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## **Finding the Rainbow Needles in the Engineering Haystack: Connecting with a Hard-to-Reach Population**

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# **Finding the Rainbow Needles in the Engineering Haystack: Connecting with a Hard-to-Reach Population**

## **Abstract**

This paper discusses the lack of representation of sexual minorities in current discussions of diversity within engineering and the methodology I used to recruit tenure-track and tenured engineering faculty members who identify as sexual minorities for my doctoral dissertation study. After a review of the current literature, I highlight methods that were effective and ineffective while I was seeking connections with individuals who may or may not share their identity with a broad audience at work. Both the Women in Academia listserv managed by the Society of Women Engineers and the National Science Foundation funded American Society of Engineering Education Virtual Community of Practice for Lesbian, Gay, Bisexual, Transgender, Queer, and Others Equality in Science, Technology, Engineering, and Mathematics proved to be effective venues for recruitment whereas the signatories of the American Society of Engineering Education Deans Diversity Initiative Letter proved ineffective. My perspectives of why this may have been the case are described in this paper. Overall, my dissertation study supported the finding that the sexual minority community of tenure-track and tenured faculty members remains hard-to-reach, but some members of the group are willing to speak out so that the community can continue to gain understanding and support within our discipline.

**Index Terms**—Diversity, sexual minorities, snowball sampling/respondent-driven sampling

## **Introduction**

Increasing diversity among faculty, students, and working professionals within engineering has been a longstanding goal of engineering professional societies, universities, and government organizations [1] - [6]. However, progress has been slow [7] - [10]. In 2014, women comprised nearly 16% of tenure-track and tenured engineering faculty, while African Americans represented fewer than 3%, and Hispanics represented fewer than 4% [10]. Percentages of African American and Hispanic tenure-track and tenured faculty have increased by less than 1% in the past decade while women have increased their representation by only 4% [10]. Although underrepresented in the tenure-track streams, women faculty and underrepresented minorities have been overrepresented among non-tenure-track faculty across disciplines [11], [12].

Across the engineering disciplines, the percentages of diverse faculty have ranged by topic and ethnicity along gendered lines [10]. For example, topics considered closer to “true” or “pure” engineering that are based on physics and hold a maverick-type image [13] such as aerospace, mining, and nuclear engineering have remained bastions of whiteness and maleness [14]. In contrast, female and underrepresented racial and ethnic faculty members have had higher representation within areas such as biological, chemical, and civil engineering [4], [8], [10]. This information is known and studied because demographics including gender, ethnicity, and disability status have been collected for decades [15] and that data has been used to track changes in participation of various underrepresented groups in engineering and many other disciplines.

Unknown within the engineering faculty and student body demographics have been two facets of diversity that have rarely been discussed until recently—the spectrums of sexual and gender identity. Sexual minorities are individuals with non-heterosexual sexual identities including, for example, lesbian, gay, bisexual, queer/questioning, asexual/aromantic, or others (LGBQA+). Gender minorities are individuals whose gender identity does not match their gender assigned at birth (transgender) or who do not meet the socially constructed binary of male/female including those who identify as queer, non-binary, or intersex. The lack of data on these groups has limited the full picture of existing diversity in engineering. It has also left unanswered the question of whether additional efforts focused on a broader definition of diversity would be necessary to access an untapped resource that might widen the pipeline of potential future engineers and reverse the stagnation/decline of entry into, and persistence within, the field. The aim of my doctoral study was to share the experiences of engineering faculty members who included sexual minority status among their identities to start to fill that gap in the discourse and offer suggestions for tangible ways to begin to improve the discursive environment [16] within engineering academic programs.

In 2015 and 2016, more than 175 engineering deans signed the American Society of Engineering Education (ASEE) Engineering Deans Council (EDC) Diversity Initiative Letter to support efforts to increase the participation of women and underrepresented minorities in engineering education endeavors across the United States of America (United States). They “commit[ted] to ensuring that our institutions provide educational experiences that are inclusive and prevent marginalization of any groups of people *because of visible or invisible differences*” [2, para. 3, emphasis mine]. Since diversity has been historically understood and measured in terms of ethnic, racial, and gender representation [17], the ASEE EDC Diversity Initiative Letter highlighted the importance of increasing the representation of those demographic groups. However, women and racial/ethnic minorities have not been the only groups that have been underrepresented in engineering.

Visible and invisible differences also encompass dissimilarities of sexual and gender identity, a topic that has been frequently overlooked in the context of engineering [18], [19]. The EDC letter listed eight professional organizations that would be engaged to provide assistance with identifying and implementing diversity measures, moving forward. However, the two professional organizations that support sexual and gender minorities in science, technology, engineering, and mathematics (STEM), including Out in STEM (oSTEM), and the National Organization of Gay and Lesbian Scientists and Technical Professionals Inc. (NOGLSTP), were missing from that list [2]. Increasing awareness of groups with invisible stigmas, such as sexual or gender minority status, has been show to be the first step toward those groups gaining greater acceptance and protection in the workplace [20], so their absence from the ASEE deans diversity initiative leaves this group vulnerable to continued discrimination within the engineering discipline.

### **The problem for lesbian, gay, bisexual, and transgender employees**

Experiences among individuals who identify as sexual or gender minorities have varied widely by industry, profession, and geographic region [21], [22]. Research has shown that a majority of lesbian, gay, and bisexual (LGB) [23] and lesbian, gay, bisexual, and transgender (LGBT) [24], [25] employees across a range of industries and settings in the United States have feared negative

consequences if their identities were known by co-workers. This has been a primary reason that it can be difficult to recruit sexual minorities for research studies in the context of academia. There has been a substantive and growing body of research regarding the experiences of LGBT employees in general and the work climate that they face [21], [24], [26] - [29] however, employees in higher education have been mostly left out of those discussions.

Higher education institutions have mirrored society and, consequently, faculty members have been subjected to many of the same social concerns as other employees [30] - [32]. The problem that my dissertation study addressed was that, as research by Fidas and Cooper [24] and Badgett, et al. [26] has shown, LGBT employees have faced discriminatory and exclusionary behavior in the workplace. While this could lead to employee dissatisfaction and turnover in any industry, the repercussions and long-term effects within higher education could be profound. Faculty members train future workers and managers who impact the environment within academic disciplines and affiliated industries for decades to come. In addition, some of today's faculty members will become tomorrow's deans, provosts, chancellors, and presidents so if faculty members feel that they must remain closeted in order to succeed in their jobs and climb the administrative ladder, those who are lower on the ladder will continue to lack role models.

### **The problem, specifically in engineering**

Even amidst nationwide efforts to increase diversity and inclusion within academia at all levels, continued marginalization and invisibility of engineering faculty members who identify as, or are assumed to be, sexual or gender minorities continues [25]. Diversity initiatives have tended to focus on increasing the numbers of visually identifiable minorities such as women, racial, and ethnic minorities other than Asians who are well-represented within engineering, and those with visible physical disabilities—criteria that exclude some sexual and gender minorities by omission [33] - [35]. There have been several possible reasons why sexual identity and gender identity were frequently excluded among diversity discussions in the United States, and in the field of engineering specifically. Within the engineering culture of depoliticization, or the belief that social issues can be separated from the technical issues of engineering, a person's sexual and gender identities fall squarely on the social side of the technical/social duality so it is considered irrelevant [36] - [37]. Yet for individuals whose minority status within engineering is visually clear, such as women and many ethnic or racial groups, their physical presence has made them difficult to ignore completely [36]. Therefore, through decades of concerted efforts, the experiences of women and ethnic/racial minorities have become part of the discussion of engineering culture and the need for change to make that culture more welcoming for them has become commonplace. The same cannot be said for sexual or gender minorities who may or may not be visually identifiable as outside the norm.

In regards to sexual identity, some researchers have suggested that it can remain hidden in most academic and work environments [38] - [40]. This opinion has been partially supported because individuals with concealable stigmatized identities do not always self-disclose [41]. However, social norms for gender expression and gender roles have made it difficult for some individuals to hide their sexual identity. Based on stereotypes made about appearance, people make assumptions regarding individual's sexuality based on failure to adhere to social norms. This has led to a double threat to women in engineering who are simultaneously acculturated to downplay

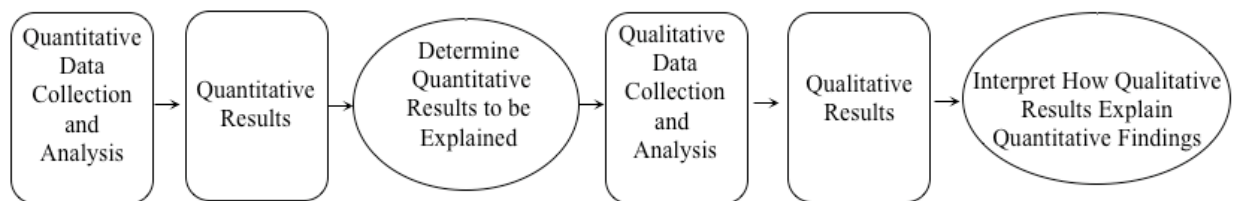
their femininity so that they are taken seriously as engineers while at the same time being expected to maintain gendered roles such as being nurturing student advisors [42].

### Overview of the study

The dissertation study was designed to answer the primary research question of, “How do full-time, tenure-track engineering faculty members who self-identify as sexual minorities experience working in Doctoral Universities as defined in the 2015 Carnegie Classification?” The primary challenge in conducting this study was finding participants who met study criteria. While this challenge has been shared by many research projects, it was especially acute for this study because of the hidden and frequently stigmatized nature of being someone who identifies as a sexual minority within engineering academia. The theoretical basis of the study was that an individual’s identity goes beyond ethnicity/race and gender to include age, disability status, education, gender identity and expression, marital status, mental health status, nationality, religious beliefs and expression, sexual identity and orientation, socio-economic status, work background, and many other categories [43] - [46]. Every individual’s identity incorporates multiple categories simultaneously [47] and, as Kimberlé Crenshaw first described, these facets of identity interact in ways that are intersectional, not additive [48]. In the simplest of terms, Crenshaw intended her concept to mean that “forms of prejudice overlap” [49, para. 3]. In other words, when someone’s identity includes multiply privileged, multiply marginalized, or a combination of both types of identities, that person’s experience cannot be explained by using existing theories based on a “single-axis” of discrimination such as race or gender alone [48, p. 139].

### Methodology used

The purpose of this study was to gain insight into the multiple dimensions of identity that tenure-track and tenured engineering faculty members held and then to investigate how they believed that the interplay of those identities shaped their interactions with colleagues and students in their academic workplace. Given the difficulties of identifying and connecting with hard-to-reach populations such as this one, and the personal nature of asking them to share their experiences based on social identities, an explanatory sequential mixed-methods approach was appropriate. This method involved collecting quantitative data, analyzing that data, and identifying results that could be more clearly explained by collecting and analyzing qualitative data. The final step in the design involved interpreting how the qualitative findings explained the questions raised during the quantitative phase. Figure 1 shows the explanatory sequential design used in this study.



**Fig. 1. Procedural diagram for explanatory sequential mixed-methods design (modified from [50, p. 56]).**

The study included an anonymous web-based survey followed by semi-structured interviews of the participants who agreed to be contacted. During the interviews, participants shared photographs of their workspaces and described how items displayed in those spaces were congruent or incongruent with their multiple dimensions of identity. The simultaneous presence of both stigmatized and privileged identities led to complex relational interactions with colleagues and students that required individuals to deny some of their identities to successfully navigate in certain professional settings.

This pragmatic approach was designed to collect data necessary to answer the research question while simultaneously allowing anonymous participation by those who were not comfortable or able to commit the time to the interview portion of this study. The brief quantitative portion of the study included a participant selection survey, which served multiple purposes. Its first purpose was as an inclusion filter, filtering out those individuals who did not meet the study's purposive inclusion criteria. Those criteria included self-identification as a sexual minority and current employment as a tenure-track or tenured professor at a doctoral institution within the United States. Next, I used the survey to collect demographic and geographic distribution data of eligible participants for the purpose of gathering a general overview of where in the United States these faculty members were working. I did this to identify if responses centered on any particular region that might limit experiences to certain socio-political cultures affiliated with geography. I included several open-ended questions about social identities and whether individuals felt the need to deny dimensions of their identity at work to allow those who wished to participate anonymously to do so in a substantive way. Information collected through the participant selection survey was summarized and used as a baseline for the second phase of the study that included a qualitative inquiry into the open-ended survey responses with a specific focus on how the faculty members perceived that their social identities shaped their interactions with colleagues and students.

As can be the case with any small and dispersed population, it can be difficult to disseminate surveys to the people for whom they are intended. In addition, institutional review boards mandate that data collection on sensitive topics such as sexuality include additional layers of protection for participants. This study relied on my personal connections using respondent-driven snowball sampling [41]. Snowball sampling/respondent driven sampling (SS/RDS) begins with a convenience sample of individuals who fit the inclusion criteria from among the researcher's personal network. Those participants are called the first wave respondents in SS/RDS terminology [51]. In early January 2017, I emailed 38 individuals whom I knew personally as either eligible to participate or who identified as allies and indicated a willingness to share details of my study. I asked these personally known individuals to participate if they were eligible and/or to contact others whom they knew personally or professionally. I asked my contacts to share a brief introductory note explaining the purpose of the study that included a statement of participation confidentiality and an anonymous link to an informational website. Individuals who were referred to my site by members of the first wave were considered second wave respondents in sampling terminology. Second wave individuals were also encouraged to share the study information to their personal and professional contacts, potentially leading to a third or later wave of respondents.

Having spent decades in engineering academia, I was well positioned to connect with tenure-track and tenured faculty members who have shown a research interest in expanding diversity

and inclusion within engineering academia. Through that cohort of colleagues, I was able to find key gatekeepers who would disseminate study information via nationwide listservs and their own personal connections. The two most effective modes of study dissemination were the Society of Women Engineers' Women in Academia listserv and that of the ASEE LGBTQ+ Equality project. Gatekeepers for those listservs were willing to share my IRB-approved study recruitment request, and list members were then willing to further forward my request among their personal networks. Via this method, I was able to obtain 11 valid responses to the anonymous survey, with seven of those respondents indicating their willingness to complete confidential, 60- to 90-minute interviews to further discuss their experiences. Survey respondents were geographically dispersed across each of the seven regions I used to group states across the continental United States. No one participated from Alaska, Hawaii, or the U.S. Territories.

To expand the reach of my study beyond the colleagues-of-colleagues pool available via the SS/RDS method, in late March 2017, I emailed a personalized request to 157 deans at doctoral institutions who each signed the American Society of Engineering Education (ASEE) diversity initiative letter. That letter stated that they, as deans, would actively work towards "ensuring that our institutions provide educational experiences that are inclusive and prevent marginalization of any groups of people because of visible or invisible differences" [2, pg. 1]. Based on that pledge, I asked each dean to forward a brief introduction about my study and the URL to the participant selection survey website along with a personal note of encouragement for faculty members to complete the survey. This request was consistent with my purposive sampling technique because these deans were not randomly selected from among a pool of all engineering deans from schools within the United States. These individuals had made personal commitments to support diversity efforts within their school or college and could, therefore, reasonably, be considered as allies in this research effort. Within the first week after sending the request, deans from five institutions responded to me via email to state that they would forward my request to their full faculty or to a segment of their faculty to whom "they believed the survey was relevant." Shortly thereafter, five people clicked the survey link; however, I did not receive any additional completed anonymous surveys after sending the initial email to the deans. All five potential respondents who entered the survey inclusion criteria page indicated that they identified as heterosexual so were excluded from participating. In response to a forwarded request to disseminate information, the IRB coordinator from one institution asked me to complete a full IRB submission at the university before allowing distribution of my participant recruitment email. I chose to not have my study reviewed at the current time but do intend to modify my selection criteria at a later date and attempt to engage both heterosexual and non-heterosexual members of that particular institution as part of a follow-up study to this dissertation.

It was not surprising to me that a single mass request to the deans did not result in additional respondents because one of the findings from the literature review was that individuals who identify as sexual minorities frequently hide that aspect of their identity from their co-workers. Hence, some deans may have believed that there were no sexual minorities employed within their faculty and, therefore, did not forward the message. Others may have felt that it was inappropriate to share an email broadly that was relevant to only a small portion of their faculty. Still others may have simply filtered out my request as junk mail because it was sent by a student and was not backed by a research organization such as the National Science Foundation. Without following up with all deans who received my email, it was impossible to determine how broadly my request was shared.

## Limitations of the methodology

Limitations of this study included the difficulty of finding members of this hard-to-reach population. During participant recruitment, I discovered that several of the individuals who I had planned to include did not meet the inclusion criteria because they were not on tenure-track appointments. I was also surprised that several of my research allies and participants who were heavily involved in diversity efforts at their own institutions admitted that they knew no one who fit the inclusion criteria. Finally, due to the small number of participants, the findings (described in an paper to be presented at the upcoming Collaborative Network for Engineering and Computing Diversity Conference in April 2018) are not intended to be generalizable. However, the findings rang true to individuals who have read my full dissertation and are likely to be included in a broader future study that will include non-tenure-track engineering faculty members who self-identify sexual minorities.

## Conclusion

Engineering academia includes diverse individuals. Among those, women and ethnic/racial minorities have been, and continue to be, well studied. However, individuals who identify as sexual minorities have remained hidden in the diversity research pool to the detriment of our understanding of the experiences of those individuals. This paper highlighted my first attempt to connect with a hard-to-reach population so that I could shine a light on the complex experiences of engineering faculty who maintain a combination of both privileged and stigmatized identities.

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