

Beyond Persistence: Graduate School Aspirations of Hispanic Engineering Students at HSIs

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Introduction

Racial disparities in academic achievement continue to raise concern over the success of the current education system. College entrance rates over the past 10 years indicate an improving, but continued underrepresentation of minorities in higher education¹⁷. Despite these improvements, the U.S. Department of Education reports African-American and Hispanic students are overwhelmingly underrepresented in postgraduate education, at both the master's and doctoral degree levels¹⁶. Hispanic representation in STEM fields (science, technology, engineering, and mathematics) is particularly low at nearly all degree levels⁵. In an effort to identify factors contributing to this disparity, researchers across disciplines document the successes and struggles minority students experience throughout their academic and professional careers^{3; 4; 9; 15}. For example, student debt⁹, insufficient guidance⁵, and limited knowledge of the application process¹³ are possible deterrents for Hispanic students aspiring to graduate degrees. Family and cultural values may also be contributors. Saenz and Ponjuan¹⁴ found, Hispanic males sometimes feel pressure to financially support their families and are unable to pursue their education. While these deterrents primarily affect undergraduate students, they significantly impact Hispanic student representation in postgraduate education.

There are many reasons why the United States' largest racial minority group (i.e., Hispanics) is significantly underrepresented in postgraduate education; however limited racial and cultural support may influence this incongruence¹⁵. This potential contributor is reflected by minority student experiences at Predominately White Institutions (PWIs) where minority students are often confronted with limited cultural diversity and racial minority presence². The lack of representation at the faculty level, for Hispanics in particular, may be due to the number of students aspiring to earn graduate degrees. Recent reports claim only 5.7% of doctoral recipients are Hispanic, the lowest minority percentage when compared to Black (8.3%) and Asian (6.6%) doctoral recipients¹². Minority serving institutions (e.g., Historically Black Colleges and Universities, Hispanic Serving Institutions) continue to graduate the highest number of minority degree holders at all levels⁸. Improving minority faculty representation is an ongoing effort intended to provide support for minority students during their undergraduate career and may influence graduate school aspirations¹⁰. Therefore, to increase Hispanic representation at the graduate degree level, it is necessary to identify which factors support Hispanic undergraduate aspirations towards earning graduate degrees.

Graduate degree aspirations may be understood through Social Cognitive Career Theory (SCCT) which argues career aspirations, and the steps taken to attain them (e.g., earning graduate degrees), are primarily due to the dynamic interaction of personal factors (i.e., personal self-efficacy, outcome beliefs, and personal goals) and the person's environment⁷. Student social

integration and involvement in on-campus organizations have a significant impact on college student aspirations and persistence. Studies indicate minority STEM majors who successfully graduate are twice as likely to have had high levels of social integration at their institution¹. Similarly, minority students attending PWIs who are involved in ethnic student organizations are often more involved, feel more positively towards their institution, and successfully graduate¹¹. These organizations have the potential to connect students of similar cultural heritage who celebrate their personal academic achievements and educational aspirations. These findings converge to support SCCT's notion that environment impacts career aspirations⁷. While we found no studies directly examining this phenomenon among Hispanic students, the current literature suggests involvement in student organizations is instrumental to Hispanic STEM majors' graduate degree aspirations. Therefore, guided by SCCT⁷ we intend to explore what environmental factors support Hispanic STEM student aspirations to graduate degrees while attending an undergraduate HSI.

Purpose

The current study aims to identify factors contributing to Hispanic students' aspirations to attend graduate or professional schools. For the purpose of this paper, the research questions: "Are there identifiable external factors that seem to influence Hispanic engineering student aspirations to a graduate degree?" and if so, "Do graduate degree aspirations change during the undergraduate experience?" will be addressed.

Methodology

Data from this study was collected during the first and second years of a three-year, longitudinal, NSF-funded study. The research methods are described below.

Participants

Twenty one (16 male, 5 female) Hispanic sophomore engineering majors, representing a range of Hispanic ethnicities, were taken from a larger cohort of 39 students recruited at two Hispanic Serving Institutions (HSIs). Both institutions were located in the Gulf Coast region of the United States, accredited by the Accreditation Board of Engineering and Technology (ABET), and offered a range of engineering bachelor's degrees. The following year, 15 students (12 male, 3 female) were retained from the original 21 for follow-up interviews.

Instruments

Semi-structured interviews were employed to gather student responses regarding undergraduate experiences in a STEM field. Year one interviews were conducted during one-hour sessions that included 42 questions encompassing experiences directly pertaining to choosing a minority serving institution and becoming an engineer (e.g., "Does being male/female affect your view of becoming an engineer?"; "Have any specific aspects of your experience at your institution been

helpful in moving you towards your career/professional goals?). Question topics ranged from how skilled a student felt in mathematics to their perspective on diversity to post-graduation plans. The next year, follow-up interviews with the same students were conducted during one-hour sessions and included 38 of the original questions. Several questions from year one were excluded for redundancy or reworded to allow more open student responses (e.g., “using a 1 through 10 scale, please rate how important family support is to your career decisions” was reworded in year two to read “Please rate how important family support is to your career decisions”). Additionally, follow-up prompts were added to 23 questions which typically yielded “yes/no” responses during year one interviews (e.g., “Please tell me more about those experiences;” “In what ways do your parents provide/not provide support?”).

Data Analysis

Interview responses were first transcribed, then formatted and grouped according to question content (e.g., perceived support questions). Using content analysis, responses were coded by three research team members. NVivo 9 software was used to code identified thematic elements (e.g. perceived faculty support, institutional pride) in student responses. Each interview transcription was coded by three separate research team members who later met to discuss and agree upon the coding of each response.

Results

Content analysis identified several prominent themes pertinent to the research question: *Are there identifiable factors that seem to influence Hispanic engineering student aspirations to a graduate degree?* Aspirations appeared to be somewhat influenced by the presence of family members who are engineers, but primarily by membership in professional organizations. Addressing the question: *Do graduate degree aspirations change during the undergraduate experience?* We found professional memberships were significant in maintaining student aspirations across two years and were influential for engineering students refining their aspirations. Student responses supporting the identified themes are highlighted below. All names in this paper are fictitious and have been changed to protect student confidentiality.

Aspirations Influenced by Family and Memberships.

When asked about their plans immediately following graduation, 21 (16 male, five female) sophomore students indicated they were considering graduate school, five of whom aspired to earn a STEM field doctoral degree. Our results indicate that sophomore engineering majors with family working in the engineering fields and those involved in professional organizations on campus (e.g. ASCE, IEEE) were equally likely to aspire to a graduate degree. Of this sample, 62% (13 students) mentioned having immediate family members who were engineers and were members of at least one professional organization on campus.

During the interview, students were asked whether they had any immediate family members in the engineering fields, and whether that family member had influenced their decision to major in engineering. For example Marco, a mechanical engineering major aspiring to attain a master's degree in either mathematics or engineering, described his father as being highly influential in his decision to major in engineering:

“Because [he] was the closest role model I had, and since I liked what my father has been doing ...all his life...I decided to pursue the same career”.

Another sophomore, Olga, was asked where she'd like to be in five years. Olga reported “I'd like to be a biomedical engineer...working...or finishing my doctorate”. This aspiration and her major selection of mechanical engineering she attributes to the influence of her family and one cousin who is an engineer:

“My oldest cousin, he's the one that's the engineer...I've always looked up to him and we kind of enjoyed the same things...I guess all my family really likes math and sciences, so that kind of helps”.

When asked whether she was a member of any professional engineering organizations Olga responded that she was. She went on to describe the importance of membership because it “[lets] you know that you're not the only one stressed out. They help you...open doors, [meet] people.”

Carlos, a sophomore aspiring to attain a master's degree also commented on the benefits of professional memberships. He described his professional organization as helpful in guiding his experience as a mechanical engineering major:

“I think the first thing is networking...because I'm getting to meet current engineering students [who] can help me...Well they've helped me... in terms of like what classes I should take or what professors... and opportunities...going on around campus in terms of engineering engineering...it's pretty helpful”

Another female student positively described her professional organization as supportive and beneficial because it allowed her to discuss gender-related issues in the engineering field:

“The objective... is enrolling more women into engineering because we don't have [many] women...in the major. So we want to tell all those girls in high schools and motivate people to see that engineering is also a major for women and that women have the potential and...intelligence to also be in...engineering.”

Each of these sophomores aspired to graduate degrees and highlighted the influence of family and organizations on the success of their undergraduate experience. It seems that having immediate family who are in the field of engineering has some influence on students' major selection and potentially their graduate school aspirations. A similar influence, although less

explicit, may come from membership in professional organizations. Students who mentioned the helpfulness of their professional memberships highlighted themes of student support, networking, and guidance through their major program. It may be these Hispanic sophomore engineers were influenced by both family members and their experiences in professional organizations when considering post-graduation plans.

Memberships Maintain Aspirations.

One year later, follow-up interviews were conducted to measure how graduate school aspirations change over time. From the original cohort 15 (12 male, 3 female) now-juniors were still considering graduate school immediately following graduation, four of whom aspired to earn a STEM field doctoral degree. Fourteen students in this sample (93%) were involved in at least one professional organization. Interestingly, six of this follow-up sample (40%) had increased their number of memberships in professional memberships over the course of the year.

During follow-up interviews, we asked Daniel where he saw himself immediately following graduation, he acknowledged:

“The ideal plan at the moment is...pursue a master’s degree...namely in the aerospace field. My...backup plan, if anything, would be to go directly into the work field...But...master’s is definitely the next step for me.”

Daniel went on to describe how his professional memberships encouraged his aspirations to graduate school:

“My involvement with [my professional engineering organization] has... helped me to see what it would be [like] to work in the engineering work field...how I would need to work and what I need to apply in order to be successful.”

From his narrative it appears that Daniel’s involvement in professional organizations as both a sophomore and junior helped him understand what it would be like to work as an engineer, and what it takes to be successful. The knowledge these organizations provide supports his current aspiration to earn a master’s degree. Daniel’s story suggests two years of professional membership provided the support and guidance he needed to persist as a STEM major and to continue aspiring towards a graduate degree.

This notion was confirmed by Mateo’s follow-up interview. When asked to describe the most helpful experiences at his institution that moved him towards his graduate school aspiration, Mateo described the influence of being a member in professional organizations:

“[Professional organizations] really help you ... [focus] on what you will be doing in the near future. Since I'm only two more years till I graduate, now I'm more focused on what I want to do my master's in and what ... university. So from the academic standpoint, I would say that those associations do help you...focus on your future.”

While other students mentioned the social and networking aspects of professional organizations, many were like Mateo and Daniel, and cited the positive influence of professional organizations on their graduate career aspirations. These students demonstrate the pronounced influence of professional organizations on post-graduation decisions. Additionally, the increase in memberships over two years suggests there may be greater benefit and support for students involved in multiple professional organizations.

Memberships Refine Aspirations.

In contrast to our other findings, we identified three students whose involvement in professional organizations influenced an alteration to their original post-graduation plans. Two students initially reported planning to attend graduate school after graduation. They described in year two interviews a new understanding of the workforce, facilitated by their student organization, which influenced a delay in their plans. These students instead discussed how they would still attend graduate school, even aspiring to a doctoral degree, but felt first gaining workforce experience was a pivotal step towards improving their career trajectory.

David highlighted some of the influential activities provided by his professional organization:

“They try to make us talk more and meet people...already working in the field ... That way I can experience more and know what I have to do before I graduate so I can get a job [more easily] and know what I’m going to do later on in my life”

Through activities sponsored by his organization, David was able to consider his career trajectory with a more informed opinion. He felt the best way to accomplish his career goal was to acquire work experience prior to earning a master’s degree:

“I would like to keep on studying, but I know that I will have to have some experience before, so... I’m going to work first, and then I will go back to do my master’s”.

Another change in perspective credited to professional memberships was provided by Luis. During his interview Luis stated his organization allowed him to communicate with companies, and consider how he could excel in his personal career. Specifically he considered how workforce experience would improve his teaching once he earned his doctorate.

“Participating [in professional organizations] has helped me ... to communicate with a lot of companies and...I would like to enter the workforce...and... at some point during my career I would like to...have a doctoral degree...Because, by having participated in the workforce, I can give students that I’m going to teach a better experience in the class and help them”.

The information made available to these students by their organizations further suggests that professional organizations are influential in undergraduate engineers’ career-related

decisions. These students believe that delaying graduate school plans to acquire work experience and knowledge will lead them to better employment opportunities in the future.

We also found one student adjusted his post-graduation plans between year one and two interviews. Vince mentioned both workforce and graduate school as post-graduation options during his first interview, but admitted he would likely enter the workforce. Already involved in two professional organizations sophomore year, by his follow-up interview Vince had increased his involvement to hold executive offices. As a junior, Vince displayed a more refined career path that included attending graduate school:

“I’d like to at least get my master’s before I start to go in the industry...probably [in] mechanical or electrical engineering.”

While Vince’s case is not generalizable, much like David and Luis’ interviews, it suggests involvement in professional organizations is influential in decision-making. Together, these cases suggest professional organizations provide an environment where critical, career-related information is readily available.

Discussion

As anticipated by Social Cognitive Career Theory⁷, we found Hispanic engineering majors’ post-graduation aspirations were significantly influenced by their environment. More specifically, students involved in professional organizations sophomore year were found most likely to persist in their career aspirations to attend graduate school. Studies have shown racial and ethnic student organizations have a significant impact on minority undergraduate student integration and success at PWIs^{6; 11}. However there is limited research on how these organizations may impact minority students at institutions where they are the majority. Results from the current study suggest Hispanics involved in professional organizations at HSIs may receive necessary support to explore different trajectories to attain their career goals, including the prospect of a graduate degree.

We identified an additional influence on Hispanic engineering majors’ post-graduation aspirations, their immediate family. While previous literature has described the cultural value placed on family within the Hispanic community, studies have argued these values may inhibit or delay educational aspirations¹⁴. Our finding adds complexity to the current conversation and suggests having immediate family in the engineering field may be influential to student decisions to major in engineering. Sophomores described how they were influenced by engineers in their families to pursue an engineering degree. One year later the same students described more influential sources than their families (i.e., professional organizations) regarding their career aspirations. This suggests students with relatives who are engineers receive early support to enter a post-secondary institution and major in engineering. However this influence may be lessened as they accumulate their own experiences while earning their degree.

From this study it appears engineering relatives and membership in professional organizations support student aspirations towards graduate degrees. Hispanic students entering post-secondary institutions may rely on the support and examples set by their family members who are engineers. It is important that undergraduates become integrated with their campus to feel supported and be successful¹. Engineering majors who found this campus integration through professional organizations were the most likely to persist as a major between sophomore and junior years, as well as to continue aspiring towards a graduate degree. Membership in professional organizations appears to provide such on-campus support, networking, and career-related opportunities for Hispanic engineering majors. Students involved in these organizations were thoughtful in their career decisions and continue to aspire to higher degrees.

The influential support provided by professional organizations may encourage student persistence through their undergraduate experience and allow students to aspire to graduate education. If it is the goal of STEM researchers to improve current statistics on minority graduate degree recipients^{5; 16} we must first identify what factors support minority student success. We have identified one possible environmental factor which may provide the necessary social integration¹ and guidance to improve these statistics.

Future Directions

As part of a larger investigation of minority student persistence in STEM, the current study identified a previously unexplored factor related to Hispanic engineering majors' graduate school aspirations. Our findings suggest memberships in professional organizations influence student decision-making, however it is unclear exactly what aspects of these organizations are most influential. This knowledge would have direct implications for increasing minority student and faculty representation at both the undergraduate and graduate level^{15; 10}. Future investigations of this relationship may clarify why some STEM field students are successful in their academic and career aspirations, as well as to redefine the role of professional organizations on institutional campuses.

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