Community Cultural Wealth of Hispanic Engineering Students: A Study of Social Networks

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Abstract

In Texas, the population segment of college-eligible Hispanics is growing faster than any other ethnic/racial group. However, the underrepresentation of this segment in engineering and computer science has profound impacts on growth and innovation in the U.S. economy. Our research, grounded in an asset-based approach, is part of a growing number of efforts that investigate the resources Hispanic students use to navigate the US higher education system, which is not designed to serve underrepresented minorities. Assets from students' communities, families, languages, cultures, and experiences bolster students as they pursue their education and career goals. This paper presents first-year results from a four-year mixed methods study conducted in partnership with the University of Texas System LSAMP (Louis Stokes Alliance for Minority Participation) and the University of Wisconsin's Networks and Cultural Assets Project (NCA). In spring 2023, we surveyed (N=222) and interviewed (N=22) Hispanic engineering or computer science majors in their junior year who attended one of eight institutions in the UT (University of Texas) System. We asked students questions about their Community Cultural Wealth (CCW) and examined the shape and features of their social support networks. Data collected included features of their social networks and the forms of cultural wealth in students' social networks. Other features include the relationships that exist between students' social networks, sense of belonging, and professional identity. These latter two variables are important predictors of degree attainment and commitment for historically marginalized students.

Introduction

Research indicates that students' social experiences significantly influence their persistence in STEM (Science, Technology, Engineering and Mathematics). Historically marginalized students often find the impersonal and individualistic atmosphere of STEM classrooms uninviting, encountering obstacles such as a lack of same-race role models, low faculty expectations, and challenges related to the social relevance of coursework (Palmer et al., 2011; Price, 2010; McCoy et al., 2017; Bonous-Hammarth, 2000). Hispanic STEM students often start their

education at community colleges, face first-generation challenges, and care for dependents, presenting additional barriers to building relationships in STEM (Kruse et al., 2015; Mobley & Brawner, 2019). These experiences can detrimentally affect students' sense of belonging and science identity formation, which are critical predictors of STEM attainment and commitment for Hispanic students (Chemers et al., 2011; Nuñez, 2009).

Previously, researchers explored the formation of science identity and sense of belonging in White, masculine STEM spaces. There is limited research that connects these aspects to Hispanic STEM students' networks comprehensively, including network characteristics like size, diversity, and tie strength (Carlone & Johnson, 2007; Hurtado & Carter, 1997; Halgin & Borgatti, 2012). This gap makes it challenging to measure the benefits derived from students' networks or identify impactful changes in network features over time (Martin et al., 2020; Rios-Aguilar & Deil-Amen, 2012).

We present preliminary results from a mixed methods study of Hispanic STEM majors in their junior year who in 2023 were attending one of eight academic institutions in the University of Texas System. In total, surveyed 433 students and subsequently interviewed 70 of them. Of the students surveyed, 222 majored in engineering or computer science. Likewise, of the students interviewed, 22 majored in the same fields. The focus of this paper is on the subset of students majoring in engineering and science. Preliminary results for the larger group were presented elsewhere (Bañuelos el al., 2023).

Students answered questions about their Community Cultural Wealth (CCW), i.e. resources they possess from their families, communities, histories, languages, cultures, and experiences (Yosso, 2005), from which we measured the contours of their social support networks including:

(1) features of their social networks (e.g. size, density, heterophily, and strength of ties),
(2) forms of CCW that are inculcated and activated in students' social networks, and
(3) relationships that exist between students' social networks, sense of belonging, and professional identity.

The latter two variables are important predictors of degree attainment and commitment for historically marginalized students (Chemers et al., 2011; Nuñez, 2009). Our project is an example of asset-based research that investigates the resources students from underserved populations use to navigate higher education (Yosso, 2005). Assets from students' communities, families, languages, and cultures bolster their chances for success as they pursue their education and career goals (Acevedo & Solorzano, 2023).
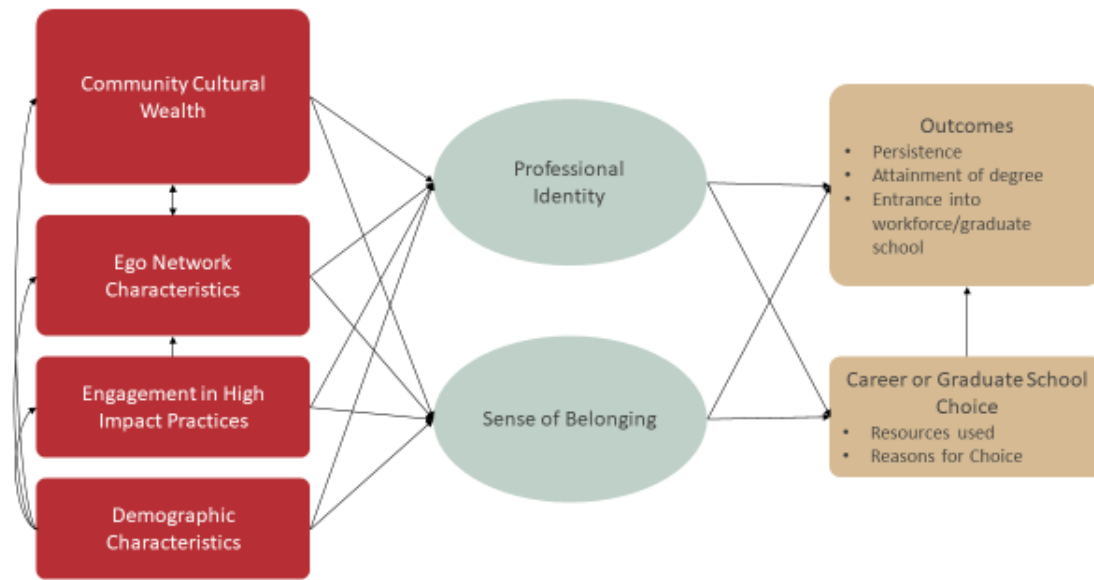
Figure 1. Proposed connections between Community Cultural Wealth (CCW), professional identity, sense of belonging, and student success.

Context

The University of Texas System has seen consistent growth in the population of undergraduate Hispanic students over the last decade (Source: UT System data, 2024). In fall 2023, the total number of undergraduate Hispanics was 95,861, corresponding to 50.2% of the total undergraduate student population. By race or ethnicity, Hispanics now constitute the new majority and eight of the nine universities in the system have or will soon have a Hispanic Serving Institution (HSI) designation.

Table 1. Undergraduate-Student Fall-Term Enrollment in the UT System (Sources: UT System Dashboard, Integrated Postsecondary Education Data System, 2024)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hispanics N	73,763	75,946	78,696	82,506	84,653	86,801	91,277	91,140	92,562	95,861
Hispanics %	43.9	44.3	44.6	45.3	45.6	46.6	48.1	48.7	51.2	50.2
Hispanics (Engineering Only) N	6,492	NA	8,466	NA	9000	NA	9,677	NA	10,611	NA
Hispanics (Engineering Only) %	4.1	NA	4.8	NA	4.8	NA	5.1	NA	5.7	NA
Total	168,166	171,368	176,422	182,248	185,728	186,440	189,801	187,157	186,497	190,651

The number of degrees awarded to Hispanics has also seen an increase over the same period. In the academic year 2022-2023, 60,493 bachelor's degrees were awarded, of which 23,265 (38.5%) were awarded to Hispanics. There is a considerable gap between enrollment and degree attainment proportions. The gap is more substantial among the institutions that have an open-access policy in which six-year graduation rates for Hispanic, first-time, full-time undergraduate cohorts hover around 50% compared to selective institutions where the rate is 70% or higher. This gap is historic and highly problematic as it points to serious issues of inequity in higher education in Texas.

More specifically, the number of engineering degrees awarded to Hispanics has nearly doubled in less than 10 years. Similarly, the number of computer science degrees awarded to Hispanics has more than quadrupled. Still, the percent increase in degrees awarded in these disciplines to Hispanics has only seen a modest increase from 28.9% in 2014 to 31.6% in 2022.

Table 2. Engineering and Computer Science Bachelor's Degrees Awarded by the UT System
(Source: Integrated Postsecondary Education Data System, 2024)

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Engineering Degrees Awarded to Hispanics	775	815	961	1085	1109	1358	1376	1518	1430
CS Degrees Awarded to Hispanics	175	246	258	325	372	475	578	687	737
Engineering and CS Degrees Awarded to All	3282	3711	4266	4695	5077	5936	6508	6752	6858

In the academic year 2022-2023, 60,493 bachelor's degrees were awarded, of which 23,265 (38.5%) were awarded to Hispanics. Clearly, there is a considerable gap between enrollment and degree attainment proportions. The gap is more substantial among the institutions that have an open access policy in which six-year graduation rates for Hispanic, first-time, full-time undergraduate cohorts hover around 50% compared to selective institutions where the same rate is 70% or higher. This gap is historic and highly problematic as it points to serious issues of inequity in higher education.

Table 3. Bachelor's Degrees Awarded in 2022-2023 (Source: UT System Dashboard, 2024)

	UTA	UTAU	UTD	UTEP	UTPB	UTRGV	UTSA	UTT	Total
Hispanics	3,278	3,182	1,076	4,363	554	6,131	4,120	561	23,265
Hispanics (%)	25.9	21.5	11.6	81.3	46.0	87.7	55.7	20.0	38.5
Total	12,665	14,784	9,281	5,368	1,205	6,994	7,397	2,799	60,493

The most current data available for engineering and computer science degrees is for academic year 2020-2021. In this year, out of 62,472 bachelor's degrees awarded by the UT System, 6,854 (11.0%) were in engineering and computer science disciplines. Interestingly, 2,205 of the

6,854-degree recipients were Hispanics (32.2%). Two institutions (UTEP and UTRG) contributed a disproportionate number of degrees awarded to Hispanics.

Table 4. Engineering and Computer Science Degrees Awarded by (UT System) Institution in 2020-2021 (Source: Integrated Postsecondary Education Data System, 2024)

	UTA	UTAU	UTD	UTEP	UTPB	UTRGV	UTSA	UTT	Total
Total Number of Degrees Awarded in Engineering	643	1,350	669	430	76	300	530	211	4,209
Total Engineering Degrees Awarded to Hispanics	171 (26.6%)	226 (16.7%)	130 (19.4%)	370 (86.0%)	18 (23.7%)	291 (97.0%)	236 (44.5%)	76 (36.0%)	1,518 (36.1%)
Total Number of Degrees Awarded in CS	486	619	868	167	29	140	268	68	2,645
Total CS Degrees Awarded to Hispanics	60 (12.3%)	52 (8.4%)	78 (9.0%)	120 (71.9%)	5 (17.2%)	107 (76.4%)	252 (94.0%)	13 (19.1%)	687 (26.0%)

Methodology

This study aims to measure the features of social networks of undergraduate Hispanic students pursuing engineering or computer science degrees, emphasizing how CCW supports students' professional identity (Byars-Winston et al., 2016; Estrada et al., 2011) and sense of belonging (Johnson, 2012; Rainey et al., 2018). The research questions for this study are:

a) What are the features of Hispanic STEM students' social networks?
b) What forms of CCW do students possess in their social networks?
c) What is the relationship between students' network characteristics and their professional identity and sense of belonging?

As part of a more comprehensive study of Hispanic students enrolled in undergraduate STEM programs in the UT System, we surveyed (N=222) and interviewed (N=22) Hispanic engineering students in their junior year. We asked students questions about their CCW and measured the contours of their social support networks. The students listed 1,063 alters (i.e. key supporters oin their social networks).

Initially, students were prompted to list up to 15 individuals ("alters or supporters") with whom they engaged in discussions over important, academic, and career-related matters over the last 6 months. From this, students were asked to provide information on the listed alters. Students were

asked to provide each alter's educational level, racial identity, and gender identity. We also asked about how alters were related to the student (e.g., family member, friend, college educator, fellow college student), how close the student felt to each alter (referred to as "tie strength"), whether listed alters knew one another (measuring "density," or interrelationships among alters) and the types of support that each alter provided (e.g., material aid, sharing worries, etc.).

To identify features of students' social networks, we conducted a descriptive analysis of student network characteristics, looking into forms of CCW students are nurturing through their networks by cross-tabulating alter characteristics and support provided by alters. We coded relationship type and support type into binary variables that indicate the affiliation of each alter with each category or the type of support each alter provides. Therefore, results should indicate the extent to which each type of relationship relates to each type of support. Variables considered for network characteristics analysis included network size, network density, average tie strength, relationship type, gender identity, racial identity, education, and support type. The preferred method to understand relationships between control variables was ordinary least squares regression.

Findings

In the following, we provide an evidence-based answer to each of the three research questions based on student responses. The tables with relevant data are included as appendices 1 through 3.

What are the features of Hispanic Engineering students' social networks?

The number of listed people as key supporters varied between 0 and 20 with an average of five supporters. The average network density, reflecting the number of interrelationships among supports, was three connections within a social network of five people. This indicated a close relationship between supporters and the students. The large majority of alters had Hispanic identities. More than a third of alters had a high school diploma or GED and about a quarter had a bachelor's degree. The social networks of students were mostly friends as the primary circle, followed by their family second and fellow college students third.

What forms of CCW do students possess in their social networks?

We found that family members provide substantial support in most categories. Spouses and significant others, in particular, provide the highest level of support in the "Hopes" and "Leisure" categories. Faculty serve primarily as role models. Alters with graduate or professional degrees seem to provide support across all areas while those with less than a high-school education provides a high level of support in the "Hope" category. The majority of the alters are Hispanic and seem to provide support in three categories: "Resistance," "Hope," and "Leisure."

What is the relationship between students' network characteristics and their professional identity and sense of belonging?

Our findings suggest that the average tie strength (how close the student felts to each other) of a network and having a community role model are both positively associated with students' professional identity. However, having a dense or closely-knit network is negatively associated with professional identity. Our analysis shows that this is particularly true for commuter students who are closer to old friends and family, and who have fewer opportunities to connect with faculty and college peers. Network size, average tie strength, and having alters who help the student navigate college life are positively related to the student's sense of belonging.

Preliminary Conclusions

The University of Texas System has seen an increasing enrollment of Hispanic students over the past decade to the point where this demographic group now constitutes the emerging majority of the undergraduate student population. As Hispanic students become the new majority, the longstanding gap between their enrollment and relative degree attainment rates takes on heightened significance and understanding the factors contributing to the success of Hispanic students becomes more important.

While this is a preliminary study on CCW, initial results suggest that Hispanic engineering students benefit from their social networks. On average, students have social networks of five key supporters and have strong relationships with three of these alters. Students receive staunch support in the categories of "Resistance" "Hope" and "Leisure," particularly from friends and family. College peers also provide support. Faculty act as role models as opposed to supporters who help navigate through the college experience. The average tie strength contributes to a sense of professional identity. However, a closely-knit network of family and friends adversely affects this sense of professional identity. Future work may lead to a better understanding of students' CCW and may help us explain how relationships nurture students' professional identity and belonging. In turn, we will aim to offer evidence-based recommendations for engineering faculty and student affairs professionals committed to developing and enhancing social support systems for students who most need them. For instance, faculty may support creating spaces in the department conducive to social interaction among students and tutoring sessions. Likewise, student affairs professionals may support and promote professional student organizations events.

Acknowledgments

Appendix 1. Network Characteristics

Whole Network Characteristics (N=222)	Mean	SD
Network Size (Range: 0-14, not including ego)	4.79	2.62

	Frequency	Percentage
Network Size (N=222)		
0	13	5.86%
1	12	5.41%
2	17	7.66%
3	25	11.26%
4	23	10.36%
5	61	27.48%
6	22	9.91%
7	18	8.11%
8	14	6.31%
9	6	2.70%
10	5	2.25%
11	4	1.80%
12	0	0.00%
13	1	0.45%
14	1	0.45%
Sampled for Name Interpreters (N=1,063)		
Yes	944	88.81%
No	119	11.19%

Sampled Network Characteristics (N=944)	Mean	SD
Network Density (0-1 scale)	0.31	0.28

	Frequency	Percentage
Average Tie Strength[1]		
Distant	28	2.97%

Less than Close	110	11.65%
Close	316	33.47%
Very Close	490	51.91%

Appendix 2. **Network Characteristics** (Continued)

Sampled Network Characteristics (N=944)	Frequency	Percentage
Relationship Type (Multiple Choice)		
Spouse of significant other	67	7.10%
Family member	354	37.50%
Friend	439	46.50%
College student	258	27.33%
College educator	53	5.61%
College educator from the current campus	48	5.08%
Co-worker	47	4.98%
Spiritual Advisor	10	1.06%
Other	22	2.33%
Gender Identity		
Cisgender Woman	431	45.66%
Cisgender Man	432	45.76%
Transgender Woman	4	0.42%
Transgender Man	2	0.21%
Non-binary	14	1.48%
Don't know	26	2.75%
Not listed	35	3.71%
Racial Identity (Missing = 1)		
American Indian or Alaska Native (Single Choice)	4	0.42%
American Indian or Alaska Native & Latina/o or Hispanic	4	0.42%
Asian or Asian-American (Single Choice)	34	3.60%
Asian or Asian-American & Latina/o or Hispanic	4	0.42%
Asian or Asian-American & White or Caucasian	4	0.42%
Black or African American (Single Choice)	15	1.59%
Black or African American & Latina/o or Hispanic	9	0.95%
Latina/o or Hispanic (Single Choice)	671	71.08%

Latina/o or Hispanic & White or Caucasian	69	7.31%
Latina/o or Hispanic & Other	2	0.21%
Native Hawaiian or Pacific Islander (Single Choice)	1	0.11%
White or Caucasian (Single Choice)	91	9.64%
Other (Single Choice)	28	2.97%
Multiple Identities Identified: American Indian or Alaska Native, Latina/o or Hispanic, & White or Caucasian (n=1), American Indian or Alaska Native & Other (n=1), Asian or Asian-American & Other (n=1), Black or African-American, Latina/o or Hispanic, & White or Caucasian (n=1), Black or African-American, & White or Caucasian (n=1), Latina/o or Hispanic, Native Hawaiian or Pacific Islander & White or Caucasian (n=1), White or Caucasian & Other (n=1)	7	0.74%
Education (Missing = 6)		
Less than high school	51	5.40%
High school diploma or GED	364	38.56%
Associate's degree	134	14.19%
Bachelor's degree	287	30.40%
Master's or Professional degree	65	6.89%
Doctorate (MD, Ph.D., etc.)	37	3.92%
Providing support		
Material aid in the form of money, food, clothes, etc. (Material)	370	39.19%
Help maintain hopes or aspirations for your future (Hopes)*	631	66.84%
Share or communicate about important problems or worries (Worries)	566	59.96%
Model ways of caring, coping, or providing for members of your community (Community Role Model)*	415	43.96%
Help develop skills, knowledge, or strategies for maneuvering through campus and/or the college experience (Campus)*	429	45.44%
Help oppose things you believe are wrong (Resistant)*	399	42.27%
Provide the opportunity to engage in leisure, relaxation, or a diversion from demands in your life (Leisure)	545	57.73%

*Denotes a form of Community Cultural Wealth.

Appendix 3. **Percentage of Support that Each Type of Alter Provides**

	N	Material	Hopes	Worries	Role Model	Campus	Resistance	Leisure
Relationship Type (Multiple Choice)								
Spouse or significant other	67	67.2%	94.0%	91.0%	55.2%	49.3%	67.2%	91.0%
Family member	354	70.6%	73.4%	62.4%	58.2%	35.9%	48.3%	55.6%
Friend	439	20.0%	63.3%	62.4%	37.1%	40.6%	40.5%	64.7%
College student	258	18.6%	60.9%	61.2%	32.2%	58.5%	38.8%	59.3%
College educator	53	9.4%	56.6%	32.1%	18.9%	71.7%	15.1%	9.4%
Co-worker	47	23.4%	68.1%	55.3%	36.2%	44.7%	31.9%	55.3%
Spiritual Advisor	10	50.0%	60.0%	60.0%	50.0%	60.0%	50.0%	60.0%
Other	22	22.7%	68.2%	50.0%	40.9%	45.5%	31.8%	50.0%
Gender Identity								
Cisgender Woman	431	44.8%	73.5%	67.1%	52.9%	43.4%	47.6%	61.9%
Cisgender Man	432	35.9%	62.3%	53.5%	35.6%	46.3%	36.6%	53.5%
Transgender Woman	4	25.0%	50.0%	100.0%	25.0%	50.0%	75.0%	100.0%
Transgender Man	2	50.0%	0.0%	50.0%	50.0%	0.0%	0.0%	50.0%
Non-binary	14	14.3%	64.3%	57.1%	42.9%	57.1%	42.9%	64.3%
Don't know	26	23.1%	42.3%	65.4%	42.3%	53.8%	34.6%	46.2%
Not listed	35	34.3%	65.7%	45.7%	40.0%	51.4%	51.4%	60.0%
Education								
Less than high school	51	51.0%	78.4%	58.8%	52.9%	5.9%	51.0%	64.7%
High school diploma or GED	364	39.6%	65.4%	65.4%	42.0%	38.2%	41.5%	60.4%
Associate's degree	134	35.8%	72.4%	61.9%	47.8%	47.8%	44.0%	67.9%
Bachelor's degree	287	35.5%	59.9%	54.4%	41.1%	53.3%	41.1%	58.2%

Master's or Professional degree	65	61.5%	81.5%	58.5%	58.5%	61.5%	52.3%	33.8%
Doctorate	37	27.0%	81.1%	54.1%	40.5%	78.4%	27.0%	32.4%
Racial Identity								
Latina/o or Hispanic	762	43.3%	68.4%	61.3%	47.1%	44.9%	44.8%	59.2%
Tie Strength								
Distant	28	10.7%	35.7%	14.3%	21.4%	50.0%	10.7%	7.1%
Less than Close	110	15.5%	39.1%	20.9%	15.5%	50.0%	15.5%	29.1%
Close	316	26.6%	56.3%	47.2%	30.4%	44.9%	31.0%	51.6%
Very Close	490	54.3%	81.6%	79.6%	60.4%	44.5%	57.3%	71.0%

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