Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48403

Critical Analyses of the Experiences and Perspectives of Multiply-Marginalized Undergraduate Engineering Students

Dr. Corin L. Bowen, California State University, Los Angeles

Corin (Corey) Bowen is an Assistant Professor of Engineering Education, housed in the Department of Civil Engineering at California State University - Los Angeles. Her engineering education research focuses on structural oppression in engineering systems, organizing for equitable change, and developing an agenda of Engineering for the Common Good. She teaches structural mechanics and sociotechnical topics in engineering education and practice. Corey conferred her Ph.D. in aerospace engineering from the University of Michigan - Ann Arbor in April 2021; her thesis included both technical and educational research. She also holds an M.S.E. in aerospace engineering from the University of Michigan - Ann Arbor and a B.S.E. in civil engineering from Case Western Reserve University, both in the areas of structural engineering and solid mechanics.

Joseph Valle, Purdue University at West Lafayette (COE)

Joseph 'Joey' Valle is a settler on the traditional and ancestral homelands of the Bodéwadmik (Potawatomi), Lenape (Delaware), Myaamia (Miami), and Shawnee People that Purdue University is built upon and near and a postdoctoral worker in the School of Engineering Education at Purdue University. Dr. Valle received a Ph.D in Materials Science and Engineering at the University of Michigan - Ann Arbor after defending their thesis on Abolitionist Engineering: An Autoethnographic Approach to Understanding How Abolition Can Transform Materials Science and Engineering. They served as President of the American Federation of Teachers (AFT) local Graduate Employees' Organization (GEO) 3550, the labor union representing graduate workers at University of Michigan, during the 2021-2022 academic year. Presently they work at intersections of equity and engineering workforce development in the ASPIRE (Advancing Sustainability through Powered Infrastructure for Roadway Electrification) Engineering Research Center.

Shannon M Clancy, Elizabethtown College

Dr. Shannon M. Clancy (she/they) is an Assistant Professor of Engineering at Elizabethtown College in Pennsylvania. She earned all of her degrees in Mechanical Engineering: B.S. from the University of Maryland, Baltimore County (UMBC), M.S. from the University of Michigan, and her Ph.D. from the University of Michigan (U-M). They also received an Engineering Education Research Certificate during their time at U-M.

Her research interests include front-end design practices, sociotechnical knowledge and skills, and queer student experiences in engineering. They use qualitative methods and fields across engineering design, psychology, learning sciences, education, and STEM education to dive deeply into these topics, understanding the how's and why's of engineers' experiences, decision-making, and sharing their stories.

Dr. Clancy is motivated by their passion for and experiences with equity-minded teaching and holistic mentorship of students as people and professionals. She particularly enjoys intertwining engineering technical practices and social implications to prepare students to become socially responsible engineers. She seeks to reimagine who can be an engineer, what engineering is, and the impact engineering has on society for a more equitable world.

Dr. Kaylla Cantilina, Northeastern University

Kaylla is an Assistant Teaching Professor in the First Year Engineering program at Northeastern University. While her teaching is centered around supporting student holistic growth, culturally sustaining pedagogies, and intertwining sociotechnical content in engineering education, her research is motivated by design as a means for social justice, and making engineering more accessible and supportive for minoritized students. She has a deep interdisciplinary background with degrees in industrial design, political science, industrial operations engineering, and design science, and earned her Ph.D. from the University of Michigan.

Critical Analyses of the Experiences and Perspectives of Multiply-Marginalized Undergraduate Engineering Students

Abstract

This paper describes the results of a study designed to identify barriers encountered by undergraduate students experiencing cultural and structural marginalization in a prestigious engineering college. This work aims to identify and investigate factors that are impeding their success using qualitative research methodologies. A team of researchers in the Midwestern United States designed and implemented a series of events with engineering students at a highly selective research institution. The student participants were all multiply-marginalized, which we define as meeting at least two of the following criteria: racial/ethnic minority, gender minority, sexual minority, and working class (which we define - specifically in the context of this institution - as an annual family income of less than $100,000 per year). Our data collection, research, and facilitation methods were designed to build toward collective empowerment and contribute to existing research in an open and participatory manner, guided by liberative, or anti-oppressive, theories, frameworks, and practices. The results of the study offer insights into the common experiences of the participants from their collective point of view. By design, the event enabled participants to build collective understanding, empathy, and action across their overlapping experiences. The results of this study identify problems that must be addressed by engineering programs hoping to serve diverse students. However, the study also offers insight into potential approaches for power-building amongst marginalized students, who are the best experts in their own experiences.

Introduction

This study takes place at a research-intensive, highly-selective public university in the Midwestern United States. This institution, and its engineering college, serves primarily white students from highly affluent financial backgrounds [1], a similar educational context to elite institutions throughout the United States and the Global North. Despite its legal status as a "public" institution, a previous study of engineering undergraduate student outcomes at this institution found that two-thirds of the undergraduate engineering students came from households earning more than $100,000 a year [1]; the median annual household income for students at this institution is over $150,000 [2]. The cultural and structural norms are well known in the community to marginalize as working class any student who is, as it is known colloquially there, "not rich." The aforementioned study of engineering undergraduates at this institution found hindered academic circumstances facing both students with annual family incomes of less than $100,000 per year and Students of Color [1]. These hindered academic outcomes included underrepresentation, lower likelihood of graduation, increased time to graduation, and lower grade point average.

The purpose of this study is to qualitatively explore our research question of why and how such inequitable quantitative outcomes are occurring within the larger context of socially marginalizing processes at this institution and in larger society. It is necessary to identify these factors in order to address the sources of the problems at their roots, rather than enacting reactionary initiatives that label marginalized students themselves as the source of their problems. With this goal in mind, a team of graduate student and faculty researchers designed a series of events framed around the theory of liberation, titled "the Undergraduate Engineering Collaborative Growth Series" (UECGS) [3]. The first event was designed to investigate the aforementioned research question. In three follow-up events during the following semester, organizing trainings were conducted to empower students to begin to address issues raised at the first event. More information on the program and its structure can be found in [3].

Frameworks

The liberative theories we employ throughout this study are rooted in community-based, cooperative, and solidarity-focused methods [4], [5], [6], [7]. The theory of liberation, or liberative theory, thus encompasses all aspects of identity around which the structural hierarchies of society are organized; this can also be referred to as "critical theories" in general (as in [8]). Through the wielding of hegemonic power, dominant groups are able to manipulate structures, conditions, and beliefs within society in order to further attain power and build their privilege. Dominant identity groups exist in relation to a potentially infinite number of attributes, and oppressive ideologies work to further the interests of dominant groups at the expense of others. The theory of liberation seeks to dismantle the many layers of systemic oppression that stifle the progress of marginalized peoples on the basis of any and all of these and other socially-constructed attributes.

Critical theories also exist under the metaphorical umbrella of liberative theories that focus on oppression on the bases of particular attributes of identity [7]. For example, with a focus on the social construction of gender, the anti-oppressive branch of feminist theory aims to dismantle androcentrism and patriarchal structures within society, thus achieving the liberation of women [9]. Kacey Beddoes has done extensive research documenting the use of feminist theories within the engineering education research space [10], [11], [12]. Focusing on race and ethnicity, critical race theorists oppose incremental measures attempting to correct for racial discrimination in favor of structural and educational initiatives addressing systemic racism against People of Color [13], [14]. In recent years, research in engineering education has begun to make use of critical race frameworks to analyze the experiences of Students of Color and call for the formation of anti-racist engineering education [15, 16]. Queer theorists challenge the same concept of social hierarchical stratification along the lines of cisheteronormativity [17]. For example, Andrea Havercamp's work has begun to illuminate and confront this within engineering education [18,

19]. Finally, critical theory (noting the confusing terminology, as “critical theory” is one of the “critical theories”) typically bases its unit of analysis on social class, recognizing the Marxian dialectic of ruling class subjugation of the working class [20]. Critical theory, along with other Marxian approaches, is problematically underutilized in the engineering education research space, especially within the United States, due to the persisting resistance to the recognition of capitalism as a system of oppression alongside racism, cisheteropatriarchy, etc. However, all critical theories currently exist and persist under a state of political attack for their explicit challenge to the social and structural status quo.

Additionally, the theory of intersectionality postulates that the experiences of multiply-marginalized individuals will be overlooked by any theory that focuses on a single identity-based attribute; alternatively, the compounding experiences of oppression must also be considered in order to achieve liberation for all people [21, 22]. This framework was pioneered by Kimberlé Crenshaw as a means of understanding the compounding effects of discrimination against Black women on the bases of both gender and race. Intersectionality is more frequently being applied in engineering education research in recent years (e.g., [23, 24]). While the educational research in this project utilizes all these critical and liberative theories individually, we also strive to apply an intersectional analysis framework to evaluate the outcomes and experiences of multiply-marginalized students.

Methodology

Data Collection

UECGS was funded by an internal faculty grant from the engineering college focused on efforts to expand diversity, equity, and inclusion (DEI). Institutional Review Board approval for the study was obtained through the institution. Facilitators, note-takers, and participants were all compensated with MasterCard gift cards for their work on this project, particularly because student labor to build systemic change is frequently rendered invisible. Facilitators were trained for their roles; details on the demographic composition of the facilitators and their training process are described in [3]. As shown in [3], the facilitation team was notably diverse compared to the overall student body at the institution, and individual facilitators report the project’s focus on illuminating aspects of the student experience that they too endured as a motivating factor for their participation in the project.

The methods employed in implementing UECSG are described in detail in [3]. In summary, 38 multiply-marginalized undergraduate engineering participants were selected occupying various social locations related to race, ethnicity, class, gender, and sexual orientation (which are shown in detail in [3]). 29 participants attended the first event in the series (online, as UECGS took place during the COVID-19 pandemic), wherein they joined two 30-minute rounds of focus

groups facilitated by graduate students from the engineering college, which was followed by a whole group share-out of the focus group discussions. Finally, they participated in a collective visioning exercise.

Focus groups centered on the topics of belonging, recruitment and outreach, institutional DEI efforts, the classroom environment, mentoring, and conflict resolution. The communicated goal of the focus groups was to name barriers the participants perceived and experienced relating to the focus group topic as well as have the opportunity to describe the harms they have experienced resulting from those barriers, if desired. In order to do so, it was imperative to establish and maintain a safe, trusting space for the participants, so group-norming [25] and facilitator vulnerability were relied upon to create a supportive community-building experience. Semi-structured discussions took place using pre-generated prompts on each topic designed by the facilitation team. Within each focus group, a graduate student note-taker recorded discussions amongst the participants. Participants were also encouraged to use a Google Jamboard to include any notes, drawings, pictures, connections, etc. that they found relevant to the discussion. After each focus group, the facilitator and note-taker were asked to write a brief reflection on what they heard from their perspectives.

For the collective visioning activity, participants used a shared Google Doc to anonymously write false statements they wished were true about the conditions of their engineering education and the broader contexts that engineering is situated within. Participants then added to the document questions that would need to be addressed and/or directions that the engineering community would need to move toward in order to bring the collective vision into reality. In only five minutes, the participants generated over three pages of ideas using this structure [3], and the graduate student facilitation team decided on the spot that they also wanted to do the activity, so they generated their own “visioning board”.

Utilizing a participatory approach to research, it is vital that the participants not be objectified for the purposes of data collection, but rather have the opportunity to build collective understanding and empathy across their experiences through these data collection methods. Collaboration offers an avenue for participants to further develop their understanding of the breadth of structural systems of oppression and the tangible impacts on their everyday lives as engineering undergraduate students. We also engaged these methods to assist participants in developing familiarity with community organizing practices for systemic change through collective action.

Data Analysis

The data collection event resulted in approximately 45 pages of multimodal data. Member checking of the data was employed at various stages in the research, including live-checking during note-taking and four days of open review of the notes by participants after the event.

Thematic analysis was employed by the researchers to qualitatively analyze the participants' contributions to the dataset, highlighting qualitatively the commonalities of the experiences of the participants. This is useful to our research process as we attempt to demonstrate the ways in which varied individual experiences of oppression are linked to overarching oppressive systems within our society. The goal of the methodological approach was to direct the focus of the research away from the researchers and onto the subjects and their experiences. Thus, the first two authors worked together to synthesize the data to a shared understanding of the common experiences, or phenomenons, of the participants based on their collective experiences.

To conduct this analysis, the researchers analyzed the entirety of the qualitative data with respect to participants' experiences in engineering education. We each identified key themes and examples of them within the data and then compared and discussed our results until we achieved intercoder reliability. For this analysis, we focused on the specific barriers identified within the data. While there was variation in the ways in which individuals experienced and interacted with these barriers, they were frequent causes of hardship for the participants that they saw as affecting their academic experience.

The researchers also recognize that our own positionalities impact our interpretation of the data, as we do not exist as objectively positioned researchers outside of the social systems we wish to study [26]. The first two authors recognize that our individual positionalities within the system at the time of the data analysis - as a working class woman and a queer Person of Color in graduate engineering programs - undoubtedly impacted the qualitative analysis we pursued and the results we obtained. Certainly, we have both experienced systemic oppression within engineering academia, including through the phenomena described below. We also embody privilege through other axes, including our power as researchers. Through our own relationships with our participants, this data, and these results, we are striving to embrace our role as part of a critically reflective process within education. In this, we remember that "there is, and there always has been, a dialectical relationship among education, politics, and power" (Ana Maria Araújo Freire [27, p. xv]).

Results and Discussion

The following barriers are identified from the qualitative data as significant and frequent impediments to multiply-marginalized students' successes within the engineering college. All names provided in the results are anonymous pseudonyms selected by the participants to describe themselves.

Impacts of Social Class

> "I've never really felt like I belonged [in the engineering college]. I came from a really bad school, test scores-wise. Coming from a small high school, mostly mixed, to [this university] was a big difference. [It was] hard to find people to relate to. [The engineering college] is really tough when you're with people who had a well-funded educational background and you are a Person of Color." - Lien

As the vast majority of the participants were working class, it was expected by the authors that money, or the lack thereof, would be a recurring topic of conversation, as the student debt crisis in the United States becomes increasingly catastrophic [28]. However, student loans were not addressed at all in the data. The biggest problem for working class students in our study was not their ability to afford attendance, but rather the ways in which their backgrounds affected them as members of the engineering community. The students described, as Lien did, the connection between working class family backgrounds and working class educational backgrounds. Taylor shared,

> "I'm from a city on the Mexican border. My high school had very poor teaching. To come to [this university] and go to class with people who went to private [and other] great schools, [it] was very hard to catch up."

This was a frequently shared sentiment. The students noted that the "great schools" their white and affluent classmates attended offered many opportunities to prepare for higher education in STEM that they were never afforded. Then, their initial hopes to receive academic support from the university were not realized. Lien continued,

> "Not coming from a good high school, I assumed [the engineering college] thought I was smart and they would give me the resources to support me at [the university]. When I got here, they didn't give me what I needed. They just gave me generic help. I wanted more personal assistance for my educational background, to take summer classes, etc. I feel like the resources that [the engineering college] has aren't tailored to my needs and demands."

Despite the substantial financial aid packages the students described relying upon, some students did report the need to hold down jobs while enrolled. Kiko, a woman whose chronic illness and multiple surgeries also impacted her academics, described the scheduling difficulties that arose from coordinating work and school. She stressed the importance of faculty posting class notes online and being flexible with office hours in order to accommodate students with jobs. However, students reported that professors attributed their lack of time to laziness rather than employment.

Participants also recognized the inherent injustice that some students are forced to have jobs during college in order to survive. In the final visioning activity, one point read, “Students with financial burdens are given other opportunities at school that will allow them to keep up with the pace of students who don’t hold jobs down while attending college,” while another cornered the root cause of the problem by simply stating, “Money shouldn’t impact education.”

Mental Health (Or Lack Thereof)

> “Professors assume everyone has good mental health and are neurotypical, they aren’t understanding of diversion from their view. The pace of professors in class is un-inclusive, they move faster than I can for assignments and topics in courses. Professors try to teach following rules and being exact, very structured around their personal deadlines ([in a] workplace analogy: not meeting your bosses deadlines makes you a bad engineer). They look at you and see someone else.”
> - Dax

Poor mental health was a universally understood phenomenon that arose in the conversations of nearly every focus group. The focus was not strongly on specific diagnosed illnesses, but rather on the (overwhelmingly negative) state of the students’ mental health in general. Workload was identified as a major contributor to poor mental health, but, perhaps more importantly, the students identified a toxic attitude within the engineering community with respect to workload. As a student shared on the visioning board, they wished for a future in which “[they] don’t feel like [they are] not doing enough if [they are] not extremely stressed out all the time.” This points to an existing environment in which students have come to identify poor mental health as a signifier of good work ethic and react to not experiencing mental health issues with guilt.

There was a shared understanding amongst the participants that professors’ actions were exacerbating issues surrounding mental health. Students reported that their professors were either unable or unwilling to accommodate mental health issues and didn’t understand the ways that their rigid teaching methods were directly contributing to the problem. As Melina explained,

> “I’ve had classes where the consensus is there’s no respect for our wellbeing or the fact that we have other classes. They’re not a disrespectful person in general but the way they act towards you is really frustrating. This has been a recurring theme in certain college classes and you’d think they’d be aware.”

The issues surrounding mental health seemed to function as a vicious cycle: students experienced deteriorating mental health, which negatively impacted their academic performance; students did not receive any empathy from professors regarding their mental health, which resulted in further mental turmoil; this additional anguish resulted in further worsening of their academic