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Exploring Black male participation on undergraduate engineering student teams using interpretative phenomenological analysis (Work in Progress)

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He began his higher education pursuits at Morehouse College and North Carolina Agricultural & Technical State University, where he earned degrees in Chemistry and Chemical Engineering as a part of the Atlanta University Center's Dual Degree in Engineering Program. While in college, he was a Ronald E. McNair Scholar, which afforded him the opportunity to intern at NASA Langley. He also earned distinction as a Phi Beta Kappa member and an American Chemical Society Scholar. Dr. Henderson completed his Ph.D. in Chemical & Biomolecular Engineering at the University of Illinois at Urbana-Champaign. As a graduate student, he was a NASA Harriet G. Jenkins Graduate Fellow and mentor for the Summer Research Opportunities Program.

Dr. Henderson has dedicated his career to increasing the number of students who are in pathways to pursue STEM careers. He believes that exposing students to STEM early will have a lasting impact on their lives and academic pursuits. He co-founded the St. Elmo Brady STEM Academy (SEBA). SEBA is an educational intervention that introduces underrepresented and underserved fourth and fifth-grade students and their families to hands-on STEM experiences.

Dr. Henderson is the immediate past Director of the Program for Mastery in Engineering Studies (PROMES, pronounced "promise"), a program aimed at increasing engineering student achievement, engagement, and graduation rates. His research group seeks to understand engineering identity trajectories and success mechanisms throughout lifespans using action-based participatory research and novel methodologies such as photovoice, IPA, and draw-an-engineer and the development of research-informed interventions to improve student success.

He was most recently recognized by INSIGHT Into Diversity Magazine as an Inspiring STEM Leader, the University of Illinois at Urbana-Champaign with the College of Liberal Arts & Sciences (LAS) Outstanding Young Alumni Award, Career Communications Group with a Black Engineer of the Year Award for college-level promotion of engineering education and a National Science Foundation CAREER Award in 2023 to advance his work that centers engineering identities of Black men in engineering.

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Dr. Horton is a Research Assistant Professor for STEM/Engineering Education. His research addresses the curricular and co-curricular experiences of marginalized groups within higher education, such as Black males, women, and faculty of color. His work is most situated within minority serving institutions. He holds bachelor's and master's degrees in history from Dallas Baptist University. He earned his Ph.D. in Higher Education Administration from the University of Florida in 2009.

WIP: "Why does race/ethnicity matter for participation on engineering student teams?" (Work in Progress)

Abstract

Engineering education requires students to successfully navigate participation in student teams at several stages throughout their undergraduate education. As a result, researchers have explored key factors for successful teaching and learning through student team projects and assignments. However, few researchers have explored the connection between racial identity and experience on undergraduate student teams. This work-in-progress paper describes a recently initiated NSF project investigating the experiences of Black men on undergraduate engineering student teams. Our project will integrate two complementary research approaches, interpretative phenomenological analysis (IPA) with photo-elicitation methods, to better understand how Black male experiences on undergraduate student teams might inform instructors' approaches to supporting undergraduate engineering student projects. We hope that our findings will provide theoretical support for a deeper exploration of the experiences of Black men on student teams. In addition, we hope our findings inspire other researchers to more deeply investigate the connection between various aspects of identity and their implications for students' participation in undergraduate engineering teamwork.

Introduction

The engineering work context is distinguished in many unique ways, but perhaps the most common feature is that almost every engineering work context involves teams. These teams involve tacit and explicit communication among team members within the team to make judgments and choices about the nature of the work that must be completed and how. Often, on complex projects, these teams are also interdependent on the work of other teams; requiring that complex webs of interdependent teams form to support the design and delivery of an engineered product, process, or service (Chowdhury & Murzi, 2019) . Consequently, the social interactions of professionals within and between teams constitute a large proportion of engineering work by time and importance. As a result, teamwork is an essential competency for engineering graduates who will need to interact with professionals from varying backgrounds to bring engineering work to fruition(Murzi et al., 2020).

Nonetheless, the experiences of Black male engineers in teams have been understudied (Cross & Paretti, 2020). As a result, there is a gap in the ways we understand the contributions of Black men to engineering teams, their positionality within engineering teams, and the obstacles or opportunities they face when seeking to contribute to or construct engineering work. In this paper, we describe our new project through which we hope to contribute to the scholarship that explores the ways that race and culture, broadly, play in or influence the social construction of science or engineering knowledge by exploring the experiences of

undergraduate Black men participating in science or engineering project teams. Our investigation is guided by the following research questions:

1) How do undergraduate Black men experience academic socialization vis-à-vis the development of professional identity and discursive literacy through their participation on engineering student teams? and,

2) How does the intersection of race and gender experienced by undergraduate Black men condition their participation in decision-making processes on engineering student teams?

Background

Researchers exploring the role of student teams in undergraduate engineering education have demonstrated that student backgrounds, prior experiences, cultural assumptions and expectations, and institutional environment all bear not only on student achievement but also particularly on the dynamics of student teams (Rodríguez-Simmonds et al., 2023). Nonetheless, the research in engineering student teams neither foregrounds the experiences of black men, nor includes them in prominent numbers among their participants. Therefore, the experiences of Black males in undergraduate engineering students still needs further exploration (Henderson et al., 2022)—especially regarding the experiences of Black males on undergraduate engineering student teams.

In our review of the literature, we found only Cross and Paretti (2020) have investigated African-American males' experiences on multiracial student teams in engineering. Their study involved semi-structured interviews with 8 African American men. Using intergroup contact theory to sensitize their analysis; they identified three key themes: positive team experiences, albeit including an awareness of negative stereotypes held by team members, lack of friendship opportunities and potential conflict associated with unmet expectations, and proactive efforts to dispel stereotypes. Their findings hint at the critical need to bring the research on student teams in engineering education into contact with the research on Black male experiences in engineering education. For example, while a key asset to Black men is their ability to draw on same-gender support networks and friendships, Cross and Paretti (2020) observed that their experiences on student teams involved limited opportunities to develop friendships among their peers. Additionally, while the positive expectations of mentors and professors could serve as a "self-fulfilling prophecy" (Burrell et al., 2015) students in Cross and Paretti's study used proactive efforts to dispel stereotypes among their peers in order to prevent negative self-fulfilling prophecies.

To situate our proposed research among the broader scholarship on Black male experiences in undergraduate education, we reviewed literature specifically focusing on Black men. Our review of the literature was guided by the following questions:

- How do Black men in engineering programs perceive or experience academic or professional socialization?

- What funds of knowledge, community assets, or counter-perspectives do they create?

- What strategies do Black men use to overcome perceived barriers or obstacles to their academic socialization? What obstacles must they overcome?

- How have they created communities of belonging that exist within and transcend their institutional contexts?

After reviewing elements of the broader literature, including important, relevant themes into which the Black male undergraduate experience can be situated and more richly understood in light of broader scholarship on engineering student teams, we concluded that these lines of scholarship share relatively little overlap. As a result, the opportunity our project will focus on is summarized in the Figure 1. On the one hand, research into the experiences of students on teams in undergraduate engineering emphasize the need for understanding the role of identity production in student teams. There are also efforts to better understand the factors that contribute to team effectiveness. On the other hand, the research described above concerning Black men in student teams has focused on community cultural wealth, robust/fragile identities, and leadership capabilities of Black male engineering students. By combining the insights from these areas of scholarship, we will be in a better position to understand and characterize the experiences of Black men in student teams in ways that inform the broader development of undergraduate engineering students.
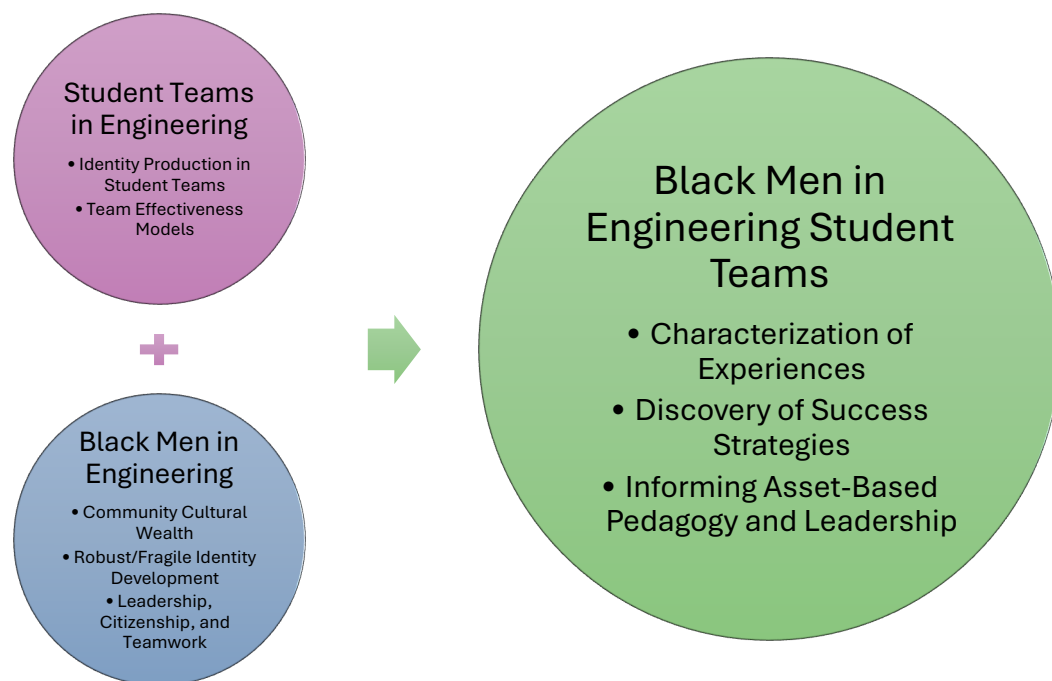

Figure 1. Research Gap at Intersection of Student Teams and Black Men in Engineering Education

Positionality Statement

We are two tenure-track engineering faculty and one non-tenure-track engineering faculty. All three of us are Black Men who are dedicated to increasing the number of under-represented individuals pursuing STEM careers. We have all participated in the design and implementation of programs intended to expand participation of students from all backgrounds in engineering.

Methods

Our project will use Interpretative Phenomenological Analysis (IPA) (Smith et al., 2021; Smith & Nizza, 2022; Smith & Osborn, 2004) situated at the intersection of constructivism and action research. An IPA approach was selected as a guide to collecting and analyzing data because of the dearth of literature related to the nuanced experiences of Black men on engineering teams. This approach is ideal since it allows researchers to apply a meaning-making lens to explore how participants make meaning of significant life experiences (Smith & Nizza, 2022;

Smith & Osborn, 2004). Given IPA's guidance for researchers to situate themselves within the richness of participants' data, smaller samples are recommended to allow for a significant time to understand the research phenomenon within individual cases as well as across the collective of participants' experiences (Smith et al., 2021).

At the time of writing this document, our research protocol is undergoing review by our Institutional Review Boards (IRBs). Once our protocol has been approved, we will recruit eight research participants from among Black men enrolled in undergraduate engineering programs or co-op programs across the country to enroll in our study for 2 years. In accordance with IPA, we seek a small, purposeful, and fairly homogeneous research sample of Black males in engineering. When an individual expresses interest in joining the study, we will screen participants with an open-ended questionnaire that asks about their gender, racial/ethnic background, year of study, and major as well as questions such as "Why is it important for Black men to pursue engineering degrees?", "How can teamwork improve engineering solutions?", and "What is engineering design?" This screening process will expose potential participants to the nature of the study and enable us to select participants who demonstrate that they can access their experiences with identity. Participants will be interviewed three times per year, and the participants will be brought together with the researchers (our team) to conduct in-person photo-elicitation interviews and create a learning community from which student-driven findings will be prepared for wider dissemination.

The men who participate in the study must be involved in team-based engineering projects during their enrollment, as the focus of our conversations with the participants will be their experiences in these student teams. To ensure this for students across institutions, this will be an inclusion criterion for our study. The men must be enrolled as undergraduate students at the start of their participation in the project, although they may graduate and remain engaged with the project during the project timeline. We leave the definition of "engineering projects" open to the participants' interpretation; however, we expect these projects might range from class projects during the first through third years of undergraduate study to senior projects or non-classroom engineering team-based experiences. These non-classroom engineering experiences might include internship experiences, extracurricular experiences that involve engineering design work, or interdisciplinary courses outside the major that the student self-identifies as engineering work. Our goal is to recruit from a diversity of institution types (e.g., HBCUs, HSIs, large state institutions, large private institutions, smaller religious institutions, engineering colleges, liberal arts colleges with engineering majors, etc.).

Interview Guide

Example questions that will be utilized in the interviews include questions about project goals, teamwork, and experience:

Questions about project goals, teamwork, and experience:

Before the interview, the participants will be asked to prepare a short description of their experiences on project teams during the intervening time (generally 1 Fall, Spring, or Summer semester). This description will take the format of a journal. The participants will share these unstructured journals with the research team before their interview takes place.

Q1: What types of projects have you worked on since we last spoke?

- Please describe the status of these projects.

- What is the broader context of these projects in school, at work, or in your extracurricular activities?

- Could you please describe the makeup of your team? (e.g., Social-economic; ethnic; discipline; gender; academic status; work status; personality; interests or skills; etc.)
- In what ways would you view yourself as similar to your teammates?
- In what ways might you distinguish yourself from your teammates?

Q2: If you could choose one of these projects to focus on, which one would you choose? Why?

- Please describe the goals or objectives of this project?
- Why do you believe your team chose these goals? What were you all trying to accomplish?
- What made these goals important? (What tradeoffs did your team face that made selecting goals important?)

Q3: Please describe what your team did to complete your project.

- Can you tell me about how your team formulated the problem(s) your project addresses?
- How did your project formulation or scope change over time?
- Why do you think your team went about things in this way?
- Tell me about some of the technical choices your team made and why.
- What types of data, observations, experiences, or other factors influenced what your team did?
- How do you feel the technical aspects of your work influenced the ways your team worked together?
- Conversely, how do you feel the ways your team worked together influenced the technical choices your team made?

Q4: Continuing with this project, what are the work processes your team engaged in to complete this project?

- Within these work processes, please describe your role(s) in bringing this project to fruition.
- I'm interested in hearing more about how your team divided the work among each of you.
- Why do you feel that the team settled on this work distribution?
- What is it about each of the team members that you feel influenced their assigned or assumed tasks or responsibilities?
- Within this broader context, how do you feel about the role(s) you assumed or were assigned?
- How would you describe your experience on this team?

Question for photovoice interview: (This question will be asked first during the photovoice interview. Other questions similar to the above may be pursued depending on time and the course of the conversation.)

Q5: You have been asked to bring a photograph that reflects your experience on engineering student teams.

- What do we see here?

- What is really happening here?

- How does this relate to your life?

- Why does this situation, concern, or strength exist?

- What can we do about it?

Closing questions:

Are there other areas of your project teamwork experience since we last spoke that you would like to discuss?

Conclusions

We believe our work has the potential to make several important contributions to the retention and academic success of Black men in undergraduate engineering programs. First, this work will contribute to the corpus of knowledge interrogating the experiences of Black men on student project teams. This work will help to understand the ways that Black male identity intersects with discursive identity and student work contexts to influence student teams and their decision-making processes. This is important because identity production and engineering judgment work indicate that both the production and recognition of engineer identities are required for effective participation in engineering work contexts. Second, our work endeavors to understand the experiences of Black men as high-achieving undergraduate students, instead of taking a deficit approach to observing and interpreting their experiences. As a result, our findings will help to inform educational practice and student support with the perspectives of resilient, successful students. Finally, our work will make contributions to the growing body of knowledge concerning the community cultural wealth and funds of knowledge Black men draw on to navigate their undergraduate experiences. In particular, our work will demonstrate how Black men utilize these assets to successfully navigate working relationships with their peers.

Acknowledgments

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