Latinx Undergraduate Students: Finding a Place of Belonging in Engineering

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Abstract

Latinx undergraduate students attending Hispanic-Serving Institutions (HSIs), where most of the school's undergraduate population comes from similar cultural and linguistic backgrounds, are looking to belong, persist, and successfully complete rigorous STEM-based educational and academic programs. HSIs have a unique opportunity to utilize their institutional practices and personnel to support and promote student success through culturally relevant pedagogy centered on Latinx cultural wealth. HSIs work with STEM academic programs to increase enrollment and academic preparedness through rigorous coursework, however, Latinx students need additional community support to feel a sense of belonging to fully develop their STEM identities. Latinx students find academic and professional success in a variety of ways including extracurricular research programs that work to develop the whole student. Latinx undergraduate students participating in the ROLE (Research-Oriented Learning Experiences) program at an HSI are supported in their academic, professional, cultural, and linguistic goals through a four-part program; students learn *technical skills* that help develop their STEM identities; *interpersonal skills* that support self-efficacy development; experience *asset-based academic and professional development*; and hone their *service skills* through community-based outreach. This study used a mixed methods approach including semi-structured interviews, surveys, and participant observations to fully understand the cultural and linguistic backgrounds, motivations, and resiliencies of the participants. This study assessed the relationships between HSIs that support Culturally Relevant Pedagogy, Latinx Communities of Cultural Wealth, and students' motivational, cognitive, and behavioral engagement resulting in the development of self-efficacy.

Introduction

The need for Hispanic-Serving Institutions (HSIs) is directly intertwined with the growing population of Latinx in the United States (U.S.). According to the Hispanic Association of Colleges and Universities [HACU] [1], there are approximately 62 million Latinx people in the U.S. The total Latinx population in the U.S. is greater than the populations of every Spanish-speaking country in the world except México. This statistic makes the U.S. the second-largest Latinx country by population in the world. Additionally, the Latinx population in the U.S. has grown 77 percent between 2000 and 2021 increasing from 35 million to 62 million, respectively [2]. As such, the need for higher levels of accommodation and representation in the Euro-centric, century-old K-20 educational systems must adapt to meet the demands of the new population dynamics, especially in states along the southern U.S.-México border.

The need for HSIs is increasing annually due to the continued growth of the Latinx population in the U.S. The defining characteristic of HSIs is based on their Hispanic/Latinx enrollment, not their institutional mission. HSIs are public and private degree-granting higher education institutions with 25 percent or more full-time Latinx undergraduate students [3]. HSI designations are based on the ratio of students enrolling as full-time which is imperative to understand as more and more colleges and universities seek the HSI designation because regional Latinx populations continue to grow faster than the rest of the U.S. [1].

The Bureau of Labor Statistics [4] stated that Latinx populations make up at least a quarter of the workforce in southern states including New Mexico (43.6%), California (37.7%), Texas (37.4%), Arizona (34.2%), Florida (29.4%), and Nevada (27.4%). HSIs in these same regions have the highest total number of Latinx undergraduate students by percentage, have the highest numbers of HSIs designated, and have the highest numbers of emerging HSIs in the nation [1]. The students who are being educated at these HSIs and who will eventually join the workforce, are experiencing an educational paradigm shift where HSIs are refocusing their methods and approaches to enrollment and retention.

HSIs enrollment and retention strategies are adapting their institutional practices to better serve Latinx students. According to a study conducted by the Excelencia in Education produced in 2010 [3], HSIs made concerted efforts to meet the needs of the Latinx student populations who were enrolling in higher numbers than ever before. HSIs targeted four components of higher education that aimed to serve their Latinx communities: recruitment, retention and persistence, faculty, and school administration. These efforts paid off as student enrollment and degree attainment have steadily increased over the last year. According to the 2023 HACU [1] demographic data release, Latinx students enrolled in an HSI will exceed 4.1 million students which will surpass all other racial/ethnic groups by 10%. Also, the percentage of STEM degrees earned by Latinx students grew from 9.2% in 2009 to 14% in 2018. Despite the concerted efforts to anchor positive changes for Latinx students within HSIs in a system-wide approach, each HSI works independently and implements recruitment and retention policies unique to their student demographics, degree offerings, and faculty representation.

Context

Historically, Latinx engineering graduates represent 6% of all engineers in the workforce with little year-over-year growth in the last decade. To further break down that statistic, Latinos make up 4%, while Latinas make up 2% of the engineering workforce [5]. To address the glaring underrepresentation of Latinx in the engineering workforce, the Research-Oriented Learning

Experiences (ROLE) program, funded by the National Science Foundation (NSF), was developed to increase diverse participation in research within engineering undergraduate programs. The researchers understand the need for HSIs to create culturally relevant programs that support whole-student development. The ROLE program at the HSI supports engineering sophomore, junior, and senior-level students in developing research skills needed in technical fields; interpersonal skills needed to be successful employees; and academic and professional skills that are transferable in their decisions to enter graduate studies or the professional world. ROLE students learn technical skills through hands-on activities in a laboratory setting; receive near-peer and faculty mentorship from individuals with similar cultural and linguistic backgrounds; attend culturally relevant workshops that support academic, interpersonal, and professional growth; and participate in outreach events within the local community and K-12 school environments.

This study will work with the ROLE research cohorts of sixteen undergraduate student participants enrolled in various engineering academic programs. The goal is to assess the motivating factors that lead to belonging, resilience, and persistence within their chosen academic programs with a social justice lens. The study aims to better understand the relationships between HSIs that support Culturally Relevant Pedagogy, Latinx Communities of Cultural Wealth, and self-efficacy.

The research questions that guided this study were:

1. What are the factors or aspects that play a critical role in the persistence of Latinx undergraduate student participants of ROLE?
2. How does ROLE support the various types of Community Cultural Wealth Latinx student participants represent?

Literature Review

Women and Latinos in Technology and Engineering

A study completed in 2018 by the NSF [6] indicated that 25% of all jobs in computing were held by women; 16% were White, 5% were Asian American, 3% were African American, and 1% were Latina. Native American women were not included in this statistic as they retain less than 1% of all computing jobs accounted for in this study. This study further broke down the percentage of jobs held by women in thirteen computing occupations including software developers, and system administrators, and showed most of all computing jobs held by White women. African American, Latina, and Asian American women consistently hold fewer jobs in all thirteen categories than their male counterparts and White workers. Another study looked at the gains individuals from minoritized backgrounds made between 2010 to 2018 in degree attainment overall then specifically in STEM. The findings indicated increased bachelor's, master's, professional doctorates, and research doctorates attainment in Black, Latinx, Asian American, and others but still trailed their White counterparts [7]. Within each year and each degree designation, minorities were graduating in higher numbers than previously seen; however, those numbers remain below 30% combined for all Black, Latinx, Asian American, and other minoritized groups [8]. To better understand why those numbers remain low despite efforts on behalf of colleges and universities, professional organizations, workforce developers, and private industry, we must understand the cultural, linguistic, educational, familial, and gender barriers women and minorities face.

Barriers Women and Underrepresented Minorities Face in STEM in College and Careers

Authors in [9] completed a systematic review of the literature to create an index of barriers that prevent women and minorities from seeking degrees and jobs in technology and engineering fields. The first barrier is a global issue that is related to gender bias [10]. Women all over the world are working in engineering and technical fields at a consistently low rate because engineering and technical jobs have been held primarily by men. Women must fight gender stereotypes in the male-dominated workforce that includes micro-aggressions, pay gaps, sexual harassment, abuse, racism, and sexism [11].

Pre-college factors play a heavy role in women's academic preparation to enter STEM fields. Diversity within STEM is critical along with early exposure, rigorous high school classes, and exposure to career opportunities critical to increasing enrollment and persistence in STEM [12]. Gender and racial expectations within certain minoritized communities impose rigid gender roles where jobs are gender-typed into feminine and masculine. To challenge those gender rules, individuals need to have external support, confidence, and opportunity [13]. White women and Women of Color are vastly underrepresented minorities within the technical and engineering fields so external support is critical in pursuing an education and career in a *masculine* field. External familial and community support uplifts, advocates, and validates women's employment choices [14]. Additionally, historically marginalized groups have not had the same opportunities to participate in STEM and subsequently find it difficult to develop a STEM identity [15]. Having a STEM identity foreshadows a person's longevity within these rigorous fields so it is critical for institutions to assess their role in shaping those identities [16]. HSIs and emerging HSIs are making an effort to recognize the unique cultural upbringings of Latinx students and bridge those cultural and linguistic experiences with their academic needs. The author in [17] explained the ways advocacy groups like Excelencia in Education support HSIs work to ensure Latinx student enrollment is representative of the greater population in several ways. One of the ways in which HSI's support their Latinx student populations is by providing diversity training among their recruitment staff. Additionally, HSI's implement policies to change existing hiring practices to recruit diverse faculty and implement strategies that strengthen the academic infrastructures needed for student retention and persistence like support services. Lastly, HSI's provide academic funding; support and encourage research opportunities; and implement culturally relevant and responsive instructional practices [18, 19].

Confidence is critical when engaging in rigorous academic and career fields; yet many women and underrepresented minorities indicate they lack confidence and report lower levels of self-efficacy in pre-college science and math courses [13]. The lack of confidence and lower levels of self-efficacy are critical in keeping minorities from selecting degrees they deem hard. Pre-college and undergraduate science and math instructors are not multicultural, have an aging faculty population, and only 19% of the total professorships held in technical and engineering university departments are held by women nationwide [20]. There is also no evidence that men have a higher cognitive ability to understand the content better than their women counterparts. However, there is evidence that men perform better on standardized performance evaluations and coursework because of sociocultural pressures placed on women more so than men [21].

Women entering academic and career pathways in technology and engineering have to contend with barriers that are not always present for their men counterparts including in the classroom and the job site. As previously stated, women and minorities in technology and engineering face micro-aggressions, inhospitable conditions, racism, sexism, and gender pay gaps that prevent long-term persistence and achieving leadership positions [22]. Women in

STEM leadership roles are difficult to gauge because academic institutions report 19% of all technology and engineering professorships are held by women but the number of department heads and other decision-makers is not effectively reported. The same goes for private firms that may list a woman in a leadership role, however, what their real levels of responsibility and decision-making abilities are, remains unknown.

Motivation, Resiliency, and Persistence in STEM

To combat the barriers women and minorities face when pursuing academic and career pathways in technology and engineering, universities, professional organizations, and private companies are taking action to increase gender equity, diversity, and inclusionary practices. Agencies and organizations have taken it upon themselves to study and report the inequities in academics and careers that reflect the negligence with which this issue has been dealt in the past six decades. Women and minorities entered the technology and engineering workforce beginning in the early part of the 20th century but only gained momentum starting in the 1960s when college attendance became more accessible [23, 24]. At the college level, Latina undergraduate students, as women of color, revealed that "the social climate provides security, motivation, stability, and drive for Latina students in STEM fields." Also, Latinas' leadership attitude in helping others and being the motivation to others played a critical role in their college performance and persistence [25, 26].

Minoritized groups are motivated to pursue technology and engineering academic and career paths for several fairly consistent reasons in the literature. Interestingly, the literature does not indicate a difference in the motivational factors of women or men entering the workforce. Women are motivated for the same reasons their men counterparts are motivated to enter the tech and engineering fields; higher wages, a genuine affinity for the areas of study and employment fields, opportunities for fast promotional movement, opportunities to be innovative, and job security [21].

Through high levels of resiliency and persistence, women in technology and engineering have fought for their right to be a part of these fields and use their unique perspectives to further innovation [25, 27]. Authors in [9] stated there is evidence that a growing number of educational and career counselors are recommending pathways for women to enter technology and engineering equally to their men counterparts leading to increased diversity at the pre-college and undergraduate levels. Lastly, a study recommended that universities increase interventions for women who have difficulties with performance and persistence in rigorous STEM fields and have opportunities for mentorship with relevant role models [25, 28]. Both recommendations will have a significant effect on the persistence and resiliency of women in technology and engineering pathways.

Higher educational institutions are working hard to understand the intersections of schools, community, language, and cultural nuances to serve diverse student communities. The collective empowerment of students is key to motivating them to persist in their studies including STEM [29]. Students develop intellectual growth that results in higher levels of resilience and persistence when they experience instruction that is not only academically challenging but also taught content that directly impacts their lives. Culturally relevant, sustaining, and revitalizing pedagogy connects academic content to students' communities by layering curriculum with content that is grounded in reflective language, traditions, events, and people [30].

Theoretical framework

This study used three theories combined as one theoretical framework: Social Cognitive Theory (SCT), Community Cultural Wealth (CCW), and Culturally Relevant Pedagogy (CRP) to understand the full spectrum of student motivations to persist in higher education. The complex relationships between cultural wealth, institutional practices of culturally relevant pedagogy, and self-efficacy were used to guide this analysis, see **Figure 1**. SCT is the combined influences of individual experiences, their environment, and other people's actions on an individual's behavior [31]. Key components of SCT are self-efficacy, behavioral capabilities, and expectations. Self-efficacy is characterized as a person's belief in their abilities to organize, manage and perform their particular goals. Motivation, resilience, and persistence are critical factors in a person's level of self-efficacy [32]. As the model indicates, an individual that has developed self-efficacy has also developed key motivational characteristics, cognitive abilities, and behaviors that play into their level of self-efficacy [31, 32, 33]. The resulting development of self-efficacy leads to behavioral changes, goal achievement, and passion for one's academic and professional trajectories [34]. For this analysis, key factors of self-efficacy including motivation, intentionality, resilience, and persistence are used as a guide in understanding why Latinx students choose technology and engineering academic and career paths.

Yosso [35] further described the opportunities Communities of Color have in reclaiming their cultural wealth when they fully recognize and honor their capital. Yosso described the community cultural wealth (CCW) theoretical framework as asset-based thinking around Communities of Color which recognizes the considerable set of skills and resources people bring to their communities of learning. HSIs and higher educational institutions in general are recognizing the interconnectedness of culturally responsive educational policies and practices, Latinx cultural wealth, and self-efficacy [22].

There are six forms of CCW: aspirational, linguistic, familial, social, navigational, and resistant capital. Aspirational wealth refers to the hopes and dreams people hold onto despite the oppressive realities they face in the workforce, schools, and everyday life. Aspirational wealth is the hope that many people hold on to for better futures for themselves and their children. Linguistic capital refers to the intellectual and social skills that are required to navigate multilingual and multicultural worlds. Oftentimes, those who are bilingual are the bridge to their cultural, linguistic, and historical origins and the unknown worlds they move to in search of additional success. Familial capital refers to the cultural knowledge and communal bonds of the people that surround and create communities where one did not exist prior. Familial wealth is the idea that immediate family, extended family, and members of a unique community that is brought together through traditions create long-lasting kinship ties where community and resource sharing is central. Social capital is an extension of familial capital in the sense that social capital draws on the resources of communities to create social networks that extend mutual aid for the benefit of everyone within the social group. Navigational capital refers to the ability to navigate institutions that were not created for Communities of Color like the higher and public education systems, the legal system, health care, and the job market. Navigational capital requires high-level resiliencies and strategies for understanding and successfully overcoming the racist, classist, and oppressive social institutions Communities of Color encounter as they move through life's stages. Lastly, resistant capital refers to the process of opposing oppression and subordination Communities of Color historically faced that new and emerging generations refuse to compromise with [35].

Culturally Relevant Pedagogy utilizes five themes that support teaching practices that address the whole student's needs: 1) identity and achievement, 2) equity and excellence, 3) developmental appropriateness, 4) teaching the whole student, and 5) student-teacher relationships [29]. Culturally Relevant Pedagogy and Community Cultural Wealth theories seek to address pedagogical needs through asset-based approaches to teaching and learning. Students come with cultural experiences that can help them learn and develop while institutions work to embrace diversity and inclusionary practices to successfully graduate students [30]. This conceptual framework is adaptable to HSIs and in particular, the ROLE program that utilizes these themes as a guide for furthering student success. HSIs look for opportunities to include identity formation (affirmation and validation); academically appropriate rigor that considers cultural aspects of motivation, engagement, and collaboration; and whole-student approaches to learning through skills development with cultural contexts, supportive learning environments, and centralizes the interconnectedness of home, school, and community.

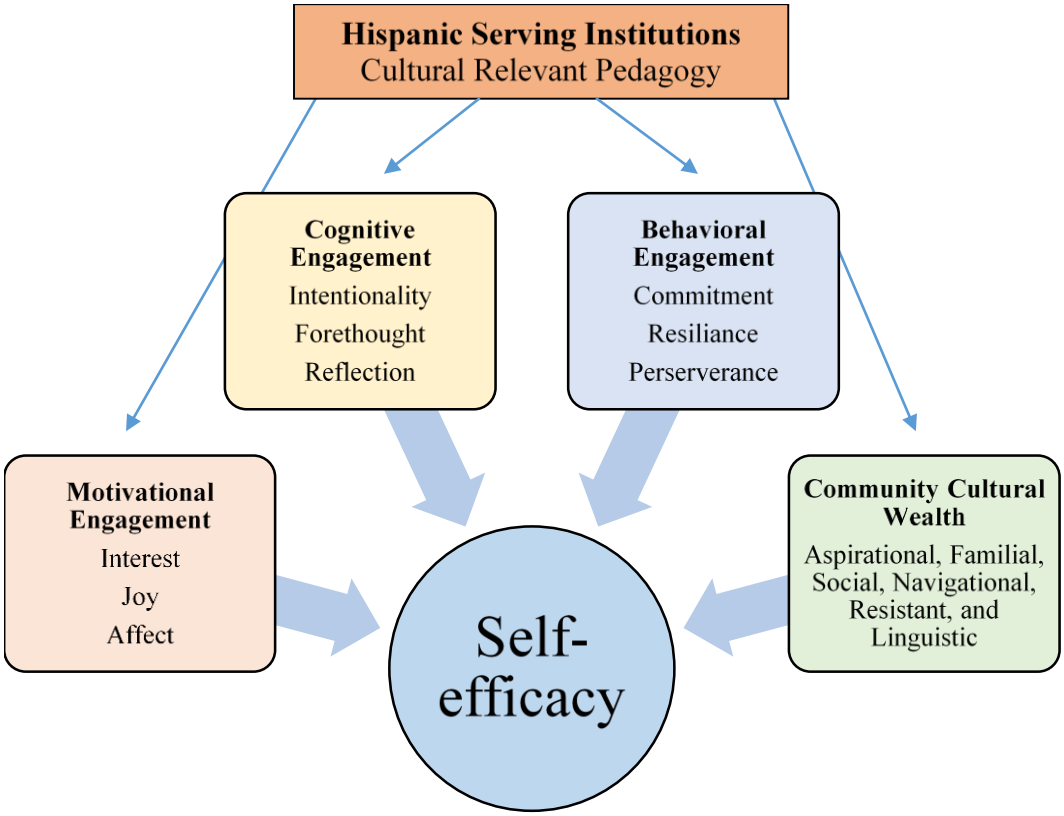

Figure 1: Theoretical framework on student self-efficacy including cultural wealth and influenced by relevant pedagogy.

Research Setting

New Mexico State University is a Hispanic and minority-serving institution that is a part of the established HSI network along the U.S.-México border. According to NMSU's annual institutional report published in 2022, 58% of full-time undergraduates are Latinx, and an additional 15% are non-White. According to the Fall 2021 NMSU enrollment data, there are nearly 14,000 students enrolled at the main campus. 59% of the students are female, 41% are

male, and 81% of the total student population enrolled are seeking a bachelor's degree. NMSU offers 95 bachelor's degrees, 62 master's degrees, and 34 doctoral programs. During the 2020-2021 academic year, the total number of students enrolled in the engineering college was over 2,100, or approximately 15% of the total student population.

NMSU supports and empowers students through culturally relevant initiatives designed to support cultural literacy by fostering relationships and inclusion between culturally unique groups of students and faculty; adopting a growth mindset and asset-based instructional pedagogy; and supporting student support services throughout the colleges and departments at the HSI. The Office of Equity, Diversity, and Inclusion prioritizes cultural diversity within the student body to ensure students will graduate with leadership skills in addition to the rigorous academic preparation students need to enter the workforce. Specifically, NMSU supports a program that is designed for Latinx undergraduate students that offer faculty and near-peer mentorship, technical skill development, community building, and academic and professional preparation.

The ROLE program at NMSU utilizes the theories of CRP and CCW to support students' academic, interpersonal, and professional skill development and goals. The ROLE program utilizes a four-pronged approach to develop the whole student. **Figure 2** describes the ways in which students are gaining skills that are culturally, academically, and professionally relevant to their college success while participating in the ROLE program.

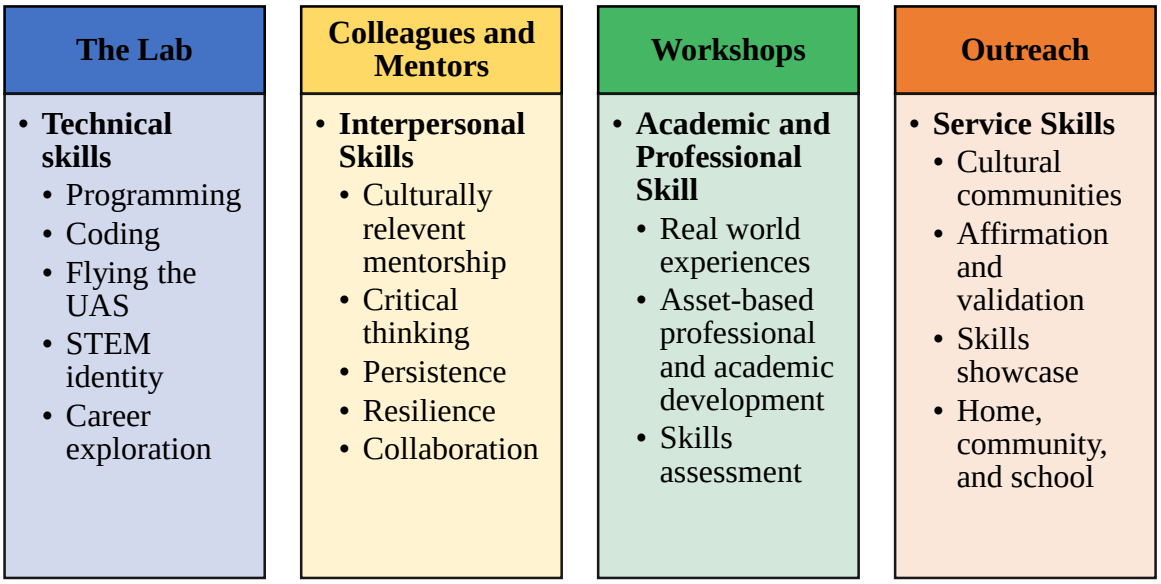

Figure 2: Core elements of the ROLE program at New Mexico State University

Methods

Data Collection

The ROLE program has had two student cohorts, the first in January, and the second in August 2022. Both cohorts consisted of sixteen minority students, 90% Latinx, 60% women, and 50% first-generation students, enrolled in different engineering academic programs and student classifications from sophomore to senior. Student participants completed two surveys and participated in a set of interviews. In both cohorts, the first survey and interview explored

students' prior academic, research, and mentoring experiences. The second survey and interview, completed by the first cohort, examined the benefits and learning outcomes of participating in the ROLE program in terms of confidence as students, perceptions of research, and mentoring relationships. The first set of one-on-one interviews was conducted during the first-month students were participating in the program. Each interview lasted on average 40 minutes. The surveys were administrated using RedCap, an institutional tool that collects and stores data. Due to the number of participants, the results included in this study are descriptive in nature and complemented the information presented through the qualitative data.

Data analysis

Survey data were exported to Excel, where the researchers analyzed students' responses. Interview data were recorded and transcribed, and the transcriptions were used for the analysis. Researchers read the interviews several times, identified data units, and classified the information using Dedoose, a software that helps in the analysis of qualitative data. Through constant comparative techniques and content analysis [36], researchers found themes and categories in the interviews that helped answer the research questions and complemented the information students reported through the surveys. The theoretical framework informed the analysis by providing the researchers with a deeper understanding of what to look for in the student's survey and interview responses. The researchers took note of key themes and topics that surrounded motivation, persistence, cultural relevance and acceptance, supportive learning environments, interconnectedness, and skills acquisition.

Findings

Survey results

Sixteen undergraduate students participated in the ROLE surveys. 81% responded that this was their first experience in a mentored research program. ROLE participants were asked a range of questions regarding their experiences in research programs, academic, leadership, interpersonal skills, and mentoring. Key information about the students' experiences, and perspectives were gleaned from the surveys including technical, academic, and professional skill development. Most notably, students were asked to assess their knowledge, abilities, and skills and indicate their levels of agreement with the following statements:

Table 1: Participant Responses to ROLE Surveys

Assertions	Strongly Agree/ Agree	Undecided	Disagree/Strongly Disagree
I have strong leadership skills.	81%	19%	-
I have strong interpersonal (social) skills.	81%	19%	-
I am able to develop a professional network.	69%	19%	6%
I am able to work effectively with others.	94%	-	6%
I am able to work effectively on my own.	94%	-	6%
I am able to manage my time effectively.	81%	13%	6%
I am able to work through obstacles or challenges.	100%	-	-
I am able to write a research abstract.	50%	19%	31%

I am able to create a research poster.	50%	19%	31%
I am able to give an oral research presentation.	75%	6%	19%
I possess a basic understanding of how to interpret research data.	69%	13%	19%
I possess a basic understanding of how to apply research data.	75%	6%	19%
I am able to communicate technical information to people within my discipline.	87%	6%	6%
I am able to communicate technical information to people outside my discipline.	87%	-	13%

Table 1: Student survey responses on their knowledge, skills, and abilities as they relate to their participation in the ROLE program.

The responses indicated in **Table 1** help informs our programmatic efforts to challenge students to develop their skills and talents to be successful students. The program included professional development opportunities that supported research abstract and poster session presentation development, how to utilize research data; communicating technical information; and creating professional networks.

Additionally, students were asked about their experiences with mentorship and plans regarding employment or postgraduate school: 81% of responses indicated the ROLE program was their first faculty-led mentored research opportunity, only 50% had participated in an oral presentation about research, and 25% were considering entering a graduate program. This information is critical because the research shows student attrition in rigorous STEM programs is partly attributed to a lack of undergraduate research opportunities, a lack of skill-building opportunities surrounding research like how to utilize data and then present technical information, and a lack of diverse faculty [11, 12]. The Latinx student participants are encouraged to seek out graduate opportunities that will diversify engineering in higher education.

Lastly, students were asked what skills and knowledge they hoped to gain by participating in the ROLE program. Their responses were diverse and informed the development of the four elements of the ROLE program as seen in Figure 2.

1. I wish to develop a bit more social skills as well as some more practical skills. Knowing how to apply some of the skills I learn in classes in what could potentially be a real-life experience.
2. I hope to learn proficiently how to program autonomous systems and have an intermediate understanding of the coding languages we are using.
3. I hope to gain the skills needed in the engineering and computer science fields. I want to be able to be prepared for jobs and understand how to learn on the job. The textbooks and school can only teach you so much. With this program, I am confident that I will be able to learn how to learn.
4. I hope to gain experience in computer programming used and the overall research aspect. I also hope to make lasting connections with my team and mentors.

5. I hope to gain knowledge of basic coding and add it to my resume. I do not get the opportunity to learn about this in my general classes since I am a civil engineer. Having some background in this will help me become more diverse as I grow as a professional engineer. I also want to be able to meet new people and work as a team to figure out where our errors are and how to problem-solve them.
6. I hope to develop my leadership, and organization skills, I also hope to gain knowledge on how to work in research and how to improve the use of databases and computer programs we will be using.

The student responses above indicate they hoped to learn a variety of skills that would positively influence their academic, personal, and professional experiences in undergraduate engineering programs. Student survey responses noted their hopes for social skill development and community-building opportunities that inform the culturally relevant pedagogy aspect of the ROLE program. Several responses indicated students wanted to participate in ROLE to learn control, programming, and coding skills which informs the technical skills portion of ROLE. And lastly, students wanted to grow their leadership and organizational skills which influences the mentorship aspect of the ROLE program.

Interview findings

Participants of the ROLE program reflected on the motivating factors to enroll in various extracurricular programs leading to belonging, resilience, and persistence within their chosen academic programs. Findings suggested that persistence takes different forms and is influenced by the type of interactions students experience with faculty, as well as discoveries of new opportunities as they move forward to attain their college degrees. Other findings included the role that Community Cultural Wealth has on the experiences of Latinx as they share space with other peers and faculty.

Positive interactions with faculty determined the kind of experiences and motivation to persist in challenging academic programs. In addition to positive interactions with faculty, STEM retention of underrepresented minorities is dependent on critical factors such as cultural connections to content, community building supported by faculty, and the feelings of being supported [18]. ROLE participants reflected on their perceptions of professors' attitudes, care for students, and interest in students' academic performance. Zero, a sophomore student in mechanical engineering technology, and Xiomara, a junior student with a minor in mechanical engineering respectively mentioned, *"I like the people in my major a lot, not just as like, "OH, they're nice professors," but like as actual people. They're very kind, and they really do try to help you out as best as they can"* and *"The actual college of engineering classes that I have taken, I've had nothing but great things. Like they've actually made me believe that I could do it*." Also, Gillian, a junior student in mechanical and aerospace engineering, agreed with her peers in emphasizing the key role that having supportive faculty has on students, she added, *"I feel comfortable with my professors, even if I don't know the material, I feel comfortable enough in the knowledge that I've gained and the people that have stood behind me and encouraged me to push forward."*

ROLE participants represented 50% of first-generation students and 81% of students experienced research involvement for the first time while in ROLE; therefore, what students

learn as they navigate college becomes critical in increasing the likelihood of persistence and successful achievement of their college degree. Two categories of factors assist in retaining students in STEM and specifically engineering fields: institutional factors, and student factors. Institutional factors include course load, academic advising, pedagogy of the institution, department, and instructor, and institutional practices [16]. Student factors that lead to persistence and successful completion of rigorous STEM and engineering degrees are content proficiency, academic engagement, peer mentorship, time management, and student motivation, all of which lead to self-efficacy [13, 24]. The knowledge about what is important to know as college students and build a robust career were discussed by a few students. For instance, Leo a junior student in civil engineering, and HQ a junior student in mechanical and aerospace engineering respectively mentioned organization and discipline as critical in college, they said, *"Probably organization and being able to talk about and keep talking about the research that I've learned,"* and *"I needed to have a structure, usually in the past (before college) I was like, very disorganized… And I was not like…I didn't have like too much discipline in my life…"* Furthermore, Zeus, a senior student in mechanical engineering shared his thoughts on the importance of developing relationships with other people in college, he vented, *"I didn't really have anyone to tell me that networking was important. Um, so until I came into college…not only would it look good for you…I guess for the resume, but it also creates friends in the future."* For Latinx students, the cultural wealth aspects are essential in their daily interactions and operations. Providing culturally relevant spaces, curricula, pedagogy, individuals, and activities are crucial in contributing to students' sense of belonging, integration, and engagement [35]. Latinx STEM identity formation is the result of a collective effort to increase student content proficiency while also valuing and understanding their motivations to be in STEM; students want to improve their family's financial situations; model success to younger generations of the same background; modeling success to younger generations, and further their cultural and linguistic representation in their chosen fields [15]. ROLE participants opined on the cultural aspects they perceived in the program, especially the commonalities they found with their peers. Students' description of finding community through their cultural and linguistic commonalities with their peers exemplifies a key factor in their persistence as Latinx undergraduate student participants of ROLE. In this instance, ROLE was the physical and metaphorical space where the program participants received support in the technical, interpersonal, and professional development areas because the tenets of the Community Cultural Wealth asset-based model are at the forefront of ROLE's program practices. Jaylen, a sophomore student in mechanical and aerospace engineering mentioned,

> *I think I shared more culture, I think with Jose. And he told me about what he's been through and what he's doing with his family and his past. And I think I related to him. And then also with Gillian and Gene, we also talked about our experiences, being a female in engineering, and how it was a little different.*

Also, Jose, a junior student in mechanical engineering technology talked about the safe space he found in the ROLE program, where he felt appreciated, and his knowledge validated. Joseph expressed,

> *I didn't have to worry that if that I was getting judged for my race or the color of my skin. I really did, I felt appreciated... I felt very comfortable…I think just being able to be a part of Latino program like this really just brought out the best in me.*

On a different topic but the same idea is the importance of institutions having Latinx faculty representation because not only helps Latinx to think of themselves in these positions but also contributes to diversifying STEM faculty. HQ considered Latina faculty as approachable and highly interactive with students, she added,

> *Latina professors, they will be, Hey, how are you today? Hey, what you're doing today. Hey, you know, they try to involve, you know, um, in what you're doing. They get involved in your life and everything. And, uh, white professors, maybe it's a culture that they, they don't get involved so much, you know, they (Latina faculty) are caring.*

Conclusion

This study sought to understand two key questions 1) What are the factors or aspects that play a critical role in the persistence of Latinx undergraduate student participants of ROLE? And 2) How does ROLE support the various types of Community Cultural Wealth Latinx student participants represent? This study demonstrated that undergraduate research programs, STEM faculty mentorship, and HSIs work hard to encourage Latinx students to enroll, persist, and successfully complete demanding academic programs when students' cultural wealth, and culturally relevant pedagogy are used in conjunction to create asset-based learning environments.

Latinx students persist and complete rigorous engineering academic programs by having access to and participating in a combination of support systems put in place at HSIs. Students need to feel supported in their learning environments academically, socially, and culturally to develop the specific skills that lead to self-efficacy. Latinx students who participated in the ROLE program identified the opportunity to build confidence in their technical, interpersonal, and professional skills as pivotal in their academic careers. Latinx students who persist in rigorous academic programs need confidence-building opportunities outside of the classroom where they can experience new things, explore their perspective area of concentration, try new skills, and meet fellow students. Higher educational institutions and HSIs support Latinx cultural wealth by implementing and supporting culturally relevant systems that transform traditionally deficit-based learning environments into asset-based ones. HSIs like NMSU are making a concerted effort to celebrate diversity within the student body through programs that represent and support culture, language, and traditions, while also understanding the deep-rooted discriminatory practices, homogenous instructional delivery, and deficit mentality higher education institutions engaged in historically. The ROLE program at NMSU is an example of what future programming could look like in relation to culturally relevant pedagogy at higher educational institutions and HSIs. ROLE strives to be culturally inclusive, academically challenging and whole-student-oriented.

Additionally, The ROLE program has created a community amongst the student participants that is informed by the students' culture and views cultural and linguistic diversity as an asset to students' overall motivation, persistence, and self-efficacy. Students continue to develop their technical, academic, interpersonal, and professional skills and talents because the environment is supportive and accessible, and practices culturally relevant pedagogy. There is still much to be done to encourage student self-efficacy in STEM, however, the ROLE program

is helping students navigate their STEM identities by supporting their personal cultural identities. HSIs support student success through a variety of culturally relevant pedagogical strategies that support underrepresented minorities in their collegiate experiences such as the ROLE program.

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