CLIMBING UPHILL: TOWARD A COMMON AGENDA FOR THE ADVANCEMENT OF BLACK AMERICANS IN ENGINEERING

J.S. London,[1,]* W.C. Lee,[1] B.A. Watford,[1] C.D. Hawkins Ash,[2] T. Holloman, C.M. Pee,[1] & C. Hampton[3]

[1]*Virginia Polytechnic Institute and State University, 363 Goodwin Hall, 635 Prices Fork Road, Blacksburg, VA 24071*

[2]*Foresight Strategy Solutions, 2033 Illinois Street, Vallejo, CA 94590*

[3]*University of Colorado-Boulder, Center for STEM Learning, 1050 Regent Dr., 393 UCB, Boulder, CO 80309*

*Address all correspondence to: J.S. London, Virginia Polytechnic Institute and State University; Tel.: +(540)231-6555; Fax: +(540)231-6903, E-mail: jslondon@vt.edu

This position paper presents a set of categorized and prioritized recommendations from a multi-year project focused on developing a common agenda regarding the advancement of Black Americans in engineering. Though broadening participation has been an expressed goal at the national level for decades, few would dispute the claim that not enough progress has been made as it relates to Black Americans' access to and experiences in engineering. To increase the likelihood of progress, the commitment of actors from different sectors to a common agenda will be needed. Thus, we offer this new agenda to encourage stakeholders to focus on recommendations believed to be necessary to catalyze progress in this area, calling on both researchers and practitioners alike. We developed this agenda by synthesizing literature, interviewing subject-matter experts, and completing a Delphi study to establish priorities among the wide range of possible next steps. Given the focus on research and practice, we have organized this suite of recommendations around things we need to know, document, act on, and create to achieve societal impact. The resulting agenda provides stakeholders with a backdrop for identifying problems that can be investigated empirically and with focal areas for addressing persistent barriers.

KEY WORDS: *underrepresentation, collective impact, national agenda, discrimination, equity*

1. INTRODUCTION

"The potential for losing students along all segments of the pathway from preschool through graduate school necessitates a comprehensive approach that focuses on all segments of the pathways, all stakeholders, and the potential of all programs, targeted and non-targeted."

–National Academies Press (2011, p. 7)

At a national level, the focus on losing students or fixing the "leaky pipeline" spotlights the complex problem of addressing racial inequities in the engineering education system. Because addressing this problem is unlikely to be achieved by a single

organization, it is vital that those working towards addressing it do so in an intentional, coordinated manner. In short, there is a need for collective impact. A central condition of realizing collective impact is participants having a shared vision for change, common understanding of the problem, and a joint approach to solving it (Kania and Kramer, 2011). We offer this common agenda as a starting point toward this end.

The development of this common agenda was born out of a relentless passion to realize the impact of engineering education research and diversify engineering. Despite continual effort to broaden participation in engineering (BPE) (Congress & Commissions on the Advancement of Women and Minorities in Science, Engineering, 2001; Holloman et al., 2018; Landis, 2005; National Research Council, 1976; Nelson and Reid, 2016; Oaxaca and Reynolds, 1989; Walter and Austin, 2012), we have made dismal progress as it relates to historically marginalized groups. After four decades, education researchers have produced mountains of scholarship that documents disproportionate representation, racial inequities, and differential lived experiences in engineering education and the workforce (London et al., 2020; Cosentino et al., 2014; Fletcher et al., 2017; Ohland et al., 2011; Pawley, n.d., 2017; Ross et al., 2017). Yet, lived experiences of trauma in these environments remain far too common (e.g., Lee et al., 2020) and the representation of Black Americans in undergraduate programs, graduate programs, faculty positions, and industry has remained rather stagnant. For example, Black Americans have accounted for less than 5% of undergraduate degrees awarded in engineering annually over this entire period (Roy, 2019). Such dismal progress in improving representation despite such large investments of time and resources over time speaks to the need to a recalibrate our approach and create a strategy that aligns the efforts of multiple stakeholders to achieve a collective impact.

The lack of progress in this area is not for a lack of trying, as a wide range of stakeholders—including researchers, practitioners, policymakers, and more—have poured significant resources, sweat equity, and invisible labor into addressing this challenge. However, most of these efforts have resulted in organizations aiming to address local needs, producing localized change, episodic progress, and little movement in the metrics that unify the widest coalition of stakeholders. In short, local efforts often represent "band-aids" or temporary solutions as opposed to the transformative changes required to address systemic problems. At times, it may seem like those engaged in this issue are proverbially fighting an uphill battle.

We posit that there is a disconnect between research and practice as it relates to addressing the plethora of systemic, organizational, and interpersonal issues that have continued to plague engineering education. And, given the need to allocate resources wisely, we believe now is the time to revisit our strategy and better coordinate our efforts to address this issue. Accordingly, our research team secured funding from the National Science Foundation (NSF) to critically examine the *Innovation Cycle of Educational Practice and Research* (Jamieson and Lohmann, 2010) as it relates to broadening participation in engineering and computer science. As a part of this study, we systematically reviewed literature on barriers to participation; interviewed subject-matter experts to discuss their professional experiences regarding broadening the participation of Black Americans; and conducted a Delphi study to reach consensus on the key issues, gaps in our understanding, and significant questions.
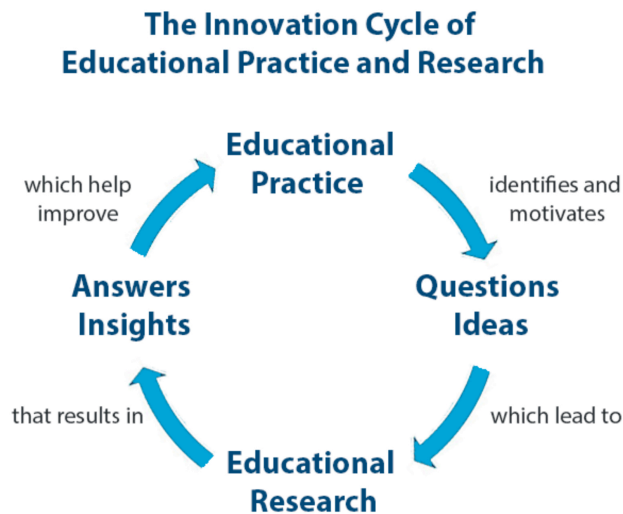
This position paper proposes a common agenda that will inform and unify the efforts of various constituents committed to the advancement of Black Americans in engineering. We offer recommendations that have been collated and categorized for a wide range of stakeholders. In doing so, we hope these words unify efforts and allow us to move forward with a coordinated strategy. We also aim to echo conditions outlined by many other critical voices, historically, and too long left out of institutional framings of engineering education research. In hopes that a committed group of actors could overcome the challenges associated with implementing these recommendations, we offer this work to a broad audience, particularly the myriad of constituents that have a stake in influencing the interest, academic preparation, or success of Black engineers. This group includes, but is not limited to, educators, researchers, practitioners, administrators, policymakers, accrediting bodies, and industry professionals. Now is the time for us—both individually and collectively—to reimagine our approach to "diversifying" engineering education given our stagnant progress.

1.1 Positionality Statement

Before we proceed, it is important to note how our positionality impacted this work (Hampton et al., 2021; Secules et al., 2021). In addition to each author identifying as a Black American, each held or was pursuing a PhD in engineering, education, or engineering education throughout the duration of this project; multiple authors had experience in industry and government; all of us had a wide range of experiences in the academy and K–12 system; and collectively we have immense expertise and personal experience with the topic from both a research and practice perspective. The composition of our team (1) increased our emotional proximity to the topic, (2) facilitated our identification of and access to participants, and (3) enabled us to carefully consider the realities and nuances of both research and practice simultaneously. Because our team identified as Black Americans, educators, and engineers, we were also able to engage this topic from both a race and disciplinary perspective. To oversimplify this advantage, it could be thought of as the ability to not only discuss Black people from the perspective of engineering, but to also discuss engineering and engineering education from the perspective of Black people. While we note the distinction between these categories is somewhat arbitrary for those who simultaneously occupy these distinct categorizations, we offer this simplification to convey the dual consciousness we aimed for during the analytic process.

2. DEVELOPING A COMMON AGENDA

The recommendations included in the proposed national agenda is the culmination of a three-phased study that critically examined the *Innovation Cycle of Educational Practice and Research* (Jamieson and Lohmann, 2010) (see Fig. 1) as it relates to broadening participation of Black Americans in engineering and computer science. Our work is situated in the Innovation Cycle of Educational Practice and Research due to the significant

**The Innovation Cycle of
Educational Practice and Research**

**Educational
Practice**

which help
improve

identifies and
motivates

**Answers
Insights**

**Questions
Ideas**

that results in

which lead to

**Educational
Research**

Adapted from Booth, Colomb, and Williams, 2008

FIG. 1: Theoretical framework

role of education researchers in addressing this challenge, largely due to their positioning in higher education institutions.

Among the numerous calls for broadening participation, many emphasize the role of research in achieving change (London et al., 2020). Despite making some progress, several publications comment on the disconnect between research and practice in engineering education, and what should be done to bridge the gap. Jamieson and Lohmann (2010) articulated a model of systematic engineering education innovation that is based on a continual cycle of research and practice, which, if adopted, would "*both* continually advance the body of knowledge on engineering learning *and* result in the implementation of more effective and replicable educational innovations, with the end result being better-educated students" (Jamieson and Lohmann, 2010, p. 1). This framework served as the lens for this study because it summarized what *should be* happening as it relates to the connection between research and practice in this area. By framing the study with this lens, it allowed us to look at both the research and practice in this space, determine if there is a need for modifications to the cycle such that the desired changes in broadening participation will happen, ask targeted questions throughout the study, and ensure that the proposed solutions are situated in the context of both research and practice.

The development of the agenda began with us systematically reviewing the literature on barriers to participation and proposed solutions for each juncture of the education-to-workforce pathway (Boyd-Skinner et al., in press; Holloman et al., 2021; London et al., 2021). We began here to ensure future efforts were not unnecessary or irrelevant due to a lack of insights about previous research. A systematic re-

view was necessary because the work that has been done in this area is fragmented, in disparate bodies of literature, and has not been synthesized. Including this phase in the study helped ensure that the subsequent phases and resulting agenda will be grounded in and informed by a comprehensive understanding of the current state of the field.

Next, we interviewed subject-matter experts ($n = 60$) to discuss their professional experiences regarding broadening participation of Black Americans in K–12, higher education, and the workforce. We included this phase because we knew some knowledge and wisdom would not be represented in the traditional forms of scholarship, such as journal articles and conference papers. Interviews allowed us to investigate the beliefs, insights, and experiences of people who regularly engage in efforts to broaden participation. We discussed their reactions to the research findings, identified gaps in our understanding that were not found in the literature, gathered input on key issues and significant questions that need to be addressed to gain momentum in this regard, and garnered insights on the breakdowns in the *Innovation Cycle of Educational Practice and Research*. Collectively, insights from the systematic literature reviews and interviews led to 64 recommendations that would serve as the original content for the final phase, the Delphi study.

Lastly, we conducted a Delphi study with a smaller sample of subject-matter experts ($n = 12$). Delphi is a methodological approach for getting input from subject matter experts (SME) and reaching a consensus on a complex problem (Avella, 2016; Hsu and Sandford, 2007; Linstone et al., 2002). It was well suited for this study because it was a cost-effective way to incorporate the input from experts across the U.S. with a variety of experience and expertise while providing a safe space for disagreement and allowing participants to take their time to respond. Insights from the first two phases were incorporated into the material that Delphi participants reacted to in the final phase. During this phase, we leveraged their expertise to revisit the description of BPE that is independent of a particular agency (e.g., NSF), refine the wording of recommendations, and establish priority among the agenda items. The Delphi study included three rounds. In the first round, experts evaluated the 64 recommendations from the first two phases based on their relevance for addressing the BPE problem (where the options were Not/Relevant) and clarity of the wording (based on a 4-point Likert scale ranging from very unclear to very clear). They were also given the opportunity to suggest new recommendations. From this round, six items were eliminated (since at least 4 out of 12 experts deemed it "not relevant"), and 15 new ideas emerged from the suggestions (those that were deemed "unclear" or "very unclear" were refined after the list of recommendations was finalized). In the second round of the Delphi study, the 15 new recommendations were evaluated based on the same criteria as the original set—relevance and clarity. One (1) item was eliminated during this round. Thus, seventy-two (72) distinct research, practice, and policy recommendations ultimately resulted from the three phases and were included in the Delphi study; see the Appendix for the complete list. In the final step of the Delphi, experts indicated the priority of a recommendation by denoting whether

it was something that we "Must Do" or "Could Do," and were limited to applying the "Must Do" designation to at most 25 of the 72 recommendations to force them to prioritize.

The combination of these three phases resulted in *A Common Agenda for the Advancement of Black Americans in Engineering*. We grouped the recommendations thematically and the agenda includes a comprehensive suite of actions associated with knowing, documenting, doing, and creating. The 72 recommendations are unevenly distributed across these four themes. We organized them thematically to facilitate readability. We also assumed that different stakeholders are positioned to respond to different challenges, and to note the different ways in which epistemic and institutional reforms become actionable. The four themes (i.e., Document, Act, Know, and Create) map to two axes (see Fig. 2). One axis (Research-Practice Axis) denotes whether the theme is related to research (i.e., advancing our understanding of a topic based on systematically gathered evidence) or practice (i.e., observable actions that affect what and how things are done in a particular context). The other axis (Process-Innovation Axis) denotes the theme's immediacy; it is an acknowledgment that some recommendations require us to leverage a myriad of things that already exist while others require us to "start from scratch," as the saying goes.

We also created the recommendations with a parallel structure: they each contain a verb (e.g., document), subject (e.g., the process of cultural transformation), and rationale (e.g., to better understand prototypes of culturally engaging campus environments). The goal was to provide both the *what* and *why* for each agenda item. Acting on many of the recommendations will require cross-sector collaborations in order to achieve success. In some instances, the proposed idea contained within a recommendation has already begun and is not a new suggestion. In this case, our
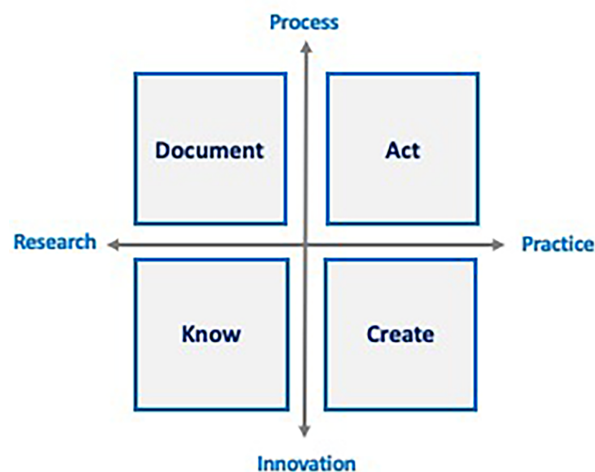

FIG. 2: Thematic organization of recommendations in the proposed national agenda

hope is that this national agenda serves as a rallying cry for others to advance the existing effort.

3. A PROPOSED COMMON AGENDA FOR THE ADVANCEMENT OF BLACK AMERICANS IN ENGINEERING

The proposed agenda highlights the need to both reconceptualize and contextualize our understanding of BPE, specifically as it relates to Black Americans. We propose the following description:

> *In relation to Black Americans, Broadening Participation in Engineering (BPE) should be thought of as the national effort to combat the effects of institutional and systemic racism on participation in engineering. The ultimate goal is to improve, enhance, and transform learning and work environments. Doing so will require addressing the following: (1) inequitable resource allocation; (2) institutional and systemic racism, sexism, xenophobia, and all other forms of marginalization, minoritization, or 'othering'; (3) chilly climates among learning and work environments; and (4) all other factors contributing to a lack of representation, disparate participation, or differential personal or professional outcomes for underrepresented groups. Because these issues manifest across every educational juncture (e.g., elementary, secondary, and postsecondary levels), strategies will require an integrated approach and the willingness to make substantial changes in engineering education systems, policies, structures, and practices.*

3.1 Agenda Overview

Though the research-to-practice cycle is often presented as the aspirational relationship to which engineering education should aspire, its dichotomy is too rigid for capturing the breadth of needs and activities required to broaden participation in engineering. As a move toward a more accurate representation, we propose a quadrant including four distinct action categories (see Fig. 3).

The first two action categories align with the research aspect of the research-to-practice cycle: (1) *Know* and (2) *Document.* When the engineering education community discusses research, members tend to focus on creating new knowledge. In this agenda, we propose an expanded view of research that includes generating new knowledge, capturing current realities, combating the systematic distortion and misrepresentation of Black Americans' experiences, and collecting data that will overcome unwarranted mistrust. We lean on existing scholarship about epistemic injustice (Fricker, 2007) to make sense of the suite of recommendations in these two categories.

The other two action categories align more closely with the practice dimension of the research-to-practice cycle: (3) *Create* and (4) *Do.* When the engineering education community discusses practice, members tend to focus on implementing and enacting
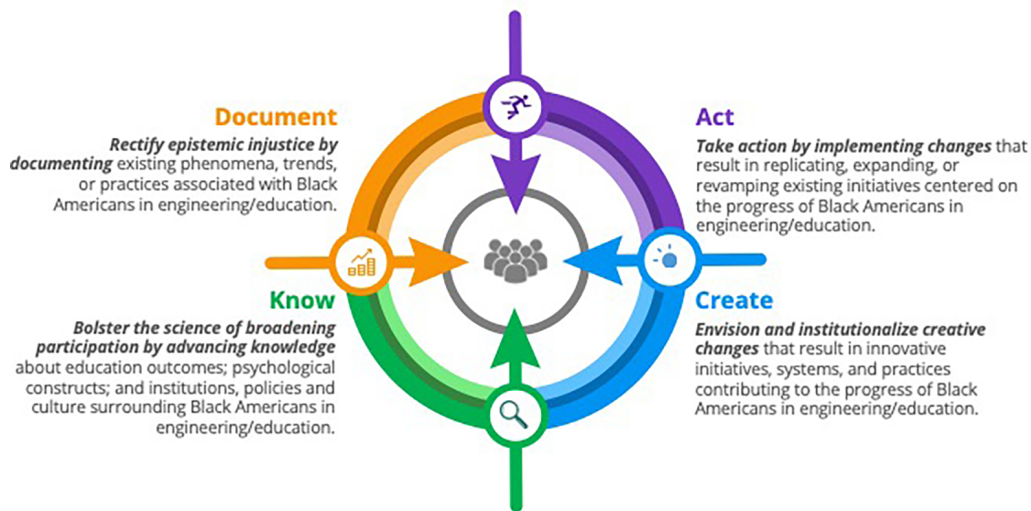
FIG. 3: A common agenda for the advancement of Black Americans in engineering

ideas. We propose an expanded view of practice that not only includes implementation, but also includes envisioning and institutionalizing. Our expanded view of practice includes the higher-order thinking skills required for creating or building something new in addition to the investments needed to sustain efforts and establish them as the norm. We leaned on Kotter's (2012) theory of change to inform our thinking on this topic.

We offer these action categories to help stakeholders situate themselves within the proposed common agenda. However, we acknowledge that the categories are more integrated than they may appear in the quadrant, and will require coordination across dimensions. In the subsequent sections, we discuss what each action category highlights about the BPE dilemma and elaborate on the actionable set of activities that may serve as a meaningful response to it. The complete list of recommendations can be found in the supplementary material online.

3.1.1 Know

Recommendations in the *Know* category are the most directly connected to the "research to practice" cycle. These recommendations speak to the need to advance knowledge and bolster the science of broadening participation in engineering. Thus, the aspect of the BPE dilemma these recommendations are designed to overcome is issues of ignorance—collectively, engineering education has lingering questions to which the answers have intellectual merit. In short, there are questions posed regarding things we do not know about individuals and educational systems. Regarding people, there is a need to conduct both explanatory and exploratory research—i.e., systematic studies that explain outcomes of interest or explore related psychological constructs. Example recommendations included investigating ways to promote a sense of belonging in engineering to

reduce barriers that stem from a chilly climate, isolation, tokenism, and stress and investigating factors that influence meaningful student engagement (e.g., student motivation) to promote successful participation.

In addition to the need for research on people, there is a need for more scholarship on systems. This body of work should include investigations of institutions, policies, and cultural elements that impact the lived experiences of Black learners trying to navigate the systems that impose embedded and woven forms of inequity and marginalization (NASME, 2021). Studies and tools focusing on root causes of inequity in wider systems must help to inform this scholarship. Two example recommendations included analyzing the impact of policy on reproducing educational and workforce inequalities to identify areas that need to be changed, and analyzing regional and national alliances (e.g., Louis Stokes Alliances for Minority Participation, 50k Coalition) to evaluate their effectiveness.

3.1.2 Document

Recommendations in the *Document* category resemble the scholarship of teaching and learning (SoTL). These recommendations speak to the need to document and make public inquiry more slowly associated with practice than that found in the *Know* category. The aspect of the BPE dilemma these recommendations are designed to overcome is multi-faceted.

The challenge most similar to the SoTL is capturing effective methods: there is a need to know what people are already doing to address issues associated with broadening participation in local contexts. Doing so will provide an accurate historical account of what does and does not work. Such insights are useful for others to learn from and for us to proverbially avoid "reinventing the wheel." This challenge is not unique to issues of broadening participation, however, it is a ubiquitous problem associated with bridging the gap between research and practice. Accordingly, there are a number of recommendations focused on capturing the ongoing realities, especially of things that work. Examples of these recommendations include: documenting the challenges that faculty encounter as they attempt to transform their curricula and pedagogy to be more racially inclusive to better understand how faculty can overcome these barriers, and implementing historical analysis of past participants from BPE interventions to learn from our successes and identify gaps in current efforts.

Two other challenges that undergird the *Document* recommendations are specific to deeply rooted issues associated with anti-Blackness. Each of these challenges can be situated in Fricker's (2007) work on epistemic injustice. According to Fricker, one form of epistemic injustice is hermeneutical injustice, which is systemic distortion and misrepresentation. With this in mind, some of the recommendations are designed to combat systemic distortions and misrepresentations of our experiences. An example of a recommendation that addresses this barrier would be leveraging research traditions that account for sociocultural techniques and practices (e.g., counternarratives) to provide space for Afro-centric knowledge construction and decentralize Eurocentric inquiries

that are not suitable for accurate depictions and explanations of non-European experiences.

On the other hand, there is also testimonial injustice, which refers to unwarranted mistrust (Fricker, 2007). In addition to confronting the increased demands for accountability in higher education, in general, BPE stakeholders are also confronted with the challenge of not being believed unless their lived experience has been documented and reported by a recognized authority figure, such as a researcher. Said differently, there is a persistent need to provide evidence that tells a compelling story and serves as proof of our effectiveness or proof of an existing program. In many ways, it seems like someone's personal opinion regarding issues of broadening participation does not matter until it is part of our collective knowledge stored in scholarly publications. Recommendations associated with this challenge allows us to refute misconceived ideas and collect data that will overcome unwarranted mistrust. An example of this type of recommendation includes documenting occurrences of seemingly objective federal and state policies (e.g. performance funding systems) to reveal how systems of racial inequity are perpetuated and reinforced.

3.1.3 Create

Recommendations in the *Create* category have more of a pragmatic undertone than the two aforementioned categories. This suite of recommendations is designed to overcome an innovation challenge and are more cognitive in nature. Enacting these recommendations require the use of high-order thinking skills that will result in the creation or building of something new. They align with the envisioning phase of Kotter's theory of change (2012) because they encourage us to envision something fundamentally different from the current approaches to broadening participation. They are a call to re-envision engineering education content and pedagogy, as well as its infrastructure.

There is a suite of recommendations that are associated with engineering content and pedagogy while the others are focused on creating infrastructures. Recommendations of this type include actions such as designing culturally relevant STEM media and literature to increase awareness and representation; developing ABET requirements focused on diversity, equity, and inclusion to enforce new norms in Colleges of Engineering across the country and hold institutions accountable; and creating an evaluation mechanism for leadership in higher education (e.g., deans) to increase accountability and the value assigned to diversity, equity, and inclusion efforts (ABET is the official name for the Accrediting Body for Engineering and Technology).

3.1.4 Act

The last category of recommendations, *Act*, also has a practical bent, but aligns more closely with the implement and institutionalize phases of Kotter's (2012) theory of

change. In some ways, these recommendations represent the fruit of all that has already been done to broaden participation. Borrowing language from collective impact, this specific set of recommendations represents mutually reinforcing activities intended to overcome challenges associated with issues of support and coordination (Kania and Kramer, 2011). Consequently, this spectrum of recommendations includes calls for investments (of time, funding, and human resources) and coordination (among stake-holders) that will lead to immediate outcomes. The two ends of the spectrum include recommendations to (1) replicate and/or expand existing efforts; and (2) revamp programs, practices, policies, and partnerships. Those falling on one end of the spectrum can be done with support and coordination alone, while those at the other end will involve more creativity and infrastructure, respectively.

Examples of recommendations that fall in this category include: replicating programs that have successfully improved representation and/or lived experiences of Black engineers to maximize the use of existing resources; providing early-exposure opportunities for K–14 students to inspire middle school, high school, and community college students to STEM aspirations in college; revamping admission criteria to ensure decisions are data-driven, holistic, and reward various kinds of capital; revamping promotion and tenure processes to increase accountability and the value assigned to diversity, equity, and inclusion efforts; providing training for pre-service and in-service teachers (K–12) on engineering and CS to better support Black students on STEM paths; promote more Black American engineers to leadership roles to set the vision and make decisions in industry, academia, and government. This set of recommendations is the longest list of items with the most consensus about the urgency of these actions.

4. CONCLUSION

As we close, we want to remind the reader that the ultimate goal is to improve, enhance, and transform learning and work environments for current and future engineers. We offer *A Common Agenda for the Advancement of Black Americans in Engineering* in hopes that it will inspire a wide range of stakeholders—including researchers, practitioners, and policymakers—to reimagine and recommit to diversifying engineering and addressing the manifestations of systemic racism in engineering education and practice. This is a complex problem that will require a multi-faceted strategy. Because these issues manifest across every educational juncture (e.g., elementary, secondary, and postsecondary levels) and in the workplace, strategies will require an integrated approach and the willingness to make substantial changes in engineering education systems, policies, structures, and practices.

There is a great deal we could do, and the Delphi results help us prioritize among the options. There is one notable item that received the most (10 out of 12 participants) votes for something we "Must Do": *Replicate programs that have successfully improved representation and/or lived experiences of Black engineers to maximize the use of existing resources* (Recommendation 2.1.) Inherent in this recommendation are a few key

assumptions. It acknowledges that effective things are already being done in this area—numerous people have been fighting this uphill battle in various locales. It also includes a notion that is part of what motivated this study: linking what we know with what we do and scaling up ideas that have already shown success. Instead of reinventing the wheel, we must overcome the temporal barriers by learning from what has already shown promise and leveraging our limited resources to do more of what has worked. Let this agenda be a call for renewed energy surrounding support, funding, and extending resources to such efforts.

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APPENDIX: RECOMMENDATIONS IN *A COMMON AGENDA FOR THE ADVANCEMENT OF BLACK AMERICANS IN ENGINEERING*

KNOW

Outcome-focused research recommendations focused on *generating new insights*	Votes (N = 12)
3.1. Investigate ways to promote a sense of belonging in engineering to reduce barriers that stem from a chilly climate, isolation, tokenism, and stress.	6
3.2. Analyze the impact of policy on reproducing educational and workforce inequalities to identify areas that need to be changed.	5
3.3. Analyze regional and national alliances (e.g., LSAMP, 50k Coalition) to evaluate their effectiveness.	4
3.4. Analyze the process of bridging gaps between research and policy or research and practice to advance an equity agenda.	4
3.5. Investigate factors that influence meaningful student engagement (e.g., student motivation) to promote successful participation.	4
3.6. Analyze how campus structures could be reorganized in cost-effective ways to provide minoritized populations with the types of culturally engaging campus supports that they need during college.	3
3.7. Investigate and amplify the experiences of Black engineers who are pursuing or recently earned advanced degrees (i.e., graduate and postdoc levels) to expose systemic factors impacting pathways through higher education.	3
3.8. Investigate the relationship between Black people's mental health and engineering experiences to highlight the impact of racial trauma and race-based stress.	2
3.9. Investigate the role of parents and other family members on Black children and on Black engineering college/university students to promote successful participation.	2
3.10. Investigate the role of multiple identities in the engineering experience to better understand how Black people navigate educational and workforce systems.	1
3.11. Analyze institutional resistance to cultivating optimally inclusive campus environments in which increasingly diverse student populations can thrive to document the types of barriers to progress and ways in which such challenges can be addressed.	1
3.12. Investigate the impact of educator characteristics to explore the impact of their race and other characteristics on student experiences and outcomes.	1
3.13. Investigate the socioeconomic and situational components that may impact the academic trajectories of Black students in engineering to promote successful participation.	1

3.14. Analyze students' interpersonal interactions and social dynamics to evaluate their relationships (e.g., peers, faculty) within their surrounding environment.	0
3.15. Investigate the relationship between faculty's pedagogical decisions and student success/retention to better understand the impact of the learning environment.	0

DOCUMENT

Process-focused research recommendations focused on *documenting existing phenomena, trends, or practices*	Votes (N = 12)
1.1. Leverage research traditions that account for sociocultural techniques and practices (e.g., counternarratives) to provide space for Afro-centric knowledge construction and decentralize Eurocentric inquiries that are not suitable for accurate depictions and explanations of non-European experiences.	5
1.2. Document the processes of cultural transformation to better understand prototypes of culturally engaging campus environments.	5
1.3. Document occurrences of seemingly objective federal and state policies (e.g., performance funding systems) to reveal how systems of racial inequity are perpetuated and reinforced.	3
1.4. Document the challenges that faculty encounter as they attempt to transform their curricula and pedagogy to be more racially inclusive to better understand how faculty can overcome these barriers.	3
1.5. Document the relationship between culturally engaging campus environments and student outcomes to better understand its added value to various stakeholders.	3
1.6. Implement historical analysis of past participants from BPE interventions to learn from our successes and identify gaps in current efforts.	3
1.7. Implement longitudinal research methodologies to better understand the long-term impact of BPE interventions.	3
1.8. Reexamine the measures used to monitor impact to evaluate their appropriateness and utility for monitoring progress towards broadening participation in engineering.	1

CREATE

Outcome-focused practice recommendations focused on *creative innovative initiatives, systems, or practices*	Votes (N = 12)
4.1. Design culturally relevant STEM media and literature to increase awareness and representation.	9
4.2. Develop ABET requirements focused on diversity, equity, and inclusion to enforce new norms in Colleges of Engineering across the country and hold institutions accountable.	9

4.3. Build national platform(s) focused on broadening participation for Black Americans in engineering to provide a backbone organization for collective impact. The function should include: guiding vision and strategy, coordinating overlapping efforts, supporting aligned activities, establishing shared measurement practices, building public will, advancing policy, and mobilizing funding.	7
4.4. Create an evaluation mechanism for leadership in higher education (e.g., deans) to increase accountability and the value assigned to diversity, equity, and inclusion efforts.	7
4.5. Create more accessible pathways to engineering degrees to minimize the barriers encountered by people on different educational pathways, such as community college students.	7
4.6. Create a measurement and ranking system to recognize contributions to broadening participation and incentivize change.	5
4.7. Build institutional capacity of Historically Black Colleges and Universities (HBCUs) for STEM research to bolster their opportunity to access funding and solve STEM challenges.	5
4.8. Avoid stereotypes associated with Black Americans when designing curricula and programs to ensure more authentic representations.	5
4.9. Form strategic partnerships to facilitate collaboration across stakeholder groups (e.g., academic institutions, communities, researchers, and practitioners).	3
4.10. Build individual and institutional capacity to broaden the pool of researchers that can conduct high-equality STEM education research and secure funding from public and private sources.	3
4.11. Develop culturally responsive curriculum and pedagogy that appeals to the interests of Black children.	3
4.12. Form more formal mentoring programs to increase the availability and accessibility of Black engineers.	3
4.13. Collaboratively develop (researchers and practitioners) research implications for practice to improve the potential impacts and mitigate potential barriers.	2
4.14. Form more persuasive arguments when garnering support for BPE initiatives to better align with the priorities of a broad portfolio of funding sources, such as presenting diversity, equity, and inclusion as matters of public health, public safety, national security, infrastructure, economic competitiveness, and/or global competitiveness.	2
4.15. Form safe employment spaces for Black Americans to reduce barriers that stem from a chilly climate, isolation, tokenism, and stress.	2
4.16. Collaboratively design (researchers and practitioners) research studies to prioritize germane practitioners' involvement earlier in the research process.	0
4.17. Create a culture where using diversity data and promising practices is encouraged as part of empowering faculty and other stakeholders to create more equitable education and/or workplace experiences.	0

ACT

Process-focused practice recommendations focused on *replicating, expanding, or revamping existing initiatives, such as programs or practices*	Votes (N = 12)
2.1. Replicate programs that have successfully improved representation and/or lived experiences of Black engineers to maximize the use of existing resources.	10
2.2. Provide early-exposure opportunities for K–14 students to inspire middle school, high school, and community college students to STEM aspirations in college.	9
2.3. Revamp admission criteria to ensure decisions are data-driven, holistic, and reward various kinds of capital.	9
2.4. Revamp promotion and tenure processes to increase accountability and the value assigned to diversity, equity, and inclusion efforts.	9
2.5. Provide training for pre-service and in-service teachers (K–12) on engineering and CS to better support Black students on STEM paths.	8
2.6. Promote more Black American engineers to leadership roles to set the vision and make decisions in industry, academia, and government.	8
2.7. Support existing faculty of color giving back to support their recruiting, hiring, and mentoring Black students.	7
2.8. Invest more financial resources in scholarships and fellowships for Black engineering students to defray the cost of higher education.	7
2.9. Expand programs that have successfully improved representation and/or lived experiences of Black engineers to maximize the use of existing resources.	7
2.10. Pay Black Americans equitably to adequately award their talents and reduce economic disparities across racial/ethnic groups.	7
2.11. Improve the cultural responsiveness of gatekeeper courses to minimize barriers encountered at critical points along the engineering pathways.	6
2.12. Invest more financial resources in HBCUs to improve the capacity of these minority-serving institutions for producing more engineers and computer scientists.	6
2.13. Require NSF proposals to include Broadening Participation in Engineering plans to ensure that BP is integrated into all engineering projects.	6
2.14. Provide cultural competency training for advisors, supervisors, and managers to improve the leadership and guidance offered to Black people in academic, social, and professional industry contexts.	6
2.15. Provide training on topics such as stereotypes, bias, microaggressions, and discrimination to promote anti-racism.	6
2.16. Demand constituent-informed education policy to ensure that Black voices are represented in decisions that affect them.	5

2.17. Facilitate high-fidelity implementation of BPE practices to assist STEM education practitioners with integrating evidence-based evidence practices.	5
2.18. Provide cultural competency training for graduate students, especially teaching assistants, to improve the educational experiences offered to Black students.	5
2.19. Provide cultural competency training for undergraduate students to help them develop this important skill prior to going into industry, graduate school, research labs, etc.	4
2.20. Exchange information and resources among stakeholder groups to strengthen collective impact.	3
2.21. Improve inter-organizational partnerships within higher education to eliminate bureaucracy and inefficiencies that result in reduced participation.	3
2.22. Hire Black American engineers to reach a critical mass.	3
2.23. Invest more financial resources in internships and research opportunities for Black engineering students to ensure students are competitive candidates when entering the job market.	3
2.24. Educate the public on the roles and responsibilities of engineers in society to broaden awareness, understanding, and appreciation of the field.	2
2.25. Hire Black American educators with STEM expertise to provide Black children with more access to teachers and mentors with shared cultural backgrounds.	2
2.26. Revamp initiatives (e.g., mentorship programs) to make existing infrastructure more need-based, flexible, and comprehensive.	2
2.27. Disseminate research and impactful practices to broad mediums that reach stakeholder groups.	1
2.28. Foster stakeholder engagement to increase community and family involvement.	1
2.29. Publish well-documented assessment reports to provide more transparent information (e.g., challenges, processes) that fully captures the entire assessment cycle.	1
2.30. Encourage non-Black faculty mentorship of Black students to broaden the pool of faculty focused on supporting these students.	1
2.31. Expand culturally responsive informal programming (K–12) to raise awareness of and accessibility to engineering opportunities.	1
2.32. Improve inter-organizational partnerships across higher education and industry to recruit talent more strategically from a wider spectrum of schools and programs.	1