Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #45476

BOARD # 353: DUE Collaborative Research: Gateway or Gatekeeper: Understanding Why Black Students Choose Engineering Technology or Engineering and the Implication of This Choice

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DUE Collaborative Research: Gateway or Gatekeeper:

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Abstract

The National Science Foundation (NSF) awarded a significant grant in 2023 to investigate the motivations behind Black students' choice of engineering technology over other engineering disciplines. This research is crucial as it addresses a gap in understanding the factors influencing academic choices among underrepresented groups in engineering fields. The findings from Phase 1 of this project reveal essential insights into students' experiences, particularly concerning faculty engagement and institutional support, which are pivotal for fostering persistence and success among minority students in engineering Burt et al. [1-3]. Research has consistently shown that faculty engagement plays a vital role in the academic success of underrepresented students. For instance, Berhane et al. [2] Highlighted the importance of positive interactions with faculty at two-year colleges, noting that such relationships significantly contribute to the persistence and transfer of Black engineering students [2].

Similarly, Henderson et al. emphasized how supportive faculty environments can enhance the experiences of minority students, leading to improved academic outcomes. [3]. These studies underscore the necessity of creating supportive academic environments that recognize and address underrepresented students' unique challenges in STEM. Moreover, the intersectionality of race and gender significantly shapes students' experiences in engineering disciplines. Campbell-Montalvo et al. [4].

Their findings suggest that understanding these dynamics is essential for developing effective strategies to support underrepresented students in engineering and STEM fields. In addition to addressing challenges, the research from Phase 1 also highlights successes achieved throughout the project. Participants reported that the supportive environments fostered by faculty and institutional programs were instrumental in their academic journeys. For example, Burt et al. [1] found that underrepresented students in STEM benefit from programs that provide validation and encouragement from faculty, which enhances their sense of belonging and commitment to their fields [1].

This aligns with the findings of Okstad et al [5], who noted that institutional leaders play a crucial role in cultivating environments that support the success of underrepresented racial minority students in STEM[5]. The insights gained from this research contribute to the academic discourse surrounding engineering education and offer practical recommendations for institutions. Institutions can better serve their diverse student populations by focusing on enhancing support systems and promoting positive environments within engineering technology programs. This study aims to illuminate the pathways that lead students to choose engineering technology, fostering hope for more inclusive and supportive educational environments.

Keywords: collaborative research, research experience, representation, engagement

Introduction

The decision to pursue a major in engineering technology is influenced by a myriad of factors that extend beyond mere interest in the field. Understanding the motivations behind this choice is

crucial, particularly in the context of increasing diversity and the need for a skilled workforce in STEM (Science, Technology, Engineering, and Mathematics) disciplines. Research indicates that the academic environment, including faculty engagement and institutional support, plays a significant role in shaping students' educational experiences and decisions. For instance, faculty involvement in mentoring and supporting students positively impacts their academic outcomes. Instructional strategies employed by faculty, such as student-centered teaching practices, significantly influence students' motivation to persist in engineering technology programs, as found by Lattuca et al. Additionally, the intersectionality of race and gender within the context of engineering education cannot be overlooked, as minority students often face unique challenges that affect their academic persistence and motivation. Addressing these challenges through targeted institutional support and inclusive practices is essential for fostering a more equitable educational environment.

Literature Review

Exploring the motivations of students choosing to major in engineering technology requires a multifaceted approach that considers the influences of faculty engagement, institutional support, and the broader social context. By understanding these dynamics, educational institutions can better tailor their programs and support systems to meet the needs of all students, ultimately enhancing their academic experiences and fostering a more diverse and capable workforce in engineering technology.

Factors Influencing Academic Choices of Engineering Technology Students

Understanding the factors influencing the academic choices of students, particularly those who are underrepresented in engineering fields, reveals significant gaps in the existing literature. A critical aspect of this issue is the role of school counselors in guiding students toward STEM (Science, Technology, Engineering, and Mathematics) careers. Falco emphasizes the necessity for school counselors to comprehend the barriers that underrepresented students face in pursuing STEM educational paths, as their involvement can significantly enhance students' opportunities for success in these fields. However, the current understanding of how counselors can influence these students' academic choices remains limited, indicating a need for further research into effective counseling strategies tailored to diverse student populations. Moreover, the impact of peer-led learning (PLTL) initiatives in introductory engineering courses has been shown to positively affect the academic achievement and persistence of underrepresented students in engineering. While these programs demonstrate promise, there is insufficient exploration of the factors contributing to their success or failure in fostering long-term commitment to engineering pathways. This gap highlights the need for comprehensive studies that analyze demographic variations and performance indicators within PLTL frameworks to understand better how these initiatives can be optimized for diverse student groups.

Family socioeconomic status (SES) is also pivotal in shaping students' academic choices and outcomes. Research indicates that students from lower SES backgrounds often face systemic barriers that hinder their educational attainment and career aspirations. Major et al. found that family influence, particularly in conjunction with gender and socioeconomic factors, significantly affects pre-university students' decision-making regarding careers. This suggests that interventions aimed at addressing these socioeconomic disparities are crucial for improving

representation in engineering fields. The literature lacks a nuanced understanding of how these socioeconomic factors interact with educational systems and counseling practices to influence students' academic trajectories. Furthermore, the concept of bridge programs, which aim to support underrepresented students in their transition to higher education, has been explored but requires deeper investigation into their effectiveness and the specific challenges these students encounter. While these programs are designed to mitigate the effects of inadequate academic preparation, there is a lack of empirical evidence detailing the long-term impacts of such interventions on students' educational choices and career paths in engineering. In summary, the existing literature reveals significant gaps in understanding the multifaceted factors that influence the academic decisions of students in engineering. Addressing these gaps through targeted research can inform the development of effective interventions and support systems that enhance diversity and inclusion within engineering disciplines.

Findings

This study, guided by belongingness and expectancy-value theory, highlights the fundamental need for belonging and fundamental expectations among Black engineering technology students across various domains, including support from peers, college advisors, professors, family members, and racial groups. The findings emphasize the critical role of interpersonal relationships and institutional support in fostering a sense of belonging.

Participants generally found college advisors welcoming but often experienced these relationships as superficial, lacking deeper engagement or mentorship. This limited depth suggests that while advisors are accessible, students might miss out on holistic support that could enhance their academic and emotional well-being. Peer networks provided valuable support, but the lack of deeper advisor engagement may leave gaps in the comprehensive support system.

Interviewees who were black males in their early twenties majoring in various engineering technology majors reported diverse experiences with faculty, significantly influencing their sense of belonging. Supportive relationships with faculty were characterized by personalized support, mentorship, and genuine interest in students’ development, contributing to a strong sense of belonging. Conversely, distant relationships led to feelings of isolation and disconnection.

The study underscores the importance of fostering a sense of belonging through supportive interpersonal relationships and comprehensive institutional support. Enhancing advisor and faculty engagement can significantly improve students’ academic experiences and sense of belonging. By adopting a more empathetic and holistic approach, educational institutions can create an environment where all students feel valued, understood, and empowered to succeed.

This study's findings were obtained by grouping codes from the established codebook and connecting related codes to the main themes. The central question of this study is why Black students choose or are placed into engineering technology (ET) programs versus other engineering programs.

The choice of engineering major reflects students' initial interest in engineering, influenced by early experiences and opportunities in STEM and the impact of high school staff. Programs like

Project Lead the Way (PLTW) and university-sponsored initiatives connected students to the Polytechnic College, influencing their decision to choose ET. High school advisors played a limited role in choosing, focusing more on graduation requirements than specific career guidance. However, some teachers provided significant advice based on students' interests and skills.

Black ET students' choice of ET is characterized by their inclination toward hands-on curricula and barriers to transferring to other engineering programs. Students' performance in STEM courses, particularly in math, influenced their decision to choose ET, which requires fewer upper-level math courses. Interviewees preferred ET's applied, hands-on approach over other engineering programs' theoretical and mathematical focus. This practical approach aligned better with their skills and interests. College advisors and staff provided information about ET curricula and opportunities, helping students make informed decisions. However, advisors also highlighted the difficulties of transferring to the College of Engineering, discouraging some students from switching majors. The representation and diversity within the Polytechnic College made some students feel more comfortable and supported in choosing ET. The potential salary associated with ET was a significant factor in students' decision-making.

These findings highlight the importance of early STEM exposure, practical curricula, and supportive institutional policies in shaping Black students' choices in engineering technology.

Discussion/Conclusion

The insights gained from this study highlight several key factors contributing to the lack of adequate representation of these students in research participation. Initially, the particular group of students contacted were not as receptive to participating in the study as anticipated. Recruitment efforts had to be repeated multiple times, and it was only through the encouragement of students familiar with the faculty researchers that participation increased. This reluctance was mainly due to the students not knowing the recruitment team and being unsure if they could trust them.

A lack of adequate representation of Black students. in research, participation can be attributed to several intertwined cultural factors. A significant historical context is rooted in the legacy of unethical research practices, notably the Tuskegee Syphilis Study, which has fostered a pervasive mistrust of medical and academic research within this community. This historical mistrust influences contemporary perceptions of research as potentially harmful or exploitative, particularly in medical contexts. Moreover, fear of discrimination or bias in research settings further exacerbates this issue, as these and other students and their families may harbor concerns about being treated unfairly or subjected to implicit biases during the research process.

The lack of representation among researchers and participants can lead to a perception that research is irrelevant to their lived experiences, further deterring participation. Family and community opinions also play a crucial role in shaping attitudes towards research participation. If family members or community leaders express skepticism or lack awareness regarding research benefits, students may be discouraged from engaging. Additionally, if research topics

do not resonate with these students' immediate interests or needs, they may not see the value in participating, leading to further disengagement.

Adopting culturally sensitive research design and implementation approaches is essential to addressing these multifaceted concerns. Increasing representation among researchers and ensuring that research topics are relevant to the communities involved can help build trust and encourage participation. Moreover, employing community-based participatory research (CBPR) strategies can facilitate collaboration between researchers and the community, ensuring that the voices of all students are heard and valued throughout the research process. By fostering an environment of inclusivity and respect, researchers can mitigate historical mistrust and enhance participation rates among all students.

Acknowledgments

This research was supported by the Racial Equity in STEM Education program in the Division of Undergraduate Education of the National Science Foundation (NSF) under Award Numbers 2224767 and 2224766. We sincerely thank the NSF for their funding and support, which made this study possible. We are also profoundly grateful to our collaborating institutions, Purdue University and The University of Toledo, for their commitment and contributions to this project. We acknowledge the efforts of all the faculty members, graduate and undergraduate students, and community partners who participated in this research. Their hard work, collaboration, and diverse perspectives significantly enriched the study and its outcomes. Finally, we appreciate the support of our respective research offices and administrative staff, whose assistance was crucial in managing the logistical and administrative aspects of the project. Their efforts ensured the smooth execution of our research activities.

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