ASEE 2022 ANNUAL CONFERENCE
Excellence Through Diversity
MINNEAPOLIS, MINNESOTA, JUNE 26TH-29TH, 2022 ASEE
Paper ID #37803

Reimagining Methodologies: Why We Center Marginalized Voices

Victoria Siaumau

Incoming PhD student at UCSD

Yumi Rosa Aguilar

they/them Undergraduate Engineering student at Cal Poly San Luis Obispo

Emily Flores

I am a first-generation Mexican American studying Computer Science, Political Science, and Ethnic Studies at Cal Poly San Luis Obispo. I lead with passion and vulnerability to foster community and create comfortable spaces for collaboration. I believe in coding ethically and ensuring that the products of our knowledge are creating a positive impact for all communities.

Jane L. Lehr (Professor)

Dr. Jane L. Lehr is the Director of the Office of Student Research and Professor in Ethnic Studies and Women's, Gender & Queer Studies at California Polytechnic State University, San Luis Obispo. She is also Director of the CSU Louis Stokes Alliance for Minority Student Participation (LSAMP) in STEM Program at Cal Poly and affiliated faculty in the Center for Engineering, Science & Mathematics Education (CESAME); the department of Computer Science & Software Engineering; and the Science, Technology & Society Program. Dr. Lehr previously served as elected co-chair of the Science & Technology Taskforce of the National Women's Studies Association (NWSA), and as a Postdoctoral Research Officer at the Centre for Informal Learning and Schools (CILS) at King's College, University of London. Her graduate training is in Science & Technology Studies and Women's Studies at Virginia Tech and her teaching and research focus primarily on the complex relationships between gender, race, culture, science, technology, and education.

Lynne A Slivovsky (Professor)

Dr. Lynne Slivovsky is Chair of Computer Engineering at California Polytechnic State University, San Luis Obispo, California, USA. Prior to joining Cal Poly she earned a PhD in Electrical and Computer Engineering at Purdue University. Her research examines design, entrepreneurship, and community engagement with a particular focus on the interplay between technology and society. She has nurtured long-term partnerships with local community organizations to provide greater access to adapted physical activity through the design of custom devices. Her work in community engagement led to her selection in 2007 as a California Campus Compact-Carnegie Foundation for the Advancement of Teaching Faculty Fellow for Service-Learning for Political Engagement and in 2010 she received the Cal Poly President's Community Service Award for Significant Faculty Contribution. She earned an American Academy of Underwater Sciences Scientific Diver certification to expand her work at the intersection of computing and marine science. She dives with her students off the Central Coast of California on projects that provide virtual educational experiences for K-12 students on marine science. She loves to cook, ride her bike, and play with her dog.

Reimagining Methodologies: Why We Center Marginalized Voices

Abstract

We are a student, alum, and faculty research team seeking to reduce harm, be responsive to / mitigate / reduce trauma, and grow justice within engineering education pedagogy / practice, related research communities (including ASEE), and the broader world. We seek to utilize research methodologies that align with these aspirations, goals, and commitments. However, many standard approaches within engineering education research – even those connected to research agendas focused on diversity, inclusion, equity, and justice – seem to both further harm engineering students from minoritized and/or oppressed groups as part of data collection processes, calling into question motivations of the research. Marginalized students are often asked to perform emotional labor and share painful experiences that are for the benefit and learning of predominantly white faculty, staff, and peers. We know that engineering education culture and environment is often a site of harm for marginalized students and understanding how systems of oppression operate within these environments gives educators a better understanding of how to intervene. However, this knowledge production and these interventions should not be at the cost of the students' well-being. Methodologies that center the experiences of marginalized peoples while simultaneously not being harmful or exploitative are lacking in engineering education research. This paper suggests a different path and reflects on how we can build a better methodology that does not further harm. We argue that building a more responsive and less exploitative research methodology starts by understanding trauma in relation to structural and systemic oppression, applying Kimberlé Crenshaw's intersectional framework to the ways we describe trauma, and being context-specific with the communities we aim to research. We hope this paper acts as a call to action for other researchers, across fields, to more critically examine their methodologies and to center the well-being of the participant over the benefit of the researcher.

Introduction:

Historically, engineering education has neglected the experiences of its students. Students are expected to work in intensive, difficult curriculums in the name of rigor and aptitude [1]. "Numerous publications have documented an engineering culture pointing not only to issues of 'climate' but also to the lack of role models, rigid pedagogical approaches that lack creative design elements and teamwork, and even subtle habits used to establish who belongs in engineering and who does not" [2]. However, "[e]ngineering has reflected some unjust biases embedded in our social structures to the point where they become so mainstream as to be invisible" [2]. In related research on women of color in physics, Maria Ong argues that, "Most students, regardless of their social and cultural backgrounds learn early in their career that ordinary qualities of scientific competence connects strongly to presentations of self…Those in science who occupy nontraditional gender, racial/ethnic, and class categories must contend with the common effects of low representation including isolation, doubts associated with tokenism,

tenuously balancing social identities, and disproportionate skepticism from others- and themselves- about their qualifications and abilities to succeed in predominantly male and/or white fields" [3]. This and other research suggest that it is not enough to increase the number of marginalized people within STEM fields, but rather center their perspectives.

Today, more engineering educators and engineering education researchers are seeking to increase diversity, equity, inclusion, and (in some cases) justice within engineering education. However, there is a lack of attention to trauma both within the content and methodological approaches in this research area. Despite the likelihood of student distress and trauma, in a search of the *Journal of Engineering Education*, the term "trauma" only appeared in 17 articles between 1993 and 2021, only three of which discussed racial trauma. There is an urgency to understand trauma in relation to systemic forms of oppression to foster a more radically inclusive methodologies and engineering culture. We need to account for the trauma students with marginalized identities experience in oppressive cultures. We argue that building a more responsive and less exploitative research methodology starts by understanding trauma in relation to structural and systemic oppression, applying Kimberlé Crenshaw's intersectional framework to the ways we describe trauma, and being context-specific with the communities we aim to research. In the following sections, we further discuss the experiences of marginalized students in engineering culture and practice, trauma in relation to structural and systemic oppression, and the need to develop research protocols that are simultaneously trauma-informed and anti-racist to create a more radically inclusive engineering culture. We hope this paper acts as a call to action for other researchers, across fields, to more critically examine the methodologies they use and create to center the well-being of the participant over the benefit of the researcher.

Marginalized Student Experiences in Engineering Education Culture & Practice

Engineering education is described to be objective and value-free but, the ways in which rigor is conceptualized and utilized makes it anything but that. As Donna Riley has argued, rigor in engineering education aims to accomplish three things: disciplining, drawing boundaries, and asserting white, heterosexual, cisgender-male privilege [1]. Rigor is used as a marker of quality and difficulty. The problem with using rigor as a marker of quality is that it is not built with equity in mind. When discussing rigor in engineering, it is important to look at *what* is being made rigorous for *whom* and what barriers are in place for certain groups of students. Engineering curriculum is designed assuming that people are not working part-time jobs, have family responsibilities, or have chronic illnesses or conditions that prevent them from staying up all night to complete schoolwork [1]. This creates the idea of the "normal" university student. A normal university student will not have these extra responsibilities on top of their schoolwork. They will be from higher income families, so they do not need to work extra jobs while in school, healthy enough to manage the workload, and not subject to constant micro and macro aggressions to their communities and social identities. This perpetuates the fact that the white, straight, abled, cisgendered man is the "norm" [4]. When students outside of that norm are

unable to keep up with the nature of their curriculum due to the barriers that rigor creates, it perpetuates the misconception that they are not built for the field and results in them feeling alienated and potentially leaving their programs. Furthermore, marginalized peoples are often stuck in the limbo between expressing their authentic identities and being accepted in their workplace. To assimilate into their workspace, marginalized peoples turn to fragmentation, approximating ordinariness, to erase pieces of their identity to be taken more seriously by the workplace culture [3].

This is a reality that many marginalized people experience in the fields of science and technology. They need to fragment or separate themselves from their identities to fit into molds built by white supremacy and hegemonic masculinity in order to appear professional and fit for the fields of science and technology, in other words, they need to separate their professional selves from their gendered and racial selves [3]. We argue that this fragmentation leads to significant emotional harm and distress to marginalized students. This distressing environment may deter students from pursuing engineering and related degree programs.

Simply increasing the number of marginalized students in a class or department does not guarantee increased participation or belongingness, as numbers and percentages do not expose the cultural norms that promote marginalization and exclusion of certain groups. At the macro level, legislation and educational policies as well as social inequities and prejudice actively drive marginalized students out of engineering fields. The resulting lower marginalized student representation in engineering can negatively further affect marginalized students since an isolating environment may damage students' self-esteem, ethnic identity, and ability to tackle societal problems [5]. Lowered academic expectations, social pressure, and microaggressions – negative verbal and nonverbal actions that can create a hostile environment – contribute to educational isolation and alienation of marginalized students at predominantly White institutions [6-7]. These unwelcoming and hostile environments can cause anxiety and reduced performance of marginalized students because of a phenomenon called "stereotype threat," or the perceived danger of confirming negative, false assumptions about one's race or ethnicity [8]. Negative experiences may also result in efforts to "prove them wrong," or to work harder than usual to achieve goals while disproving inaccurate beliefs of inferiority of certain races and ethnicities [9].

The notion of naturalization (the "problem is them"), or the small number of people of color in engineering as a result of natural occurrences, also plays a contributing factor on racial, gender, and LGBTQ2+ disparities. The naturalization argument accepts the small number of people of color who might apply to an institution as inevitable (or "natural"), when, in fact, it is the fault of the oppressive nature of the education system that keeps people of color from applying [10]. While it may be tempting to address the notion of naturalization by actively recruiting individuals with marginalized identities, the environment will likely still harm them. The concept

of "critical mass" suggests that the sole action of recruiting and sustaining a sufficient percentage of a marginalized group will cultivate social change in an environment and can be used as an indicator of success or failure. Yet, this idea is inherently flawed. Change requires more than targeted numeric percentages [11]–[14], it requires a foundational transformation to reduce harm, and potentially trauma, to marginalized students.

We also want to highlight that it is not just about the culture of engineering but the work of engineering as a source of trauma. Engineering has been used as a tool of oppression disguised as "progress" since its genesis as a response to fulfill militaristic needs and to further imperialist agendas [15]. In the US, engineering has also been utilized as a tool of colonialism. We can see this in the example of the transcontinental railroad and how something seen as a fantastic feat of engineering contributed to the genocide and violent displacement of Indigenous peoples [16]. Engineering cultures and frameworks are inherently informed and rooted in the violent histories it began in. The socio-historical construction of engineering has created a framework and environment informed by oppressive systems of the past and present that continue to perpetuate exclusion and harm in both workforce and educational cultures.

If our goal is to cultivate foundational transformation we must center the people who are most harmed in conversations about change within engineering education. Reflecting on both the harmful historical and present-day cultures within engineering education and how they are informed by the oppressive systems operating within US culture and society, we must develop the methodologies to center marginalized student voices that do not perpetuate harm or make these students relive potentially traumatic experiences. To this end, we must develop an understanding of student trauma that is structural, systemic and intersectional.

Trauma in Relation to Structural, Systemic and Intersectional Oppression

The American Psychological Association (APA) defines trauma as, "any disturbing experience that results in significant fear, helplessness, dissociation, confusion, or other disruptive feelings intense enough to have a long-lasting negative effect on a person's attitudes, behavior, and other aspects of functioning. Traumatic events include those caused by human behavior (e.g., rape, war, industrial accidents) as well as by nature (e.g., earthquakes) and often challenge an individual's view of the world as a just, safe, and predictable place" [17]. We argue that this definition of trauma, however, is too narrow, particularly within the context of the U.S. as it is not structural, system, or intersectional

Marginalized peoples in America continue to face oppression in both systemic and individual ways [18-19]. This is amplified for people who hold multiple marginalized identities and face multiple systems of interlocking oppression [20-21]. Consequences of interlocking systems of oppression show up in different ways for different people. Sexism and hegemonic masculinity

are the root of power based violences like the 1 in 6 women[1] who are sexually assaulted each year [22]. The U.S. perpetuates and is built on harm towards Black individuals [23-24]. In the past year alone, George Floyd, Breonna Taylor, Ahmaud Arbery, and countless others whose names were not as widely circulated, were murdered by police, demonstrating the over-policing of Black individuals and the prevalent anti-Black racism in America. The shooting targeting a predominantly Asian spa in Georgia resulted in the shooter killing 8 individuals, 6 of whom were Asian women, serves as one example of the anti-Asian violence justified through racism and xenophobia that we've seen during the Covid-19 pandemic. In the past year, 44 trans individuals, particularly Black trans women and trans individuals of color, have been murdered because of their identities [25], with many of their stories not being shared by major media outlets. Despite many of these hate crimes coming to national attention, the perpetrators of these crimes were, often, protected by the very systems that harm marginalized peoples: white supremacy and hegemonic masculinity (see Cherokee County sheriff's Captain Jay Baker publicly stating that the shooter responsible for the deaths at the Georgia spa was, "just having a bad day" [26]).

These malicious and heartbreaking acts above stem from multiple systems of oppression operating within the U.S. and adversely affect everyone who shares the social identities of these victims, including engineering students. Understanding engineering student trauma in relation to the systems of oppression that are currently operating within a US context is essential in understanding the experiences of marginalized peoples [27] particularly when understanding vicarious trauma from hate crimes or experiencing microaggression related to a social identity that, "may arouse immediate or delayed PTSD and related symptoms in the experiencing person if the experienced event(s) serves as a catalyst for recalling previous personal memories or identity-group histories of extreme threat" [28]. This means that engineering students, particularly those with marginalized identities, are experiencing distress and, potentially, trauma that needs to be considered when conducting engineering education research.

Utilizing Intersectional & Trauma-Informed Lenses to Build Better Methodologies

As noted above, when developing methodologies to engage with students from this anti-racist and trauma informed lens, it is important not to look at them from a binary perspective. A student's experience is built not from one identity, but from the combination of all of their identities. Kimberlé Crenshaw coined the term intersectionality to provide a more nuanced legal framework to analyze the specific experiences of women of color and more specifically Black women. Grounded in Black feminist and feminist of color critique, Crenshaw describes intersectionality as a "prism" to analyze social justice issues and how interlocking systems of

[1] We recognize the complexity of the term "women" and that this statistic may not capture the harm the Trans women and feminine non-binary individuals experience. For more information on gender based violence against trans women and gender non-conforming people, see https://reports.hrc.org/an-epidemic-of-violence-fatal-violence-against-transgender-and-gender-non-confirming-people-in-the-united-states-in-2021 and https://vawnet.org/sc/serving-trans-and-non-binary-survivors-domestic-and-sexual-violence/violence-against-trans-and

oppression or disadvantage can sometime compound. This "prism" of analysis can allow us to better understand individuals' experiences and their relation to systems of oppression. As stated previously, people with marginalized identities are more likely to be harmed because of the current systems of oppression operating [18-19] and that both vicarious experiences and microaggressions can induce immediate or delayed PTSD/related symptoms [28] with more severe symptomatology [29]. By being cognizant of these systems of oppression and their effects on students, we can develop trauma-informed methodologies to not cause further harm or act as the "catalyst" that Helms, et. al. discuss.

While developing trauma-informed methodologies it is important to be cognizant of intersectionality as well as the context of the educational and professional fields participants may be a part of. One's experience relies on both the identities they hold and their interactions with the field they are a part of. While all systems of oppression are interlocking and inform each other, they can manifest differently across fields and environments. Understanding participants as entrenched in a specific education and workplace culture gives specific context to what they may be experiencing. We argue that trauma-informed methodology should be modified to understand these specific contexts, across fields, not just those that study trauma. Furthermore, when discussing trauma-informed methods, it's important to think about who is being considered in the conversation. Many research methodologies and pedagogies regarding trauma tend to center the emotional response, discomfort, and guilt of white, cisgender, heterosexual men, while neglecting the emotions and discomfort of marginalized people while consuming their experiences to teach those of the dominant group lessons they can never experience [30-31]. It is our responsibility, as researchers who will benefit from students disclosing their experiences, to minimize harm that students may experience when sharing their experiences. Therefore, the goal should not only be to collect and understand the experiences of marginalized engineering students and center their voices but to also create a research protocol that is trauma-informed AND anti-racist to prevent further harm from coming to these students. While this type of work and rethinking should be utilized more broadly, for our purposes, we focus on engineering education.

Conclusion

What does it look like to minimize harm and center the care and well-being of the participant over the goals and outcomes of the project? In our research, one way we mitigate harm is to explicitly remove the requirement of personal anecdotes. Removing the requirements of these disclosures mitigate the ways in which recounting participant experiences may interact with systems of violence and potential trauma. To do this, for one of our projects, participants read the narrative "Snow Brown and the Seven Detergents," by Banu Subramaniam that discusses themes of assimilation, racism, and sexism within educational STEM fields. Reading this narrative allows for participants to utilize the experiences of the characters to describe educational environments. This is just a start, however. We integrate the Design Justice principles and utilize

frameworks from Participatory Action Research (PAR) to expand our approach to doing research with participants rather than on them.

It is tempting to look at predominantly white institutions (PWIs) and assume that the solution to all problems would be to increase diversity among students, however, this assumption would be false. An increase in the number of marginalized peoples on a campus does not guarantee an increase in students' sense of belongingness or participation [11-13]. Unfortunately, recruitment efforts tend to be easier to implement, so these institutions, rather than change their policies and curriculums, instead enroll more marginalized students to increase their diversity demographics. This exposes more students to more harm. In order to do better, we need to characterize the specific culture of engineering present on PWIs from the perspective of students who hold marginalized identities in order to build the foundation and frameworks for future interventions and to create a more radically inclusive engineering culture. To do this a protocol must be trauma-informed to account for and recognize the trauma that many students and faculty experience by existing in this oppressive culture. We argue here that the trauma being centered should not be that of only white students and faculty but of marginalized students and faculty who must constantly exist in an oppressive space. In order for this to be accomplished, the protocol must be BOTH trauma-informed AND anti-racist.

Acknowledgements
This material is based upon work supported by the California State University STEM-NET Seed Grant Program; the Research, Scholarly & Creative Activities Program awarded by the Cal Poly division of Research, Economic Development & Graduate Education; the Cal Poly BEACoN Research Mentoring Program; and the Cal Poly Office of Student Research.

References

[1] D. Riley, "Rigor/Us: Building Boundaries and Disciplining Diversity with Standards of Merit," *Engineering Studies,* vol. 9, pp. 249-265, Dec 2017.

[2] M. Camacho and S. Lord, *The Borderlands of Education: Latinas in Engineering.* Plymouth, United Kingdom: Lexington Books, 2013.

[3] M. Ong, "Body projects of young women of color in physics: Intersections of gender, race, and science," *Social Problems*, vol. 52, no. 4, pp. 593–617, Nov. 2005.

[4] A. E. Slaton, "Engineering segregation: The University of Maryland in the twilight of Jim Crow," *OAH Magazine of History*, vol. 24, no. 3, pp. 15–23, 2010.

[5] L. L. Long and J. A. Mejia, "Conversations about diversity: Institutional barriers for underrepresented engineering students," *Journal of Engineering Education*, vol. 105, no. 2, pp. 211–218, 2016.

[6] T. Strayhorn, R. Johnson, and B. Barrett, "Investigating the college adjustment and transition experiences of formerly incarcerated Black Male Collegians at predominantly white institutions," *Spectrum: A Journal on Black Men*, vol. 2, no. 1, p. 73, Oct. 2013.

[7] T. Yosso & D. Solorzano, Leaks in the Chicana and Chicano Educational Pipeline. Latino Policy & Issues Brief. Number 13. UCLA Chicano Studies Research Center, Jan 2006

[8] C. M. Steele and J. Aronson, "Stereotype threat and the intellectual test performance of African Americans.," *Journal of Personality and Social Psychology*, vol. 69, no. 5, pp. 797–811, 1995.

[9] J. Moore, O. Madison-Colmore, and D. Smith, "The prove-them-wrong syndrome: Voices from unheard African-American males in engineering disciplines," *The Journal of Men's Studies*, vol. 12, no. 1, pp. 61–73, 2003.

[10] D. Riley, A. E. Slaton, and A. L. Pawley, "Social Justice and inclusion," *Cambridge Handbook of Engineering Education Research*, pp. 335–356, Jan. 2015.

[11] S. Cheryan, V. Plaut, P. Davies, and C. Steele, "Ambient Belonging: How Stereotypical Cues Impact Gender Participation in Computer Science," *Journal of Personality and Social Psychology*, vol. 97, no. 6, pp. 1045–1060, 2009.

[12] J. Stolk, K. Hubbard, and S. Cetinkaya, "Critical Mass or Critical Culture?," in *Proceedings of IEEE Frontiers in Education Conference*, 2017.

[13] M. Ohland, R. Long, and R. Layton, "Investigating the Notion of Critical Mass of Women in Engineering using Longitudinal Student Records," in *Research in Engineering Education Symposium*, 2008.

[14] J. Creswell and V. Plano Clark, *Designing and Conducting Mixed Methods Research (3rd edition)*. Los Angeles: SAGE Publications, 2018.

[15] T. Reynolds, "Overview," in *The Engineer in America*, T. Reynolds, Ed. Chicago: University of Chicago Press, 1991, pp. 7-26.

[16] S. Vong, "The impact of the Transcontinental Railroad on Native Americans." *National Museum of American History, Behring Center*, 3 June 2019, https://americanhistory.si.edu/blog/TRR. Accessed 25 Apr. 2021.

[17] "Trauma and shock," *American Psychological Association*. [Online]. Available: https://www.apa.org/topics/trauma. [Accessed: 20-Sep-2021].

[18] I. F. Lopez, "Institutional racism: Judicial conduct and a new theory of racial discrimination," *The Yale Law Journal*, vol. 109, no. 8, pp. 1717–1884, Jun. 2000.

[19] M. M. Zamudio and F. Rios, "From traditional to liberal racism: Living racism in the everyday," *Sociological Perspectives*, vol. 49, no. 4, pp. 483–501, Dec. 2006.

[20] K. Crenshaw, "Mapping the margins: Intersectionality, identity politics, and violence against women of color," *Stanford Law Review*, vol. 43, no. 6, pp. 1241–1299, Jul. 1991.

[22] TED, *The Urgency of Intersectionality*, *2016*, Accessed on: Sep. 20, 2021. [Streaming Video]. Available: https://www.ted.com/talks/kimberle_crenshaw_the_urgency_of_intersectionality

[22] *RAINN*. [Online]. Available: https://www.rainn.org/. [Accessed: 20-Sep-2021].

[23] M. Alexander, *The new Jim Crow: Mass incarceration in the age of colorblindness*. New York, New York: New Press, 2020.

[24] Z. D. Bailey, J. M. Feldman, and M. T. Bassett, "How structural racism works —racist policies as a root cause of U.S. racial health inequities," *New England Journal of Medicine*, vol. 384, no. 8, pp. 768–773, Feb. 2021

[25] *HRC*. [Online]. Available: https://www.hrc.org/. [Accessed: 20-Sep-2021].

[26] E. Shapiro, "Georgia sheriff's department under fire after official says spa shootings suspect had 'really bad day'," *ABC News*, 18-Mar-2021. [Online]. Available: https://abcnews.go.com/US/georgia-sheriffs-department-fire-official-spa-shootings-suspect/story?id=76533598. [Accessed: 20-Sep-2021].

[27] YouTube, *Trauma from an Intersectional Perspective (Webinar Recording)*, *2020*, Accessed on: Sep. 20, 2021 [Streaming Video]. Available: https://youtu.be/uLqyVaGDzso

[28] J. E. Helms, G. Nicolas, and C. E. Green, "Racism and ethnoviolence as trauma:

Enhancing professional training.,” *Traumatology*, vol. 16, no. 4, pp. 53–62, 2010.

[29] J. McClendon, K. Chang, M. J. Boudreaux, T. F. Oltmanns, and R. Bogdan, “Black-white racial health disparities in inflammation and physical health: Cumulative stress, social isolation, and health behaviors,” *Psychoneuroendocrinology*, vol. 131, p. 105251, Sep. 2021.

[30] M. Boler and M. Greene, *Feeling power: Emotions and education*. New York, New York: Routledge, 2009.

[31] K. K. Kumashiro, *Troubling education queer activism and anti-oppressive pedagogy*. New York, New York: Routledge, 2002.