

Board 220: Audio for Inclusion: Broadening Participation in Engineering Through Audio Dissemination of Marginalized Students' Narratives

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Introduction

The transformation of engineering culture towards inclusion is a key objective in the retention and professionalization of a diverse engineering workforce. Faculty are key stakeholders impacting that inclusion because of their prominent role in shaping students' underrepresented, marginalized, and/or hidden identities and core experiences in engineering classrooms. Yet, many faculty are not provided with practicable resources and training that can enrich their knowledge, empathy, and understanding of students' diverse and marginalized experiences that differ from their own. This lack of resources has slowed the transformation of engineering culture and provides an opportunity for practical impact by researchers and faculty developers. However, the topic of developing inclusive culture remains understudied and has evaded traditional approaches to education research. Quantitative approaches can broadly identify the presence of marginalization or inclusion, but they lack the nuance to enhance a reader's inclusive understanding. In contrast, qualitative and narrative-based approaches provide rich accounts of marginalized experiences and perspectives, but do not typically reach a broad audience of technical engineering faculty. Thus, these accounts are often disseminated to faculty and researchers already interested and invested in broadening participation, perpetuating a cycle of "preaching to the choir".

In the *Audio for Inclusion* project, we answer BPE's call for innovative methods that increase research impact on broadening participation outcomes by proposing a **novel audio narrative dissemination approach to foster inclusive understandings for engineering faculty**. Specifically, we ask the following research questions:

- What marginalized student narratives related to identity and agency are present in engineering educational culture?
- How does hearing these narratives impact faculty perspectives of diversity and inclusion in engineering classrooms?

Intersections of Inclusion in Undergraduate Engineering

Several scholars of broadening participation in engineering have identified undergraduate education as a critical juncture in the pathways of underrepresented groups. Across this body of research, the marginalizing experiences of White women and people of color have been named as a root cause for their attrition and underrepresentation in the engineering profession (Geisinger & Raman, 2013; Ong et al., 2020; Seymour & Hunter, 2019). While work on gender and racial marginalization has revealed exclusionary and oppressive structures within our educational systems (e.g., Simmons & Lord, 2019), studies have expanded the scope of broadening participation scholarship to include the representation and experiences of individuals belonging to other marginalized groups such as those of low socio-economic status, members of the LGBTQ community, and people with disabilities, among others shown in Figure 1 (e.g., Cech & Rothwell, 2018; Haverkamp et al., 2019; Mobley et al., 2019; McCall et al., 2020b; Smith & Lucena, 2016). This body of work is relatively new, and while we are gaining a

foundational understanding of how academic systems impact the recruitment and retention of different student groups in engineering, more work is needed to expand and deepen our understanding to intentionally include and engage diverse students in engineering education and the engineering field.

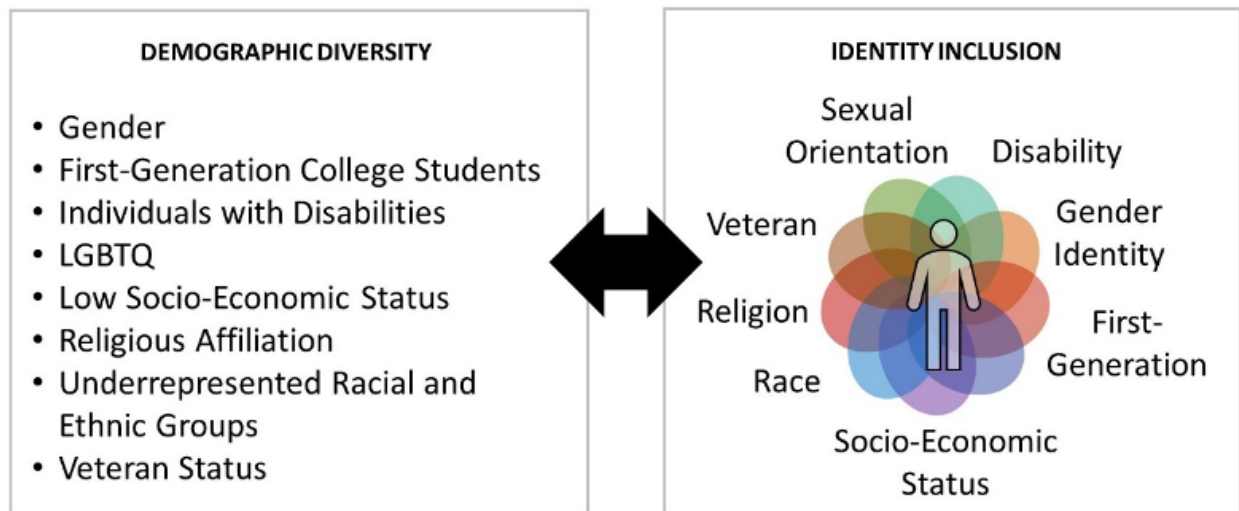


Figure 1: Reciprocal Relationship Among Dimensions of Diversity and Inclusion

In this project, we support the development of more inclusive undergraduate environments in two ways. First, we align with prior scholars who contribute to broadening participation by shifting conversations from demographic populations and quantitative representation to identity, lived experience, and personhood (Cech & Rothwell, 2018; Lundy-Wagner et al., 2013; McCall et al., 2020b; Secules et al., 2018a; Walden et al., 2018). We recognize the importance of not only expanding the population of engineering students from different groups, but also of improving the climate and support for the identities that intersect within each individual (see Figure 1). Second, we position inclusion as an intentional act of providing space for students from marginalized groups to express their identities in engineering education and beyond (Seymour & Hunter, 2019). Recognizing that diversity and inclusion are mutually and reciprocally interrelated (Figure 1), we maintain a focus on inclusion to deeply consider multiple systems of oppression that may overlap within a single individual’s experiences to reveal how student identities are treated within the sociocultural structures of undergraduate engineering education, and to broaden faculty awareness of the wider challenges that weigh on students in the classroom.

The Known Unknowns of Inclusion

Diversity is often thought of as easily observable, for example, the apparent gender and racial makeup of the particular students in engineering classrooms. However, hidden beneath the surface of this picture are additional identities, experiences, and aspects that we have named the known unknowns of inclusion (Secules & McCall, 2019). First, we know that students hold significant identities and experiences that are not immediately apparent to others (e.g., sexual orientation, disability status, veteran status, socio-economic status, etc.). Due to their non-apparent nature, these dimensions and experiences are not frequently encountered by faculty and often go unnoticed in everyday settings and interactions. Through this perceived absence, it is

assumed that students embody the normative social positions associated within engineering. But these normative assumptions are not conducive to equitable learning and can significantly influence the ways students interact with faculty, classroom infrastructure, and course resources.

Second, students who conflict with normative sociocultural expectations in engineering experience a range of emotional and cognitive impacts that lie beneath the surface view of the classroom. Students across apparent and non-apparent marginalized identity groups also encounter and must navigate microaggressions (Blosser, 2019), stereotype threat (Steele, 2010; Steele & Aronson, 1995), and imposter syndrome (Clance & Imes, 1978; Ramsey & Brown, 2018). Women and Black and Latinx students are subject to spotlighting, hypervisibility, and tokenism because of their lack of representation in engineering class contexts (McLoughlin, 2005; Blosser, 2019). As they currently exist, the norms that govern our engineering classroom environments require that individuals make complex and calculated decisions regarding their marginalized identity presentations, the sociocultural assumptions made about those identities, and the contexts in which these identities can or cannot be enacted. Experiencing academic contexts in these ways increases students' cognitive load and emotional labor that detract from learning academic content and fully engaging in the classroom (Cech & Waidzunus, 2011; Fuller et al., 2009; Newheiser & Barreto, 2014; McCall et al., 2020b; Rueda & Mehan, 1986). Thus, though many aspects of marginalized student experiences are known areas of concern, it is difficult for faculty to gain an intimate knowledge of them in their classroom contexts.

Perspective-Taking to Enhance Faculty Understandings of Inclusion

Faculty are key stakeholders in creating equitable and inclusive experiences for undergraduate students (Glass et al., 2015). However, faculty understandings of equity and inclusion are often limited due to a lack of awareness of or experience with students belonging to different identity groups (Mayat & Amosun, 2011; Rao & Gartin, 2003; Zhang et al., 2010). Faculty are also embedded within the sociocultural norms of engineering academic culture and thus may take for granted certain problematic aspects of faculty-student interactions (Secules et al., 2018b; McCall et al., 2020b; Stevens et al., 2007; Trenshaw et al., 2013). In general, engineering faculty lack diversity, equity, and inclusion (DEI) professional development opportunities (Wynants & Dennis, 2017), and the resources created for them tend to target knowledge and compliance (e.g., the process for accommodations) rather than a deeper understanding of their students. If faculty can gain more awareness and experience about marginalized student identity groups, they can increasingly position themselves as active and responsive agents for inclusive change (Blair et al., 2017).

Therefore, it is imperative to develop support mechanisms in which faculty can understand and empathize with the ways marginalized identities and experiences impact students. The empathy practice of perspective-taking has shown promise for developing ethical responsibility, promoting an awareness of others, and facilitating effective interpersonal interactions among engineering design learners (Hess et al., 2017; Walther et al., 2017). While the majority of research has focused on empathy in students, empathy and perspective-taking have been described as an avenue for engineering faculty to “understand their academically diverse student population” (Hess et al., 2012, p.15), allowing them to more adequately assist students needing personalized intervention. In this study, we expand on much-needed support mechanisms for faculty with the concept of perspective-taking. With this lens, we will bring students' firsthand

experiences directly to faculty as a means of amplifying marginalized student voices, educating faculty about these experiences, and informing strategies for promoting inclusion in engineering education.

Qualitative Research Brings Student Experiences Firsthand

We must listen to these hidden and experientially diverse [students] one story at a time using research methodologies that are appropriate to the task. (Foor et al., 2007, p. 108)

Qualitative research is uniquely positioned to provide insight into student experiences, and could be used to expand faculty empathy and awareness. While quantitative research can help document the extent of a problem, several authors have noted the important function of qualitative research in listening to and revoicing the experiences of marginalized students (Secules, et al., 2018a; Pawley, 2013; Foor et al., 2008). For example, Foor, Walden, & Trytten (2008) note that qualitative research “provides a microphone for the voices of the marginalized to be heard” (p. 113). A novel contribution of Foor, Walden, & Trytten’s 2008 “Achieving Individual Diversity” paper was their emphasis on the holistic nature of each student’s marginalizing experience and the need for individualization when responding to and supporting students. Pawley’s publications from her Learning from Small Numbers NSF CAREER grant further highlighted that research methods used to quantitatively summarize or qualitatively code participants’ marginalizing experiences into larger categories tend to misrepresent students (Pawley & Slaton, 2015; Slaton & Pawley, 2018). Pawley points out limitations of traditional research methodologies related to a lack of recognition of holistic experiences of intersections of privilege and oppression and to a colonizing sense of the researcher assigning the identity and experience of a participant.

While Pawley’s study drew on narrative methods as an investigative and analytical tool, she noted her own challenge with traditional forms of qualitative dissemination: “we also need other methods that preserve the narrative ‘voice’ of participants in dissemination products” (Pawley, 2013, p. 17). Further, although qualitative research creates opportunities for empathy and understanding, it is typically disseminated in longform journal articles or books. While these traditional forms of dissemination help establish a scholarly body of knowledge, they do not produce institutional change (Henderson et al., 2011) as faculty are unlikely to read long published works in areas adjacent to their technical research. These challenges motivate our broader examination of qualitative research methodologies and our attempt to innovate to expand the impact and reach of this powerful source of insight.

Opportunities for Alternative Dissemination Modes

While true communication involves both transmitting and receiving information, the word dissemination focuses on the transmitting process. The 21st century has seen a massive increase in tools for transmitting information; yet, paradoxically, it has also reduced our collective attention span for receiving information (Ury, 2016). As researchers, we have increased our tools for dissemination, but our audiences have not equally increased their time for absorbing and acting on that information. In the case of engineering education, faculty are engaged in research dissemination activities of their own with little time to explore and implement research outside of

their own domains. There is a growing recognition in education and across disparate fields of a disconnect between scholarly research dissemination and practice (in engineering education, Froyd et al., 2017; Henderson et al., 2011; in science communication, Husein et al., 2019; in public health, Brownson et al., 2018; Weaver & Spiers, 2018).

This disconnect has led multiple scholars to highlight the limits of traditional dissemination and to call for new approaches to research output, including YouTube video, podcasts, and other novel formats (Bartlett, 2013; Brownson et al., 2018; Chandler et al., 2015; Moylan et al., 2015; Pollard, 2016). A small but growing number of STEM education researchers have utilized audiovisual dissemination techniques to increase the visibility of underrepresented groups in STEM (Beyond the (Micro)scope podcast, Clairborn & Xu, 2020; Modern Figures podcast by Waisome & McMullen, 2020), to inspire future STEM professionals (STEMoires podcasts, Husein et al., 2019), or to engage broader community conversations (Research Briefs podcast, Streveler, 2020; Engineering Change podcast, Pearson, 2020). Audio and audiovisual formats may have additional affordances for reaching engineering faculty who do not engage in reading outside of their own research areas. To our knowledge, there are no comparable efforts leveraging student experiences of marginalization to increase faculty understandings of inclusion.

While audio and audiovisual are powerful new media formats, proponents of this kind of research dissemination have pointed out some cautionary guidelines (Weaver & Spiers, 2018; Singer, 2019). Confidentiality and privacy become major concerns when presenting individual stories through audio or audiovisual formats where a participant may not recognize the consequences or potential harm associated with having their own image, name, or story disseminated in a more accessible way (i.e., one that could “go viral”). Other issues include researcher and participant agency regarding shaping the end product, balancing vocabulary levels and communication styles that may vary across potential audiences (e.g., researchers, participants, audiences), and evaluating the effectiveness and quality of the end product. For this project, we are particularly focused on protecting student confidentiality and privacy in our research design, and ensuring communicative effectiveness of our end product.

Theoretical Framework: Figured Worlds and Narrative Agency

In their seminal work, Holland and colleagues (1998) conceptualized the complex interactions between social systems and individuals as agency and identity formation in *figured worlds*. They define this concept as the realized capacity for an individual to purposefully and reflectively act (i.e., agency) on contexts containing “socially-produced, culturally-constructed activities” (i.e., figured worlds, Holland et al., 1998, p. 40-41). As individuals iteratively interact with and within these figured worlds, they make meaning of themselves and form their identities. Figured worlds include four characteristics: (1) they are historically developed through the works of participants; (2) they include social encounters in which participant positions matter; (3) they are socially organized and reproduced; and (4) they relate individuals to associated activities and familiar social types. From this perspective, identities comprise both personal and social characteristics that shape and are shaped by one’s environment, relationships, and interactions. The ways we choose to speak, dress, and navigate these figured worlds, and the feedback we receive from them, serve as indicators of identification with social groups and their associated privileges (Holland et al., 1998).

The concept of figured worlds has been applied in a number of studies to examine the interactions among identities and cultures in educational settings (Carlone et al., 2014; Horn, 2008; Jurow, 2005; Tonso, 2006). The concept of figured worlds allows for a nuanced, critical exploration into the inclusivity of engineering education contexts due to its emphasis on agency. In this study, we position engineering education as figured worlds in which students enter and, through participation, become engineers. This figured world has been historically and culturally established through an accepted set of identity indicators and practices that assume idealized experiences and positions associated with them. We operationalize agency in two ways: (1) as an individual's perceived ability to deviate from established sociocultural norms associated with aspects of identity and lived experience, and (2) as narrative power to tell one's own story.

Intersections of Oppression as Figured Worlds: In addition to considering the overall engineering educational landscape as a figured world, we conceive of each of the major intersections of social identity and oppression (e.g., race, gender, class, sexual orientation) as figured worlds. Consistent with the theory of intersectionality (Crenshaw, 1989; in higher education, Mitchell et al., 2014; Bruning et al., 2015), systems of oppression such as gender and race are conceived as complex and holistic, so that the experiences of Black women in society are not accounted for by combining the experiences of Black men and White women. The leveraging of identity and oppression as figured worlds resists a common simplification of intersectionality as “multiple identities” and helps emphasize the contextual and reflexive nature of identity formation with regard to cultural definitions of social groups (Berhane, Secules & Onuma, 2020). Similarly, our project conceives of student individuality in terms of these multiply defined, marginalized identities, which contributes to nuanced interactions with engineering culture.

Our project also draws on narrative-based methods (e.g., Cruz & Kellam, 2018) to emphasize the agency of students telling the story of their own lives (Secules et al., 2018a). Narrative-based methods take a “view of human experience that humans, individually and socially, lead storied lives” (Connelly & Clandinin, 2003, p. 477) and assume that our identities are, in some sense, a story that we tell ourselves and others (Sfard & Prusak, 2005). In many cases, experiences of marginalization in a dominant culture involve having that story taken from us or told for us. The agency to tell the story of our own lives has been named by critical scholars as a powerful form of resistance against oppression (hooks, 1992; in engineering contexts, Secules et al., 2018a). That story also has the power to make identities more legible and understandable in a given social context. In our study, we consider the social identities embedded within intersections of oppression as the basis for a story that students can tell to themselves, to a researcher, and to broader educational stakeholders through our audio dissemination approach. We anticipate this to be a powerful act of storytelling for the students and a potentially transformative listening experience for engineering faculty and other.

Study Design

In this paper, we discuss the first phase of a larger study to develop an audio narrative approach aimed at fostering inclusive understandings of students' marginalized experiences among faculty. This first phase, referred to as *Capturing Student Experience* (shown in the left portion of Figure 2), was designed to gather an initial understanding of the marginalizing experiences had by students and to develop audio recordings of student narratives to be shared with faculty in the second phase of the study.

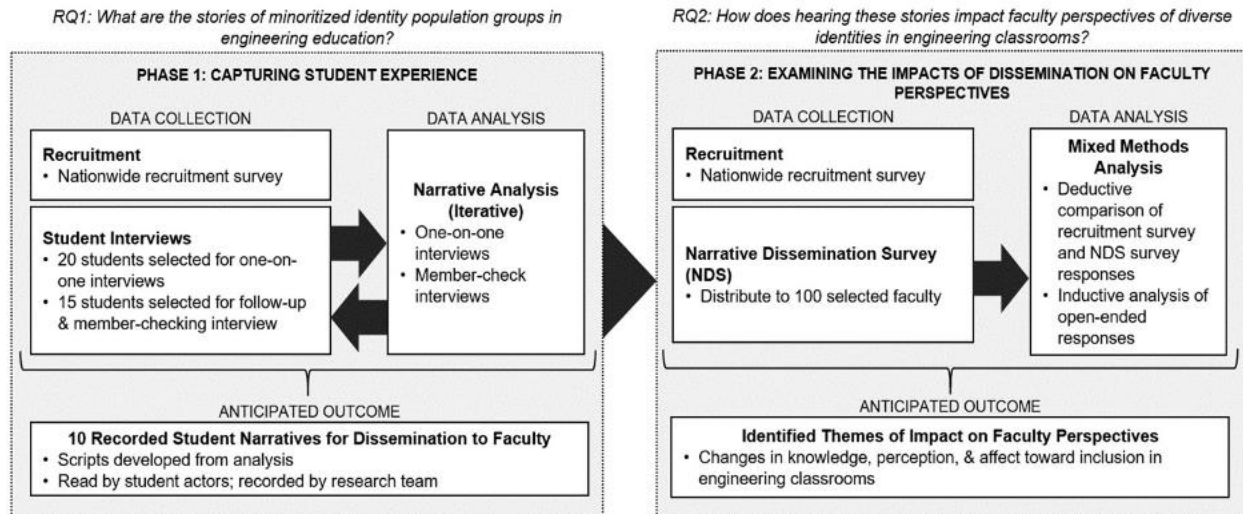


Figure 2: Overview of Research Methods for Larger Study

Students who identify with a variety of marginalized identities (e.g., racially/ethnically minoritized, LGBTQ, veteran status, disability status, etc.) were recruited nationwide using an accessible online survey distributed via email through a variety of academic centers (e.g., campus diversity centers, disability resource centers, etc.) and student organizations (e.g., Society of Women in Engineering, Out in STEM, etc.). This recruitment survey served a dual purpose: to make students aware of the study and gather general background information to facilitate participant sampling for interviews. Participants were sampled based on the marginalized identities disclosed in the recruitment survey to achieve a wide variety of identity experiences and to gather a diverse range of perspectives. One-on-one semi-structured interviews were conducted with 20 participants via Zoom. Each interview lasted approximately 60 minutes. The interview protocol was designed to provide enough structure to explore identity experiences through our theoretical perspectives of engineering education and intersectionality as figured worlds, yet flexible enough to co-create a coherent narrative with each participant (Secules et al., 2018a; Groen et al., 2018a). Example questions from the interview protocol included:

1. What are a few identities that you have that are either visible or invisible to others?
2. Can you tell me about one of those identities and when it became important to you?
3. How does your identity relate to your experience in engineering education?
4. What's one thing you wish was different about engineering education?
5. What's one thing you would tell a person like you, or your professors, if you could?

To gain an initial understanding of the experiences described by each participant, a member of the research team read through the transcripts, relistened to the recording, and noted standout stories and moments of emotional salience. A narrative script was assembled by the research team according to narrative analysis and dissemination methods (Boklage et al., 2019; Kellam et al., 2015; Secules et al., 2018a) for participants with the following goals in mind: 1) preserving the meaning, continuity, and emotional impact of the interview; 2) highlighting components of the interview that are likely to be beneficial for enhancing faculty understandings of a participant's experience; and 3) removing or revising significant identifying details to preserve the student's anonymity. Due to the sensitivity of interview topics, member-checking was conducted by sending the final narrative scripts for review and approval by participants. Cleaned,

de-identified narrative scripts were then audio recorded by student actors at Florida International University. To facilitate recording, scripts were annotated with indications of tone and emotion to reflect those portrayed by the participant during the interview.

Progress to Date

To-date, we have interviewed a total of 21 participants across 11 institutions nationwide. Because of the richness of one of the participant interviews during the project pilot, we decided to include that participant in our dataset. The identity intersections of these participants span many demographic groups (e.g., gender, race and ethnicity, disability status, veteran status, etc.) that include: Black, Muslim international woman; Pansexual Disabled woman; Neurodivergent Queer nonbinary person; Transracial Asian-American adoptee woman; White gender-fluid individual with autism, anxiety and depression; and Hispanic Veteran man. While this is not an exhaustive list of the identities of our participants, they demonstrate the variety of identity intersections among engineering students.

We have finalized a total of eight narrative scripts, and three scripts have been recorded with student actors. Analyzing the interviews and constructing the narrative scripts for actor recording has been one of the most challenging and time-consuming activities of this project. Creating a brief yet meaningful recording that accurately and concisely captures a participant's experience in a way that listeners (i.e., faculty) can easily interpret and understand requires several iterations of single-researcher and group analyses. During these iterations, we recognize that any language or ordering change we make to create the narrative script has the potential to alter the original meaning intended by the participant. While we have procedures in place to ensure credibility of the resulting narrative scripts (i.e., member checking), this is a topic that we continuously grapple with as a research team.

Over the next several months, we will begin to share finalized audio with faculty members using focus groups. These focus groups will be designed to last approximately one hour and will be conducted using techniques similar to those used in product development and feedback focus groups. The main outcome for these focus groups will be to obtain feedback regarding the audio resources as well as identifying strategies for disseminating the audio to a wide range of faculty across engineering disciplines. Findings from these focus groups will be presented in future publications.

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