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Broader Success in Engineering: Contributions of the Society of Hispanic Professional Engineers (SHPE) at a Hispanic Serving Institution

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ID 48659 Broader Success in Engineering: Contributions of the Society of Hispanic Professional Engineers (SHPE) at a Hispanic Serving Institution (Work in Progress)

Amid recent shifts in support systems at higher education institutions, the engagement and success of underserved engineering students have become increasingly important within the engineering profession. As university-wide support systems and programs for underrepresented groups are being reduced or eliminated [1], [2], professional associations like the Society of Hispanic Professional Engineers (SHPE) play a vital role in supporting students with underserved identities in engineering programs [3], [4]. SHPE is a professional association dedicated to serving the Hispanic community by advancing STEM awareness, support, and development as well as access by admitting students of any race or ethnicity (https://shpe.org/about-shpe/). The broader scope of SHPE's contributions is particularly critical at Hispanic-Serving Institutions (HSIs), which serve a large proportion of Latinx and other students of color pursuing and completing engineering degrees [5], [6].

In this study, we aim to explore how engineering programs cultivate SHPE students' sense of belonging, engineering identity, and career readiness though learning opportunities such as undergraduate research and internships. We focus on students who have engaged with SHPE and examine how engineering faculty and administrators have leveraged SHPE to support these students, especially during a time when underserved students may experience a disconnect from institutional support systems. Our study seeks to address the following research questions:

1. How do SHPE students develop their engineering identity and career aspirations at Hispanic Serving Institutions?
2. How do SHPE students navigate challenges and build a sense of communities at Hispanic Serving Institutions?

This study will present interview findings from eight engineering students attending a Hispanic Serving Research University who have actively participated in multiple SHPE events and activities. Additionally, we will offer implications for engineering faculty and practitioners on how to provide alternative forms of support for underserved students to promote broader success in engineering programs.

Literature review

Latinx and Hispanic engineering students at HSIs

The Latinx community is the fastest-growing demographic in the United States and is projected to constitute 75% of the nation's workforce in the future [7], [8], [9], [10]. A recent report indicated that the percentage of engineering degrees awarded to Latino students increased significantly, rising from 7.0% in 2010 to 13.6% in 2021—an impressive growth of 94.3%. During the same period, the number of bachelor's degrees in engineering earned by Latinos more than tripled [10]. Despite this positive growth, policymakers and scholars have emphasized the continued need to support Latinx students in engineering [9]. Latinx students remain underrepresented in engineering majors, a disparity linked to limited diversity in STEM

education and negative experiences such as stereotypes, bias, discrimination, and exclusion [11], [12], [9].

The majority of Latinx students are enrolled at Hispanic-Serving Institutions (HSIs), which make up 18% of all colleges and universities [13]. HSIs are widely recognized as essential in supporting and advancing the success of Latinx students [14], serving over two million students [13]. Although HSIs are designed to promote inclusivity through their "servingness" mission, many still exhibit characteristics of predominantly white institutions. Consequently, Latinx students, particularly those in the competitive and white, male-dominated culture of engineering fields, may experience feelings of isolation. Additionally, challenges such as understaffing and underfunding limit the capacity of HSIs to provide adequate support, disproportionately affecting the academic development and success of Latinx students [15], [14]. Thus, professional associations like SHPE play a critical role in addressing these challenges and supporting Latinx students, even at HSIs.

SHPE and its impact on Latinx engineering students

Some studies have recruited research participants through SHPE. For instance, Diaz et al. [16] investigated the factors that motivate underrepresented minority students to pursue graduate school using data collected from SHPE members. Likewise, Revelo and Stepin [17] examined variations in engineering identity among Latinx students by gathering data from national SHPE members. While these studies leveraged SHPE as a recruitment platform, their primary focus was not on the experiences and learning of the students nor on the role of SHPE in supporting students' growth and success in engineering.

Other studies have highlighted the benefits of SHPE for Latinx engineering students [18], [19], [20]. Campbell-Montalvo et al. [21] found that Latinx students who were members of SHPE experienced a sense of inclusion, developed a range of professional skills, and built social capital to achieve their career goals at predominantly white institutions. Similarly, Revelo [18] reported that SHPE provides Latinx students with opportunities to develop professional and leadership skills through networking with SHPE alumni and attending SHPE conferences. Revelo also emphasized that these students cultivate a sense of community and commitment, referred to as the *SHPE familia.*

While SHPE has a positive influence on students, research suggests that the benefits can vary depending on how events and activities are implemented or the specific challenges students face. Walden and Shehab [22] found that SHPE could unintentionally create exclusivity if events are tailored primarily to Spanish speakers, making non-Spanish-speaking students feel unwelcome. Conversely, if programs are conducted exclusively in English, first-generation immigrant students may feel excluded. Additionally, Campbell-Montalvo et al. [21] noted that some participants faced barriers to fully engaging with SHPE due to time conflicts with classes or office hours. These students also expressed concerns about their readiness to participate in SHPE, citing perceived gaps in their engineering knowledge or skills.

To our knowledge, there is limited research on how SHPE encourages community college students to engage with its opportunities, supports their transfer to four-year institutions, and prepares them for engineering careers. However, SHPE's impact potentially extends beyond four-year institutions. Rodriguez and Berhane [23] suggest that Hispanic-Serving Community Colleges (HSCCs) partner with local or national SHPE chapters to foster connections between

HSCC students and broader communities, such as four-year institutions, local businesses, and the tech industry.

Methods

Data collection

We employed purposeful sampling methods to recruit eight engineering students who have participated in SHPE for this study. See Appendix A for the interview protocol. The interviews are scheduled to take place in January and February 2025. During these interviews, we asked students about how their involvement in SHPE had influenced their choice of major, career readiness, and engineering identity. Additionally, we focused on discussing how they navigate challenges they have encountered and the role SHPE has played in helping them overcome these obstacles. Finally, we explored students' perceptions of their sense of belonging both within the college and in the broader context of the College of Engineering. Through these discussions, we aimed to gather insights on how faculty and practitioners have supported SHPE students in navigating their college experiences.

Study context

The study was conducted at the University of North Texas (UNT) in Denton, Texas, a four-year public university with an enrollment of approximately 46,000 students. UNT is one of 22 Hispanic-Serving Institutions (HSIs) classified as a Tier 1 research university [24], [25], embodying a distinctive mission and culture as a Hispanic-Serving Research University. Located in Denton, a college town, the university is near one of the largest metropolitan areas, the Dallas-Fort Worth metroplex, with more than 7.5 million people, providing abundant job opportunities and a rich tapestry of racial and ethnic diversity [26].

Study participants

In this study, eight Hispanic/Latinx students involved in the SHEP program participated in interviews. All were first-generation college students, including five women and three men, ranging in age from 21 to 33. The majority were senior students, with two in their third year, one in their fourth year, four in their fifth year and one graduate student who recently completed her undergraduate engineering degree at UNT. Their majors included computer engineering, mechanical and energy engineering, electrical engineering, and materials science and engineering. Additionally, two non-engineering students involved in SHPE participated. These students have been actively involved in SHPE, taking on various leadership roles. Table 1 provides an overview of the study participants' characteristics.

Table 1.

Characteristics of Study Participants

Pseudonym	Major	Gender	Age	Class year
Yeraldine	Engineering	Woman	23	Fifth-year or beyond
Megan	Engineering	Woman	27	Third year
Kari	Engineering	Woman	22	Fifth-year or beyond
Ashley	Non-engineering	Woman	21	Third year
Daniel	Engineering	Man	24	Fifth-year or beyond
Junior	Engineering	Man	22	Fourth year
Jessica	Engineering	Woman	28	Graduate student
Antonio	Non-engineering	Man	33	Fifth-year or beyond

Data analysis

This study is an exploratory qualitative study that used a naturalistic approach to qualitative methods [27]. We conducted 1-hour semi-structured interviews to address our research questions. In terms of the mechanics of coding, we followed Saldaña's [28] guidelines for using multiple cycles of coding to first establish codes (e.g., descriptive and first-impression codes), condense codes into categories, and synthesize categories into themes. We considered how themes may emerge across participant interviews, while also considering that themes or patterns may emerge within participants' different social identities and college experiences.

We worked collaboratively to address their criteria for trustworthiness by establishing (a) credibility by member-checking with respondents; (b) transferability by using thick description; (c) dependability by having Dr. Siller Carrillo Hector—who was not involved in data collection—serve as an external evaluator to review codes and themes; and (d) confirmability by engaging in reflexivity through journaling and dialogue.

Positionality statement

We are an interdisciplinary team of faculty and graduate students with expertise in engineering education and higher education, specifically focusing on equity and diversity. Our diverse social identities and disciplinary backgrounds enable us to gain deeper insights into the educational journey and engineering identities of the study participants. At the same time, we acknowledge that our biases and perceptions may influence the research process, including the development of interview protocols, coding and thematic analysis, and discussion of the findings.

Limitations

Like other qualitative studies, this research has several limitations. Because the study focuses on eight students from a single Hispanic-Serving Research University (HSRU), the findings may not be generalizable to broader populations or contexts.

Findings

We structured our findings around two guiding research questions. First, we examined how SHPE students perceive their engineering identity in relation to their other social identities and how they leverage SHPE opportunities at an HSI to shape their career aspirations and preparation. Second, we explored how SHPE students navigate challenges and foster a sense of community within an HSI.

How do SHPE students shape their engineering identity and career aspirations?

To better understand students' engineering identity, we asked, *"What does engineering identity mean to you, and how have your experiences in this program shaped that identity?"* Rather than framing their responses in terms of identity—*who I am*—students described engineering in terms of its function—*what engineers do.* Three students specifically framed their responses around the roles and contributions of engineers in society and how these roles shaped their career aspirations. Megan stated, "To be an engineer means to take what people have done before you and help improve the lives of people and build upon that." Similarly, Junior shared, "At the end of the day, engineers... we see a problem or we see a product. How can we fix it? How can we make it better?" Daniel echoed this perspective, saying, "Engineering at its core is definitely problem-solving. I think you use engineering to solve pretty much any problem." Rather than viewing engineering as part of their personal identity, students interpreted the question through the lens of their professional role—focusing on engineers as problem-solvers who improve society.

Given that the students framed engineering identity around what engineers do, they also linked the knowledge and skills required to function as an engineer to their academic preparedness and social identity, particularly as women. Daniel said, "I think [engineering] just means freedom for me. It's like knowledge is power, and if you have knowledge, you can do whatever you want." This quote suggests that the students perceive engineering identity as closely tied to knowledge and skills. However, two other students expressed how these skills sometimes made them feel distant from their engineering identity. Junior reflected on the challenges of acquiring these skills, sharing, "I used to think, I don't belong in engineering because I felt like I wasn't smart enough. I didn't know how to code. I didn't know how to do so many things." Luna connected her engineering identity to her experience as a woman, saying, "To me, being an engineer... I don't really know how to describe it, but it has developed me a thicker skin doing more stuff or not being scared of men."

Yerdaline highlighted that financial awards from engineering occupations were "a good motivator" for her, and learning about internship preparation and professional development through SHPE encouraged her to pursue various internship opportunities. Similarly, Daniel noted that "the support and encouragement" from SHPE helped him not only in his college career but also in his post-college career.

Three Latina women, in particular, discussed how engineering offers a broad range of job opportunities and its potential to contribute to society. Megan, for instance, shared how one of the SHPE events taught her about these possibilities, expanding her view of engineering careers and their societal impact.

> I told them I wanted to be a teacher and reach children, one of them mentioned that she was an engineer but her company hosted a lot of events for children, so, even though she was an engineer, she was still able to make an impact in her community and help students. And so I decided to go with that route instead.

Ash, inspired to work in engineering through the legal aspect, shared that her career aspiration isn't the traditional engineering route, saying, “Engineering doesn’t have to be one way... There's so many different ways to go into it that you don't have to follow the traditional path.” Kari expressed her desire to teach college students using her engineering degrees, reflecting a non-traditional but equally impactful career path.

How do SHPE students navigate challenges and build a sense of communities?

These students found that SHPE provided a sense of belonging, connection, and safety. They all highlighted the positive impact of SHPE programs and connections in helping them feel supported and motivated to pursue careers in engineering. Many of them shared common challenges, such as a lack of family understanding about engineering or college education as first-generation students, a common theme found in existing literature. They also spoke about difficulties in mastering math and engineering concepts to progress in their majors. Through SHPE, they found a sense of home and support, forming connections with faculty and peers. For example, while they didn't initially interact with faculty through SHPE, they learned how to engage with faculty and ask questions through the organization.

Particularly, the connections through SHPE seems to be very critical to Latina students, given that they talked more about the chilly climate against women in the field of engineering. Yeraldine stated that she thought about changing her major because “There's been times where they (her male peers or male faculty) make me feel dumb because I'm the only girl in the room, and I don't know what I'm talking about." Yeraldine appreciated the contributions of SHPE for her to feel belonging in the college and on campus broadly. Megan also stated that through SHPE, as a part-time based in school enrollment, she still “found a sense of community with them, and even though I wasn’t full-time school a lot of the time . . . I always had something to come back to, even though at one point I was out of school.”

Furthermore, when these students encountered faculty members who actively reached out to them and validated their identities and experiences, Junior, Kari, and Yerdaline shared that these interactions boosted their confidence in engineering. The support from faculty appears to complement the positive contributions of SHPE, working together to enhance these students' experiences and growth in the field.

Discussion and implications

Our study confirms that SHPE provides a supportive environment where students develop a sense of belonging and pursue engineering or engineering-related careers. These students share characteristics commonly found among Latinx engineering students at HSIs, as noted in previous literature [15], including being first-generation college students and receiving emotional support from their families despite their families’ limited knowledge of the college-going process.

Additionally, they demonstrate strong resilience in overcoming challenges, such as the underrepresentation of women in engineering [21] and gaps in prerequisite math skills [8]. Their academic achievement or sense of connection cannot be solely attributed to SHPE; however, their experiences indicate that the organization plays a central role in fostering positive outcomes for Latinx engineering students, alongside faculty validation and supportive peer interactions.

Several implications emerge from these findings. First, further research is needed to examine the experiences of Latinx students who do not participate in SHPE or engage only as general members, as their experiences may differ from those who take on active leadership roles. Given that the participants in this study were deeply involved in SHPE, they may have maximized the benefits of the organization's opportunities. Second, this study focused solely on students' perspectives, but gathering insights from faculty, administrators, and practitioners on areas for improvement in SHPE would be essential. As key decision-makers, their perspectives can inform policies and practices that enhance the impact of SHPE, particularly in the current political climate that challenges DEI initiatives.

Finally, SHPE can play a crucial role in helping students develop their engineering identity as both who they are and what they can do as engineers. Interestingly, the study participants primarily described engineering in terms of its function rather than as a personal identity. Given that engineering identity is a key factor in students' persistence in engineering education and careers [17], [18], faculty and practitioners should consider how SHPE programs can not only help students see themselves as engineers but also promote broader recognition of Latinx students as engineers within the field.

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Appendix A

Interview Protocols for Students

This study focuses on how SHPE experiences shape the progress and outcomes of engineering students at a Hispanic Serving Institution. We are particularly interested in your major and career choice, engineering identity, and sense of belonging.

1. Please introduce yourself. Would you like to share any backgrounds which are critical to knowing more about who you are? (majors, class year, whether they transferred or not, where you came from, age, race/ethnicity, gender)
2. Please share why or how you chose engineering or computer science as your major and UNT as your school.
3. We want to discuss your dreams or goals for after you finish your undergraduate degree. Are you interested in pursuing an engineering or computer science career?
4. How long have you been involved in SHPE, and how did you first get involved?
5. Can you share how SHPE has contributed to achieving your career goals?
6. What does "engineering identity" mean to you, and how have your experiences in this program shaped that identity?
7. Can you share how you have navigated challenges or difficulties you faced in the College of Engineering or at UNT in general?
    a. To start, could you tell us how your family, friends, or home community members have supported you?
    b. Could you also share how your engineering faculty, staff, peers have supported you? Can you share a specific example?
    c. Could you tell us more specifically about any support you have received from SHPE?
8. How would you describe your connections or sense of belonging within the College of Engineering?
    a. What do you think how SHPE has contributed to your sense of belonging?
9. How would you describe your sense of connection to the campus outside of College of Engineering?
    a. What resources or people outside of engineering have contributed to your sense of connection or belonging at UNT?"
10. What improvements would you suggest to better support Latinx students in engineering and computer science programs?
11. Is there anything you want to share that we have not asked?

Thank you so much for participating in this interview.