

Negotiating Belongingness: A Longitudinal Narrative Inquiry of a Latina First-generation College Student's Experience in the Engineering Culture

Dr. Dina Verdín, Arizona State University

Dina Verdín, PhD is an Assistant Professor of Engineering Education Systems and Design in the Ira A. Fulton Schools of Engineering at Arizona State University. She graduated from San José State University with a BS in Industrial Systems Engineering and from Purdue University with an MS in Industrial Engineering and PhD in Engineering Education. Her research broadly focuses on broadening participation in engineering by focusing on the issues of access and persistence. She uses asset-based approaches to understand minoritized students' lived experiences (i.e., including first-generation college students and Latinx). Specifically, she seeks to understand how first-generation college students and Latinx students author their identities as engineers and negotiate their multiple identities in the current culture of engineering. Her scholarship has been recognized in several spaces, including the 2018 ASEE/IEEE Frontiers in Education Conference Best Diversity Paper Award, 2019 College of Engineering Outstanding Graduate Student Research Award, and the Alliance for Graduate Education and the Professoriate (AGEP) Distinguished Scholar Award. Her dissertation proposal was selected as part of the top 3 in the 2018 American Educational Research Association (AERA) Division D In-Progress Research Gala.

Negotiating Belongingness: A Longitudinal Narrative Inquiry of a Latina, First-Generation College Student's Experience in the Engineering Culture

Abstract

Research studies have long argued that a sense of belonging is essential for minoritized students' continued engineering persistence. Common factors that have been found to promote a sense of belonging include campus diversity, institution's culture, perceived class comfort, faculty interactions, and peer support. Yet, there is much to be understood about how nontraditional students sense of belonging is promoted within the engineering culture. The purpose of this study is to understand how one Latina, first-generation college student, and a nontraditional student (i.e., age greater than 25, parental responsibilities, and part-time student) negotiated ways of belonging in engineering admits a culture that continuously denied her a sense of belonging. Specifically, the author sought to answer the following research questions,

RQ1. How did the engineering culture, classroom, and university environment contest Kitatoi's sense of belonging?

RQ2. How did Kitatoi establish a sense of belonging amidst the engineering culture at her institution?

Data for this study came from five rounds of narrative interviews collected over a year and a half of one participant, Kitatoi. Kitatoi spent six years as a part-time community college student and has now completed one academic year at Research State University. Research State University is a Hispanic Serving Institution with a Carnegie Classification of highest research activity, with an enrollment of 41% Latinx undergraduate student population, 50% first-generation college students, and nationally praised for being a beacon of social mobility to students in the surrounding geographic area, specifically enrolling a large portion of Pell Grant eligible students than nearly every university in the country.

The method used to analyze the interviews was an analysis of narratives; this method allows researchers to organize storied data into salient narrative threads, themes, and patterns across a participant's experiences. The author looked across five transcribed interviews, collected after completing each quarter, to understand common and salient experiences and relationships among the experiences. Reliability and validity were considered using the typology outlined in the quality management model.

Kitatoi's experiences were organized into four themes that were common across multiple interviews. Her sense of belonging was often (re)negotiated for the following reasons, 1) when positioned at the outskirts of engineering despite the diverse campus environment, 2) when instructors reproduced a particular way of being an engineer that left her struggling to feel a sense of belonging, 3) when juxtaposed her ways of belonging with her peers, and 4) her belongingness was supported when she identified peers with similar work styles.

The findings from this analysis of narratives can continue to shed light on the ways minoritized students' sense of belonging in engineering is disrupted even in a campus culture that is praised for its demographic diversity. Strategies for instructors to implement in their classrooms, framed to support nontraditional students, are outlined.

Introduction

Students' evaluation of their belongingness in a new context is an evaluation of "who I am" (i.e., their identity) and "what the setting allows or can allow" [1, p. 272]. Belongingness is an evaluation of person-environment fit, i.e., "who I am" relative to the engineering culture. Baumeister and Leary's seminal work [2] theorized that people are "naturally driven towards establishing and sustaining belongingness" [p. 499]. Tonso [3] posited that "identities serve as focal points for learning to belong in communities of practice" [p. 27] and once inside an engineering community of practice, students begin to formulate their identities. The engineering community of practice is a powerful influencer that shapes who students become and the culture of engineering ... "is not simply training in a prescribed set of appropriate, academic courses, but is [socialization] into a well-established system of practices, meanings, and beliefs" [4, p. 218]. Thus, belonging to the engineering community of practice compels students to acquire the cultural norms, values, and behaviors appropriate for this community. Such norms may encompass students' knowing what it takes to act like, be recognized as, and establish a sense of belonging as a competent member of the community [5], [6].

A sense of belonging and identity are inextricably intertwined, reciprocally support and inform each other. Hazari et al. [7] found that for women physicists in their senior year (i.e., fourth-year or greater), a sense of belonging supported their identification as a physics person. In comparison, a study by Verdín et al. [8] found that identifying as an engineer supported sense of belonging in both the discipline and the classroom setting. However, both studies used data collected at one point in time; thus, there is much to be learned about the interplay between establishing a sense of belonging and its support of identity development over time. Holland [9] studied the effect of belonging on students' intentions to persist or switch STEM fields found that "the main difference between switchers and persisters *was how belonging issues were handled*" [p. 318 emphasis in original].

In the article by Verdín et al. [10], Sandra's account, is one example of how women "handle" their sense of belonging. Sandra, a Latina, shared how her peers in a mechanical engineering course held limiting views about women in engineering, she stated, "I have had friends ... they have told me in the past that it is hard for them to listen to a woman because ... 'it's like ... in my mind it's still set that I know what I'm doing because I'm the guy ...'" [10, p. 281]. While she successfully graduated with a mechanical engineering degree, Sandra reflected, "I can understand where they are coming from 'cause maybe that's the culture in his family and where he's from" [10, p. 281]. Put simply, Sandra's friend had deeply held beliefs that women were less knowledgeable than men; nevertheless, her male friend's beliefs were his issues alone and not a reflection of her or women as engineers. The idea that to belong in engineering is to be male is embedded in the field due to the historical traditions of being a masculine-oriented profession. A historical examination of the construction of U.S. engineers reminds us that engineering was once a site where men would prove their manhood "by enduring stress and hardship" [11, p. 398] and where women "appeared as the *other*, entering a field that everyone assumed was and must be male territory" [12, p. 28]. Men are by default assumed to possess the patterns of behaviors and meanings associated with engineers; they have the advantage of being assumed membership into the "club," while there is "no such cushion of presumed competence for women" [13, p. 139]. Enculturation (i.e., adopting patterns of behavior and meanings) into the engineering culture often requires an understanding of

how students associate with, withdraw from, or negotiate the community's cultural norms and their own identities (e.g., being female and minoritized in engineering).

In engineering, cultural differences often affect students who live at the margins of the prototypical white masculine normativity; this outcome is evidenced by the low representation of ethnic minorities, women, and those who live at the intersection of both. The present study focuses on how one minoritized woman's sense of belonging in engineering was contested and negotiated. Specifically, using a longitudinal narrative approach by answering the following research questions,

RQ1. How did the engineering culture, classroom, and university environment contest Kitatoi's sense of belonging?

RQ2. How did Kitatoi establish a sense of belonging amidst the engineering culture at her institution?

Theoretical Framework: Sense of Belonging

Sense of belonging is used as a guiding framework for this study. A sense of belonging encompasses both cognitive and affective elements [14]. At the cognitive dimension, the evaluation of belonging is based on one's collective information about their experiences within a group (i.e., engineering culture) and with members of the group (i.e., engineering peers, professors, etc.). At the affective dimension, evaluation of belonging is based on feelings that develop from experiences within a group or with members of the group [14]. The cognitive and affective dimensions inform each other as an individuals' "cognitive processing often results in an affective response" to the event being evaluated [14, p. 483]. Dasgupta [15] illustrated the importance of belonging,

Because the need to belong is particularly strong under adversity or stress, it is likely to play an important role in the lives of individuals who belong to historically disadvantaged groups and find themselves in adverse situations where their group is numerically scarce and their abilities cast in doubt [p. 232]

Boone and Kirn [16] investigated two domains of belongingness, belonging in the engineering classroom and belonging in the engineering major for first-generation college students. They found that compared to their counterparts, first-generation college students were more likely to feel a sense of belonging in the classroom and engineering major, albeit their sample was overrepresented of White men [16]. Additionally, a study by Verdín et al. [17] found that first-generation college students' feelings of belonging in the classroom environment supported their beliefs about graduating with an engineering degree. These studies collectively offer promising and important insights into the benefits of establishing a sense of belonging for first-generation college students both men and women. However, we know that women experience the engineering culture differently than men, and minoritized women may face even greater threats to their sense of belonging [18], [19]; it's important to understand how minoritized women experience the engineering culture. Recent work found that minoritized women report differences in belongingness compared to women in the majority group (i.e., White and Asian women) [20]. Specifically, minoritized women were less likely to feel as though they belonged in the classroom

environment than women in the majority group. Feelings of belonging in the major and the classroom did not support minoritized women’s persistence beliefs, but it supported majority women’s persistence beliefs [20]. This distinction was a result of minoritized women not having established a sense of belonging in engineering. Thus, in light of prior studies, it was important to understand the barriers that may contest minoritized women’s belongingness and the negotiation strategies they must implement to establish a sense of belonging.

Methods

Data for this study came from five rounds of narrative interviews collected over a year and a half of one participant, Kitatoi. Kitatoi was the pseudonym chosen by the participant. The goal of the first interview was to understand the participant’s background experience, the pathway that led her to engineering, and early engineering-related experiences. The first interview was focused on broad open-ended questions, 1) Can you tell me about how you came to be where you are now, 2) Tell me about your pathway into engineering, and 3) Tell me about your experience as a first-year engineering student. The second through fifth interviews started with the broad overarching question of “Tell me about how your experience has been this past quarter.” A list of follow-up questions were compiled to capture aspects of her story that may have been missed in the previous interview. More information about the interviews can be found in Table 1.

Table 1

Information about the number of interviews and Kitatoi’s current enrollment

Number of interviews	Interview timeline	Context
Interview 1	2019, March	Winter quarter, transferred to Research State University from community college. First-quarter at Research State University
Interview 2	2019, August	Interview took place before the start of Fall quarter (third quarter at Research State University). This interview was a reflective account of her second-quarter
Interview 3	2019, December	End-Fall quarter, overview of experiences in the third-quarter at Research State University
Interview 4	2020, March	Spring quarter, enrolled in a fifth-quarter at Research State University. This interview was a reflection of fourth quarter and fifth-quarter experience
Interview 5	2020, September	Fall quarter, enrolled in a sixth-quarter at Research State University a reflection of fifth quarter and current experience

Participant Overview

Kitatoi is a full-time mother of three who spent six years as a part-time community college student. Her trajectory through community college and decision to pursue a mechanical engineering degree has been documented in prior published work, see [21]. She has now completed six quarters at Research State University. Research State University is a Hispanic Serving Institution with a Carnegie Classification of highest research activity, with an enrollment of 41% Latinx undergraduate student population, 50% first-generation college students, and nationally praised for being a beacon of social mobility to students in the surrounding geographic area. Research State University has been featured in higher education news outlets for enrolling a large portion of Pell Grant eligible students than nearly every university in the country.

Analysis

The method used to analyze the interviews was an analysis of narratives. Analysis of narratives allows researchers to organize storied data into salient narrative threads, themes, and patterns across a participants' experiences [22]. The author looked across five transcribed interviews, collected after completing each quarter, to understand common and salient experiences and continuity among Kitatoi's experiences. Reliability and validity were considered using the typology outlined in the quality management model. The quality management model, proposed by Walther et al. [23], was used as it illustrates types of validity that are not linked to a particular research tradition or practice. Their typology for quality was used when *making the data* and *handling the data*.

Theoretical validation is concerned with the fit between social reality and the theory produced [23]. When reconstructing Kitatoi's narratives (handling the data), the author was careful to capture her experience (i.e., social reality), as it was lived as opposed to how it fits a specific theory. *Procedural Validation* is concerned with incorporating features into the research design that improves the fit between reality and theory [23]. Polkinghorne [24] described several validation strategies that can "convince readers of the likelihood that the support for the claim is strong enough that the claim can serve as a basis for understanding ... human realm" [p. 476]. Polkinghorne [17] advised researchers to help participants elicit their experiences' reflective meanings since experiences are not surface-level phenomena. In the five interviews with Kitatoi (making the data), questions probing deep reflection were asked, e.g., "how did this experience make you feel?" Additionally, Polkinghorne [24] discussed mitigating social desirability, creating an atmosphere of comfort, and gaining the confidence of the participant. Thus, in each interview, a statement reminding the participant to speak freely about her experiences and that the aim was not to judge or criticize her experiences was conveyed (i.e., making the data). *Communicative validation*, concerned with the knowledge that is co-constructed in the social context [23], member-checking was used to ensure that her experiences were retold correctly, i.e., handling the data.

Positionality of the Researcher

Berger [25] posited three significant ways a researchers' position impacts their study: 1) access to the field, 2) shapes the nature of the researcher-researched relationship, and 3) the researchers' worldview and background affect how they "construct the world, use language, pose questions, and choose the lens for filtering the information gathered from participants and [to] make meaning of it" [p. 220]. Access to the field entails having a shared or unshared connection with participants, e.g., researcher and participants could have grown up in similar neighborhoods, thus creating a link and subsequently shaping their relationship. Understanding who the researcher is and how their views develop their study design, method, data collection, and data analysis enhances the quality of the research [25] and secures the research's trustworthiness [26]. The author identifies as a Latina who grew up in a low-income community, is a first-generation college student who has engineering degrees and is now an engineering educator. The lead researcher's positionality influences how the data were examined and the nature of the researcher-researched relationship.

Results

Kitatoi's sense of belonging was both contested and negotiated when she was positioned at the outskirts of engineering despite the diverse campus environment, when instructors reproduced a

particular way of being an engineer, and when juxtaposed with her peers who fit the engineering culture. Nevertheless, Kitatoi negotiated ways of belonging when she could identify with peers that had similar work styles. While there are differences within the Latinx culture, struggling to belong remains prevalent as the Latinx students continue to be underrepresented in engineering [27], [28]. In the following subsections, the author discusses the four themes in depth and their impact on Kitatoi's sense of belonging.

Positioned at the outskirts of her diverse campus environment and engineering.

Research State University has been continuously praised by *U.S. News & World Report* for being a beacon of social mobility for low-income students due to a large portion of Pell Grant eligible student enrollment and graduation rates. Considering the demographics of the student population Kitatoi's experience of not fitting in is especially pronounced. Kitatoi had a rocky transition from a community college (i.e., semester system) to Research State University (i.e., quarter system), "I just feel like I don't have enough time to do everything that I have to do in order to be really successful in these classes or even just enjoy my time at the university" [interview 1]. While she "... learned to be a good student, manage my time, study well ..." [interview 1] when attending community college as a part-time student, the demands of full-time student status, required for her Pell Grant eligibility, was overwhelming causing her to fail two classes her first quarter. As a response, Kitatoi reduced her course load the following quarter moving her from full-time to part-time student status. This shift in student status resulted in a ripple effect that further pushed her sense of belonging further into the margins as she stated,

the fact that I need to be there part-time ... the people at the financial aid, the professors that I talk to, they kind of look at me like I'm doing it wrong, *like I'm not being a good student* because I'm not able to be in this club ... that club, have a full-time schedule [interview 2].

Kitatoi actively tried to integrate herself into the campus environment by seeking to participate in a Chicano Studies Mentoring Program and "students with kids" group. However, due to the overwhelming number of Latinx students seeking mentorship and a limited amount of student mentors, she was left without the benefit of the mentoring resource. Likewise, the group tailored for students with kids was intended for students with toddlers, not young adolescence, "I'm not going to put my kids in daycare ... They don't need it" [reflection from interview 5]. The resources available to students to benefit their campus integration were not readily available or fit her current situation,

there are resources, but they're just at times that I'm not even on campus, or I'm not able to just go at whatever time I want. I need to be back home at a certain time because of the kids [interview 2].

While Research State University may be well equipped to serve its predominantly minoritized student population, there is also a common characteristic across students. The majority of the students attending this institution are enrolled as full-time students, 98% in 2018, and 95% are under 24. The homogeneity of the students enrolled at this institution positioned Kitatoi at the outskirts. In the second interview, when she was enrolled at Research State University for a third

quarter, she summarized her sentiments towards the institution's general treatment of nontraditional students, stating,

I just pretty much want to transfer because I feel like [Research State University], they don't give a shit about people's situations ... because I don't fit the numbers ... I talked to my advisor ... and he was telling me about statistics and generally people do this. Generally, students are like this, like that. And I told him, "Yo, how many of these students have three kids and are close to hitting 40? How many of your students are in my situation? None, right? So, that doesn't make sense to me, and it's not fair that you're holding me at these standards just like these other 20-year-old male students with no kids. That's not fair ..." I kind of have it set in my mind like [Research State University] just doesn't want me there because I don't fit ... they pretty much like to see numbers. If their students are doing well, then it's good reputation for the school. If there's one bad apple ... they tend to get rid of it, and I feel like that with me ... I just feel like yeah, they don't want me there, or I'm not good enough for that school ... [Interview 2]

Kitatoi's experience of not fitting into the institution was further exacerbated by the Dean of her mechanical engineering department, recounting,

The Dean of my department ... I talked to him ... I told him my situation. And pretty much [implied] basically if you can't handle this major, there's other majors that you could consider ... the help that I feel like I should be getting, it's not there at all. So, I feel like I have to pretend like I'm a 20-something year old with no other responsibilities, so that I can feel like I belong in these classes ... [Interview 2]

In her third quarter, the image of who belonged at Research State University and engineering was taking form and was limited to 20-year-old males with no family obligations and afforded time to carry a full course load and join clubs. Walton and Cohen [29] posit that when individuals feel insecure about their feelings of belongingness, they become hyper-aware of subtle cues that remind them of not belonging. It's noteworthy to point out that Kitatoi's experiences of not belonging were less than subtle. The overt manner in which she was reminded she did not belong was through advising strategies that simply did not consider her current life situation and her professor's lack of empathy towards her struggle to balance motherhood responsibilities and course demands. However, despite the unwelcoming culture, Kitatoi wasn't deterred from continuing her education. While she never explicitly stated that people like *her* belonged at Research State University or mechanical engineering, Kitatoi did try to reposition herself as an insider in the broader culture by demanding that her institution make space for people like her stating, "there should be help for people like me. I shouldn't be punished because I'm not able to be full-time ..." [Interview 2].

Research State University received its Hispanic-Serving designation in 2008, thus having more than a decade to properly understand the complexities of *servicing* Latinx students. Garcia [30] argues that because institutions that are predominately white become HSI due to demographic shifts, the institution's white normative standards (i.e., indicators of prestige and effectiveness grounded in whiteness) remain. Thus, HSIs with historical white normative standards still rooted in their administrative practices and a predominately white male engineering program further contested Kitatoi's sense of belonging.

Five quarters into her time at Research State University, Kitatoi was no longer in academic probation, however she was still enrolled as a part-time student as that strategy best supported her current life circumstance. Yet, Kitatoi still felt like an outsider in her institution and broader engineering culture,

I don't feel like I belong there, I don't feel like I connect with the school ... I just have that mentality of, "I just need to go through this part. I'm just passing by" ... And I'm fine with that, that doesn't bother me anymore [interview 4]

Decades of research focused on college student's college departure affirm that students are more likely to withdraw from their institution, all together, when they are not sufficiently integrated socially and academically [31]–[38]. Kitatoi's resignation to "just passing by" and her lack of connectedness with the institution are worrisome. Seymour and Hewitt [39] and Marra et al.'s [40] work emphasized that women who leave STEM disciplines decide to switch into non-engineering degree programs due to feeling as though they didn't belong in the discipline, irrespective of actual performance markers. Kitatoi repeatedly faced experiences of being positioned at the outskirts of her campus and engineering environment. She also spoke about how instructors' ideologies of what it means to be an engineer disrupted her sense of belonging.

Instructors' reproduction of who belongs in engineering.

In the engineering classroom, instructors reproduced the idea that there was a particular way of being like an engineer, leaving Kitatoi struggling to establish a sense of belonging. In the first quarter at Research State University and her first exposure to a mechanical engineering course, Kitatoi was confronted with the unrealistic expectation of what it means to belong in engineering, stating,

[the] Dean of the department ... He was actually one of my professors the very first semester ... he has this attitude of, "You just need to be the best. You just need to know this already. This should be common sense. You should be able to do this in your sleep. You should be able to know all these formulas, memorize all these formulas." He had that mentality of you just need to already be smart enough for this major, if you're going to make it in this major ... And that got to me ... I'm not at the level that he's already expecting everybody to be. Maybe I'm in the wrong major ... maybe I shouldn't be here because if I want to be here, I'm already way behind how this professor's expecting everybody to be ... [interview 2]

Engineering faculty and their practices are typically students' first exposure to the engineering field. Faculty not only teach students engineering concepts but they also serve as formal or informal mentors that can shape how students experience the academic climate and influence their feeling of belongingness [41]. The ways of belonging constructed by the Dean of the department promoted a fixed view of one's ability; implicitly rejecting the idea that students can *become* capable knowers and doers. Research has found that a fixed mindset rhetoric only serves to systematically disenfranchise minoritized students' performance in STEM; Canning et al. [42] documented how minoritized students' motivation and achievement are negatively shaped by STEM professors' fixed mindsets. The Dean's rhetoric was also a reproduction of masculine social norms which implicitly tell women that to belong in engineering they must fit the image of

stereotypically masculine traits [e.g., 12]. Comprehensive research studies have documented the notion that brilliance and genius equate to masculinity [e.g., [44]–[46]], and these messages have adverse effects on women’s interest in the field and belongingness [45]. The message Kitatoui was receiving from her environment placed her in a state of negotiation, evaluating her *want* (i.e., “if I want to be here”) with the expectations of the type of student that should be walking through the doors of an engineering classroom (i.e., “you just need to already be smart enough for this major”). The constructed narrative of who belonged in engineering was shaping Kitatoui’s thoughts of who should and should not be an engineer. These early socializing messages of who belongs in engineering are intended to train engineering students to conform to a culture by learning to portray a “convincing and correct performance in a role ... and that performance involves very masculine rituals and images” [47, p. 668]. Still, Kitatoui agentically resisted the constructed narrative of who belongs in engineering, “I wouldn’t be sitting in your class if I was a genius already ... I don’t think you [the Dean] should be making your students feel like you need to already be a genius ...” [interview 2]. Kitatoui’s statement was a negotiative act against the ways of belonging portrayed by the Dean and can be understood as her attempt to redefine who belongs in engineering, i.e., not already made geniuses. Unfortunately, the reproduction of what it means to be a “good engineer” was a recurring message engineering professors propagated at Research State University.

Five quarters into her mechanical engineering degree program Kitatoui continued to receive messages of the level of competency expected of engineers, recalling, “In my statics class, my professor ... he would just say, “You know, I think to be a good engineer, you should be able to solve this really easily ...” [interview 4]. The engineering faculty at Research State University participated in a boundary setting practice, where particular qualifications were intended to restrict ““true” engineers” from other lesser qualified individuals [48, p. 311]. While the messages that bound students into believing there is one particular way of being a “good engineer” are harmful to students. Kitatoui resisted the idea that she could not achieve the “good engineer” status, declaring

“Okay, I’m going to practice these types of problems and come the final, I’m going to do better in these kinds of problems.” ... it’s like a mental note that I would say to myself, “Okay, I’m going to prove it come the final ...” [interview 4]

The idea of what constituted a “good engineer” left Kitatoui’s sense of belonging contested. Yet, she strove to prove to her instructors and herself that she was a “good engineer.” Kitatoui, unbeknownst, played into the meritocratic game to prove that she could solve difficult equations easily and thus was a “good engineer.” Yet, her approach was common, as Seron et al. [19] has documented that the culture of engineering reproduces a particular way of being, in that it socializes women into believing that raising concerns about marginalization is “tangential ... to what counts as the “real” practical and objective work of engineers” [p. 4]. At the end of the fourth interview, Kitatoui’s reflection of what constituted a “good engineer” was filled with resentment, while she received a B in her statics class, the image of who belonged in engineering left an unpleasant feeling, stating,

I think it’s really messed up. I think a lot of the times tambien [also] that whole good engineer, student engineering means I have to be a dude that spends all of my days in office hours or at the TA’s office hours brown nosing or asking them questions just all day long like I have nothing else to do, which I think that’s wrong ... not every student is able to do

that. But I don't think that they're going to be better engineers than, say, me. But I think the professors do think that ... [interview 4]

The narratives faculty portray in their classrooms about the type of people that belong in engineering only serve as instruments to determine who should and shouldn't participate in the field [41], [49]. Pawley's [49] work reminds us of the historical concern universities had about "diluting" engineering's status due to increasing women's participation [p. 63]. Perhaps the mechanical engineering faculty members intended to preserve their discipline's status by binding their field to a set of hegemonic ways of being. Equally plausible is the lack of understanding of how rhetoric that maintains the fields masculinity adversely effects the few women in their classes.

The engineering culture is an interconnected system where instructors are not only imposing a certain way of being like an engineer, but peers are absorbing these early socializing messages and reproducing them. The next section describes Kitatoi's contested sense of belonging when juxtaposing her ways of being with her peers.

Belonging contested and negotiated when juxtaposed with her peers' ways of being like an engineer.

Observing one's environment and how others interact in the environment can prompt minoritized women to reevaluate their sense of belonging [50], as behaviors they observe from others may not reflect their behavior. Prior to the fifth interview, upon reviewing the four interview transcripts, I noticed Kitatoi often compared herself to her peers. I made it a point to ask her how she would describe her learning to understand how she may be positioning herself relative to her peers; she stated,

I always thought that I learned things or understood things a lot, at a slower pace than what seemed to be the rest of my class ... I always thought that I need to hear things once or twice ... really dig deep ... rather than just getting everything really quick ... [interview 5]

The dualism between taking a "slower pace" and "getting everything really quick," contested her sense of belonging in the engineering classroom environment. While she is observing others presumably promptly absorbing the course material, her reality is different. She often finds herself confused about topics covered in the lecture and requires multiple forms of exposure, i.e., "I need to hear things once or twice." Perhaps what Kitatoi was really bearing witness to was the ingrained dispositional belief her peers had about being the "cream of the crop" [4], [51, p. 36]; which, to uphold, requires a *display* of competence. Robinson and McIlwee [52] argued that engineering competence was a function of how well one presents the image of what it means to "look like an engineer ... and act like an engineer," an image equated to masculinity [p. 406]. Having spent six quarters at Research State University, Kitatoi continuously observed her male peers present an image of themselves as truly in their element, stating,

I can kind of see it in the way the other students talk and the way that they're like, they don't talk about like they're worried about an assignment ... that confidence that other people have that I don't have ... a lot of the times there are questions that like, "Oh shit." ... I wouldn't have thought of those questions ... Let's say I get back an exam and it's very average, or maybe below average, and I kind of see other people around and they don't have an expression in their face that says that they got an average or below average score. That's kind of also where I get it from ... I guess, confidence level that other people seem

to be at ... I feel like it's typically just groups of guys ... They just look like they arrived unprepared, started late, like their buddies, you could tell that they hang out after class ... with my friends at school ... we have a class coming up and we're headed to it. That's all we're talking about. If we turn in an assignment, that's what we talk about. If we have a test coming up, that's what we talk about ... others that I'm referring to, they talk about ... everything else, all the other stuff, except for what's actually going on in the class, which makes me think that they must just have that shit down. That they're not even worried about it [interview 5]

Recent work by Verdín [20] found that students' beliefs in their capabilities to do well in engineering subsequently supported their sense of belonging in the major and in the classroom environment. Kitatoi's narrative further expands on the connection between feeling confident in one's ability and sense of belonging by exposing how one's confidence is contested in the engineering culture. The calm demeanor observed in her male classmates translated to confidence in doing well in the course. In previous interviews, Kitatoi spoke about how she preferred to form study groups with other female classmates. She, along with the other few female classmates, specifically focused on the classroom content when they interacted with each other, a practice that wasn't shared by her male classmates, i.e., "others that I'm referring to [male classmates] ... talk about ... everything else, all the other stuff, except for what's actually going on in the class." Whereas Kitatoi interpreted her male classmates' behavior as confidence in their ability, their behavior can also be interpreted as performative acts of masculinity. Scholars have found that success in a male-dominated occupation is strongly associated with gender-stereotypic performances such as displaying masculine personality (e.g., competitive, aggressive, daring, brilliance) [43] and fields that value brilliance as an inherent trait often evoke a masculine environment [45]. In Kitatoi's classroom environment, masculinity was being enacted through the emotionless expressions in her peers' faces when a major exam was returned with a grade, when difficult questions were posed in class, and a general sense of confidence that they naturally belong in that particular class environment (e.g., "arriv[ing] unprepared, start[ing] late"). Observing the cliques of guys in her class uphold masculine social norms contested her beliefs of what it means to belong in engineering. Nevertheless, Kitatoi negotiated her sense of belonging over time, "... I think it was just time. Time taking the classes that yeah, changed my mind ..." [interview 5] and repositioned herself in a location that fit her work style and how she saw herself, stating,

I feel like I'm kind of the behind the scenes person while these type of people are the ones up in front of the crowd explaining *my work* because we're in the same class. We're learning the same subject. I think that's a good way of explaining how I see the situation ... I think just being long enough on campus or in these classes, being there long enough to know that there's other students that do have the same question that I do, or there are other students that also have no clue as to what's going on, but they're going to figure it out, rather than just flashy, really smart, just knows everything off the top of their head type of person ... [interview 5]

Kitatoi came to identify two forms of belonging in engineering, those who 'fit' the stereotypical way of being, i.e., "flashy, really smart ... knows everything off the top of their head ..." and those that needed to spend time in the library working through problems. She negotiated her belongingness in engineering by positioning herself in a location that did not contradict how she

saw herself. It is commendable that Kitatoi, after repeatably stating she felt like she didn't belong, (e.g., "I feel like I'm the student that doesn't fit in ...I'm kind of like an outsider ..." [interview 2], "I don't feel like I belong there ..." [interview 4], and "Besides feeling like I don't belong... definitely feel like I'm sort of isolated" [interview 5]) would find a way to position herself in a manner that supported her sense of belonging. However, a perceived mismatch between a culture and students' values, beliefs and identities can induce them to consider other fields that offer a match to their ways of being [15], [50]. For the time being, Kitatoi seemed to have found a way of belonging by negotiating how the culture expects students to be and how she sees herself. Continuing to follow Kitatoi's engineering trajectory will further inform whether her negotiated ways of belonging were enough to help her persist towards degree completion. The last theme presented in this paper is a final examination of Kitatoi's efforts to establish a sense of belonging.

Identifying peers with similar work styles supported her sense of belonging.

The classroom and campus environment seeped in masculine social norms and young student vibes, contested Kitatoi's sense of belonging. In the current engineering culture, establishing a sense of belonging for minoritized women is a continuous negotiation process. Kitatoi found ways to belong in engineering by recreating an environment that was conducive to her ways of learning, ways of being an engineering student, and in an environment that did not reproduce masculine social norms, evidenced in the following account,

I would get together with these two other girls ... we had pretty good chemistry going on with studying for the classes ... we would work on one class and then move to the other class if we needed to ... we were our support, just us three girls, we were very supportive of each other because we're all on that same boat ... there's like 80 people in this class, and there's like seven girls. And there's three of us here, so holy shit, we've got to stick together type of thing. I think that helped a lot, even mentally *it made me feel more like I belong*. Like yeah, I can do this because if I'm not understanding something, I wasn't the only one that's not understanding it. Or maybe they didn't understand something, but I did, so I was able to have a conversation with them ... Just the fact that they were females, it just made it a lot more comfortable with either even asking questions, emailing the professor, being stuck on the same thing, or being just stuck at all. It wasn't a feeling of, "Oh, I must be dumb because I'm a girl, and I shouldn't be in this class." [interview 2]

The second interview with Kitatoi was a reflective account of her second quarter at Research State University. The practical strategies of identifying individuals with the same learning and studying style served to provide her with a counterspace where she can begin developing a sense of belonging. Forming a study group with other female students was equally instrumental, especially when considering that Kitatoi was observing how the majority of her peers reproduced masculine performative norms that contested her belongingness. Implicit stereotypes of who belongs in engineering leaves an imprint on students' self-concept (i.e., ideas about oneself [15], [53], however, creating a counterspace that allowed her to express concerns of course content without having her self-concept threatened was a strategy she continued to employ over time. Counterspaces were originally theorized as spaces where students with similar racial/ethnic backgrounds could gather in a "safe space" to share their common experiences, see [54], [55]. Ong et al.'s [56] more recent work found that minoritized women from heterogeneous backgrounds, but in similar classes, formed counterspaces by "band[ing] together for study groups" [p. 220] and

shared content knowledge. “Spaces” were not always physical but also conceptual or ideological [38]; the ideological space Kitatoi created aligned with her sense of who she was as a learner. In the follow-up interviews, Kitatoi continued to describe the specific strategies she used when choosing the type of people to associate with, this was evident in her 3rd and 4th interview,

... what I look for in people that I want to study with is that they’re driven ... that I can have a conversation with regarding the material because I think that’s how I learn also better, if I have a conversation, like a back-and-forth ... because I can study with those people. I can get something out of it ... rather than the ... people that are just so smart. They don’t even have to talk about anything ... I think I’d rather hang out with people that are like ... “Yeah, I’m struggling, but I’m going to figure it out” versus somebody that just understands something right away ... I think I connect more with people that figure things out. Doesn’t matter how difficult it is or how long it takes them ... [interview 3]

I tend to look for people that sit around the same area that I do, towards the front ... or taking notes, ask[ing] questions ... versus the people that are ... talking a lot during class or even before class, like, “... Why do we have to be here? I wish there was no class today.” Yeah, we all feel like that, but you’re here, put your game face on ... I kind of see they’re a younger crowd, they have this I don’t really care type of vibe ... when I’m looking for somebody ... to study with ... just have the same type of work habits, don’t like to leave their assignments till the last minute ... [interview 4]

Belonging uncertainty is especially pronounced for individuals who receive subtle or not so subtle messages of who belongs in a certain space i.e., the male dominated culture of engineering [15], [29], [57]. However, students can employ mechanisms to create safe environments where their abilities and performance are not challenged or called into question. Kitatoi found a counterspace with others who would not criticize her learning style and with those who did not display performative acts of masculinity. As well, similarities among peers matter [15], however sometimes it is not possible to build networks with peers that share a similar background especially when the demands of motherhood and being a commuter student are compounded. The absence of a connection with in-group peers was noticeable, when asked if she would prefer to be around peers who are similar to her (i.e., Latinas, first-generation college students), Kitatoi stated,

I think I would like that. I think it would be just fun. More of a sense of community ... there is people kind of like me that are doing the same thing that I’m trying to do ... I think if I had more of that, I think it would be a lot more enjoyable rather than feeling out of place or like, “I’m the only one doing this, I’m the only one that brings frijoles [beans] for lunch” ... [interview 4]

While Kitatoi did not limit herself to studying with other Latinas or other women first-generation college students, possibly because of the scarcity in engineering, her focus was ideological as it pertains to how they approach learning difficult material. Her strategy of focusing on how people approach learning was enough to build a sense of belonging, as she stated,

The people that I have studied with [White and Asian women], they’ve been just like me ... and they’re doing fine. They’re just as much as in this field as I am ... Clearly, not

everybody just has all the answers off the top of their head. They'll just figure it out or if they don't remember, they know where to look to get it ... [interview 5]

Discussion and Implications

Students' who aspire to become part of the engineering community of practice are expected to acquire the cultural norms, values, and behaviors appropriate for their respective community [58]. However, for minoritized women in engineering, who are also nontraditional students, the process of acquiring the cultural norms and values of the community often means they have to "pretend like [they are] a 20-something year old with no other responsibilities" or "have to be a dude." This study sought to understand how Kitatoi's sense of belonging was impacted through the engineering culture, classroom, and university environment and how she came to establish a sense of belonging amidst an unwelcoming engineering environment. In Kitatoi's narrative account, her sense of belonging was negatively impacted when juxtaposing her ways of being with those displayed by her peers who fit the stereotype of an engineer, through the views of instructors who reproduced a particular way of being an engineer that left her feeling like an outsider, and through a university environment that could not accommodate a part-time student's needs. In the five interviews with Kitatoi, there was a recurring message of feeling like an outsider, not fitting in, and not belonging in the campus and classroom environment. The feeling of "not being good enough" was expressed twenty times throughout the second interview, alone; this sentiment resulted in a diminished sense of belonging. The mechanical engineering department culture espoused ideologies, assumptions, and values of who belonged in engineering which felt incongruent with Kitatoi's self-concept.

Women who do not fit the engineering culture must develop strategies to succeed amidst the unwelcoming space. Kitatoi employed a strategy of creating for herself a counterspace where her self-concept as a student who needs to revisit course content and needing to discuss course material did not call into question her competency. The act of creating a counterspace helped her negotiate her sense of belonging and ultimately allowed her to see that there were other women "just like me" who belonged in mechanical engineering just as much as she did. While it is not a radical approach to revisit course material and form a study group, the cultural norms Kitatoi was experiencing explicitly told her that she needed to be a type of student who "should be able to do [course material] in [her] sleep ... should be able to know all these formulas, memorize all these formulas," and "get everything really quick." Her mechanical engineering Dean and instructors' socializing messages called into question her state of belonging in the discipline. At play was a "cultural construction of ability, of being "not cut out"" for the discipline [59, p. 62].

While the objective of the study was not to shame or blame individuals at Research State University, it is certainly important to call attention to the practices that are systematically contesting minoritized women's sense of belonging. Research has found that departments and programs who focus on collaboration rather than competition and student-centered approaches rather than institution-centered approaches have an increase success rate of all of their students, and more specifically minoritized students [60]–[62]. The work of Rainey et al. [63] found faculty strategies that statistically supported minoritized women's sense of belonging in the classroom environment which include:

- Creating an atmosphere where students feel they could ask their instructors for help if they did not understand course-related material
- Instructors being available to meet.

- When instructors fostered an atmosphere of mutual respect.
- When students were able to leverage their home experiences to solve an engineering task.

Educators may rightfully conclude that the first three practices listed are standard practices in engineering education; however, Kitatoi's experience is a powerful and eye-opening account that establishing a welcoming atmosphere is not always guaranteed even at "Hispanic-serving" institutions. The last strategy, i.e., drawing on home experiences to scaffold problem-solving tasks, is closely related to the concept of funds of knowledge [17], [64], [65] which maintains that students enter universities with accumulated bodies of knowledge that can serve as capital towards learning. The ability to use one's accumulated bodies of knowledge to support their engineering learning is especially important towards establishing a sense of belonging in the classroom for minoritized women compared to other racialized groups (i.e., majority men and women) [57]. Additionally, the strategy of helping students leverage their own funds of knowledge is a practice that educators can carry out in their classroom environment.

Negotiating ways of belonging in engineering is a mechanism that can help students persist in the field, however the process of negotiation can also bring issues of cultural mismatch to the forefront. A practical remedy to support minoritized women's negotiated sense of belonging can be through a social-belonging writing intervention. Shnabel et al. [66] found that writing about social belonging improves academic performance and identity threats among negatively stereotyped group members. The study was conducted with Black and White high school students; however, there is merit to translating this intervention from a secondary context to a post-secondary context. Engineering educators can consider using this exercise as extra credit that prompts students to consider how their approach to learning or strategies to learn course material supports their belongingness in the discipline. The goal of the social-belonging writing intervention could be to bring to the forefront how students learning strategies are strategies befitting engineers, thus supporting their sense of belonging in the discipline.

Conclusion and Future Work

This study was a narrative analysis of five interviews with one Latina, first-generation college student whose nontraditional path into engineering has been a constant struggle. Three major sources contested her sense of belonging, which include the "Hispanic-Serving" Institution's white normative standards, the masculine social norms espoused by her department's faculty, and peers' reproduction of masculine ways of being an engineer. Nevertheless, Kitatoi found a way to belong through a counterspace created not by in-group peers but by peers who shared similar ideologies towards learning. The author will continue to follow Kitatoi's trajectory with the hope of tracking her successful degree completion and understanding the strategies she continued to employ to foster a sense of belonging. As well, future work will also closely examine the interplay between establishing a sense of belonging and identity development.

References

- [1] G. M. Walton and S. T. Brady, "The Many Questions of Belonging," in *Handbook of*

- Competence and Motivation Theory and Application*, 2nd ed., A. J. Elliot, C. S. Dweck, and D. S. Yeager, Eds. New York: The Guilford Press, 2017, pp. 272–293.
- [2] R. F. Baumeister and M. R. Leary, “The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation,” *Psychol. Bull.*, vol. 117, no. 3, pp. 497–529, 1995, doi: 10.1037/0033-2909.117.3.497.
- [3] K. L. Tonso, *On the outskirts of engineering: Learning identity, gender, and power via engineering practice*. Brill Sense, 2007.
- [4] K. L. Tonso, “The Impact of Cultural Norms on Women*,” *J. Eng. Educ.*, vol. 85, no. 3, pp. 217–225, 1996, doi: 10.1002/j.2168-9830.1996.tb00236.x.
- [5] J. Lave and E. Wenger, *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, 1991.
- [6] E. Wenger, “Communities of Practice and Social Learning Systems,” *Organization*, vol. 7, no. 2, pp. 225–246, 2000.
- [7] Z. Hazari, D. Chari, G. Potvin, and E. Brewé, “The context dependence of physics identity: Examining the role of performance/competence, recognition, interest, and sense of belonging for lower and upper female physics undergraduates,” *J. Res. Sci. Teach.*, no. August 2019, pp. 1–25, 2020, doi: 10.1002/tea.21644.
- [8] D. Verdín, A. Godwin, A. Kirn, L. Benson, and G. Potvin, “Understanding How Engineering Identity and Belongingness Predict Grit for First- Generation College Students,” 2018.
- [9] D. G. Holland, “The Struggle to Belong and Thrive,” in *Talking About Leaving Revisited: Persistence, Relocation, and Loss in Undergraduate STEM Education*, E. Seymour and A.-B. Hunter, Eds. Switzerland: Springer, 2019, pp. 277–327.
- [10] D. Verdín and A. Godwin, “Exploring latina first-generation college students’ multiple identities, self-efficacy, and institutional integration to inform achievement in engineering,” *J. Women Minor. Sci. Eng.*, vol. 24, no. 3, pp. 261–290, 2018, doi: 10.1615/JWOMENMINORSCIENENG.2018018667.
- [11] L. M. Frehill, “The Gendered Construction of the Engineering Profession in the United States, 1893–1920,” *Men Masc.*, vol. 6, no. 4, pp. 383–403, 2004, doi: 10.1177/1097184X03260963.
- [12] A. S. Bix, “From ‘Engineers’ to ‘Girl Engineers’ to ‘Good Engineers’: A History of Women’s U.S. Engineering Education,” *NWSA J.*, vol. 16, no. 1, pp. 27–49, 2004, doi: 10.1353/nwsa.2004.0028.
- [13] J. S. McIlwee and J. G. Robinson, *Women in engineering: Gender, power, and workplace culture*. SUNY Press, 1992.
- [14] K. A. Bollen and R. H. Hoyle, “Perceived Cohesion: A Conceptual and Empirical Examination,” *Soc. Forces*, vol. 69, no. 2, pp. 479–504, 1990.
- [15] N. Dasgupta, “Ingroup experts and peers as social vaccines who inoculate the self-concept: The stereotype inoculation model,” *Psychol. Inq.*, vol. 22, no. 4, pp. 231–246, 2011, doi: 10.1080/1047840X.2011.607313.
- [16] H. Boone and A. Kirn, “First Generation Students Identification with and Feelings of Belongingness in Engineering,” 2016.
- [17] D. Verdín, J. M. Smith, and J. C. Lucena, “The influence of connecting funds of knowledge to beliefs about performance, classroom belonging, and graduation certainty for first-generation college students,” in *ASEE Annual Conference and Exposition, Conference Proceedings*, 2020, vol. 2020-June, doi: 10.18260/1-2--35343.

- [18] M. Ong, C. Wright, L. Espinosa, and G. Orfield, "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harv. Educ. Rev.*, vol. 81, no. 2, pp. 172–209, 2011.
- [19] C. Seron, S. Silbey, E. Cech, and B. Rubineau, "'I am Not a Feminist, but..': Hegemony of a Meritocratic Ideology and the Limits of Critique Among Women in Engineering," *Work and Occupations*, vol. 45, no. 2, pp. 131–167, 2018, doi: 10.1177/0730888418759774.
- [20] D. Verdín, "The Power of Interest: Minoritized Women's Interest in Engineering Fosters Persistence Beliefs Beyond Belongingness and Engineering Identity," *Int. J. STEM Educ.*, vol. 8, no. 33, pp. 1–19, 2021.
- [21] D. Verdín, "'I Learned How to Divide at 25': A Counter-Narrative of How One Latina's Agency and Resilience Led Her Toward an Engineering Pathway," in *An Asset-Based Approach to Advancing Latina Students in STEM*, Routledge, 2020, pp. 147–164.
- [22] D. E. Polkinghorne, "Narrative configuration in qualitative analysis," *Int. J. Qual. Stud. Educ.*, vol. 8, no. 1, pp. 5–23, 1995, doi: 10.1080/0951839950080103.
- [23] J. Walther, N. W. Sochacka, and N. N. Kellam, "Quality in interpretive engineering education research: Reflections on an example study," *J. Eng. Educ.*, vol. 102, no. 4, pp. 626–659, 2013, doi: 10.1002/jee.20029.
- [24] D. E. Polkinghorne, "Validity Issues in Narrative Research," *Qual. Inq.*, vol. 13, no. 4, pp. 471–486, 2007.
- [25] R. Berger, "Now I see it, now I don't: researcher's position and reflexivity in qualitative research," *Qual. Res.*, vol. 15, no. 2, pp. 219–234, 2015, doi: 10.1177/1468794112468475.
- [26] A. K. Shenton, "Strategies for ensuring trustworthiness in qualitative research projects," *Educ. Inf.*, vol. 22, no. 2, pp. 63–75, 2004, doi: 10.3233/EFI-2004-22201.
- [27] J. Roy, "Engineering by the Numbers," *Am. Soc. Eng. Educ.*, pp. 11–47, 2018.
- [28] National Science Foundation and National Center for Science and Engineering Statistics, "Women, Minorities, and Persons with Disabilities in Science and Engineering," 2019. [Online]. Available: www.nsf.gov/statistics/wmpd/.
- [29] G. M. Walton and G. L. Cohen, "A Question of Belonging : Race , Social Fit , and Achievement," vol. 92, no. 1, pp. 82–96, 2007, doi: 10.1037/0022-3514.92.1.82.
- [30] G. A. Garcia, *Becoming Hispanic-serving institutions: Opportunities for colleges and universities*. Johns Hopkins University Press, 2019.
- [31] J. Engle and V. Tinto, "Moving Beyond Access: College Success for Low-Income, First-Generatoin Students," 2008.
- [32] R. Maestas, G. S. Vaquera, and L. M. Zehr, "Factors Impacting Sense of Belonging at a Hispanic-Serving Institution," *J. Hispanic High. Educ.*, vol. 6, no. 3, pp. 237–256, 2007, doi: 10.1177/1538192707302801.
- [33] N. G. Christie and S. M. Dinham, "Institutional and External Influences on Social Integration in the Freshman Year," *J. Higher Educ.*, vol. 62, no. 4, pp. 412–436, 2017.
- [34] D. L. McCoy and D. J. Rodricks, "Critical Race Theory in Higher Education: 20 Years of Theoretical and Research Innovations," *ASHE High. Educ. Rep.*, vol. 41, no. 3, pp. 1–117, 2015, doi: 10.1002/aehe.20021.
- [35] H. Ashar and R. Skenes, "Can Tinto's Student Development Model be Applied to Nontraditional Students?," *Adult Educ. Q.*, vol. 43, no. 2, pp. 90–100, 1993.
- [36] E. T. Pascarella and P. T. Terenzini, *How College Affects Students: A Third Decade of*

- Research. Volume 2.* ERIC, 2005.
- [37] K. W. Reid, "Understanding the Relationships among Racial Identity , Self-Efficacy , Institutional Integration and Academic Achievement of Black Males Attending Research Universities," vol. 82, no. 1, 2015.
- [38] V. Tinto, *Leaving college: Rethinking the causes and cures of student attrition.* ERIC, 1987.
- [39] E. Seymour and N. M. Hewitt, *Talking about leaving: Why undergraduates leave the sciences*, vol. 12. Westview Press Boulder, CO, 1997.
- [40] R. M. Marra, K. A. Rodgers, D. Shen, and B. Bogue, "Leaving engineering: A multi-year single institution study," *J. Eng. Educ.*, vol. 101, no. 1, pp. 6–27, 2012, doi: 10.1002/j.2168-9830.2012.tb00039.x.
- [41] E. Blosser, "Gender Segregation Across Engineering Majors: How Engineering Professors Understand Women's Underrepresentation in Undergraduate Engineering," *Eng. Stud.*, vol. 9, no. 1, pp. 24–44, 2017.
- [42] E. A. Canning, K. Muenks, D. J. Green, and M. C. Murphy, "STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes," *Sci. Adv.*, vol. 5, no. 2, 2019, doi: 10.1126/sciadv.aau4734.
- [43] M. A. Cejka and A. H. Eagly, "Gender-Stereotypic Images of Occupations Correspond to the Sex Segregation of Employment," *Personal. Soc. Psychol. Bull.*, vol. 25, no. 4, pp. 413–423, 1999.
- [44] L. Bian, S. J. Leslie, M. C. Murphy, and A. Cimpian, "Messages about brilliance undermine women's interest in educational and professional opportunities," *J. Exp. Soc. Psychol.*, vol. 76, no. January, pp. 404–420, 2018, doi: 10.1016/j.jesp.2017.11.006.
- [45] L. Bian, S. J. Leslie, and A. Cimpian, "Gender stereotypes about intellectual ability emerge early and influence children's interests," *Science*, vol. 355, no. 6323, pp. 389–391, 2017, doi: 10.1126/science.aah6524.
- [46] M. Bennett, "Self-estimates of ability in men and women," *J. Soc. Psychol.*, vol. 137, no. 4, pp. 540–541, 1997, doi: 10.1080/00224549709595475.
- [47] H. Dryburgh, "Work Hard, Play Hard Women and Professionalization in Engineering- Adapting to the Culture," *Gend. Soc.*, vol. 13, no. 5, pp. 664–682, 1999.
- [48] A. L. Pawley, "Universalized narratives: Patterns in how faculty members define 'engineering,'" *J. Eng. Educ.*, vol. 98, no. 4, pp. 309–319, 2009, doi: 10.1002/j.2168-9830.2009.tb01029.x.
- [49] A. L. Pawley, "D Chapter 3: What counts as 'engineering': Towards a Redefinition," *Eng. Soc. justice Univ. beyond*, p. 59, 2012.
- [50] C. Seron, S. S. Silbey, E. Cech, and B. Rubineau, "Persistence Is Cultural: Professional Socialization and the Reproduction of Sex Segregation," *Work Occup.*, vol. 43, no. 2, pp. 178–214, 2016, doi: 10.1177/0730888415618728.
- [51] E. de Pillis and L. de Pillis, "Are Engineering Schools Masculine and Authoritarian? The Mission Statements Say Yes," *J. Divers. High. Educ.*, vol. 1, no. 1, pp. 33–44, 2008, doi: 10.1037/1938-8926.1.1.33.
- [52] J. G. Robinson and J. S. McIlwee, "Men, Women, and the Culture of Engineering," *Sociol. Q.*, vol. 32, no. 3, pp. 403–421, 1991, doi: 10.1111/j.1533-8525.1991.tb00166.x.
- [53] R. F. Baumeister, "Self-Concept, Self-Esteem, and Identity," in *Personality: contemporary theory and research*, V. J. Derlega, B. A. Winstead, and W. H. Jones, Eds. 2005, pp. 246–280.

- [54] T. J. Yosso, W. A. Smith, M. Ceja, and D. G. Solórzano, "Critical race theory, racial microaggressions, and campus racial climate for latina/o undergraduates," *Harvard Educational Review*, vol. 79, no. 4, pp. 659–690, 2009, doi: 10.17763/haer.79.4.m6867014157m707l.
- [55] D. Solorzano, M. Ceja, and T. Yosso, "Critical Race Theory, Racial Microaggressions, and Campus Racial Climate: The Experiences of African American College Students," *J. Negro Educ.*, vol. 69, no. 1/2, pp. 60–73, 2000, [Online]. Available: <http://www.jstor.org/stable/2696265>
<http://about.jstor.org/terms>.
- [56] M. Ong, J. M. Smith, and L. T. Ko, "Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success," *J. Res. Sci. Teach.*, vol. 55, no. 2, pp. 206–245, 2018, doi: 10.1002/tea.21417.
- [57] M. Ayre, J. Mills, and J. Gill, "'Yes, I do belong': the women who stay in engineering," *Eng. Stud.*, vol. 5, no. 3, pp. 216–232, 2013, doi: 10.1080/19378629.2013.855781.
- [58] E. Wenger, "Communities of practice and social learning systems," in *Social learning systems and communities of practice*, Springer, 2010, pp. 179–198.
- [59] S. Secules, A. Gupta, A. Elby, and C. Turpen, "Zooming Out from the Struggling Individual Student: An Account of the Cultural Construction of Engineering Ability in an Undergraduate Programming Class," *J. Eng. Educ.*, vol. 107, no. 1, pp. 56–86, 2018, doi: 10.1002/jee.20191.
- [60] S. D. Museus and D. Liverman, "High-performing institutions and their implications for studying underrepresented minority students in STEM," *New Dir. Institutional Res.*, vol. 2010, no. 148, pp. 17–27, 2010, doi: 10.1002/ir.358.
- [61] K. Borman, R. Halperin, and W. Tyson, *Becoming an engineer in public universities: Pathways for women and minorities*. Springer, 2010.
- [62] D. R. Johnson *et al.*, "Examining Sense of Belonging Among First-Year Undergraduates From Different Racial/Ethnic Groups," *J. Coll. Stud. Dev.*, vol. 48, no. 5, pp. 525–542, 2007, doi: 10.1353/csd.2007.0054.
- [63] A. Rainey, D. Verdín, and J. M. Smith, "Classroom Practices that Support Minoritized Engineering Students' Sense of Belonging."
- [64] C. Rios-Aguilar and J. M. Kiyama, "Funds of Knowledge: An Approach to Studying Latina(o) Students' Transition to College," *J. Latinos Educ.*, vol. 11, no. 1, pp. 2–16, 2012, doi: 10.1080/15348431.2012.631430.
- [65] J. Marquez Kiyama and C. Rios-Aguilar, *Funds of knowledge in higher education: Honoring students' cultural experiences and resources as strengths*. Routledge, 2017.
- [66] N. Shnabel, V. Purdie-Vaughns, J. E. Cook, J. Garcia, and G. L. Cohen, "Demystifying Values-Affirmation Interventions: Writing About Social Belonging Is a Key to Buffering Against Identity Threat," *Personal. Soc. Psychol. Bull.*, vol. 39, no. 5, pp. 663–676, 2013, doi: 10.1177/0146167213480816.