

Board 221: CAREER: Disrupting the Status Quo Regarding Who Gets to be an Engineer - Exploring the Intent-to-Impact Gap for Rectifying Inequity

Dr. Jeremi S London, Vanderbilt University

Dr. Jeremi London is an Assistant Provost for Academic Opportunities and Belonging, and an Associate Professor of Practice of Mechanical Engineering at Vanderbilt University. London is a mixed methods researcher with interests in research impact and organizational change that promotes equity.

Dr. Brianna Benedict McIntyre, National Action Council for Minorities in Engineering

Dr. Brianna Benedict McIntyre recently joined the National Action Council for Minorities in Engineering as the Director of Research. She earned a B.S. and M.S. in Industrial and Systems Engineering from North Carolina A&T State University and a Doctor of Philosophy in Engineering Education from Purdue University. She is committed to promoting inclusive excellence and serving others in her academic and local community. Her primary research is grounded in understanding how interdisciplinary engineering programs exist as hybrid spaces for undergraduate students navigating a traditionally siloed engineering culture and challenging the dominant narrative of becoming an engineer. She has also contributed to research efforts focused on latent diversity, identity development, and organizational change efforts to broaden the participation of African American and Latiné/x/a/o students in engineering. These research efforts have resulted in publications and presentations for the science education and engineering education research communities. She is an active member and professional development leader for the American Society for Engineering Education's Commission on Diversity, Equity, and Inclusion. Her most notable accomplishment was her recognition as one of seven recipients of the 2019 American Association of Colleges and Universities (AAC&U) K. Patricia Cross Future Leaders Award based on her commitment to civic engagement; Purdue's College of Engineering Outstanding Service and Leadership Award in 2019; and Purdue's Graduate School Mentoring Award in 2021.

Ms. Nicole Adia Jefferson, Virginia Polytechnic Institute and State University

Nicole Adia Jefferson's current graduate research assistantship explores how leading engineering schools have successfully recruited, retained, and graduated diverse cohorts of engineers. Because of this exposure, her research interest are investigating the gap between the stated DEI goals of exemplary engineering colleges and the actual experiences of their students. Nicole's commitment to educational equity is demonstrated by contributions to curriculum development, notably with the National Action Council for Minorities in Engineering, where she developed programs to help high school students transition into engineering disciplines. Her experience extends to the classroom, where she has served as an Adjunct Faculty member and Technology Education Instructor, mentoring young computer scientists and engineers. These roles have allowed her to directly influence the next generation of engineers, where she emphasized the importance of inclusivity in education. Nicole aspires to influence engineering education policy and establish a consortium that prepares researchers to tackle the challenges of equity in engineering education. Her goal is to help create an academic environment where diversity is not just accepted but celebrated, reflecting the true demographic makeup of our society.

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Abstract

Although broadening participation efforts aim to transform who has access to engineering by targeting those historically excluded, Black and Brown students' participation remains stifled by the exclusionary culture and practices ingrained in engineering education. Consequently, there is a need for scholarship that advances our understanding of systemic changes that center equity, challenge exclusionary cultural norms, and ultimately contribute to disrupting the status quo of who gets to be an engineer. This project uses Kotter's change theory and Acker's inequality regimes to identify and examine signature practices and change strategies within and across six exemplars. While previous executive summaries focused on the signature practices informed by the interviews with faculty and staff, this year's executive summary will characterize the institutional values and commitments to diversity, equity, and inclusion. This effort will inform future efforts to understand the intent-to-impact gap by comparing the institution's values to student's lived experiences.

Introduction

Substantial investments and programmatic efforts have been dedicated to advance diversity, equity, and inclusion (DEI) in STEM disciplines and organizations for underrepresented and underserved populations [1]. However, the enrollment and graduation trends of Black and Brown undergraduate engineering students remain dismal compared to their white and Asian peers [2]. This disparity has inspired recommendations for federal and philanthropic organizations to invest in research aimed to understand the policies, programs, and practices of minority serving institutions efforts to translate these insights to predominantly white institutions [1]. This recommendation leans into the premise of this research project where we identify and examine signature practices and change strategies of exemplars necessary to disrupt the status quo in engineering education.

In addition, a critical insight from this year's research activities is the need to bridge the gap between intent and impact in diversity, equity, and inclusion efforts. Previous studies demonstrate the significance of examining the espoused values and rationale for investing in diversity, equity, and inclusion efforts, emphasizing the necessity to understand the underlying structural norms that marginalize underrepresented students in engineering education and careers in addition to compositional diversity and its potential benefit to faculty and the institution at large [3, p. 260]. While Colleges of Engineering (COEs) may commit to diversity, equity, and inclusion, mere intent "doesn't necessarily lead to increased diversity" [4, p. 6] or mediate chilly racial climates within an institution [3], [4]. Instead, rectifying structural inequities and inclusive leadership is crucial to ensuring these commitments lead to real change [3], [4]. As a result, this executive summary aims to characterize the exemplars' intentions by identifying and examining the institutional values and DEI commitments declared in the strategic plans and other relevant institutional documents. We

organized the executive summary around three topics—project overview, year three research and education activities, and critical insights from the document analysis.

Project Overview

Using a multi-case research design framed by Kotter’s *Leading Change* theory and Acker’s *Inequality Regimes* as theoretical foundations [5], [6], this CAREER award aims to uncover the change strategies institutionalized by six exemplary COEs to improve Black and Brown students’ access to engineering education and careers. The institutions included in this study are: 1) Florida International University (FIU), 2) University of Maryland-College Park (UMD), 3) University of Maryland-Baltimore County (UMBC), 4) George Mason University (GMU), 5) Morgan State University (MSU) and 6) University of Central Florida. This research project is guided by the overarching question:

What combination of insights and actions form a robust, actionable change model for broadening participation in engineering and set COEs on a viable path to parity? The corresponding sub questions include:

- (1) How and why do COEs envision, implement, and institutionalize changes that address systemic inequities and positively impact the recruitment and retention of Black and Hispanic students?
- (2) What conditions and strategies contribute to the long-term success of COEs committed to recruiting, retaining, and graduating diverse cohorts of students?

We explore these research questions through multiple data streams—semi-structured interviews with faculty and staff, focus group interviews with undergraduate engineering students, and publicly available documents. This year’s research activities involved completing data collection, except for the interviews with senior administrators, data selection of key publicly available documents, and document analysis. These research activities enable the research team to provide a richer, more comprehensive understanding of the strategies and signature practices that contributed to the exemplars ability to recruit, retain, and graduate Black and Brown engineers at record numbers compared to their peer institutions [2]. A detailed description of the research design can be accessed in the previous executive summaries [7].

Year 3 Research and Education Activity Summary

During year 3, the research team met with the advisory board to discuss our Year 2 accomplishments and Year 3 progress. We primed the discussion with three questions concerning the book structure, publisher identifications, balancing the good and bad insights about exemplars within our future publications, and handling requests from institutions interested in translating the research findings into their context. In addition, we focused on professional development experiences, exchanged insights with the broader STEM community, conducted focus group interviews with undergraduate engineering students, and document analysis. This section highlights the three primary activities of the project’s third year.

Professional Development

The research team engaged in professional development activities that will build our capacity to construct compelling impact narratives that tell the story of how equity-oriented change came about at each exemplary COE. Throughout the third year, we engaged in a monthly book club to build capacity in engineering culture, race relations in higher education, caste system, document analysis, and case study research. In Spring 2023, we audited a graduate course on research-practice partnerships to build capacity for forming and maintaining productive partnerships in preparation for the project's next phase focused on translating the research findings into a toolkit that can be implemented by university leaders at institutions across the United States.

Exchange Insights with the STEM and Engineering Education Community

STEMinist Empowered invited our team to facilitate a 90-minute Mentorlite workshop on navigating and overcoming negative messaging in STEM learning and working environments at the 2023 STEMNOIRE Research and Wellness Conference. Approximately 18 women, ranging from undergraduate students to industry leaders, engaged in our session titled, “STEM Won’t Break My Soul”: Leveraging Improv to Mitigate the Internal Calculus Triggered by Negative Messages [8]. In this workshop, we invited participants to use the social identity wheel to identify their most salient identities and reflect on how they inform their interactions with others in STEM environments. Together, we discussed factors influencing how we process negative messages and strategies to navigate and overcome the (un)intended harm of negative messages. Drawing on the factors and strategies discussed, the participants formed groups and practiced navigating interactions involving negative messaging during an Improv activity. Lastly, we asked participants to reflect on how they can commit to becoming more conscious of negative messages and prevent themselves from internalizing negative messages or perpetuating psychological harm to others in the future, closed with declarations of personal affirmations to navigate STEM environments.

Data Collection

Originally, our research plan focused exclusively on faculty and staff associated with admissions, financial aid, earning an undergraduate engineering degree, various forms of co-curricular support, and individuals who establish and maintain initiatives to diversify faculty, cultivate partnerships with community colleges, and promote curricular transformations that center on inclusive pedagogical practices. However, over time, it was apparent that a critical voice was absent from the findings resulting in the need to include an additional data stream. We purposefully recruited students at each site using the following criteria—(1) One focus group with Black student leaders at each site; (2) One focus group with Brown student leaders; (3) One focus group with Black students across academic ranks; (4) One focus group with Brown students across academic ranks.

To date, we have conducted 48 interviews with faculty and staff and 14 focus group interviews with undergraduate engineering students across 6 institutions, reviewed transcripts for accuracy and created interview profiles. These interviews are associated with each site: MSU (1), UMD (4), FIU (3), UMBC (4), and GMU (2). While we conducted the focus group interview with MSU undergraduate engineering students virtually, we conducted four site visits with the other institutions. The field observations offered a real-time, tangible sense of how DEI initiatives were being enacted and experienced. This hands-on approach was crucial in ensuring a well-rounded and thorough understanding of the DEI efforts at the exemplars.

In addition to one-on-one and focus group interviews, we retrieved strategic plans for each exemplar to serve as supplemental research data and to track change and development (i.e., capture the institution’s intent for rectifying inequity through various change efforts)—revealing how the institution envisioned change from 2010 to 2020. We used a comprehensive search approach to locate the strategic plans on university websites, employing terms such as ‘strategic plan,’ ‘institutional priorities,’ and ‘educational goals.’ However, this strategy revealed that some exemplars had limited public access to strategic plans from 2010-2020, with some universities opting to share the latest plans or updates to previous plans. To overcome this dilemma, we contacted university libraries and archives to identify past strategic plans. We also worked with our on-site coordinators, who engaged with university leadership to access the personnel managing archives. These efforts were pivotal in obtaining at least one strategic plan from each university that at least started within the desired decade but may have extended beyond 2020. This data stream addressed the research questions, informing key insights for this executive summary.

Research Questions

- 1) How are diversity, equity, and inclusion-oriented values defined in the strategic priorities?
- 2) What organizational structure supports these strategic priorities?

Data Analysis

We employed document analysis [9] to address the research questions guiding this executive summary. The initial step of document analysis involved reviewing each institutional document and reporting notable details, stakeholders involved in the strategic planning process, diversity, equity, and inclusion framing, key definitions or terms, and other resources [9]. This process resulted in the identification and retrieval of additional documents to support our understanding of the institution’s approach to advancing diversity, equity, and inclusion. For example, we identified a Strategic Plan for Enhancing Cultural Diversity at Morgan State University 2022-2025. This strategic plan indicated how all Maryland institutions must develop and implement a plan for cultural diversity in response to Maryland Education Article §11-406, noting the significant role the state legislation plays in ensuring cultural diversity within higher education institutions in the state of Maryland [10].

The following step involved developing a codebook informed by previous work examining institutional culture in higher education. Kuh and Whitt (1988) define *institutional culture* as “as persistent patterns of norms, values, practices, beliefs, and assumptions that shape the behavior of individuals and groups in a college or university and provide a frame of reference within which to interpret the meaning of events and actions on and off the campus” [11, p. 6]. By examining institutional culture, we can learn how culture shapes the learning and working environment and the institution’s approach to change [12], [13]. While we considered multiple frameworks to characterize institutional culture, we drew upon Holcombe [14] to create the initial codes to characterize strategic priorities emphasizing diversity, equity, and inclusion and three archetypes of DEI work—cultural or student support centers, chief diversity officers, and cross-campus DEI committees—to characterize the organizational structures implemented to support the strategic priorities to develop the codebook.

Analysis of the strategic plans was guided by a deductive and inductive approach [15]. We used a deductive coding approach in the first coding cycle to identify how three exemplars characterized diversity, equity, inclusion, and organizational structures in their strategic plans. Along with the coding process, the research team created memos to document new ideas and emerging questions to discuss in the weekly research meetings. Over time, we observed a limitation with the initial codebook and discussed adding a code to reflect the strategic priorities referencing an aim to broaden access to higher education. In addition, when the research team discussed the similarities and differences between each exemplar's strategic goals and strategies to implement them, we created an additional code to recognize the role of accountability within the organizational structure. These emerging codes were implemented in the second coding cycle.

To examine patterns across the exemplars, we created a matrix to illustrate which exemplars had occurrences of DEIA and baseline archetypes of organizational structure. Our analysis has begun to reveal the nuances of how institutions conceive DEIA and their Organizational Structures to uphold these values at their institution. In the context of the larger study [7], these strategic plans will complement the data gathered from interviews and focus groups and provide a broader context for bridging the institutions intent-to-impact gap.

Key Insights

Over time, we have garnered multiple insights from each data stream. We have observed how considerable social inequities (based on race, ethnicity, class, and gender) operate simultaneously, resulting in a compounding complexity associated with implementing organizational change efforts to improve Black and Brown students' awareness of access to, and pursuit of engineering education and careers. For example, most exemplars are concerned with helping students meet basic needs to combat food, clothing, and housing insecurity and developing and implementing interventions to support their social and academic integration. In addition, we observed the importance of using intersectional approaches while problematizing the policies, programs, and initiatives associated with undergraduate students accessing and navigating engineering education. These insights motivated our interests to characterize the intentions by identifying and examining the institutional values and DEI commitments declared in the strategic plans and relevant institutional documents.

Diversity, Equity, Inclusion, and Access Strategic Priorities

In addition, several key insights have begun to emerge into how diversity, equity, inclusion, and access (DEIA) values are articulated and operationalized in the strategic plans for three of the six exemplars represented in this CAREER project—GMU, FIU, and MSU [16]-[19]. Each exemplar emphasized DEIA within its strategic documentation, ranging from dimensions of diversity in terms of race, ethnicity, culture, socioeconomic status, first-generation college status, place-bound, language, and, to some extent, gender, and sexual orientation, reflecting multiple layers of diversity. However, the scope and application of the reference to DEIA varied across institutions, given the unique populations served. Notably, these exemplars often emphasized the importance of creating accessible pathways, community engagement, and partnerships as core to its mission and priorities.

FIU's commitment to the underserved includes a center for families and children, EMBRACE (*a healthcare program for autistic adults*), Panther Pride (*provides success coaches, mentors, and financial assistance for students formerly in foster care*), and Panther Life (*offer students with learning disabilities an opportunity to audit classes and experience college*). FIU framed its diversity, equity, and inclusion efforts by emphasizing its role as a diverse and community-focused institution. As a federally designated minority-serving institution and majority-minority institution, FIU highlights the fact that more than half of its undergraduate students are recipients of Pell grants, often the first in their families to attend college. This demographic representation underscores FIU's commitment to serving students from various socioeconomic backgrounds and providing opportunities for upward social mobility.

MSU's strategic plan intentionally described what terms like "Urban" and "Diversity" meant in the context of a Historically Black College and University (HBCU). They were concerned about embodying the importance of broadening access to educational opportunities for low-income students and students classified as underprepared to pursue an undergraduate education. A key point raised by the undergraduate students involved how this strategic plan "would reaffirm the continuing significance of Morgan as a HBCU even as it embraces its diversity mandate [19, p. 10]." They were concerned with how the strategic plan would support students with limited academic preparation or low SES. Strategic Initiatives for student success and preparation involved:

- improving retention and degree completion,
- increasing student enrollment by partnering with regional community colleges, and
- building an educational environment enriched with cultural and socio-economic perspectives.

In addition, MSU aimed to implement living-learning communities in residential life to integrate curricular and co-curricular initiatives and increase opportunities for students to participate in undergraduate research, service learning, and civic engagement—specific strategic initiatives for engaging with the community involved in implementing the Morgan Mile.

Additionally, these institutions acknowledged the importance of global perspectives within their DEIA strategies, with FIU notably prioritizing initiatives aimed at the recruitment and retention of international students and niche programs recognizing the linguistic diversity represented on their campus. Likewise, the exemplars emphasized the importance of global engagement to ensure their students are prepared to be global leaders in their respective fields. One of GMU's strategic goals involved offering global learning opportunities for domestic students and expanding recruitment of international students. In addition, GMU offers niche programs for international students to ensure they receive adequate support from the application to graduation, including multiple pathways to mitigate barriers for multi-lingual learners transitioning to a learning environment situated in the English language.

In addition to student initiatives, the exemplars focused on increasing faculty diversity to enhance student success. One of GMU's strategic goals is to create a diverse academic community, which involves recruiting, retaining, and mentoring diverse faculty and staff. This strategic goal will be actualized by recruiting a new cohort of diversity recruitment advocates and intentions to hire a Director of Faculty Diversity Initiatives. MSU also emphasized their priority to recruit diverse faculty and faculty who value diversity. Likewise, these institutions have emphasized the

importance of innovative teaching and learning by investing in teaching and learning centers equipped with instructional designers as a resource to strengthen the curricular experience and redesigning gateway courses to improve student success. These examples highlight a culturally diverse teaching staff's role in enriching the educational experience of a diverse student body.

Supporting Organizational Structures

We have begun to garner some insights into the organizational structures implemented to support diversity, equity, inclusion, and access for three of the six exemplars represented in this CAREER project—GMU, FIU, and MSU. We have observed the presence and role of Chief Diversity Officers and Cross-Campus DEI Committees within GMU and MSU strategic plans. In contrast, FIU's strategic plan mentions the commissioners tasked with creating the strategic plan, asking, and finding solutions, excluding explicit mentions of Chief Diversity Officers or Cross-Campus DEI committees.

While FIU includes concrete goals and strategies, it does not include details on implementation. They plan to develop a strategic plan steering committee that meets quarterly to assess and review the status of the reports [18]. Although FIU may not directly articulate its goals and strategies within a DEIA framework, they illustrate their defined goals and the strategies to be employed to realize their student success priorities, stating "...that student success is everyone's responsibility [18, p. 18]." This approach provides action plans that could implicitly support DEIA values. As an explicit example, GMU defined goals and strategies for achieving them while incorporating DEIA values into some of their strategic goals, metrics, and representative accomplishments and stating with one of their strategic goals' that GMU will create an inclusive and diverse academic community in conjunction with academic leadership [16]. While both FIU and GMU provided goals and metrics, MSU provided an extensive blueprint for DEIA integration within the strategic plan that encompasses defined goals, precise objectives, anticipated outcomes, and a clear assignment of the accountable office(s) or organization(s) responsible for applying and assessing their goals efficacies. For example, Morgan's goal to "...offer challenging, internationally relevant academic curricula, welcoming and supporting a diverse and inclusive campus community," would be accomplished by objectives like "Increase cultural and socio-economic diversity of the student body and provide effective student support services to increase student academic success." Showing anticipated outcomes like a "Broad range of cultural and socio-economic diversity among students." Then, the benchmark will be measured by evaluating several programs and activities, including student feedback on programs. With an assessment method of an APEX Report, the Student Affairs offices and Institutional Research are responsible for measuring outcomes [19, p. 31].

Discussion on student support centers within exemplar strategic plans further illuminates the diversity of approaches to DEIA implementation. While these exemplars' strategic plans advocate for academic support mechanisms, the focus and specificity of these support centers vary, ranging from broad educational support niche areas like parent-student support centers, co-working spaces, and co-curricular support through labs and maker spaces.

While these findings begin to demonstrate how change happens in engineering education, these insights also demonstrate the importance of bridging the intent-to-impact gap when developing

and implementing programs and initiatives designed to rectify inequities in undergraduate engineering education. An educator's mere commitment to DEI does not eliminate them from (re)producing barriers to accessing or pursuing an engineering education. These findings have implications for engineering educators and leaders interested in adopting the signature practices in their institutional context.

Looking Ahead

In this executive summary, we described the project's progression over the third year of the CAREER award, designed to understand how exemplars disrupt the status quo. We illuminated the exemplar's intentions by identifying the institutional values and commitment and framing diversity, equity, and inclusion in the strategic plans. It is important to note that these strategic plans were defined prior to the unfolding of the anti-dei crusade.

As we progress into the fourth year of the grant, we will complete data collection, continue data analysis efforts, and exchange insights with the engineering education community. The principal investigator will conduct one-on-one interviews with senior administrators at each site to uncover how change efforts unfolded over the decade (i.e., 2010 to 2020). Immediate next steps involve preparing a manuscript that intends to explore the intent to impact gap to a relevant journal. This manuscript will expand on this executive summary wherein we will present an alternative story of how change happens in engineering education by comparing the intentions illustrated in institutional documents and faculty and staff interviews to student insights. Additional efforts to exchange insights involve preparing a manuscript that recognizes inequity and signature practices that change agents can use to rectify inequity in engineering education to a relevant journal. This manuscript will expand on the community conversation facilitated via the ASEE Commission on Diversity, Equity, and Inclusion. Lastly, we will initiate discussions with administrators in a College of Engineering at a Midwest institution to discuss their priorities for addressing racial inequity within their institutional context and develop the impact narratives and BPE change model for the impact playbook.

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