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Latina Students Increased their Self-Confidence through a Research Engineering-Focused Program at a Hispanic-Serving Institution

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Abstract

Minority engineering students face multiple challenges and sometimes hostile college environments that make students doubt their abilities and consequently, harm their persistence in engineering programs. In particular, women of color, such as Latinas, deal with a high level of underrepresentation in engineering and face difficulties in fitting into this male-dominated discipline. Increasing student determination is key to making it possible for current college students to better navigate engineering. The multilevel intersectionality framework, which considers individuals' intersections of identities, informed this study by considering Latina students' multiple identities and aspects that intersect with being engineering students. A qualitative study with data collection conducted through interviews found how a research-oriented NSF-funded program contributed to changes perceived by students. Such changes were related to increasing student confidence in their abilities, improving students' learning process through research involvement, and positively influencing students' perceptions of themselves as researchers due to their interactions with mentors. Institutions that serve a diversified student population should make better efforts to provide programs and spaces where minority students can foster higher self-confidence and positivity towards engineering.

Introduction

Reducing the gender gap in educational outcomes requires better recognizing the systemic barriers that exist in higher education. Individual, group, institutional, and societal factors play an essential role in maintaining the gap in women's college attainment, particularly in engineering. According to the National Girls Collaborative Project [1], young women have similar abilities in mathematics and sciences but differ in their confidence, interest, and belongingness to science-related fields, compared to young men. Historically, engineering has been framed and perceived as a male-dominated discipline, emphasizing traits such as competitiveness, aggressiveness, and intensiveness [2]. Overall, women only earned 24% of engineering bachelor's degrees [1]. Women enrolled in engineering programs with below-average representation might experience pursuing engineering differently than women with average and above-average representation. Authors in [2] discussed this difference highlighting that first-year women who were underrepresented in the engineering programs demonstrated high engineering identity, and strong persistence of effort and desire to enter the engineering industry. Overall, in the science, technology, engineering, and mathematics (STEM) workforce, just 16% are women, and less than 10%, of all workers, are women of color [1].

In this study, self-confidence refers to the belief in one's ability to accomplish tasks, the affirmation of the right to be in engineering, and the optimism that success can be achieved. Some scholars have researched women's confidence in engineering and related fields. For

instance, see [3] who investigated the differences in self-confidence in math and science skills, open-ended problem-solving skills, and professional and interpersonal abilities between men and women over time. Statistically, confidence was high for both genders; however, qualitative data showed that overall women have lower confidence than men.

Women in this study were Latina student participants in the Research-Oriented Learning Experiences (ROLE) program in engineering at New Mexico State University (NMSU). NMSU is located on the southern U.S.-Mexico border, in the state of New Mexico. The ROLE program "supports engineering undergraduate 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" [6]. More details about the ROLE program can be found in the Methods section. This study's goal was to gain insight into the aspects that played a pivotal role in improving the confidence and efficacy of minority women in engineering after participation in the ROLE program at this SBHSI. The central research question driving this study was: 'In what ways did the ROLE program contribute to strengthening the self-confidence of female participants as engineering students?'

Conceptual framework: Multilevel intersectionality
The multilevel intersectionality framework developed by Núñez [7] guided this study. In the '90s, Crenshaw [8][9] coined the intersectionality concept highlighting the multiple forms of oppression individuals could face based on their identities. There are several categories that people use as identifiers including "race, ethnicity, gender, class, sexuality, national belonging, religion, language, phenotype, and able-bodiedness" [7]. Núñez's [7] study focused on the social identities of high school students including Latino, im/migrant, and citizenship status, and considered dominant and marginalized oppressive systems that impact their educational outcomes. Núñez [7] argued the need to consider distinct aspects including 1) individual socially constructed identities at a micro-level, 2) external factors such as influence, contexts, and relationships (e.g., intersubjective and experiential factors), and 3) historical events, see Figure 1. The importance of accounting for these multiple identities and aspects is found by deeply analyzing their intersections and impact on Latina engineering students. In this study, we concentrate on identities self-reported by student participants, specifically *Latinas*, *women*, and *engineering students*. Despite being categorized under a specific unit; each identity might be explained through different/multiple lenses and perspectives.
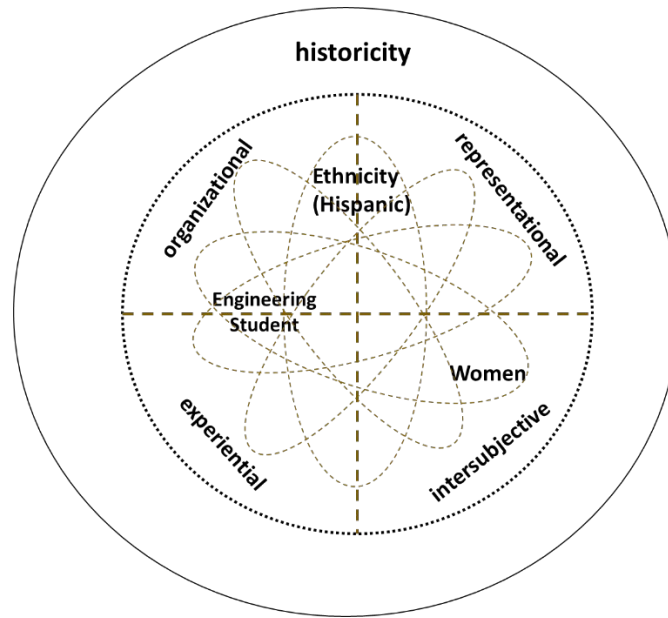
Figure 1. Adapted model representing multilevel intersectionality

1) Individual socially constructed identities
Latinx
In higher education, Latinos enroll mostly in HSIs and emerging e-HSIs, that is, 62% of students at these institutions are Latino, with 48% of these being women [10], [11]. Latina students remain highly underrepresented in STEM-related disciplines from postsecondary education to the workforce. For instance, in terms of degree attainment, Latinas only received 14% of women's STEM bachelor's degrees, 10.5% of women's STEM master's degrees, and 8.3% of women's STEM doctorate degrees. Overall, Latinas received 1.9% of STEM graduate degrees [12]. As women of color, Latina students face multiple barriers to developing interest, engagement, and encouragement in highly technical and male-dominated disciplines [5], [13].

Women
In 2019-2020, women received 34% of all postsecondary STEM degrees, making women underrepresented in the field [12]. What does studying in a male-dominated space mean for women? There are different expectations that women must meet in engineering spaces. One aspect is to behave in certain ways to be accepted and valued. Such behaviors involve showing a lack of self-assurance, ambition, and initiative, which avoids confrontations with their male peers but also limits women's career opportunities [4]. Women more than men often take full advantage of formal and informal mentoring opportunities in college and outside college, increasing their opportunities to make informed decisions and extend their network [15].

Engineering students

Women enroll at different rates in engineering programs. Programs such as Construction, Management Engineering, Electrical Engineering, Mechanical Engineering, Aerospace Engineering, and Information Technology, are less popular programs among women [2]. Authors in [16] noted how women were able to find a solution to a problem considering the situations and the context — aspects that were less evident for men. This is one of the main reasons why the role of women in engineering is key to addressing contemporary complex problems. In STEM, research mentors play a vital role in students developing a stronger scientific identity with mentors who share demographics or values [17].

2) External aspects including influences, contexts, and relationships

    a) Organizational - as women, Latinas have a particular role in their families

Latinx students' college experiences are deeply shaped by their personal, social, and cultural backgrounds, which are, in turn, heavily influenced by factors such as family, immigration status, economic affluence, and access to information, resources, and networks. [18], [19]. Latina students report that family obligations and expectations shape their experience in college [20]. For instance, they may feel pressure from parents to fill a gender role in their family at the same time they pursue their education [21], [22].

    b) Representational - low expectation of Latinx / women

There are several ways in which Latinx are minoritized within higher education [23]. Hostile climates on campuses persist for various reasons, most commonly affecting women of color in STEM due to their physical appearance not conforming to that of other students/faculty [24], [25]. Another instance of minoritization is observed in the absence of family-type shared values in STEM programs. This absence of core values negatively impacts Latina students' academic performance by depriving them of vital support for their socio-emotional well-being and limiting campus belongingness [27].

    c) Intersubjective - Latinx interaction and connection with others

Historically, dominant groups commonly from middle-class backgrounds have set the norms and rules of what is normal, even in terms of identity development. The authors in [28] stated that "Latino immigrants face multifaceted racialization in the news media and that this racialization shares substantive similarities with African American racialization processes." Other problems have to do with Latinx being educationally, socially, and economically oppressed and suffering stigmatization as people with less intellectual value [29].

    d) Experiential - women self-thinking on their role as engineering students

Women's perceptions of themselves as engineering students can vary. Chachra and Kilgore [3] noted that women perceived themselves as less confident in their math skills despite finishing their engineering degree in four years comparable to their male counterparts. Co-curricular

activities such as undergraduate research programs, and informal learning activities such as after-school activities and summer camps are usually developed with the idea of increasing students' abilities and furthering their knowledge, particularly minority and underrepresented students in STEM. Despite these benefits derived from exposure to more real-world project-based experiences and leadership, women can still feel intimidated and doubt their ability to perform technical tasks [5], [30].

3) Historical events
In the past, people from North America, including Mexico, as well as Central and South America experienced Spanish colonialism and racial categorization based on white European standards. In the 1800s, for example, Mexico was liberated from the Spanish yoke seeking to improve their rights and living conditions [31]. More recently, the creation of the racial/ethnic category of Hispanic triggered conflicting views of ambiguity grouping Mexican, Latin American, Caribbean, and Spanish populations into the same category and creating identity issues for these individuals [33], [34]. Individuals who self-identify as Latinx are stigmatized as an inferior race, regardless of U.S. citizenship status, or whether they are first, second, or third-generation Americans. Such labeling contributes to persistent inequalities and discriminatory practices in varying contexts, including educational settings [25].

The multilevel intersectionality framed in this section highlights multiple elements that Latinas, as women and engineering students, face in their search for a place in engineering. There are multiple socio-emotional, economic, cultural, and academic aspects to consider in facilitating Latina engineering students to develop interest, persist throughout, and gain confidence.

Methods
This is a qualitative one-shot case longitudinal study that explores a phenomenon in depth within its real-world context. There was no control group to compare the effectiveness of the ROLE program. Women participants pursuing engineering degrees reflected on the importance of programs like ROLE that helped them reinforce their self-confidence as students interested in engineering. Participants took part in a set of interviews, in the first month of the ROLE program. In this interview, they responded to questions related to their prior experiences with research, their academic programs, and their relationships with peers and faculty. For example, a couple of questions were to "Describe your academic experience in your Engineering program related to your peers' relationships," and "What can you tell me about your previous research experiences?" A second interview was conducted at the end of the ROLE program. In this last interview, participants shared their experiences with ROLE in terms of technical, interpersonal, and personal learning, changes in their perceptions of research, and support from peers and mentors. Other questions included "How was your experience in developing the relationship with your mentor (s)?" and "How has your participation in this program reinforced your identity as a Latina/o in Engineering?" Second interview responses informed and framed this study. On

average, interviews lasted 40 minutes. All interviews took place in the university facilities when students were available. Researchers used consent forms to comply with the Institutional Review Board (IRB) requirements. All interviews were recorded and transcribed; the transcriptions were used for the analysis. Researchers used Dedoose, a qualitative tool to help in the data analysis. Researchers started with the unitization of data, that is, every piece of information that can be understood by itself is classified under a theme and then reclassified using categories. Researchers started the analysis using initial coding, in which units of data are classified into general themes from each transcript that was analyzed. A second analysis included the use of axial coding which helps address the study's purpose and research question [35]. The axial coding resulted in 3 themes, which are shown in Table 1 along with the number of responses.

Table 1. Themes and counts

Theme	Counts
1. Personal learning after participating in ROLE	52
2. A research space for minority undergraduates	48
3. Relationship with faculty and peer mentors	54
Total	**154**

Context
The ROLE program is housed in the Unmanned Systems Laboratory in the Electrical and Computer Engineering Department at New Mexico State University (NMSU). Funded by the National Science Foundation (NSF) Broadening Participating in Engineering program, ROLE aims to trigger interest in research activities and development in engineering among minority undergraduate students. The ROLE program has had three student cohorts since its inception in January 2022, with six to eight students in each cohort. During students' time in ROLE, students spend six hours weekly in the laboratory. During the first months in ROLE, students learn about Linux OS, Robot Operating System (ROS), Python programming language, as well as how to operate a motion capture system that provides indoor GPS capabilities. In the final result, all software and hardware tools are put together to control the flight of a real-time aerial robotic system – the Bebop quad rotorcraft manufactured by the company Parrot. In the subsequent months, students work in small teams to develop specific projects such as vision-based object detection and obstacle avoidance. The goal is to replicate real-world missions like flight surveillance operations, in a controlled laboratory environment. For the most part, students attend the laboratory on the same days and hours; therefore, they can work together and support each other's learning.

Participants

ROLE participants included minority and underrepresented students in engineering. ROLE's goal is to attract Latinas and they have composed at least half of each cohort. However, attrition is also an important aspect to consider because women more than men have abandoned the ROLE program for reasons such as family responsibilities, job duties, and the need to focus more on classes. Table 2 explains students' attrition in the three cycles of the ROLE program.

Table 2. ROLE student participants' attrition

Gender self-identification	1st Student Cohort		2nd Student Cohort		3rd Student Cohort	
	IG	FG	IG	FG	IG	FG
Women	6	3	5	4	4	2
Men	2	3	3	4	5	3

IG: Initial Group / EG: Final Group or students who completed the program

All participants who self-identify as Latinx were either born in Mexico or had Mexican heritage. Table 3 shows student demographics from ROLE participants who were included in this study.

Table 3. Participant Demographics

Pseudonym	Engineering program	Prior research experience	Most expressed change/learning after ROLE
Gene	Mechanical & Aerospace	No	Discipline and commitment
Jaelyn	Mechanical & Aerospace	No	Confidence
Gin	Aerospace	No	Persistence
Leon	Civil	Yes	Patience
Poisonlvy	Mechanical & Aerospace	No	Capability
Xiomara	Mechanical	No	Assertiveness
Ginger	Mechanical Eng Technology	No	Curiosity
Kiera	Mechanical & Aerospace	No	Knowledgeable
Luna	Electrical and Computer	No	Determination

Mentors

ROLE mentors, who work with and guide students, include a faculty member from the Electrical and Computer Engineering (ECE) Department, two master's students, one from Computer Science (CS) and another from ECE), and one peer mentor – an undergraduate and former

ROLE participant from CS. The mentors spend time in the lab, guiding the student participants in learning and mastering the technical concepts and research skills needed to complete their projects. Students present deliverables weekly regarding programming assignments in real-time robotic demonstrations. Mentors use the learning management system Canvas to organize resources and materials that students can access. Students use Canvas to submit their assignments and to interact with mentors when questions arise. Also, graduate mentors and the peer mentor hold informal discussions about topics such as graduate school, research as graduate students, culturally related topics, and other shared interests.

Findings
This study's findings show the contribution of ROLE in facilitating a positive change in Latinas as women and engineering students. The changes perceived were tied to increased self-confidence, discoveries about learning in a research environment, and the influence of mentors in the learning process and as role models. Each theme will be explored in detail.

Increased confidence as Latinas, women, and engineering students
In both cohorts, Latina students expressed changes in their perspectives about being involved in research and being able to get something out of it. In the following three quotes, students commented on gaining confidence as part of their involvement in research activities. Xiomara mentioned,

> I think I've been able to gain that different side of research through all…So those are the different types of skills, like just being confident in it or learning a completely different language from the research that I'm used to.

Then, Jaelyn said, "I learned about myself. Before, I wasn't into coding. I didn't think that I could learn it, but I think now, I'm more confident in my coding abilities and into a different field." Both students were in the Mechanical Engineering program and reflected on the importance of interdisciplinary research work as engineering students. Finally, Poisonlvy added, "As a Latina, I think it has given me confidence that it doesn't matter where you come from, you have the same capability to do the work that not only men or any other race can do." The experiences of these three participants highlighted their ability to view themselves as valuable contributors to engineering research projects, both as Latinas and as women. This recognition triggered a sense of empowerment in their skills. Another participant, Kiera described how this research space supported her as a Latina, she mentioned,

> I feel like Latinos or Latinas personalities are hardworking. I feel like that's one of the things that defines us the most. So, working with a team that is equally as hardworking because of our nature and our culture is really fresh compared to other cultures who may not have that same culture or upbringing.

Xiomara added, "I would say the most important thing is learning that research may look very different from what you thought it would." Aligned with the previous quote, Leon verbalized a change in her perspective regarding her acceptance into the research community as a minority student, a woman in engineering. Leon mentioned, "By being a minority woman, this program made it so I could feel accepted into like, any STEM field or anything knowing that I'm capable of being selected for these kinds of programs." However, being selected is the first step to succeeding in these types of programs, and Gin realized that commitment and persistence become critical aspects of research. She said, "Being able to be persistent about the research too, especially when it's like you don't quite know how to solve a problem… and just trying to find avenues around how to solve it." Participants revealed excitement about participating in a research-focused program because it was a new experience for them but soon discovered that they needed to commit and stay focused on their research duties.

A last quote also related to the aspect of increased confidence is one Xiomara shared. This participant not only believed that she could be a key element in the research project but that she could also contribute to the field. She showed pride in being an engineering college student after this experience in ROLE, as she expanded her knowledge by learning from others. Xiomara vented,

> I guess that made me more confident that I could bring stuff to the table, like the stuff that I do in my other field, like I can't bring it to engineering…so the biggest thing was coding. I never thought I would do that. I never thought I would use that. I thought that it was a computer science job, not an engineer's job. So, I think those two things definitely helped me learn and broaden my experience.

All participants experienced a transformation in their abilities, capabilities, and conviction regarding opportunities to have key roles in research activities and projects. Their research involvement impacted them in such a way that students' self-confidence adapted to the new roles and transformed how they perceived themselves as engineering students, women, and Latinas.

Personal learning through research as engineering students
Participants' learning is related to the previous theme because they expressed positive changes due to their involvement in this research-oriented program. It was a challenging experience; therefore, participants had to develop specific skills to be able to make it. The following two participants shared about how they discovered something that helped them to succeed. Ginger stated, "It made me a lot more curious. When I was researching, I found out that I was like really curious about knowing more about that specific topic or any other related subject." Likewise, Leon added, "Patience, patience is key to anything that you don't know. And also, being able to figure out stuff on your own rather than relying on anyone else to show you." On the one hand,

Xiomara revealed the need for others to be able to make things happen in a field that she is not completely immersed in as her major is in Criminal Justice with a minor in Mechanical Engineering. On the other hand, Leon opined the need for patience and autonomy when challenges are present.

Another participant shared a different perspective on how being involved in a research program impacted her academic and experiential journey. This experience must resonate with other students whose native language is not English. Poisonlvy commented,

> It has really helped me to engage more with students... it has been really hard for me to engage with people. Not because I don't want to, but because … for me, English is my second language.

Having diverse academic, personal, and cultural experiences may complicate an appropriate and timely integration into college and develop a sense of engagement and interest in their discipline. Poisonlvy put in evidence of such struggle and how helpful this program was for her in developing a sense of belongingness.

Overall, it was a positive personal learning experience for students participating in research for the first time. It was an eye-opening experience for students and a life-long impact to realize what research was about. Gene summarized her experience and individual learning,

> It's just made me kind of really excited about engineering. It's really cool to see the hands-on experience of it. Whether or not that's what I do in the field, I kind of just learned that I do like being able to work directly with what I'm trying to change, if that makes sense. And I just learned a lot of patience and a lot of staying disciplined and committing to finding the answer to the problem and then just making sure that it does work and whatnot.

As engineering students, participants were convinced that their personal learning would change their perspective on their abilities. They were more aware of their weaknesses but also of their strengths and motivation to stay involved in research-related activities in engineering.

Positive relationship with mentors as women engineering students
One of the most important aspects of this research-focused experience is the relationship participants develop with their research mentors. In the three cohorts of the ROLE program, students experienced interacting with faculty and peer mentors. Both mentors have positively impacted the research experiences of these Latina engineering students. For instance, Jaelyn and Luna commented respectively on the role of the faculty mentor in their first steps as researchers,

I think he [the mentor] did a good job in guiding us, but also letting us do trial and error and figure it out as well…So we got to talk to him more and I guess also more personally as well, and then every single week, a few hours.

I really had a positive experience. Like I always had help. I would always ask them questions and they would answer right away or try their best even to answer my questions. So, I thought that was really important in a sense.

In these quotes, both participants highlighted the faculty mentor's supportive approach in guiding their research endeavors, emphasizing the sense of support they received. They also highlighted the trust and honesty component of the relationship. In addition, the second student cohort also had a peer mentor, and participants described the type of connection they developed. From Poisonlvy's perspective, both mentors did a great job in maintaining a balance between assigning challenging tasks and allowing the time to perform them. She added, "I think that my mentors...they're really good mentors because they don't overwhelm you like you have to do it right now. Like they give you the pace and because I think that's what it takes to learn." The peer mentor, specifically, seems to develop a deep connection with students by creating a positive learning environment. The following quotes emphasize a few participant perspectives on this. Gin, Xiomara, and Leon stated, respectively,

I think it's pretty good. We communicate with each other really well and he explains the codes and everything really well too. I think he knows how to kind of water down the complexity of some of the codes and be able to help us learn it to where we can use it, apply it, and understand it. He's really nice and approachable too. I feel like if I had any questions, I don't feel afraid to ask him for help or anything.

He (peer mentor) is really good at like guiding us. Like I said, he asks us questions that he expects us to answer and then he he'll guide us from there. He's never been one to just give up and be like, okay, this is what you have to do. So, he is really good, and I think from a woman's perspective, he never like mansplained something. Do you know what I mean? Like talks down in a way. He's very caring and inclusive and cares about the way that we are learning the information.

At the beginning of this program, I was really timid and shy to ask questions. I was like, okay, I'll figure it out. Or I'd rather ask my peer rather than my mentor. But now, I'm at the point where I'm not afraid to ask questions and I made a connection that I'm like, okay, I'm stuck. I'm going to do as much as I can and then ask for help. So, when I do ask for help, my mentor comes and he's like, okay, tell me what you did. What do you think went wrong? And then he'll like, show me or give me a hint of how I can correct my mistake.

These participant quotes revealed interesting aspects of how women often feel "afraid to ask questions" and they prefer to figure it out on their own. There is also the aspect of suffering microaggressions. Students used the word "mansplain" in describing a common experience women suffer in male-dominated spaces like engineering.

In general, participants felt supported and encouraged to be in this research space where mentors cared about their learning process and progress. By setting high expectations, mentors provided the appropriate climate to spark in these Latina woman engineering participants a sense of empowerment and motivation to become researchers.

Discussion
This study's findings contributed to understanding the importance of providing space, time, and opportunities to minority and underrepresented individuals like Latina engineering students, enabling them to envision success within their academic fields. This study aimed to investigate how the ROLE program helped reinforce women participants' self-confidence as engineering students. One of the themes explained the *increased confidence as Latinas, women, and engineering students* in having the opportunity to participate in research-oriented activities, which made them aware of their valuable contribution to the field. The ongoing hostile climate that women of color experience in engineering programs contributes to their doubts, concerns, and challenges associated with the right to be an engineering student. Scholars in [4, 5] studies emphasized attitudes that women show in working with men who display higher confidence in their technical skills and meeting overall engineering demands. As a result, women take a more passive role in aspects such as competitiveness, ambition, and initiative to better fit in male-dominated environments [4]. Despite having to fight such battles, student participants who spent between a semester and a year in the ROLE program showed specific confidence traits that can contribute to mid and long-term decisions. All these traits are related to the changes students perceive after a period of research focus time including discipline, commitment, persistence, patience, capability, and assertiveness. All participants of the program were aware of important changes that switched their mindset to a more positive, inclusive, flexible, and interesting engineering approach and climate. As the authors in [16] expressed, women must be able to approach engineering from their perspective and voice their opinions in such a way that they contribute to the engineering field.

For minoritized and underrepresented students, such as Latinas in engineering, it is essential to develop higher levels of confidence to persist, seize opportunities, and voice their ideas. In this study, Latina participants of the ROLE program developed a sense of accomplishment and learning that they might not have otherwise discovered. In the ROLE program, students were exposed to sociocultural support that is not traditionally experienced in engineering. The ROLE leadership team was convinced that providing a space where students could feel welcomed, respected, included, heard, and encouraged would empower these Latina students. Participants

also reflected on their *personal learning through research as engineering students*, in which participants discovered that being able to ask for help and gain trust in their abilities was important in their initial steps as researchers. The conceptual framework on multilevel intersectionality [7] helped inform the need to consider all the different identities of participants described as Latinas, women, and engineering students to truly capture their experiences. In addition to considering participants' identities, it is important to take into account the external factors that influence the types of experiences in engineering. For example, [27] highlighted the lack of family-type shared values in STEM academic programs affecting the socioemotional well-being of Latina students and consequently, their persistence in these disciplines. Family background, immigration, economic status, and the strength of their professional network influence their ability to access information, resources, and people in college and beyond, which, in turn, affects their persistence in the field. All these internal and external factors shape Latina students' academic performance and define Latinas' success as students and later as professionals.

In the ROLE program, participants had access to mentoring in mentored research activities. Latinas, as women engineering students who participated in this study reported *positive relationships with mentors*, who were all men. A common trend among some participants was the advice to not be afraid of asking questions, confirming the type of climate usually experienced by women in engineering. In general, minoritized students such as Latinas in STEM greatly benefit from mentoring and mentors become role models helping them reinforce students' identities and ability to be successful [14], [15]. Either formal or informal mentoring contributes to minoritized students' potential to be better informed in making decisions and broadening their network [15]. In turn, authors in [17] noted that in research-related activities, mentors who share values and oftentimes, demographics help boost mentees' confidence as scientists. In this study, participants shared their experiences with research mentors and explained their mentor's approach to creating a safe and inclusive learning space. Research mentors' pedagogy and teaching style resonated with the learning process of students in the different phases of the research program. Participants described research mentors as approachable, trustworthy, honest, communicative, understanding, and caring. These characteristics influenced the laboratory climate and research experience of students who are more likely to continue exploring other research opportunities.

This section discussed the positive impact that participants -Latina students in engineering-experienced during their involvement in the ROLE program at NMSU. This NSF-funded program aims to provide appropriate and culturally relevant experiences, where students, in addition to gaining research and technical skills, develop interpersonal skills and long-term abilities to be successful as engineering students, and later, as professionals. This study captured different abilities students discovered and developed that will help them in their decision-making and contributions to engineering in the present and future.

Implications

There are some implications for practice that institutions can adopt in developing undergraduate research programs for minoritized and underrepresented students in Engineering. Latinas in Engineering represent a small fraction of the total STEM student population and workforce; therefore, it is essential to create programs that meet the needs of students and help them move forward better prepared. The following recommendations can help institutions be intentional in creating those programs:

1. Implement culturally relevant research programs that help broaden the participation of women of color, in particular, Latinas. This can help promote their heritage, traditions, and values in such a way that students do not perceive a disconnection between the home/ community and the university environment.
2. Set a collaborative and community-building tone among participants of the program. Establish a friendly and supportive laboratory setting where all students, including women, can feel included, accepted, respected, and valued. Students will develop academic engagement within engineering as they enjoy the learning process of conducting research.
3. Show the value of students' contributions to research by participating in outreach events and real-world situations where students can apply their knowledge. Students will develop a sense of empowerment and ownership of their learning. It will also create a feeling of accomplishment and willingness to continue learning.

Closing remarks

The ROLE program at NMSU was created with the idea of improving the academic experience of Latina students pursuing engineering through their involvement in research activities. The program cohorts have been composed of mixed groups. Despite being unable to achieve a woman-only cohort because of the small number of Latinas enrolled in engineering at NMSU, the ROLE program has managed to create solid groups of students who trust, support, and help each other. Students' immersion in research through ROLE has influenced their decisions about remaining in engineering and increased the possibility of furthering their education with graduate school. More academic information and navigational skills are needed to ensure that Latina engineering students make informed decisions and take advantage of the multiple opportunities that an engineering career can offer.

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