Understanding Engineering Doctoral Preparation and Socialization through McNair Scholars Program Alumni

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Abstract

In this work in progress paper (WIP), we examine McNair alumni pursuing doctoral degrees in engineering disciplines to examine how the program prepared them to cope with the challenges of graduate education. Recent trends in engineering education show an increased effort to mitigate the rate of attrition in graduate programs. Previous work has identified several factors that correlate with student departure, including academic environment, interest, advisor-advisee relationship, self-efficacy, and Socialization. Furthermore, underrepresented groups in graduate education often contend with elevated or additional challenges to their preparation and Socialization because of their historically marginalized social identities. Various programs and initiatives, such as the Ronald E. McNair Postbaccalaureate Achievement Program (or McNair, for short), have sought to increase graduate enrollment among these populations. While programmatic data indicates the program increases graduate enrollment among underrepresented students, the literature lacks a complete understanding of how participation in the program as an undergraduate impacts an individual's daily lived experience as a doctoral student. Understanding how this program facilitates a higher rate of graduate persistence among its alumni will demonstrate how attrition can be mitigated proactively at the undergraduate level.

This study proposes a qualitative investigation to see how McNair influences underrepresented students' perception of and relationship with their doctoral programs. A Qualtrics survey regarding graduate preparation and Socialization will be distributed to the directors of all active McNair programs in the U.S. In addition, the directors will forward our survey to their alumni currently enrolled in doctoral education. The data from the study will consist of semi-structured interviews collected from individuals who complete the survey and exhibit salient responses to the McNair program's influence on their graduate experiences. We will then analyze the interview transcripts through thematic analysis to identify common themes and narratives that connect each participant's experiences in the McNair program with their socialization experiences as doctoral students. The findings of this study will reveal how student preparation can facilitate their persistence when the transition to graduate education. Ultimately, these findings will show which support mechanisms and services are lacking from the typical graduate socialization process. This insight will allow all engineering departments to better facilitate the preparation of students before beginning graduate education. Furthermore, it will outline preventative measures to mitigate many of the everyday adverse situations graduate students encounter.

Introduction and Literature Review

Doctoral programs exhibit the highest attrition rates in academia compared to other degree types [1]. The Council of Graduate Schools estimates attrition rates as high as 35% and 44% for domestic men and women students, respectively [2]. These statistics are even higher for traditionally underrepresented groups in higher education, such as Black students, who exhibit a ten-year completion rate of only 48% [3]. Engineering programs continue to see these rates despite most engineering graduate students being fully funded and taking less time to graduate when compared to other disciplines[4]. While the literature documents the prevalence of graduate attrition and its costs for various stakeholders, the phenomenon remains understudied in engineering, especially when considering a number of its unique disciplinary characteristics [5]. First, engineering graduate programs are majority populated by international students. In 2019, more than 57% of all engineering doctoral degrees conferred in the U.S. went to students with temporary visa status[6]. Second, 80% of engineering graduate students are fully funded, and the time to

degree completion is shorter when compared to other disciplines. Third, engineering students are typically organized into research groups with peers conducting similar research under a single faculty advisor [4]. Despite some apparent advantages, engineering graduate attrition rates remain relatively high, suggesting an incomplete understanding of attrition and how the relationship between students and the academy changes during their course of study [7].

Recently, researchers have increased their efforts in understanding and identifying elements of graduate education that contribute to attrition. These efforts are critical as departed students are losing time, money, resources, and talent to advisors, departments, universities, and project sponsors. The literature reveals that the struggles doctoral students face are largely the result of complicated relationships with and within the academic environment [8]. Factors that affect student persistence are commonly grouped into personal factors, such as imposter syndrome and mental health, and systemic factors, such as funding and advisory fit [9]. These issues are even more prominent for individuals with non-normative identities in fields like engineering, which is recognized for being gendered and raced [10]. Students from historically marginalized populations have a complicated relationship with the academies, particularly in engineering. Individuals from minoritized and disadvantaged backgrounds often lack the social, academic, and financial support needed to enroll and persist in graduate school, evidenced by the stagnant rate of doctoral engineering degrees awarded for over a decade [11]. Members of these groups are often susceptible to additional threats and challenges to their academic success and sense of well-being, such as racial or gendered micro-aggressions, imposter syndrome, and difficulties socializing into the culture of their departments [8], [10], [12], [13]. Matters related to the advisor relationship or quality of life and work may include different dimensions for women, people of color, or women of color, compared to how those facets manifest for affluent white male students advised by white male faculty [14]. Understanding how students negotiate a relationship with their academic institutions, research, and colleagues and what happens when this does not occur smoothly will provide valuable insight to mitigate attrition.

While identifying and understanding the causes of attrition is essential, it is necessary to develop practices and interventions that will promote student retention simultaneously. Over the last few decades, several programs and initiatives have emerged to encourage scholastic achievement and support underrepresented populations. For example, students who participate in research internships, mentoring relationships, and summer bridge programs complete their degrees at higher rates than students who lack these experiences [15]. In addition, several initiatives, such as the federal TRIO programs, have emerged in recent decades to address the issues faced by underrepresented populations and promote their degree attainment. Students enrolled in these programs receive various benefits ranging from academic and career counselling to financial support and application assistance [15]. For example, the Ronald E. McNair Postbaccalaureate Achievement Program is a Department of Education (DoE) initiative governed by the Higher Education Act of 1965. McNair became the seventh federal TRIO program in 1989 [16]. The program aims to diversify the national professoriate by supporting members of underrepresented groups in pursuing doctoral degrees. Underrepresented groups include populations historically marginalized in graduate programs, including racial and ethnic minorities, first-generation low-income college students, and women in STEM fields [17]. Eligible students can join at any time, but they must be enrolled as full-time undergraduates, express intent to pursue doctoral education, be able to complete a summer research internship, and be in good academic standing at their institution [18].

Additionally, students must be U.S. citizens or permanent residents. They must either be first-generation low-income undergraduate students or members of a group underrepresented in graduate education (Black, Native American Indian, Alaskan Native, Latinx, Native Hawaiian, and Pacific Islander). Per DoE requirements, two-thirds of an institution's McNair students must qualify as first-generation low-

income students and the remaining third qualify as underrepresented. Programs often recruit students who are eligible under both criteria [18].

There are currently 187 actively funded chapters of the McNair program scattered throughout the U.S. During the school year, McNair students receive academic advising, faculty mentoring, research experience, graduate admissions counselling, financial aid counselling, and other resources conducive to graduate education [16]. All McNair students must complete a summer research internship at their institution under the guidance of a faculty mentor before they graduate. Upon graduation, student involvement with the program terminates; however, their chapter must track their academic and career progress for ten years. The DoE allows programs to operate largely autonomously with the license to adjust the program to the needs and culture of their university. Programs vary in the amount of information they provide to the DoE. Some report the minimum information required, and others report more detailed information about specific activities and events [19].

Until recently, studies regarding the education and employment outcomes McNair program have been rare, with the latest publicly available analysis of the program from the DoE dating back to 2008 [18]. Renbarger and Beaujean's quantitative meta-analysis of the program remains the only comprehensive impact study conducted in its 32-year history [19]. While more comprehensive measures of the program's impact are needed, it is more important to understand how the experiences of individual students who have participated in programs like McNair translated into their graduate experiences. However, the literature lacks a qualitative understanding of why these students are more successful at navigating graduate education when the benefits of the programs are primarily limited to undergraduates [19]. The success achieved by McNair alumni suggests that aspects of their experiences as undergraduates provided a platform upon which they were better able to contend with the challenges encountered as doctoral students. This success indicates that it is possible to pre-facilitate well-being and prepare students to cope with the challenges of graduate education before their enrollment. By understanding the socialization experiences of McNair alumni, we will provide insight on what practices and policies universities and departments can incorporate to promote student thriving and retention. This work will conduct a deep qualitative analysis to describe the little-understood daily transitions these graduate students make as they grow into their roles as researchers [20]. To this end, our investigation is led by the following research question:

1. How does the McNair Scholars Program promote successful Socialization and persistence among engineering doctoral students?

Theoretical Framework: Socialization Theory

Socialization is how an individual learns, adopts, and practices the norms, values, and attitudes of the culture or institution in which they reside [21]. In graduate education, Socialization is the sociological procedure of role identification in which new students construct their new professional identities through interacting with others and their work [22]. Understanding this process is critical because students who successfully integrate into the culture of their academic setting are more likely to complete graduate school and have positive long-term career outcomes [23]. Crucially, Socialization begins well in advance of graduate school. During this anticipatory learning period, new students begin to adopt the values of attitudes of the academy [24]. This idea dovetails with the trends seen in Renbarger and Beaujean's meta-analysis, which found that students who participated in the McNair Scholars Program attained doctoral degrees at six times the average rate [19].

Graduate socialization is complex and unique to every graduate student. Difficulty navigating the socialization process is a known deterrent to students, especially those with marginalized identities [25]. Historically, Socialization in engineering centered around the fictional "ideal" student [26]. This archetypical model resembles a competitive single white male student obsessed with his research and willing to dedicate long hours to it at the expense of other aspects of life. The impact of student socialization centered around such a model has increased amid the diversification of engineering programs and focus on departmental culture [14]. The more a student's identity deviates from the fictional paradigm, the more likely they are to encounter difficulties socializing into the culture of their department. Students with non-normative identities often find the more hegemonic and competitive qualities seen in the ideal student often conflict with non-academic aspects of their life, such as personal relationships. More specifically, the emphasis on more hegemonic attributes typically associated with masculinity has also served to sideline other qualities commonly denoted as more feminine, such as interpersonal skills and collaboration [27]. Promoting more stereotypically masculine traits in the ideal student archetype at the expense of other attributes has played a crucial role in portraying women as "others" in engineering [28]. This study will understand what aspects of Socialization begin before graduate school and how students conceptualize and navigate "otherizing" departmental cultures.

Methods

Upon receiving IRB approval, we will distribute an email containing information about our study to the directors of all 187 currently active McNair Programs. In addition, the email will request the directors to forward the email containing our Qualtrics survey to all alumni enrolled in doctoral education as indicated by their program's records. The survey will take less than fifteen minutes to complete, with respondents who do so eligible to win a $10 Amazon gift card. The survey, containing a mixture of Likert-scale questions and open-response items, will ask participants their demographic information, the services and graduate school preparation they received from their McNair program and their experiences as graduate students. At the end of the survey, respondents will be asked if they would be willing to interview their experiences. Respondents who consent to be interviewed will be sent a follow-up email inviting them to participate. This study aims for a corpus of n = 30 students, with eligible participants being students enrolled at the time of recruitment in an in-person engineering doctoral program. Purposive interview participant selection will be further determined by maximum variation sampling regarding race/ethnicity, gender, time spent as a McNair scholar, and whether they are first-generation low-income students [18], [29], [30]. Participant selection will also be based on open-ended responses from the survey, particularly those we are likely to glean the most information about our study [31].

The design of the interview protocol will be influenced by Liddell et al.'s Survey of Early Career Socialization in Student Affairs used in their study of professional identity [32]. The semi-structured interviews will be conducted online via Zoom and recorded before the audio files are professionally transcribed and analyzed in NVIVO. We will employ a constructivist phenomenological approach when examining the data to explore how participants interpreted their experiences and characterize their preparation and persistence in graduate school [33]. We chose thematic analysis as our method in conjunction with this analytical stance. Thematic analysis involves identifying and interpreting patterns of meaning, or themes, from codes generated from the data. These themes then provide a framework for charting the experiences and narratives supplied by participants to our concept of interest, e.g., graduate socialization [34]. Since thematic analysis is a popular and highly versatile analytical technique, numerous implementations exist. We will adhere to Clarke & Braun's adjudication of the method during our analysis [34]. Lastly, by using open and axial coding techniques, we will ensure that our analysis

remains grounded in the articulations of our participants and our results accurately reflect their experiences [33], [35].

Discussion & Conclusion

As institutional characteristics can profoundly influence student socialization, we will also consider the different socialization experiences of students who attended different universities. For example, students who attended undergraduate institutions that primarily serve underrepresented racial and ethnic populations encounter different socialization processes than those who attended predominantly white institutions [30]. This study seeks to remain grounded in the Socialization of individual students and is not intended to compare different institutional cultures or McNair programs. However, we acknowledge that the culture of a student's undergraduate institution will influence the culture of the McNair program and thus their preparation and Socialization for graduate school. We anticipate our findings to correlate with the mission of the McNair Program, which seeks to equip students with information about how to navigate graduate school. However, we are keen to discover discrepancies between a student's experience in graduate school and their preparation through McNair.

It will be noteworthy to see how students identify with their McNair eligibility criteria, e.g., do students who fall under both criteria identify more with their status as first-generation low-income students or more with their status as underrepresented. We also hope to uncover how a student's transition to a doctoral program affects their experiences within it. For example, our results will reveal whether a student's anticipation of the challenges they are likely to encounter contributes to their persistence or if their lived experience cannot validate the effectiveness of their preparation. The goal of this work is to discover means by which experiences that occur at or before the time of enrollment can affect the Socialization of graduate engineering students. By examining the McNair Scholars Program alumni, we hope to recommend that departments incorporate holistic changes to promote student success instead of patchwork initiatives [36]. This study will also provide insight to individuals considering graduate education by outlining many of the difficulties graduate students face and highlighting characteristics of successful and unsuccessful socialization processes. As we continue to work on this study, we anticipate and welcome input and recommendations from the practice community about enhancing and refining this investigation.

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