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The Students Are Doing The Best They Can: Reframing Why Inequitable Community Engagement Happens in Engineering Design Higher Education*

KAYLLA CANTILINA
College of Engineering, Northeastern University, 360 Huntington Ave, Boston, MA 02115, USA. E-mail: k.cantilina@northeastern.edu

ROBERT P. LOWETH
School of Engineering Education, Purdue University, 701 West Stadium Drive, West Lafayette, IN 47907, USA.
E-mail: rloweth@purdue.edu

Community engagement is a core part of socially engaged engineering work, and undergraduate engineering programs are increasingly providing curricular and co-curricular opportunities for students to develop community engagement skills. However, if not conducted and managed with an intentional focus on equity, these opportunities risk exploiting communities and exacerbating existing problems regardless of student efforts or skill level. While prior research has mainly explored students' skills and mindsets related to community engagement, this study uses an agentic framework, combined with Domains of Power, to investigate how factors beyond students' control – i.e., external factors – impact the equitable nature and outcomes of students' community engagement experiences. Using data-driven composite counterstorytelling, the researchers present a semi-fictional, transferable narrative grounded in data from their own and their participants' community engaged experiences to explore how external factors influence engineering students' stakeholder engagement activities and outcomes in curricular and co-curricular design project contexts. The data-driven composite narrative describes the experiences of a student, Ash, during two pivotal stakeholder engagement opportunities: a design project during their first-year Introduction to Engineering course, and a co-curricular community-based service-learning project. Analysis of Ash's narrative highlights how external factors, including interpersonal, curricular, institutional, and societal factors, impact the equitability of engineering students' stakeholder engagements. The outcomes of the analysis suggest different ways that faculty and administrators can support students, in addition to developing new stakeholder engagement pedagogies.

Keywords: agency; Domains of Power; composite counterstory; community engagement; engineering students; equity

1. Introduction

Engineers engage communities – individuals who share a collective relationship such as occupying the same geographical space or social position [1] – in their design processes for myriad reasons, including to define their design problems, identify possible solutions, and evaluate solution feasibility [2, 3]. Community engagement is a crucial precondition for engineers to avoid perpetuating harm towards marginalized community members with the technologies they create [4, 5]. Thus, engineering students should develop skills for equitable community engagement such as stakeholder mapping, resource mapping, cultural humility, ethnographic-informed design methodologies, and sociopolitical context assessment as part of their undergraduate education. To support students in developing the above skills, engineering programs are increasingly providing curricular (e.g., capstone [6]) and co-curricular (e.g., community service-learning [7]) opportunities that involve communities with real-world problems. However, literature has shown that such opportunities, if not conducted and managed with an intentional focus on equitable processes and community outcomes, risk exploiting community stakeholders' time and resources for the sake of educating privileged White students [8]. This unintentional exploitation is rooted in a legacy of charity-based White supremacy and paternalism that historically has and presently can exacerbate existing problems, or worse, create new ones [9].

This paper explores how factors outside of students' control impact the nature and outcomes of engineering students' community engagements. Borrowing from the underlying concept of many agentic theories [10, 11], we title these factors outside of student control as "external factors" – ranging from interpersonal relationships to structural supports or barriers – that influence student project outcomes irrespective of "internal factors" such as individual student knowledge and mindsets. Prior work has explored internal factors including students' knowledge gaps and challenges related to stakeholder engagement [12], their successful practices [13], and their mindsets related to stakeholder engagement [14]; these prior studies have provided

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valuable insights for supporting student learning. However, relatively few studies have additionally investigated specific ways that external factors impact the nature and outcomes of engineering students' community engagements as well.

The above research gap is important to address because of several reported student challenges with engaging stakeholders equitably, such as limited interaction with stakeholders outside of problem scoping [15, 16] and limited use of stakeholder perspectives in decision-making [16–18], that could reflect logical student responses to the external, structural constraints of their projects, rather than student deficits. In other words, external project factors should be accounted for, in addition to developing improved pedagogies for community engagement, to expect significant changes towards more equitable community outcomes from community engaged student projects. To this end, this paper uses a data-driven composite narrative analysis approach grounded in the tradition of counter-storytelling to demystify how power structures, through external factors, impact student agency. As with other narrative analysis work [19], our goal is to raise critical questions about the experiences of engineering students involved in community engaged projects and the impacts of these projects on communities.

2. Background

2.1 Barriers to Socially Equitable Community Outcomes in Undergraduate Community Engaged Engineering Projects

Prior work has identified several external factors that can impact how undergraduate engineering students engage communities in their design projects – although specific details about *how* these factors impact student agency and community outcomes are limited. For example, co-curricular service learning design projects represent one common pedagogical setting where students engage community stakeholders. In many cases, these projects serve communities that are geographically distant from the teams' home universities. Assuming that students wish to graduate within four years, this distance means that students are constrained by semester schedules in how much time they can spend in partner communities [20–22]. When researching partner communities in advance of field work, students may struggle to locate publicly accessible information, particularly for rural communities [20, 23]. Program-related factors can also influence how students approach their work. Thompson and Jesiek [24] examined three domestic undergraduate engineering engagement programs and identified six structural themes – such as program purposes, partnership structures and project deliverables – that influenced interactions with project partners.

Engineering students also engage communities in engineering classes such as capstone design and, increasingly, cornerstone (i.e., first-year) design. Studies of capstone engineering design students have suggested additional external factors, such as assignment timelines and grading rubrics, that influence how engineering students approach community engagement. For instance, Loweth et al. [16] examined the information gathering meetings of six capstone design teams to determine with whom teams met, when their meetings took place, and the strategies that teams used to gather information during meetings. The authors found that teams tended towards early meetings where they confirmed design goals and parameters; they tentatively concluded that course constraints may have played a role in this behavior. As another example, Guanes et al. [18] studied how capstone engineering design students employed empathic behaviors (i.e., behaviors related to understanding stakeholder needs) in their projects. They found that while their participants considered a wide variety of project stakeholders, they ultimately prioritized the perspectives of faculty members and other individuals whose perspectives would directly impact their course grade.

Engineering culture (including norms, practices, and ways of interacting that have been observed across engineering educational environments [25]) represents another factor that influences engineering students in curricular and co-curricular engagement contexts. For example, Cech [26] has described a "culture of disengagement" in academic and professional engineering contexts that positions public welfare concerns, including community engagement, as tangential to "real" engineering work. This culture of disengagement has been corroborated in other studies of engineering students and may include symptoms such as: viewing inequitable social outcomes as resulting from fair distribution of resources [27, 28]; discounting social solutions to engineering problems in favor of technical solutions [29, 30]; discounting community knowledge in favor of technical engineering knowledge [17, 30]; and positioning technical engineering work as unrelated to social or political concerns [26]. While these norms may exist within individual mindsets, they also exist structurally within academic engineering environments and affect curricular and content choices, assessment, and funding options.

In addition to documenting external factors that influence student projects, literature has also provided recommendations for successfully navigating

these factors. For example, Wood and Mattson [31] examined failure reports published by Engineers Without Borders Canada and identified seven pitfalls that contributed to project failures, including "Lacking the contextual knowledge needed for significant impact" and "Neglecting to make a plan for or developing partners for long-term sustainability." To avoid these pitfalls, the authors proposed a "Design for the Developing World Canvas" that design teams could use to think through the impacts, customers, product, delivery, manufacturing, and revenue models of their projects. As another example, Leydens and Lucena [32], synthesizing prior work, identified six "Engineering for Social Justice" criteria to guide engineers in performing equitable community work. These criteria included 1. Listening Contextually, 2. Identifying Structural Conditions, 3. Acknowledging political agency/mobilizing power, 4. Increasing opportunities and resources, 5. Reducing imposed risks and harms, and 6. Enhancing human capabilities. The Center for Socially Engaged Design at the University of Michigan developed a socially engaged design process model that emphasizes how power and positionality impact designers' processes – the goal of this process model was to scaffold student learning and support reflection [33]. Furthermore, Ozkan and Hira [34] proposed a "For Whom? – With Whom? – As Whom?" model to encourage critical, justice-oriented conversations in first year engineering courses.

The above recommendations and frameworks all are useful for supporting engineers in thinking through the broader implications of their design decisions, planning in advance for navigating external project factors, and practicing more equitable design behaviors. They also encourage designers to think about how their personal and social identities influence their stakeholder and community engagements. However, a common limitation of these recommendations is that they primarily focus on designers as individual (or team) decision-makers, rather than as actors within broader curricular, institutional, or societal contexts. These broader contexts can constrain engineering students' agency and outcomes in community engaged projects regardless of students' knowledge or mindsets. As illustrated by Nieusma and Riley [35], it is entirely possible for engineers to engage stakeholders with the best intentions and try to follow equitable practices as individuals (i.e., follow all the recommendations and models outlined above), but still produce inequitable outcomes overall because they cannot individually overcome the structural challenges that they encounter.

2.2 Models and Frameworks for Equitable Community Engagement in Higher Education Literature

Several contemporary models for community engagement were developed outside of engineering to address how power operates to constrain student agency and outcomes within community engagement experiences. These models recognize that service learning pedagogies historically originate from forms of charity work that perpetuate neocolonial, White supremacy, and paternalistic relational norms between students and the communities they seek to serve [8, 36]. These models thus target the logistical, ideological, and power related barriers that characterize traditional engaged learning experiences. For example, Clayton's SOFAR framework [37] highlights how inequitable power dynamics manifest in relationships between (S)students, (O)rganizations in the community, (F)aculty, (A)dministrators, and (R)esidents of a community. The SOFAR model supports practitioners in evaluating whether their service engagements are exploitive, transactional, or transformation through mapping the stakeholders involved and describing how power moves between and through relationships. This evaluation becomes a first step in addressing barriers to equitable outcomes.

Other scholars have turned to frameworks grounded in social justice to address how engaged learning reproduces hegemonic oppressive power relations such as racism, classism, and sexism. These models commonly decenter students to center communities. For example, Mitchell's critical service learning framework "pays particular attention to social change, its questioning of the distribution of power in society, and its focus on developing authentic relationships between higher education institutions and the community served" [38, p. 101]. Critical service-learning emphasizes the development of critical consciousness in students instead of solving a community's assumed need. By being community led, critical service learning addresses barriers of cultural difference and class/race-based saviorism by fostering students' understanding of how their social identities impact their and their community stakeholders' relationships to power, oppression, and privilege.

Other forms of critical service learning have centered specific structural barriers to social justice. Clark-Taylor proposed the integration of intersectional feminist pedagogies in service learning [39] to analyze the "interconnectedness of racism, sexism, and classism, that replicates the dominant model of community engagement" [40]. Likewise, through a decolonizing lens, Santiago-Ortiz [41] posited that critical service learning, despite its investment in

social justice, insufficiently addresses the power of settler-colonial logics and thus must take an intentionally anti-colonial stance. Lastly, Telles identified barriers to equitable community engagement through issues of racial inequities where the invisible burden of facilitating and mentoring community engagement activities disproportionately falls on faculty and staff of color [42]. In summary, the above models and frameworks emphasize that power creates or prevents pathways for students and faculty to achieve equitable community outcomes. However, as described by Collins [43], power is intersectional and socially-situated. In order to translate models of equitable community engagement to engineering, we must first clarify how power operates within community engaged engineering contexts specifically.

3. Methods

3.1 Research Questions

This study investigated how external factors, as representations of power, impact student agency and community outcomes. Guided by agency and Domains of Power as conceptual frameworks, we used data-driven composite counterstorytelling and critical event analysis to answer the following research questions:

1. *What* external factors influence engineering students' community engagement activities and outcomes in curricular and co-curricular design contexts?
2. *How* do these external factors reflect different domains of power operating within the context of curricular and co-curricular engineering engaged projects?

As a narrative work, this paper deeply explores how external factors may impact individual students who participate in community-engaged design activities. The narrative shared in this paper is not meant to be transferable to all curricular or co-curricular design contexts, but is meant to resonate with engineering students of color who, like our research participants, want to use their engineering knowledge to make the world a better place.

3.2 Conceptual and Analytical Frameworks

Our research study was grounded in two conceptual frameworks: Domains of Power [43] (Patricia Hill Collins' addition to Intersectionality originally developed by Kimberle Crenshaw), and Giddens' and Archer's conceptualization of agency [44]. We used these frameworks to investigate (1) how power manifests in different ways at different scales and through different structures, and (2) how human agency is influenced by internal and external factors (structures). Prior education research has applied Intersectionality and agency in conjunction to study the complexity of privilege and disenfranchisement of Latina/o students [45], Latina pathways to graduate school [46], and gender bias toward South African women school principals [47]. Our paper builds on this prior theoretical work to study the distinct contexts and culture of engineering higher education.

3.2.1 Agency

We derive our agency framework from theories developed by sociologist scholars Giddens and his contemporary, Archer. Foundationally, Giddens [48] developed the theory of "structuration" to understand how individuals and social forces interact to determine our social reality. Giddens' core argument about agency is that our social reality is formed through a binary feedback loop where two distinct entities: social structures and individual action, directly and constantly inform each other. Individuals act on their goals and needs within the bounds of the pre-existing rules and constraints that form social structures. Archer augmented Giddens' theory by introducing "reflexivity," or how individuals recognize and position themselves in relation to social structures [44]. Reflexivity provides a means to analyze boundaries and overlaps between social structures and individual actions, allowing for deeper exploration of the internal considerations, beliefs, and decision making processes held by individuals in relation to their social reality. Beyond Giddens and Archer, our conceptualization of agency is also influenced by postmodern schools of thought that include diverse ways of understanding agency through considerations of power, identity, and rationality [49]. Drawing from these foundations, we define agency as including both external *and* internal relationships between students and the social structures they operate within. Social structures manifest as external factors that limit the number of rational choices that students can make, and we investigate how students navigate these external factors in exercising their will.

3.2.2 Intersectionality: Domains of Power

Intersectionality is a Black feminist analytical framework that was originally developed to describe the distinct ways that Black women are oppressed due to the intersection of their minoritized racial and gender identities [50]. Applications of Intersectionality as an analytical framework have expanded to include social categorizations beyond race and gender such as socioeconomic status, disability/ability, sexuality etc. to provide a holistic understanding of how our social world is constructed. Broadly, intersectionality provides us

with "a lens through which you can see where power comes and collides, where it interlocks and intersects" [51]. This study leveraged Intersectionality as a lens to understand how external factors represent power wielded at different levels and in different forms. Patricia Hill Collins formalized this lens by building upon Intersectionality through her framework, Domains of Power [43], which situates power relations that facilitate oppression. These domains intersect and are interrelated.

Collins' described four interrelated Domains of Power – (1) structural, (2) disciplinary, (3) hegemonic, and (4) interpersonal. The structural domain of power represents "large scale social institutions" that reproduce inequities (e.g., sourcing K-12 public school funding from income taxes perpetuates racism). The disciplinary domain of power relates to the "organizational practices of social institutions" or the "rules of the game" (e.g., standardized tests disproportionately exclude students of color from higher education). The hegemonic or cultural domain of power includes "ideologies such as White supremacy, patriarchy, and heterosexism" (e.g., the false narrative that low-income students of color do not want to be in school). The interpersonal domain "shapes social relations between individuals in everyday life" (e.g., White teachers tone policing Black women for expressing their opinions) [43, 52]. We use Domains of Power to analyze the different forms and levels of power that manifest through external factors to impact students' community engaged experiences.

3.3 Data-driven Composite Counter-Storytelling

Data-driven composite counter-storytelling is a critical research method that uses multiple data sources to capture and convey the dimensions of subordination within the lived experiences of minoritized people. This research method is part of the broader tradition of narrative research that uses personal and group stories to illuminate how culture and power operate in society [19]. An important aspect of composite counter-storytelling is that it can protect the identities of participants and data sources that would otherwise be impossible to anonymize [53]; this is crucial given that composite counterstories often explore sensitive topics related to violences and harms experienced by minoritized individuals [54]. As with other types of narrative research, the goal of composite counter-storytelling is to present and analyze factual individual experiences in sufficient depth to advance scholarly knowledge while also inviting questions about the assumed universality of dominant experiences.

Prior work has used composite counter-storytelling to understand and explore the experiences of students, teachers, and other education stakeholders of color that deviate from dominant narratives of Whiteness [55, 56]. We follow in the tradition of these researchers by creating a character composed of data from several participants and from our own lived experiences, and situate this character in a particular social context to illustrate a specific phenomenon of oppression [54]. In addition to protecting our participants' identities, composite counter-storytelling also provides a means to demonstrate thematic relationships that uniquely emerge through the comparison of participants' experiences, beyond the analysis of individual accounts. At their core, composite counterstories "expose barriers that inhibit success and derail social consciousness, creatively position quotidian experiences as critical cultural commentary, teach those unfamiliar about marginalization, and challenge and transform the imposition of domination" [57].

We employed data-driven composite counter-storytelling to address dominant narratives in engineering education that (1) student learning outcomes are more important than community outcomes or student personal outcomes and (2) co-curricular project failures mainly stem from student knowledge gaps, rather than structural or institutional factors. Dominant narratives are the existing status quo assumptions, occurrences, and priorities that are unchallenged by the majority. Dominant narratives inadvertently contribute to inequitable experiences or outcomes because they erase the experiences and perspectives of those with less power [58]. In studies of community engaged learning opportunities, dominant narratives are perpetuated through research questions that focus on student learning outcomes over community outcomes (e.g., [20, 59]) and/or student failures (e.g., [31]), as well as through methodological and analytic choices that de-link student perspectives from their lived realities. This study contributes to the growing body of work (e.g., [60]) that explicitly challenges dominant narratives related to community engaged learning opportunities in engineering, in our case by using counter-storytelling to elucidate crucial details within the lived realities of engineering students that explain student actions or outcomes but have often been overlooked in previous research as being out of scope.

3.4 Data Collection

Following the practices outlined by Solorzano and Yosso [54], we built the data corpus for our composite counterstory from a range of sources including data gathered from student teams based at a large, American, predominantly White university that encouraged social engagement in curricular and co-curricular design work; curricular and

co-curricular artifacts; data published in prior literature; and autoethnographic reflections on participation in educational opportunities involving community engagement. KC contributed: previously unpublished interview data with eight undergraduate engineering students from four co-curricular student design teams (diverse gender and racial demographic makeup); over 100 blog posts from a single undergraduate co-curricular international community engaged engineering design team recounting project updates over the course of seven years; daily journal entries during field visits that included photos; over an hour of video footage of prototype construction and testing as well as interviews with community stakeholders (users, community leaders, resource suppliers, non-profit workers); travel planning documents such as budgets for three field visits; logistical documents such as emails between students and advisors; notes from calls between undergraduate team leaders and community partners; and reports compiled for annual design review. RL contributed anonymized, previously published data on six mechanical engineering capstone design teams' stakeholder engagement practices [16, 61–63] and the needs assessment practices of a co-curricular community engaged design team [20, 64, 65].

The two authors also leveraged autoethnographic data from shared or similar experiences, including: syllabi, course schedules, and assignment descriptions from three first-year engineering design courses; written reflections on teaching those first-year courses; written reflections on mentoring seven co-curricular community engaged design teams; reflections on facilitating over 100 (across both authors) one-off socially engaged design workshops for undergraduate students in first year and capstone design courses and for co-curricular design teams; reflections on facilitating 12 workshops about equitable service and engagement across multiple disciplines; and reflections on participating in curricular and co-curricular engineering projects as undergraduate students (previously described in part in Cantilina & Loweth [66]). We collected reflection data through contemporaneous verbal and text conversations and through structured individual written reflections on our experiences. Verbal conversational data, which was not audio recorded, was entered into our data corpus via written notes.

3.5 Our Theoretical Sensitivity

Within composite counter-story work, theoretical sensitivity refers to "a personal quality of the researcher that indicates an awareness of the subtleties of meaning of data" [54]. Theoretical sensitivity is crucial in enabling researchers to craft counter-stories that align with existing conceptual and analytic frameworks and the research questions of the study. In this work, our theoretical sensitivities were cultivated by our experiences and perspectives from participating in community engaged teaching, learning, and design practice. Our social identities such as cultural background, gender identity, and race/ethnicity also influenced our broader roles as researchers, how we made sense of our own experiences relative to the research topic, our motivations for doing the work, and the ways in which we chose to analyze the data. While our individual theoretical sensitivities contributed to our respective approaches to conducting this work, our use of researcher triangulation through leveraging differences in our perspectives also strengthened our analysis.

KC's theoretical sensitivity in relation to this work is rooted in her values and experiences as a student, engineering design educator, and researcher. As a student, KC was driven to community engaged design because it combined her values surrounding fairness and global equity with the strong culture of making from her family and design undergraduate studies. Additionally, KC's social identity as biracial meant she was socialized in a multiethnic household where discussing global and social issues of race, gender, and class were normalized. This socialization and "outsider status" make her acutely aware of the White supremacy and paternalistic elements of engineering culture, key themes that show up in this work. This dissonance motivated her to participate in socially engaged design projects, one of which was an international service learning team that resembled the experience of this study's participants. This project, while rewarding, highlighted the limited power of students and inequitable default nature of engaged engineering experiences. As a researcher, KC has investigated a wide body of literature relevant to the research questions, and as an educator, has had access to student experiences through teaching and mentoring many engaged engineering design teams. Having been on the inside and outside of these experiences has given her insights into where and how power operates within the academy to influence student agency and community outcomes.

RL's theoretical sensitivity related to this work stems from his experiences as an engineering student, an engineering design educator, and as an engineering education and engineering design researcher. RL originally pursued an engineering degree because he enjoyed making and because he wanted to make the world a better place. While his educational journey ultimately took him outside of engineering (as described elsewhere [66]), he was

still socialized into dominant ways of engineering thinking and knowing, in part because he was a straight White man operating in a straight, white, and masculine academic space. Later, in graduate school, RL's engineering education research led him to recognize how his undergraduate engineering experiences were raced and gendered, and also to recognize how broader curricular, institutional, and societal factors may have shaped his experiences beyond his immediate awareness at the time. Furthermore, as a design mentor, instructor, and researcher, RL had access to the experiences of many other students with diverse identities; these additional experiences highlighted aspects of RL's undergraduate experiences that were transferable to other contexts, and also elucidated the role that instructors play in shaping students' experiences. In this work, RL's theoretical sensitivity facilitated his identification of the sometimes subtle ways that engineering students' agency is affected by external factors beyond their control and, relatedly, how white men are privileged in engineering academic environments.

3.6 Data Analysis

We first reviewed our data corpus for examples of student experiences where power affected student agency. We modeled our analysis around critical event narrative methodology, also known as critical incident technique [67], in which researchers search for moments and incidents where an event significantly changed the participant. Changes can include the shifting understanding or belief about a certain thing, or new realizations about the world around them. Webster et al. [68] note that ''Because events are critical parts of people's lives, using them as a main focus for research provides a valuable and insightful tool for getting at the core of what is important in research.'' Our goal in identifying critical events in our participants' and our own stories was to capture important shared experiences related to community engaged engineering work. We also chose to identify critical events first, rather than immediately coding for external factors, because these critical events possessed relevant contextual and situational details that could be lost if we pulled external factors out of the data in isolation. We initially reviewed the data separately and shared our observations of potentially relevant participant experiences and related artifacts, after which we agreed upon critical events that reflected the experiences of our participants and were relevant to the research questions. For each critical event that we identified, we collated similar event descriptions sourced from different participants along with surrounding details and relevant artifacts.

After identifying critical events, we collectively coded the data contained within each event for external factors that impacted student agency and students' ability to positively impact communities through their engineering work. Similar to our process for identifying critical events, we each coded different events, reviewed each other's analysis, and discussed to resolve differences. While coding, we recognized these external factors by leveraging our theoretical sensitivity and by the fact that the same factors repeatedly emerged across critical events in our multiple data sources and participants. An example of a critical event from our data and a selection of associated external factors are shown in Fig. 1.

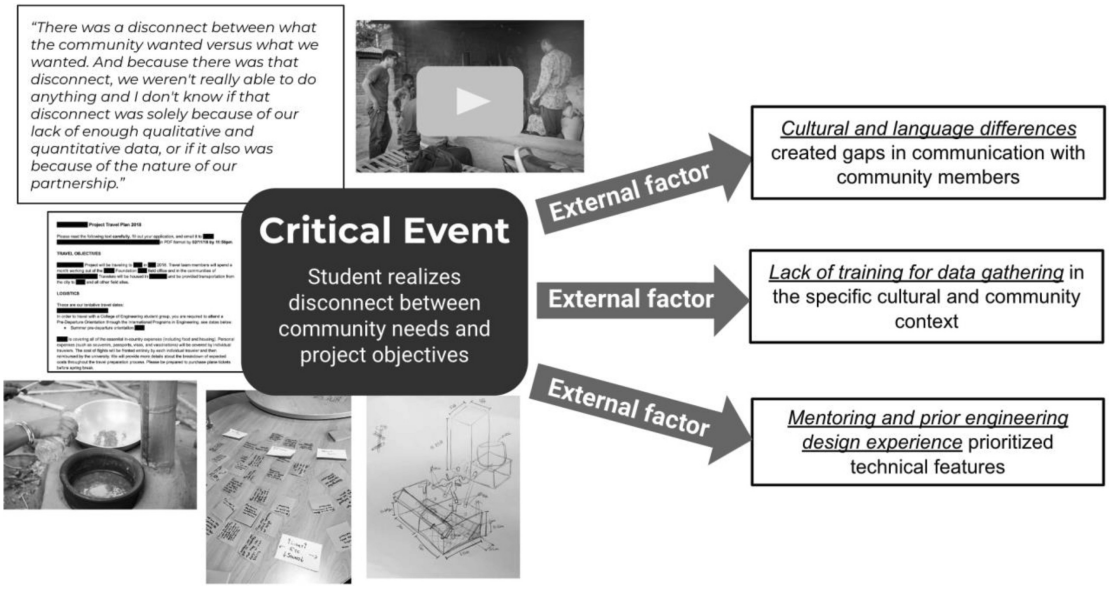

Fig. 1. Example of our critical event narrative analysis process.

To answer our second research question, we used our conceptual framework of Domains of Power to organize the external factors into corresponding domains to demonstrate various ways that power operates to influence student agency. We initially sorted external factors into Domains of Power according to Patricia Hill Collins' framework (structural, disciplinary, hegemonic, and interpersonal) [43]. However, as we reviewed our data, we realized that our analysis process would benefit from a greater tailoring to the specific academic context we were studying. For example, Collins' structural domain of power describes how systems and structures impact individuals; in academic engineering contexts, students experience the structural domain of power largely through curricular and institutional structures. Thus, we sorted factors into separate curricular and institutional Domains of Power, rather than a single structural domain of power. We also realized that Collins' disciplinary domain of power, which relates to how disciplinary rules and regulations maintain the status quo, maps onto engineering disciplinary culture. Engineering culture (including common norms, practices, and ways of interacting in engineering) pervades multiple aspects of engineering educational environments as the metaphorical "water we swim in" [25, 69]. Thus, we did not assign external factors to an explicit disciplinary domain of power; rather, we treated this domain in our context of study as closely intersecting our other Domains of Power: individual, curricular, institutional, and hegemonic.

To write our counterstory, we worked collaboratively to create characters, dialogue, events, and artifacts that mirrored as closely as possible the experiences of our participants. Crafting our counterstory, as is typical of narrative research [19], involved "smoothing" participants' experiences into an ordered sequence of events linked together by a coherent plot. Narrative researchers smooth participant narratives to enhance readability and ensure that research findings are communicated clearly. Our plot takes the form of a *Bildungsroman* or "coming of age" narrative, which Kim [19] notes is a standard genre in narrative research. Our process was iterative as we revised and revisited the data continuously until we felt our counterstory accurately represented our participants' experiences and our findings and demonstrated external factors across interpersonal, curricular, institutional, and hegemonic Domains of Power.

4. The Narrative as Findings

4.1 The Main Character: Ash

Ash is a student of color who chose to pursue an engineering degree because they believed engineering could make the world a better place. Ash enrolled at a university whose engineering curriculum placed a strong emphasis on understanding the societal implications of technologies. This narrative follows Ash through two community-engaged design experiences: a cornerstone design class and a co-curricular design project. While the specific details (e.g., names, country, project) of these two experiences are fictionalized to protect participant and institutional identities, the overall events described in Ash's narrative align closely with the experiences of our research participants.

The actions of Ash and their design teams are influenced by several external factors, which we summarize at the end of the narrative. The factors that we highlight in Section 5 are those that we identified from our data analysis. However, the goal of Ash's narrative is to reveal the intersectional and often subtle ways that Domains of Power affect individuals. Thus, readers may recognize additional external factors beyond those we explicitly include within Ash's narrative. We encourage readers to identify possible external factors as they read Ash's narrative and to reflect on how these factors may relate to their own academic contexts.

4.2 Cornerstone Design Course

4.2.1 Cornerstone Design Experience Prologue

Every student at Ash's university took a one-semester cornerstone design class, ENGR101, in either their first or second semester. While each ENGR101 section had a unique syllabus developed by the section instructor, course learning goals stipulated that all sections were required to introduce students to "the engineering design process" and provide opportunities for students to practice designing for stakeholders. This part of Ash's narrative includes two events: a description of how Ash's professor introduced the community-engaged design project for their section and Ash's team's reflections on interacting with a marginalized community stakeholder.

4.2.2 Welcome to Engineering 101

> "Hello everyone, and welcome to 'Engineering 101: Engineering for Social Impact'!"

It was the second day of the semester, and Ash was sitting in their required first-year engineering class, ENGR101. They'd had several sections to choose from, and felt lucky to get their first choice option: Engineering for Social Impact. The syllabus had promised some sort of "socially engaged" design project, and Ash couldn't wait to get started. Already, the course seemed more interesting than the large-lecture calculus and physics prerequisites that Ash had sat through on Monday.

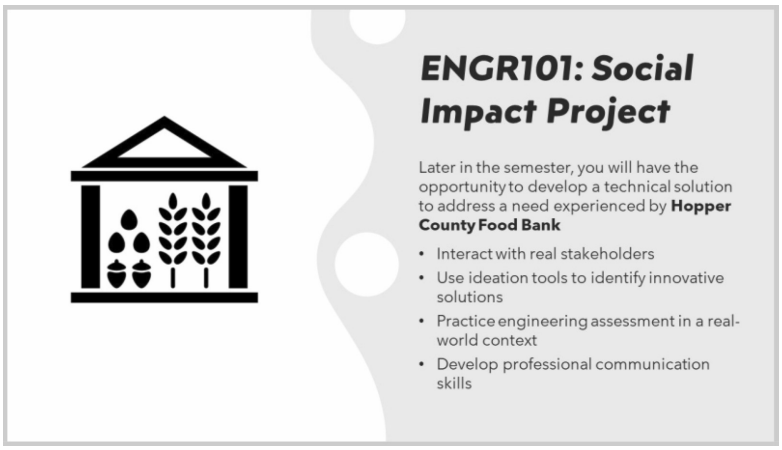

Fig. 2. Project introduction slide shown to students by Dr. Taylor.

> "My name is Dr. Taylor, and I use she/her pronouns. Today is syllabus today, so I'm gonna introduce myself and the rest of the teaching team and then talk a bit about what the semester will look like. As for me, I am a lecturer in the College of Engineering here at State University. I got my Ph.D. in Mechanical Engineering from the University of Central Valley, where I studied engineering design, and I am so excited to get to know you all better this semester."

Dr. Taylor's enthusiasm was palpable – by Ash's guess, she couldn't be older than 30, maybe 35 tops. Definitely a significant change of pace from the middle-aged men who were teaching the rest of their courses this semester.

> ". . . anyways, about the semester. The first several weeks we'll teach you about basic engineering analysis processes using Excel. I know, I know – not the most interesting stuff, but the College says I have to teach this for ABET. It'll all be worth it though when we get to the second half of the semester, which is my favorite part – the design project! [assignment slide shown in Fig. 2] We'll be designing technical solutions for a local food bank, so you'll get a chance to practice doing engineering design, including problem definition with real stakeholders, idea generation, engineering analysis, the works. Any questions?"

No questions thus far. Ash looked around the room – typical engineering classroom. Roughly 60 students. Majority White of course, maybe slightly more women than in Ash's math and physics classes. Regardless, Ash had already started to get used to being one of the few people of color in their engineering classes. The important part was that this section of ENGR101 seemed to be everything that Ash wanted from their engineering degree. They came to college wanting to make the world a better place. At least so far, Dr. Taylor seemed to be promising the tools to do that.

> "Alright, so with that out of the way, I'd like you guys to get to know each other better. So, I've prepared this icebreaker activity. . ."

4.2.3 Defining the Problem

Ash felt that they were starting to get the hang of this college thing. They were doing well in their classes, and after what seemed like an eternity of dull Excel problems they had finally started working on their design project in ENGR101 (project schedule shown in Fig. 3).

Teamwork was a core part of the course, and Dr. Taylor had used a survey to make teams. Dr. Taylor was pretty mum about what the survey actually did, beyond mentioning something about aligning schedules. Regardless, in a class of mostly white students, Ash had ended up on a team with another person of color, a Latina named Maria who dreamed of being an aerospace engineer. Ash's other teammates included Mark, who was interested in electrical engineering, and Stacey, who was interested in biomedical engineering.

The first deliverable for the design project related to "problem definition." Dr. Taylor had spent the last two lecture periods discussing what students were expected to produce – a needs statement along with criteria and constraints – and then reviewing recommended practices for conducting effective interviews. Each team was required to interview two stakeholders of their choice associated with the

Milestone	Date Due
Project Start - Oct 12th	
1. Problem Definition	Oct 24th
2. Idea Generation	Oct 31st
3. Concept Evaluation	Nov 14th
Thanksgiving Break - 11/21 to 11/26	
4. Iteration	Nov 30th
5. Final Report	Dec 9th

Fig. 3. ENGR101 project schedule included in the ENGR101 syllabus.

food bank and use this information, along with secondary research, to complete their first design report – which was due in the following class period. Mark and Stacey had interviewed a volunteer at the food bank, and Ash and Maria had interviewed one of the unhomeless Black men who used the food bank. They were now meeting to go over their findings and complete their design report.

> Mark: "Alright, so, looks like for Monday we gotta write up a problem background, needs statement, and identify criteria and constraints. What do we got?"
>
> Stacey: "Well, I remember the volunteer we talked to, they mentioned how during Covid it was sometimes really tough because they needed to minimize contact between volunteers and the homeless folks to avoid spreading the virus, but also they didn't want to just leave all the food out to get stolen."
>
> Mark: "Yeah, that's good that's good. So, we wanna design some sort of system that can help with that, right? Ash, Maria, what are y'all thinking?"

Ash had been partly following the discussion, partly reflecting on their interview with the unhomeless food bank patron. Their experience was so different from Ash's! Rather than talk about their experience with the food bank, the patron had mostly discussed how it was so difficult to find stable employment given their arrest record. They had at least been able to count on the local shelter for a bed, but things had gotten even worse during Covid. Now they were out on the street again, quickly running out of remaining cash, desperately looking for opportunities. Ash had heard stories about the cycle of poverty. Who hadn't, growing up as a person of color? Their dad had always been extremely strict that Ash needed to stay on the right side of the law. For the most part though, they'd been protected from the actual implications. Ash was deeply moved from the interview but did wonder in the back of their mind why the patron was not paid to spend time helping their class.

But back to the meeting.

> Ash: "Oh, uh, well, something Maria and I's interviewee mentioned actually didn't really have to do with the food bank at all. They talked a lot about how employment was so rough, especially having an arrest record. I wonder if there's a way to hit two birds with one stone, you know? Can we figure out this contact issue and do some sort of employment thing?"
>
> Stacey: "Like employ the patrons at the food bank maybe? That would potentially get rid of that contact issue – then the homeless are just interacting with each other, and the volunteers are safe."

Maria looked visibly uncomfortable at this suggestion, but neither Stacey nor Mark seemed to notice.

> Mark: "Yeah. . . I think this has potential. But is it a technical solution? Cause you know, we're engineers. Making social systems isn't really our thing. What's the need that we're addressing?"
>
> Ash: "How about something like 'The food bank needs a way to reduce contact between volunteers and homeless patrons while preventing theft of food.' but then our criteria and constraints could focus on employment of patrons as a core criteria?"
>
> Mark: "That's dope. Let's write it up! Ash, let's you and I nail down our needs statement and criteria. Stacey and Maria, can y'all finish up the project background?"

4.2.4 Cornerstone Design Experience Epilogue

After turning in their first design deliverable, Ash's ENGR101 class swiftly moved to idea generation and development of low-fidelity prototypes. Dr. Taylor provided useful feedback on Ash's problem statement, which helped their team develop a novel solution: a low-tech food checkout and monitoring system that was constructed by unhomeless patrons and that could be mass produced for other food banks, thus offering a steady stream of employment. Since none of the remaining design deliverables explicitly required Ash to interact with stakeholders, their team never actually tested their solution for feasibility. Nevertheless, Ash ultimately received an A in the course and their team won an in-class award for developing a highly creative solution.

4.3 Co-curricular Design Project

4.3.1 Co-curricular Design Experience Prologue

While Ash enjoyed their ENGR101 experience, there ultimately weren't any resources to keep working on their team's design project after the semester ended. Instead, in their second semester, Ash joined a pre-existing and institutionally funded co-curricular design team focused on improving the quality of life for a village in Ghana through the development and implementation of low cost water filtration systems. The team hoped that, through their efforts, they could reduce the amount of daily work required by local women. The project was co-sponsored by the College of Engineering and by an alum of the university, with the alum hoping that the project would fulfill their company's corporate social responsibility requirements. Over their Sophomore year, Ash became a core member of the team and, using design skills learned in ENGR101, spent months developing concepts and prototypes based off of observations and stakeholder interview data from the team's previous two-week annual trips to the village. It is now their Junior year and Ash, as the new team lead, is planning and budgeting the team's annual site visit tentatively scheduled for two weeks around the university's Spring Break. This part of Ash's narrative includes three events: Ash's preparation for their site visit, the site visit itself, and the aftermath of the site visit.

4.3.2 Preparing for the Trip to Ghana

Around Thanksgiving, Ash and their team finished a comprehensive draft of their plan for accomplishing their design goals in Ghana. The last step before they could start booking flights was to clear their plan with their project mentor, Dr. John White. Dr. White was an ambitious assistant professor who would soon be up for tenure review. He could give great feedback . . . provided you could get his attention or fit into his schedule. Ash had thus far only interacted with Dr. White in passing, although older team members passed down stories of alternately being embraced and absolutely ripped apart during meetings. Hoping to make a favorable impression on Dr. White, and anxious to start booking flights, Ash takes several hours to craft an extensive email with multiple documents and details to give Dr. White a complete picture of how much work the team has done to prepare for their trip.

Several weeks later, in the midst of a late night of work, Dr. White finally skims Ash's team's plan and documents and sees several red flags. Too tired to document all of the issues that he sees, and given that Ash has already sent him a reminder email, Dr. White decides it is better to just meet with the team ASAP. He sends a quick email to the team from his phone (Fig. 4).

The email sends the team into a panic. It's already the end of the semester, and several team members, including Ash, had already traveled home for break. They had thought they had done a good job thinking through all possible issues – especially since they hadn't heard from Dr. White for several weeks. Ash responds and sets up a Zoom with Dr. White for Tuesday morning.

Now, it's the morning of the meeting. Dr. White emailed that he would be a few minutes late, and Ash is on the Zoom call chatting with their teammates Jackson, the project design lead, and Hannah, Ash's project co-lead.

> Ash: "I'm really nervous about how this is gonna go down. I already spent way too much time on all this planning instead of working on my exams."
>
> Jackson: "Dude I know, why do we even meet with this guy in the first place, it's not like he's ever actually helpful, he just trashes what we do and makes things even more confusing."
>
> Hannah: "We don't have a choice though. We need Dr. White's approval to actually travel to and work with the community. That's like, kind of the whole point of this project you know?"

Dr. White shows up 10 minutes late, flustered after having come from an important meeting about his upcoming tenure review.

> Dr. White: "Sorry I'm late. I've been running on coffee all day but I also have to leave a few minutes early so I only have 15 minutes for this. Remind me, what are we talking about again?"

Ash reminds Dr. White about the team's plan for field work in Ghana.

> Dr. White: "Oh yeah, you guys are grossly unprepared to do this work in the field and several things need to be changed in order for this to be up to my standards for approval. Where's your daily engagement schedule? Where's your risk assessment? Your interview protocol is all closed ended questions, and your validation plan isn't actually measuring any of the specifications you identified. Um.. what else? Oh yes, I was expecting to see a stakeholder map or something similar . . . Background research was good. . . Trip history was good . . . Nice work on the prototypes so far . . . Yeah I think that was it. Any questions?"

Stunned silence from Ash, Jackson, and Hannah. Ash's head is swimming with anxiety. This sounds like so much extra work. Dr. White takes the silence as a cue to continue.

> Dr. White: "I just want you guys to be successful but it seems like you are all lacking in some skills and knowledge that you should have by now. I know time is short, so I can sign off on your travel to allow you to book airfare. However, my condition is that you need to make time to attend some workshops to update

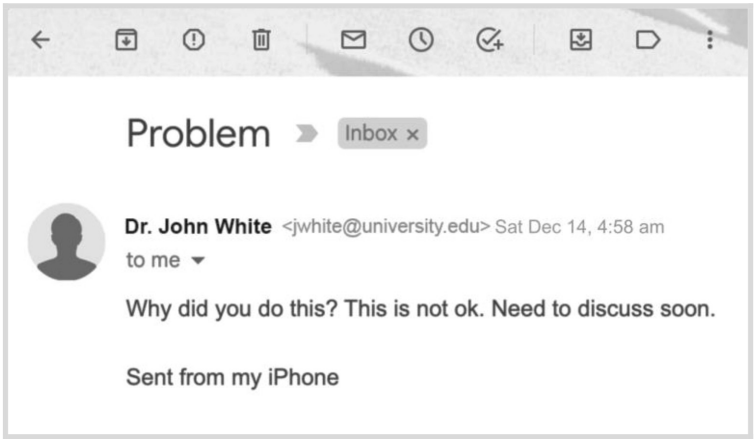

Fig. 4. Email response to Ash's team from Dr. White.

your travel plan before . . . When were you planning to travel again? Ah yes, I see. Spring Break.''

Taking Dr. White's advice, the team signs up for four workshops to supplement their knowledge of cultural sensitivity, entering, engaging, and exiting communities, needs assessment, and appreciative interviewing. These workshops were conducted by centers on campus that catered to a wide audience of students engaged in service-learning. Thus, the workshop content focused on transferable skills that could apply to any service-learning context, not Ghana or even Africa specifically. The workshops helped Ash and their teammates feel more prepared for their fieldwork. They learned a lot; Dr. White wasn't wrong. After the workshop, Ash and Hannah iterate on their target agenda for the trip.

Ash: ''I feel like we need at least 5 days to just get to know our stakeholders. I want to make sure people actually trust us. I've literally never been to Africa.''

Hannah: ''Yeah but spring break is only two weeks and we also have to prototype, test it, get user feedback, and actually try to solve this water filter problem. We have to prioritize.''

4.3.3 Fieldwork Trip to the Partner Village in Ghana

Ash and 5 members of the predominantly White team travel to Ghana to engage the village community members. When they land, they are guided by Kofi, a manager of the factory the university alum (Mr. Mensah) owns who will act as their Akan to English translator. Kofi expresses how impressed he is with the students and hopes his children can someday go to the United States for college. The next day, Ash and the team are introduced to the community stakeholders by Kofi.

Kofi: *in Akan* ''I would like to introduce you to this team of students from America sponsored by Mr. Mensah to work on a project for the village. Mr. Mensah hopes you, as his employees, will treat them as his guests.''

Ash: ''We are here to support your efforts to access clean water more conveniently through the design of a water filter''

There is chattering amongst the villagers and Ash hears the word ''Oburoni'' said a few times but assumes it probably means students or something. Eventually, many villagers offer to take time off work and procure supplies with their own resources to help prototype the design concept in the field.

During the first week of interviewing, the team tries to talk to a diverse group of people. However, most of the conversations with men in the village are short. Kofi explains that it's because accessing water is a ''woman's issue'' so the team finds themselves mainly working with a woman named Efia with whom they rely on Kofi to communicate with.

Halfway through the last week, Ash and the team are gathered around Efia as they observe her using their water filter prototype. Ash asks a series of questions, after each question, pausing to hear what Efia has to say.

Ash: ''Do you like it? Is it easy to understand how to use it? Is it filtering fast enough for you to get the amount of water you need to cook and clean?''

Kofi translates Ash's question but Efia does not respond. She continues to pour unfiltered water into the device and just smiles. Silence lingers for a while as Ash and the team try to make sense of her reaction.

Ash: ''If she had a problem with our design I feel like she would have said something about it . . . but since she didn't, that means she probably likes it . . . right?''

Kofi nods and the team agrees. At the end of the second week, Ash and their team have identified that access to clean water was indeed a need that the community stakeholders had, they were able to build some relationships with the villagers, and they produced three different prototypes of their design, all of which filter water successfully. However, the filters do not work fast enough to actually save the women more time and effort than their original process.

4.3.4 Aftermath of the Trip to Ghana

While sitting in the airport waiting to board their flight, Ash recalls how when they were first introduced to the village stakeholders, they said the word ''oburoni'' and decided to look it up on their phone. Scrolling, Ash pulls up the Wikipedia page for ''oburoni'' and learns that it's the Akan word for White or light-skinned foreigner, as well as one heavily influenced by foreign cultures. Though contemporarily not used in a derogatory way, the word is potentially derived from a similar word to ''wicked people'' in reference to the history of White colonizers that enslaved Ghanians between the 1600–1800s.

Putting their phone away, Ash turns to Hannah.

Ash: ''Do you think we really helped those people? Like, will they use any of our prototypes?''

Hannah: ''I don't know, but we tried our best I think, and that's all that matters right?''

Something doesn't sit right with Ash, and they spend the following weeks trying to gather their thoughts and make sense of their feelings. As Ash sorts through documents to fill out reimbursement forms, they think about how Efia did not work and therefore lost two weeks of wages to help the team; same with Kofi. After doing some calculations Ash

Fig. 5. Estimated cost of Ash's flight To Ghana sourced from Google Flights.

is absolutely blown away by how much the trip cost in total, with each team member's flight cost alone being over $4,500 (Fig. 5).

After the trip, Dr. White requests a meeting with the team to debrief.

> Dr. White: "This looks great guys, a really well put-together report and I am impressed you were able to make multiple prototypes. You know, I got an email the other day from the College's marketing office asking if I could recommend exemplary students involved in international co-curricular projects for them to profile for the alumni magazine. I'm happy to send them your names. You should hear from them soon."
>
> Ash: "But none of the prototypes worked . . . in fact, we spent so much money sending students on this trip that the money we spent could have been more than enough to give every village stakeholder's household a water filter."
>
> Dr. White: "Yes but that's not the point. This is supposed to be a learning experience and it's clear you all really matured as designers. And plus, it's not like you could have used the university's funding for that anyway, the money is earmarked for sending students abroad and cannot be used for anything else."

4.3.5 Co-Curricular Design Experience Epilogue

After the trip debrief with Dr. White, university marketing reaches out to Ash's team to ask if they can write a news story about the project and its success, and use some of the photos the team took in a few brochures. Multiple faculty congratulate the team for how rigorous and community-engaged their design process was. Although Ash and the team feel like they learned a lot from their trip and are better engineers and people because of it, the fact that they did nothing to actually solve the community stakeholders' problems with their design weighs on Ash for months. Having wanted to become an engineer to help minoritized people like themselves, Ash's experience on their design team fell short of achieving this goal. After their Junior year, Ash steps away from the co-curricular design project and spends the summer pessimistically reflecting on whether social change can *actually* be achieved through engineering. Upon graduation, Ash has significant doubts about what to do next. Their options are to continue to wait for something to appear on the job market that aligns with their values, go to graduate school for a degree that is more socially engaged, or accept a lucrative engineering job offer at a defense contractor.

5. Discussion

5.1 Zooming out from Ash's Narrative

Table 1 highlights how external factors, organized by Domain of Power, influenced Ash's agency. These Domains of Power are mutually influencing; however, for simplicity we first describe each domain separately before describing intersections between domains.

5.1.1 Interpersonal

The interpersonal domain of power relates to relationships and interactions between individuals. External factors within this domain of power included interactions between students, between students and mentors, and between students and stakeholders. For example, in Ash's first year engineering course, their individual agency was influenced by their teammates. Mark (a White man) took charge of their team meeting and established an early project direction. At that point, the only ways for Ash to make their voice heard on an equal level as Mark would be to openly disagree

Table 1. External factors in Ash's narrative organized into Domains of Power

Domain of Power	Definition	External Factors
Interpersonal	Relationships and interactions between individuals	mentor-student, Instructor-student/class, teams of students, student-stakeholders
Curricular	Course structure, content, expectations, and outcomes	Syllabus, assignments, grading criteria, workshop constraints, letter grades
Institutional	Institutional norms, rules, and procedures	Funding, tenure requirements, academic calendar, time to graduation, financial aid, accrediting bodies in education (e.g., ABET)
Hegemonic	Dominant social ideologies that reinforce oppression	White Supremacy, hetero-patriarchy, neocolonialism, neoliberalism

with Mark or to try to blend their ideas with Mark's. Ash ultimately opted for the route with less interpersonal conflict. Note that Maria never talks during the interaction.

During Ash's time in their co-curricular design team, their individual agency was influenced by the power dynamic between the team and their advisor Dr. White. Dr. White had limited time to engage with the team and his communication style was received by students as harsh and anxiety inducing. This introduced a substantial obstacle in Ash's trip planning because they felt they had to shape their behavior around Dr. White and his expectations. Additionally, in the field, interpersonal factors impacted Ash's team because of the underlying power dynamic between Mr. Mensah, the village stakeholders, and the students. Not wanting to upset their employer, the village stakeholders did not provide the honest feedback to Ash's team that the team needed to make adjustments to their prototype.

5.1.2 Curricular

The curricular domain of power relates to course and curricular structures, content, expectations, and outcomes. External factors within this domain of power included syllabi and assignments, grading criteria, and curricular resources. For example, in Ash's first year engineering course, their individual agency was influenced by the 8-week timeframe of their course project. Ash was only given two weeks to define their design problem, and none of their later assignments graded them based on further stakeholder interactions. While Ash could have gone above and beyond the requirements of ENGR101 to engage stakeholders equitably, doing so would not have benefited their course performance.

Another factor operating in the curricular domain of power was the wide-scope and one-off nature of the workshops in which Ash's team participated to supplement their preparation to travel to Ghana. These workshops were meant to be transferable to different contexts and thus could not explore specific cultural, political, and social nuances of Ash's community stakeholders. The workshops also did not involve extended support for Ash's team. Thus Ash's team were on their own in translating the workshop material to be relevant to their project; their agency was constrained by their limited knowledge and curricular support in navigating tricky and unexpected situations – such as the men in the village saying that getting water was a "women's problem."

5.1.3 Institutional

The institutional domain of power relates to departmental and university-level norms, rules, and procedures. External factors within this domain of power included departmental funding, academic reporting requirements, tenure requirements, and the academic calendar. In Ash's first year engineering course, institutional external factors emerged through (1) the need for the design project to fit within a one-semester course, meaning that Ash had no resources or practical incentives to work further on their project after they had received their final ENGR101 grade, and (2) the need for ENGR101 to fulfill multiple ABET accreditation requirements within the overall engineering curriculum, thus further shortening the project timeline. Another institutional factor that limited Ash's agency to make a positive community impact was the financial structure of the college and its obligations to alumni donors. The college set aside finances to support international student activities and Mr. Mensah donated his money for a specific educational purpose. As a result, the money available to Ash's team could only be spent in limited ways: plane tickets and semi-functional prototypes were valid expenditures, but setting up a community resource fund or buying and shipping water filters to the community were not permitted.

5.1.4 Hegemonic

The hegemonic domain of power relates to dominant social ideologies that reinforce oppression. External factors within this domain of power included ideologies of white supremacy, heteropatriarchy, neocolonialism, and neoliberalism. For example, Ash's first year engineering course relied on the uncompensated labor of homeless Black men to achieve student learning gains. Ash, as a first-semester student, was in no position to challenge this inequity; on the contrary, Ash's team was validated by an in-class award for incorporating the perspective of a Unhomeless Black man into their solution. During Ash's co-curricular project, their presence in Ghana, regardless of their intentions, was laden with a legacy of western countries "saving" "impoverished" communities from their "needs." This underlying White saviorism pervaded Ash's project and their interactions with their stakeholders. Even if Ash's team had been aware of and taken deliberate steps to counter this White saviorism, they still would have encountered substantial barriers to achieving equitable, just outcomes since addressing centuries of colonialism is outside the scope of a single student project. There were also notions of White supremacy that impacted how stakeholders like Kofi viewed the students. While Ash and team were student designers, they were perceived and treated as experts due to stakeholders' beliefs about primarily White American universities. Thus, despite Ash's

team's best efforts, their communications with stakeholders frequently resulted in one sided default agreements.

5.1.5 *Intersecting Domains*

While Ash's narrative demonstrates how external factors operate in each domain of power, our conceptual framework of Intersectionality emphasizes that these domains operate simultaneously. Each external factor in Ash's narrative intersects with and relates to other external factors across domains. For example, ABET represents an institutional factor that sets curricular learning goals and influences course content. The need to fulfill ABET requirements at the department level influenced curricular choices made within ENGR101, including the timeline of the course project and the emphasis on generating a technical solution. Thus, while Ash's agency in ENGR101 was most directly influenced by curricular factors, these curricular factors in turn stemmed from and conveyed influences from institutional and hegemonic factors. As another example, tenure requirements enforced by the institutional domain of power impacted Dr. White's capacity and lack of incentive to mentor Ash's team interpersonally. Ultimately, the factors we described in each domain are only a subset of the factors that may be identified in Ash's narrative. The purpose of Ash's narrative was to demonstrate that these intersecting domains and factors are multifaceted.

Fig. 6 provides a visual model of the intersecting domains of power experienced by Ash. We title this model as "Critical Agency" because it combines aspects of Intersectionality and agency theory. As the focus of our narrative, Ash is at the core of our model. The rings in our model reflect nested layers of scale and proximity, with the interpersonal domain of power positioned closest to Ash and the hegemonic domain, which operates at the level of societal structures, positioned furthest from Ash. However, as reflected in Ash's narrative, all Domains of Power can directly impact student agency, and can also impact factors in other domains.

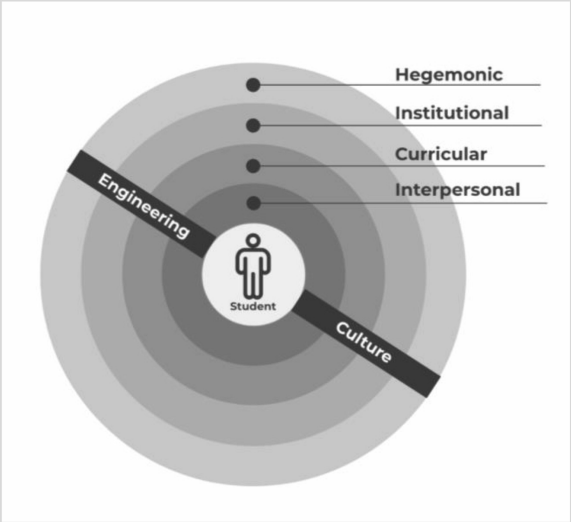

Fig. 6. A model for Critical Agency in Ash's narrative.

The cross-cutting band of engineering culture in our model represents how norms and beliefs are internalized by engineering students and faculty and function at different levels, in different Domains of Power, in different ways. For example, relative to the hegemonic domain of power, in Ash's first year engineering class, their instructor and teammates repeatedly referred to the need for a "technical" solution. Ash's teammates interpreted this technical emphasis as a constraint on their solution possibilities, and this impression was reinforced by the course assignments and grading criteria. This cultural norm of engineering as a technical discipline thus operated across interpersonal and curricular domains.

5.2 *Critical Agency in Engineering Students' Community-Engaged Experiences*

Ash's narrative provides an example of how power operates specifically within community engaged engineering contexts as a step towards translating models of equitable community engagement from other disciplines to engineering. Previous models have emphasized interpersonal domains of power [37] and hegemonic domains of power as influencing community engaged work [38, 39, 41]; research has also highlighted how the institutional domain of power may impact these experiences as well [24]. The advantage of using a narrative research approach in this paper was that we could demonstrate how different Domains of Power in reality operate *together* to make it difficult for students such as Ash to achieve equitable design outcomes. Ash's narrative also highlighted engineering-specific external factors, such as technically-focused grading criteria and strict curricular timelines, that may affect engineering students engaged in curricular and co-curricular community-engaged work.

Our model of Ash's experiences in Fig. 6 has visual similarities to ecological theories in higher education. These ecological theories explain how factors operating at different levels impact student outcomes such as identity development [70]. However, our model extends beyond most ecological theories: Fig. 6 highlights the agentic role of individuals in navigating domains of power and emphasizes that the external factors that influence student agency are intersectional. Fig. 6 also shows rela-

tionships between different factors and illustrates a hierarchy of power that implicates all individuals in the academy, not just students.

As discussed in our background, power is situational and context dependent [43]. Thus, our model in Fig. 6 should not be read as prescriptive or as applying to all engineering contexts. Rather, through Ash's narrative, we sought to show forms of power and associated external factors that may exist across academic engineering environments. While forms of power and external factors likely differ across contexts, we anticipate that the underlying concept of Critical Agency – i.e., that engineering students' actions may be influenced by external factors and intersectional domains of power beyond their control - is likely transferable. For instance, other research (e.g., [17, 18, 29]) has described engineering students struggling to navigate forms of power similar to those described in this paper, although this prior work did not investigate impacts on students' agency. Future work could explore how engineering student agency is impacted by external factors in other academic engineering environments to build on the concept of Critical Agency as reflected in Ash's narrative and to evaluate the transferability of the specific domains of power and external factors summarized in Table 1.

5.3 Limitations

One limitation of this study is that we describe external factors that pertain to a specific context: curricular and co-curricular community engaged engineering projects at a large, predominantly White, American university that encourages social engagement in engineering. The external factors experienced by Ash may not be directly transferable to other academic engineering environments. Student and faculty experiences can vary greatly as curriculum, project, class, and institutions create different circumstances where engaged learning happens. Institutions outside of the US would also involve different external factors. In other words, a narrative set at a different type of institution or educational environment would likely highlight different external factors.

Relatedly, the narrative presented in this paper is highly influenced both by Ash's social identities and by our respective positionalities and theoretical sensitivity. Ash has a certain set of identities as a student of color from a middle class background from the United States; their narrative demonstrated how they individually experienced external factors. Students with different identities might experience power and external factors differently. In terms of crafting Ash's narrative, we also prioritized the inclusion of situations that would highlight the external factors identified in our data. One example is the cornerstone ENGR101. Although Ash's experience in ENGR101 is grounded in factual occurrences and represents an amalgamation of data from our participants, the degree of stakeholder engagement encountered by Ash is high compared to typical cornerstone experiences. This high degree of stakeholder engagement was necessary to show multiple external factors within one coherent narrative; in reality, students' experiences with external factors are not always so explicit.

5.4 Implications

> ". . . the researcher evaluates what the researched stories all might mean, while finding ways to transfigure the story's commonplace to illuminate the larger society, and bringing the readers together with the now of the research phenomenon we have set out to explore. Rather than providing the solution to our research problem, the coda can be presented as an invitation to genuine dialogue among readers for problem finding, because narrative inquiry, is deeply about the light, about the road rather than about the in to which it leads" [19, Ch. 7]

Ash's narrative is meant to resonate with engineering students of color who want to use their engineering knowledge to make the world a better place. Their narrative is also meant to raise critical questions about the nature of community engaged engineering experiences to encourage reflection among engineering students and faculty. In the following subsections, we propose questions that Ash's narrative may generate for students and faculty. We also discuss implications for students and faculty related to these questions.

5.4.1 Reflecting on Ash's Narrative from a Student Perspective

Engineering students that share Ash's motivations and identities may relate to Ash's narrative. They may also wonder how to avoid the cynicism that Ash experiences at the end of their narrative. Critical reflection questions, written from the perspective of student readers, could include:

- Is there a difference between the impact I want to have and the impact I am realistically able to have with my community-engaged engineering work? If so, what barriers am I facing?
- How do the barriers that I am encountering relate to the domains of power described in Ash's story? Who has power in these domains?
- How should I navigate power structures in my own project environments?
- How can I come to terms with what I can and cannot do in potentially inequitable projects?

Students can use Ash's narrative and the above

questions to reflect on how their agency in community-engaged engineering projects may be influenced by external factors beyond their control. Through this reflection, students can develop critical consciousness of the ways that power operates in the academy; this critical consciousness can in turn empower students to effectively navigate and push back on external factors that contribute to inequitable project outcomes. For example, there were several points within Ash's narrative where they might have been able to shift project outcomes, provided they had a greater awareness of external factors. In ENGR101, awareness of racial and gendered teaming dynamics could have empowered Ash to counterbalance Mark's assertiveness in the group. Likewise, a greater awareness of external factors could have enabled Ash to recognize situations where their agency would be significantly constrained, such as the inherently exploitative nature of their co-curricular design project, and instead pursue other opportunities. Critical consciousness can also support engineering students in developing their own "politics of refusal" where they recognize the power of their individual choices and their capacity to resist dominant ways of doing and being [71]. Rooted in feminist and anti-colonial thought, refusal creates opportunities to imagine new ways of achieving social change [72]; in Ash's case, refusal could be a first step towards finding value-driven ways to work toward social justice through engineering.

Students can also use Ash's narrative to make sense of their own experiences to support belonging and persistence. Counterstories are frequently used to build solidarity amongst minoritized students by showing that their identity-based experiences are real and valid [54, 73]. Many students like Ash unknowingly participate in inequitable engaged design projects, after which they realize their complicity in exploitation and become disillusioned about their ability to create impact. Ash's narrative can guide these students in realizing that they did everything they could to act based on their values, and that the inequitable community outcomes were not their fault. This sense-making and validation can contribute to an understanding of the implicit norms, rules and behaviors – the "hidden curriculum" [74] – that outlines the systems and structures of power that oppress minoritized students. Understanding these power structures can in turn enable minoritized students to use their agency to navigate toward holistic success. While Ash's narrative applies to community engaged learning specifically, students may find Ash's narrative relatable to other engineering education contexts and thus useful for understanding power and agency in other situations as well.

5.4.2 Reflecting on Ash's Narrative from a Faculty Perspective

Engineering faculty may see Ash's narrative as reflecting many of their own frustrations with supporting community-engaged experiences in academia. Faculty may also find Ash's experiences to be relatable, or shocking, depending upon how they align, or do not align, with their own experiences. Critical reflection questions, written from the perspective of faculty readers, could include:

- What power do I possess to support students? In what domains is my power located and to what degree? How have I used my power, explicitly or implicitly, in the past in my interactions with students?
- How can I use my power to provide socially equitable community-engaged project opportunities for students and/or support student agency?
- What barriers do I encounter based on my faculty position that limit my power or agency?
- What aspects of Ash's narrative remind me of my students or own experiences as a student, instructor, and mentor? What can I learn from this reflection?

Engineering faculty can use Ash's narrative and the above questions to reflect on their position within academic power structures. Faculty have significant power to impact student experiences, although they may not always be aware of the multiple dimensions of their power. For example, faculty impacts on curricular structures are obvious; Ash's narrative further demonstrates how faculty participate in interpersonal, institutional, and hegemonic power structures as well. Reflection on these multiple domains of power can support faculty in recognizing opportunities to better support students, as well as challenges to overcome. As an example involving Dr. White, reflection on interpersonal and hegemonic power could have led Dr. White to recognize how his mentoring style was rooted in White, masculine norms that were received much differently than intended by mentees with minoritized identities. Reflection on institutional power could have led Dr. White to recognize how his own stress over tenure advancement was impacting his interactions with students. Explicitly identifying power-related challenges is the first step in navigating these challenges successfully.

Engineering faculty can also use Ash's narrative and the above reflection questions to plan more socially equitable community-engaged engineering experiences. Since domains of power are intersectional, faculty mentors should prepare explicit

plans to navigate multiple domains of power related to their projects. The domains identified for Ash's narrative – interpersonal, curricular, institutional, and hegemonic, plus engineering culture – are a good place to begin; faculty should also be vigilant for other domains of power that may apply to their specific project contexts. As a first step in developing their engagement plans, faculty could prepare a blank model similar to our Fig. 6 with the domains of power from this study and fill in external factors that they believe may impact their project(s). Prior work has already identified several factors, such as semester timelines [20] and institutional incentives [24], that are likely transferable across project contexts. However, external factors are not static and may be unknown to faculty and students in advance. Thus, faculty mentors should also add to this model throughout the project duration and adapt plans as new factors emerge.

6. Conclusion

We generated a data-driven semi-fictional collaborative counterstory describing the educational experiences of a middle-class engineering student of color named Ash. Through this counterstory, we illustrated how interpersonal, curricular, institutional, and hegemonic Domains of Power affected Ash's ability to engage stakeholders equitably. These Domains of Power operated through a range of external factors including curricular and semester timelines, teammates and mentor relationships, institutional incentives, and societal norms. By several traditional metrics, Ash's experiences were successful – they achieved stated learning goals in ENGR101 and their co-curricular project was celebrated by Dr. White and featured in the alumni magazine. However, Ash's efforts also produced essentially no benefits for stakeholders (and in fact imposed costs on them), and left Ash cynical and seriously questioning their motivations for becoming an engineer. Our goal with this paper was to demonstrate how disparate outcomes for students, stakeholders, faculty, and institutions can occur simultaneously – since power in the academy operates in intersecting ways and at multiple levels. Ultimately, students *are* often doing the best they can within the constraints of the external factors that they experience. Engineering students and faculty can use Ash's narrative to reflect on their own experiences participating in or mentoring community-engaged engineering projects. These reflections can support students and faculty in identifying critical structural and societal barriers that make equitable outcomes difficult to achieve and in reimagining alternative ways of structuring engaged learning opportunities to center equitable outcomes for both students and stakeholders. We invite readers to consider how Ash's experiences relate to their own stories and other issues of agency in the academy, to find closure on past experiences that resemble Ash's and to ignite change toward social justice in engineering education.

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Kaylla Cantilina is an Assistant Teaching Professor in the First Year Programs at Northeastern University. Her research and teaching is motivated by design as a means for social justice, and explores the ways that students and educators seek to achieve equity through engineering design processes, education, and outcomes. The goals of her work are to (1) challenge White supremacist ideologies and practices that maintain inequities and injustice in design and engineering education and (2) to develop tools and pedagogy to advance equity by centering the needs of minoritized students and communities. She holds degrees from the University of Michigan in Industrial and Operations Engineering (MS), Design Science (MS), Industrial Design (BA), and Political Science (BA), as well as a graduate certificate in Engineering Education Research.

Robert P. Loweth is a Visiting Assistant Professor in the School of Engineering Education at Purdue University. His research explores how engineering students and practitioners engage stakeholders in their engineering projects, reflect on their social identities, and consider the broader societal contexts of their engineering work. The goals of his research are (1) to develop tools and pedagogies that support engineers in achieving the positive societal changes that they envision and (2) to address systems of oppression that exist within and are reproduced by engineering education and work environments. He earned his BS in Engineering Sciences from Yale University, with a double major in East Asian Studies, and earned his PhD in Mechanical Engineering from the University of Michigan. He also holds a Graduate Certificate in Chinese and American Studies, jointly awarded by Johns Hopkins University and Nanjing University in China.