better empowers community groups to advocate for themselves and serve their own interests in public processes that impact their livelihoods [49, 13, 11].

2.2.3 Our contribution

We see our work as laying important groundwork for the design of ecosystems to support community-engaged learning through mapping the various misalignments that exist in establishing university-community collaborations. We also see it as helping to create connections between service learning and topics within CSCW such as digital

civics and computational ecosystems.

We note that service learning and digital civics share many of the same goals and values, but also have differences that suggest opportunities for work at their intersection. Both seek to support people in becoming active participants in their communities and emphasize issues of justice and equity. Both highlight issues of relationships and alignment as important challenges for design. Digital civics may benefit from considering how students and universities engaged in service learning programs might play a role within civic life. Service learning may benefit from considering how technology can support relationship-building, address issues of misalignment, and empower engagement in educational civic activities.

We believe the pervasiveness and evolving landscape of technology paired with the emergence of digital civics present an opportunity to reimagine engineering education to embrace service learning in way that provides value to both students and community partners.

3 Methods

3.1 Recruitment Context and Participants

This study came out of efforts to support more collaborations between engineering programs at University of California, Santa Cruz and the neighboring community. As a first step towards this goal, we ran a one-year matchmaking pilot program in which we conducted intake interviews to understand the needs of interested community

organizations and did the work of identifying and reaching out to various programs across campus to find a potential fit for the community client’s project interests. Once a fit was identified, the pilot program team wrote up a project proposal and handed off the client to the corresponding campus program. The program was advertised through articles and flyers posted in local community newsletters, and listed potential programs and courses that might support a variety of potential project types. Interested community members filled out an interest survey that asked them about any needs or project ideas they had in mind, what they saw as critical for successful partnerships, the time-scale and scope of their ideal collaboration, and the technical skills they perceived as most relevant for their organization.

3.2 Semi-Structured Interviews

We conducted semi-structured intake interviews with 8 community organizations between December 2020 and April 2021, six of which came through the interest survey and two of which were umbrella organizations we reached out to that work alongside many of the non-profit organizations in the community. Our participants included two small for-profit tech consultancies, three non-profits, a municipal program, and two umbrella organizations that work with many non-profits in the region. Four of these eight resulted in successful project collaborations. We do not describe further details about the organizations to preserve anonymity.

The interviews were roughly 75 minutes long. They started with questions for understanding the organizational context (e.g. *“Can you start by telling us a little*

about your organization and your role in it?”). This was followed by questions eliciting details and context around the project need they described, potential fit with different programs, and any future partnerships they might be interested in when reviewing the list of programs (e.g. *“In the intake survey, you mentioned [INSERT] as one specific need. Can you tell us a little more about this?”*). We then asked them about expectations or parameters they had in mind for collaboration (e.g. *“In the intake survey, you mentioned a couple things critical for a successful partnership, including [INSERT]. Can you tell us a little more about that?”*) Finally, we asked them to share more broadly about the community’s views of the university and the possibility of designing programs that more deeply integrate student learning and community collaborations (e.g. *“How would you say that most community members currently view the role and impact of the university in the community?”*)

3.3 Qualitative Analysis

Our interviews were recorded on Zoom, transcribed first on Otter.ai, then cross-checked and cleaned up by a researcher. Our original idea was to characterize common patterns of barriers and strengths for collaboration to define “profiles of alignment” that might allow one to design ways to support matchmaking systems. Towards this goal, we initially open-coded the transcripts for barriers and strengths for collaboration through an inductive thematic analysis process [18] that all researchers participated in. However, we found that the idea of reducing an organization’s context into simple “profiles of alignment” was an unrealistic view of alignment. In reality, characterizing

alignment was much more complex. For example, as will be touched on later in the discussion (**Section 7**), things that seemed like strengths for alignment could often be misalignments and vice versa, depending on the context. After several rounds of coding and affinity diagramming, we saw that following an approach like Sharma et al.'s might be effective in which they mapped misalignments at the level of systems, goals, and expectations for characterizing barriers to undergraduate research [44]. This led us to additional rounds of coding and affinity mapping focused on identifying themes related to misalignments in systems, goals, and expectations. After discussing initial codes and affinity diagramming, we defined a codebook of themes and subthemes and used this to recode all the transcripts, with each transcript being assigned to two researchers. All remaining discrepancies were then discussed and resolved with the entire team. In what follows, we present our themes and subthemes around misalignments. Because we also worked with several of these organizations through the pilot matchmaking program, we will sometimes also provide interpretations and context of the interview data based on that experience.

Part II

Results

4 Hard to match educational content and timeline to supporting real-world projects

Participants described the challenge of aligning real-world projects with the content and timelines of educational systems. One individual described the need to find ways to “*apply [the classwork] towards the project*” (Nonprofit 2):

“It is based on their classwork... so it was very specific. And we couldn’t go and expand beyond [that] few weeks... I have to really come up with the tiny bits of projects and pieces for them. By the time they learn and do it, [it] is satisfying the coursework, but it is not adding much value to me.” - Nonprofit 2

Another described their perception of the lack of “*curriculum at [research universities] that really deep dives*” (Small tech consultancy 2) into a project from beginning to end (as compared to community colleges that tend to be more oriented to practice):

“On the web development side, I never think of [the R1 university] as doing web development work... There’s some projects that come out of certain courses, but it’s not like going to [a community college] and it’s like, hey, here’s three or two semesters of web development related courses.” - Small tech consultancy 2

Several described the collaboration timeline at universities as too short for “*deep tech*” (Small tech consultancy 2) or “*technology related work*” (Small tech consultancy 2), resulting in challenges with turnover and a need for “*some continuity... somebody to be able to carry [context] forward*” (Nonprofit 3). This is particular true for the single quarter/semester course timeline which “*runs by so fast*” (Nonprofit 2), but is also due to the natural fact that students graduate. These system-level attributes make it hard to get projects across the finish line:

“I think the hardest thing for us is turnover, because you know, students are graduating or their their schedules get packed, and really busy. And so we want someone... who would be able to commit three months, minimum, or a year or longer” -Nonprofit 1

“Students can graduate then leave. So that ball shouldn’t drop, someone needs to carry forward, that that really depends on who said, who leads that effort on university side.” -Nonprofit 2

A final way in which the educational content is misaligned with supporting real-world projects is that university courses fail to provide students with training in how to be successful in a work environment. While there were not any direct quotes talking about this, it was evidenced in the unmet expectations around professionalism in student reliability and communication that will be discussed later in the section on misaligned expectations (**Section 0.6**).

4.1 Universities lack centralized and accessible ways for the community to get involved

Participants also described a challenge to even identify and contact the right programs to work with. Universities lack a standardized and centralized way for communities to engage. Participants described how *“each university or community college has their own system and their own way of doing things” (Umbrella organization 1)*. The lack of common terms can make it difficult to understand and navigate opportunities, especially for non-profits who have limited resources and bandwidth to decode the system:

“I used to work at [a university]. So I’m familiar with like, a lot of your programs and offices, but if you think about an employer, it’s different at every

university, like for internships for credit, it's called field study at one place. It's called, like Community Learning at another place. So, it's really difficult to find the information and find the right person to connect with....And Career Center isn't even the title at every college... So nothing's uniform across the region." -Umbrella organization 1

This all creates an opaqueness that prevents a symbiotic relationship between the university and the community. In the case of student organizations, there may not always be a person appointed from the school's side to oversee and ensure the project's or collaboration's success, although they are *"excited for input from the university."* (SCMAC) Many participants independently brought up the concept of a contact or point person as a way to address some of their concerns. One states that the consistency of someone from the university would help ensure that they *"have the overall picture"* and *"can help move through the programs"* (Nonprofit 3). Multiple participants expressed a need for more than just the students' help for a successful collaboration:

"I think it's really important for that project, or that intern to have someone who can support them on that project, aside from myself, and aside from our team, but like a third party, which would be the UCSC, like either a professor or another alum with some more experience, just so they have that support system. And it's not just like, me and them" - Nonprofit 1

Finally, physical accessibility can also be a system-level barrier. One local organization that was located in the mountains near the university described the physical distance as a barrier to creating and maintaining collaborations, while another talked about how parking difficulties made collaborations difficult:

"I think people [around the school] feel that we're a little bit isolated, people feel it's a lot further up than it really is. So we have the sometimes difficulty in working with Santa Cruz in the larger community." -Nonprofit 3

"We've been up there a bunch, but it's always a huge hassle with parking. And we had to call. I couldn't find parking. I mean, it's just difficult to access it. You know, it almost seems like there's the separate city up there. We've gone to art shows up there and some events and but it would be fun to have more integration. -Small tech consultancy 1"

4.2 Nonprofits lack the structure, processes, and resources needed for student work

While the previous two themes applied to community organizations in general, the small non-profits we interviewed had the additional challenge of lacking the structure, processes, or resources for supporting student engineering projects.

Some of this related to the fact that most non-profits do not have existing engineering projects or employees, which means that they are not able to scope out project requirements, mentor students, or help to get projects across the finish line. For example, when asked about their needs, one expressed that they are *"sure that there's ways students can help us optimize what we're doing"* (Umbrella organization 1), but *"I just don't know what it is."* (Umbrella organization 1) They suggested that having students take *"an inventory of how we're operating, and what they would recommend could be a more strategic way or more efficient way to do things."* (Umbrella organization 1)

In contrast, a small technical consultancy described how they ensured success by defining clear project requirements for students:

"if we throw somebody into a project and they don't have the proper project requirements, if things aren't clearly defined, then they're going to spend time going in the wrong direction. It's not going to be beneficial to either party" (Small tech consultancy 2)

Non-profits also don't have the ability to provide technical mentorship, describing how:

*"I think it's really important for that project, or that intern to have someone who can support them on that project, aside from myself, and aside from our team, but like a third party, which would be the UCSC, like either a professor or another alum with some more experience, just so they have that support system. And it's not just like, me and them or them in one person."
- Nonprofit 1*

And finally, non-profits don't have the technical ability to make use of partial student work as they are not able to independently "close the loop" in getting projects across the finish line and integrated into their organizational context. One described how "haven't had the ability to pass on the knowledge" (Nonprofit 1) when students leave projects, so they need to ensure there is continuity all the way up to a successful integration:

Certainly having some continuity seems like it would add value. And, that having somebody who knew, if we had spent the time doing the interviews in the setting, the other thing, we had set goals and stuff like that, that would be valuable for somebody to be able to carry that forward. -Nonprofit 3

Besides the lack of technical expertise for engineering projects, small community nonprofits are also often extremely under-resourced so have limited funding to pay interns and limited bandwidth to mentor students:

"the second thing that I think a lot of nonprofits struggle with is just funding, we don't always have funding specifically for internships, it really depends on the season, the fate of the, the fate of the county, education, state funding all of that." - Nonprofit 1

*"We have to make sure that we're mentoring them and training them and all that. But, you know, oftentimes, we declined to have a social media intern for that reason, because we just don't have a staff bandwidth to train it right."
(Umbrella organization 1)*

One organization that works with many community organizations in hiring

interns described how employers should think about the long term benefit in investing in mentoring students:

“[employers] don’t realize the return on investment, you know, to take on an intern ... But the return on investment of taking on an intern is this opportunity to train and groom your talent pipeline, and a lot of them don’t, they just aren’t connecting the dots between the work that you put in to mentor an intern can really help you recruit and train your talent.” -Umbrella organization 1

This rationale, however, has limited applicability for non-profits working with engineering students, who would be unlikely to continue on to work for the non-profit afterwards due to a lack of engineering projects and positions.

5 Misaligned Goals: Delivering Project Impact VS Course Completion and Career Development

Misalignments in the system are compounded by subtle misalignments in goals. At first glance, at the surface level, the goals of community organizations and students seem aligned. Students want experiential learning and resume building which aligns with achieving real impact on community projects. Community organizations want projects completed and many express a passion for investing in student learning. However, despite this, subtle misalignments arise from the *level of importance* each party places on different things, resulting in misalignments when people are not able to achieve what they’d ideally want due to the limitations of student time and ability, and the significant demands of reaching sustainable impact. While community organizations care about student learning, what is critical to them is that the collaboration produces outcomes

and impact that are worth the time they put in. On the other hand, community organizations perceive students as caring about project impact, but ultimately not having skin in the game. If they end up not being able to reach impact, they will still have obtained their goal of experiential learning and resume building.

5.1 Community organizations care about student learning, but it has to be worth their time

Organizations are enthusiastic about students getting involved and are supportive of student learning. For example, one nonprofit described a policy of regularly checking in with students about their learning goals and stated that *“we just teach them as much as we can” (Nonprofit 1)*.

”We’ll recap with the intern and be like...are you learning what you want to learn? ... To me, it was really clear that we needed to define those boundaries. And we couldn’t have an intern just do everything. Like we had to have an intern like specifically for outreach, or specifically for programs or specifically for a website, and not one intern that tries to do everything.

But if we really had to make sure that we had that system in place, and also have a system for them to communicate their concerns, and to like, not feel bad if they don’t know anything, about a certain topic, and to be okay, with asking for help. And I think we learned that it was really a lot of our responsibility to check in with the intern to make sure like, hey, like, it’s okay, if you don’t know what you’re doing. Like, it’s fine, like we can help and work on that together. And then let’s see what else. -Nonprofit 1”

However, working with students requires time and energy. One organization that works with many local non-profits acknowledged that there might be “*some natural hesitancy*” (*Umbrella organization 2*) about student collaborations as organizations have to consider whether these resource costs are worth it. The importance of the experience being worth their time is also evident in the common practice of hiring interns to fill roles they cannot fulfill themselves, with one person that works with many community organizations saying “*I would be, you know, 99% sure they’re asking for that because they don’t know how to do it themselves*” (*Umbrella organization 1*). Ultimately, as much as organizations are interested in student learning, they have to prioritize their own operations and missions:

”I’m just thinking about how can we get involved over the long term without it being, taking too much of our time? Or is there some skin in the game? Like, do we have some skin in the game in terms of what the outcomes gonna be, you know, like, no angel perspective, obviously, because we have to keep the lights on.” (*Small tech consultancy 2*)

Another organization described past experiences working with students who came in with specific projects and learning goals in mind, and stated that this kind of mentorship “*takes a fair amount of bandwidth*” (*Small tech consultancy 1*). They emphasized that they would like to prioritize outcomes for their organization in future projects:

“Going forward, though, I think we’re, we will, we definitely want to look for is a group of students, is a group of you guys that can really tightly integrate [with company goals] and produce something that we can use.” (*Small tech consultancy 1*)

5.2 Students care about filling professional roles and impact, but

primarily through the lens of experiential learning and resume-building

Organizations recognize that students care about project impact. One organization described a student who “*put in the extra effort because it was important to him*” when working towards a project goal, which resulted in a “*better*” project outcome (Small tech consultancy 2).

However, this same organization also noted that “*that’s a quality that doesn’t seem to be as common as it used to be*” (Small tech consultancy 2). Indeed, students were often described as being focused on their own learning goals, rather than on outcomes for the organization. One organization pointed out that a past intern “*just wanted to do [the project] for her own enrichment and understanding, and you know, obviously to... better obtain skills*” (Small tech consultancy 1). Another past intern at this organization “*wanted to come in and focus on learning a specific software program... so he actually came with his own project in mind*” (Small tech consultancy 1). While students who come in with specific projects in mind might achieve their learning goals, organizations acknowledge that these projects do not necessarily produce relevant outcomes for them.

One organization alluded to how their recognition of students’ focus on learning skills makes it all the more important that they make sure there is alignment when establishing the partnership: “*the biggest thing we look for is that their goal aligns with the internship goal (Nonprofit 1)*”, further elaborating

“So for example, if we have like a community engagement and outreach

person that we are, an internship that we need, we look for someone who's like, I want to engage with the community, and I want to contact people and want to learn that skill. So making sure that their long term goals align with this internship. And I think that's the biggest thing. -Nonprofit 1"

In addition to focusing on specific learning goals, organizations recognize that resume-building is a key motivator for students. One organization described how they make a point to highlight this opportunity, as students might not realize that working with a nonprofit provides valuable professional experience:

"From our end, when I was working with the [state university] students, I used to tell them, you can add on position work experience on your LinkedIn profile. I would be happy to write your recommendation letters for you... whatever you have done for us, it is like, valued as equivalent, as equally as excellent as the corporate work, whatever you have done. Building a website, any company needs that, and you are doing the similar work here. So don't underestimate the work of a nonprofit, though you're not getting paid." -Nonprofit 2

6 Misaligned Expectations: Expectations of Professionals VS That of Volunteers and Learners

Misalignments in systems and goals are compounded by or reflected in misaligned expectations. Students can be well-meaning in their desire to use different skills to support the organization without realizing that some types of contributions require longer-term understanding and involvement with the organization. On the other hand, organizations can have expectations of student reliability and communication that is unrealistic given the priority that students are placing on their coursework and their potential lack of workplace experiences. Non-profits working with engineering students often

also do not have a good understanding of what they can realistically expect students to produce, especially given the non-profit's inability to provide technical specifications and mentorship.

6.1 Students don't realize that some contributions need longer-term understanding and involvement

Driven by their overall mission and goals, organizations expect their projects to bring impact to the broader community that they are serving. On the other hand, students seek to provide value to the organizations by being involved in a part of the organization's project and are not able to fully establish a strong background of the impact that the project has.:

"When students choose to work with organizations, they are representing the organization's overall values and missions. Therefore, it is important that they have a solid foundation and understanding of what the organization is like and how it works— something that comes with ongoing experience."
-Umbrella organization 1

Misaligned expectations also fail to allow students the time and experience to develop a sense of the impact of their work. Students often have good intentions. According to one nonprofit, *"it's coming from a really good place"* but they may forget that they are representing an organization and people outside perceive students as a part of that organization. One participant states *"they're interfacing with the public, but maybe they're not actually speaking on behalf of members in a public forum,"* which they are not always aware of:

"These people are very passionate about the work and want to see things change and, and it's not what they were saying was untrue. But, that can

be something that you really have to be very clear that when you're standing in a public, you know, position in that regard, say giving you three minutes on record, that you have to be very cognizant that you're representing an organization and not you know, yourself. If you do that disclaimer, people are still, in many cases, going to see you as the voice of [P6's organization]]."
-Umbrella organization 1

Overall, orgs are seeking a balance between a student who is excited to make change, while still allowing time and experience to build up to that change appropriately.

Here, the participant states that *"humility is kind of the first thing that comes to mind"* from students to alleviate some of these qualms:

"Sometimes when you're just in that really intensive, higher ed learning environment, it's like you've heard that new idea, and it must be perfect, that must work everywhere. And so it's like, yeah, hey, I'm the intern, but I'm gonna like speak up and hope to really change this organization's long term thinking on this, that may be true, there may be places where that makes sense. But you have to have a lot of humility as you kind of navigate that type of conversation about how much you're advocating for." -Umbrella organization 2

6.2 Community orgs expect professionalism in student reliability and communication

Organizations need reliability, but volunteers, especially full-time students, struggle to provide that. Despite making a commitment to organizations, students still have a variety of other responsibilities in the realm of academics that may disrupt their involvement with the organization at hand:

"If people ultimately have difficulty managing their time, and being able to focus on the project... like I said, they have to go to school, I get that. But you know, they'll need to be able to set aside time to work on the project and to make strides" -Small tech consultancy 2

Additionally, the voluntary nature of the work makes it hard for people to commit— this is especially hard to compete with the demands of school:

”as volunteers, you’re kind of up to you to decide your time and that kind of stuff. So they may find that a difficulty.” -Nonprofit 3

This struggle highlights the inherent difficulty in balancing volunteer work with academic demands, often leading to unfinished projects and goals if organizations overestimate students’ reliability.

6.3 Nonprofits expect meaningful student contributions without providing mentorship

A misalignment manifests where organizations expect from students without factoring in their own ability to mentor. A working environment is unlike a university one; there is not as robust or strong of a support system as in university classes. Despite this, some nonprofits expect students to complete tasks that neither the student nor the organization has any experience in:

”employers want to hire an intern to do work they don’t know how to do and I have to tell them, like, that’s not how an internship works. You are mentoring and training a student, you’re not hiring them to do things you don’t know how to do. And that’s, it’s the two things you mentioned, it’s always technical stuff, and social media. That they want a student to do because they don’t know how to do it.” -Umbrella organization 1

Regardless of if nonprofits are equipped to guide and mentor students, the expectation always set that they can still benefit from the ‘free labor.’ One participant states that if you are in the mindset of offering projects *”in terms of your resource based*

on what you're going to get back then, it may not be the right fit". p7 This mentality erases the student's learning from the collaboration:

"You may have to clarify that it needs to be a partnership mentality rather than a free labor mentality, like you're doing it for a little bit of sort of this higher purpose than just the human hours, coming cheaply." -Umbrella organization 2

The support system is simply not as strong or robust as it is in college classes. This gap fails to guide students towards building the responsible skills employers and organizations desire. Next, organization leaders expect students to take responsibility for their tasks, but there is an inherent lack of structure that helps the student establish that responsibility:

"We just really depend on volunteers, and hopefully they have the skill. I mean, this is how it's worked for 20 years. - Nonprofit 3

Part III

Evaluation and Conclusion

7 Design Implications

Our findings show that misalignments in systems, goals, and expectations make it challenging for community members to find the right connections to campus programs, to align educational experiences with supporting real-world projects, and to engage in collaborations that are set up for success. Many of these challenges relate to those that have been identified for service learning broadly, but some highlight challenges unique to those still trying to establish new partnerships and some are more pronounced in the engineering context, where learning outcomes focused on more technical work can be more challenging to align with producing real-world project outcomes in short time periods, especially when working with non-profits who do not have the technical expertise to build on, mentor, or coordinate student work.

Our study revealed important insights from the community's point of view, which is reported to be largely underrepresented in the most recent 2023 systematic literature review of service learning in computer information science [33]. Currently, most of the corpus focuses on the student benefit and experience, which has been shown to cause an imbalance of power between stakeholders, and severely limits benefits for all parties. The consequences of community partners' voices being neglected in past literature are verified in our findings. Participants who have collaborated in service-learning projects before overall ended up with a nonfunctional project, or one that would soon become nonfunctional. We found that participants felt they had catered more to the requirements of the class and finished projects turned out to be useless to

their organization. Furthermore, participants expressed a need for multi-quarter partnerships or help with turnover, which is a more passive example of lack of partners in mind. (Section 4.3) Of course, these consequences are unintentional, but it is clear here that there is a pattern. Although the focus and motivation of service-learning has always centered around student education, we can see how the neglect of satisfying community partners ultimately hinders a student's learning experience. As described in the literature review, students benefit holistically from service-learning. This includes soft skills, critical thinking, leadership, and involvement in prosocial jobs/behaviors. If community partners are struggling to both provide mentorship to students and feel benefits to their organization, the opportunity to grow in these areas become out of reach. Without dedicated service to the client, students are not provided with the experience of relationship building, caring for others, or practicing an ethic of care to learn the professional and soft skills that service-learning is designed for. Our study highlights barriers to the effectiveness of service learning in engineering. Our results emphasize the importance of rethinking current approaches to ensure that educational activities align effectively with real-world projects. Institutions need to continually evaluate and adjust their approaches to ensure that projects are meaningful and relevant for all involved. Engineering students participating in service learning projects should have the opportunity to apply theoretical concepts learned in the classroom to practical, community-based projects. However, as our study reveals, achieving alignment can be challenging due to various factors, including differences in project timelines, curricular constraints, and communication barriers. To address these challenges, collaborators

and researchers must prioritize ongoing evaluation and adaptation of service-learning programs. At minimum, institutions should integrate real-world projects, establishing clearer communication channels between academic and community partners, and providing faculty with training and support in service learning pedagogy. Additionally, our findings reveal the need for a 'point person'. This 'point person' would address issues participants have with the opaque nature of collaborating with the university. They would also support nonprofits in providing consistency for students, especially when collaborating across multiple quarters. We can see here that they need more help from the university for both the sake of their org and the proper mentorship for students.

8 Conclusion

Our study uncovers important insights into the challenges of establishing community-engaged student projects in engineering from the perspective of community organizations. Through interviews with community stakeholders interested in collaborating with university programs, we identified three key levels of misalignments that make these partnerships difficult. Of course, there is no perfect alignment, but viewing misalignments through the lens of means versus ends could help identify partnerships that leverage each side's strengths to meet and exceed the other's needs. Collaborations between different types of organizations, such as nonprofits working with student consulting groups overseen by faculty, may help address resource and mentoring limitations. Expanding programs to span multiple quarters and designing processes for preserving

project context across student turnover could better support long-term impact. eFuture work should explore co-designing engagement models with community partners and developing infrastructure that systematically supports the relationship-building and expectation-setting needed for effective collaboration. Furthermore, studies could evaluate the impact of interventions aiming to overcome specific misalignments identified in this work. By shedding light on the complex misalignments that hinder community-engaged engineering education, this research lays a foundation for reimagining structures to enable more mutually beneficial and impactful university-community partnerships.e

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