

CAREER: Broadening Participation in STEM: A Qualitative Analysis of Resilience Experiences and Strategies of Latina STEM Majors in Hispanic Serving Institutions

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Introduction

Women, Latinx, Black, and Indigenous groups continue to lag behind in STEM representation [1]. In the last decade, the Latinx population has grown 23%, a growth higher than the nation's rate [2]. There are currently 569 Hispanic Serving Institutions (HSIs) in the U.S. which enroll two-thirds of all Latinx undergraduate students [3], with the last decade in particular experiencing an acceleration of HSI growth [4]. However, an increase in Latinx student enrollment does not necessarily result in a proportionate increase in degree completion [5].

Yet, compared to others, Latinx students do not enroll [6] nor graduate [7] in proportionate numbers to population demographics. Women of color are “proportionately underrepresented” in comparison to White and Asian women in the number of higher education degrees earned in the U.S., with greater disparities at the doctoral level, thus representing untapped potential in addition to the need of achieving equity in STEM [8]. This disparity is not explained by a lack of interest in STEM among college minority women [8]. Moreover, among Latinx students in STEM, Latinas graduate with fewer STEM degrees than Latinos [9]. It is thus important to examine the situations experienced by Latinas and their strategies as they persist in STEM in order to increase their retention. Considering that intersectional identities of marginalized groups can be key to understanding their experiences [10], cultural considerations, background, and family among Latinas are areas in need of further study as these areas influence the higher education experience. The research questions that guided this study was: How do experiences in HSIs in Texas influence and promote resilience of Latina students in the STEM fields? What strategies promote resilience among Latina STEM majors in HSIs in Texas?

Theoretical Framework

Resilience is a broad construct defined as the ability to “rebound,” adjusting to adversity or trauma [11] or “behaviorally-manifested social competence.” Though a broad concept, multidisciplinary experts have defined resilience as an adaptive and positive functioning after adversity and with passing time [12]. In terms of the social environment, resilience involves internal and external factors that affect this ability to manage obstacles [13]. Theoretical applications of resilience can be applied to Latinas in STEM fields by considering their persistence in their fields within various external and internal contexts, such as family and culture [14].

Thus, this study is supported by an emerging model of Latina resilience, a model introduced by the principal investigator of this work [14]. This model utilizes Yosso's [15] community cultural wealth (CCW) framework and takes into account the various contexts (such as home and college contexts) whereby Latinas bring their knowledge, behaviors, and values [14]. The model is a way of understanding how Latinas are resilient through their culture and various contexts, and this can be used to better understand the conditions in which resilience occurs.

Literature Review

Latinas in Higher Education and in STEM

Prior to college, Latinx students are more likely than their White counterparts to come from underfunded schools and not perform as well academically [16]. It is not surprising then that Latinx students and their families have little knowledge about college readiness and logistics [17]. However, one way to tackle this issue of underrepresentation is to move focus from the deficit-perspective and shift to an asset-based approach. When given a voice, Latinas reveal assets that can guide them through STEM degree completion [18].

STEM is of interest because not only does the STEM experience differ by gender, it varies by racial/ethnic group. Latinas, as minority female students, are among those to report a low sense of belonging in STEM [19]. Computer science and engineering fields are particularly lacking in female representation and Latinas are no exception [1]. Interestingly, Latinas and Black high school girls are more likely to pursue computer science and engineering if they held *counter-stereotypical* perceptions about people in STEM [20], or “perceptions that scientists are multi-faceted individuals with a variety of interests and talents who do not work in isolation.” This demonstrates the unique perceptions of minority women studying STEM.

Latina cultural considerations

Latinx students makeup a significant part of the first-generation student base, therefore understanding and integrating a cultural perspective is important. A cultural mismatch between an institution (emphasizing independence) and first-generation college students (more likely to hold interdependent values) has been found to be directly detrimental to their academic performance [21]. Community cultural wealth (CCW) is essential for Latinx students because those “who leveraged CCW to navigate postsecondary STEM fields often found themselves at odds with the middle-class values embedded at selective institutions in higher education” [22]. Furthermore, Latinx students pursuing STEM degrees are known to draw on their culturally grounded capital, including aspirational (giving back to their community) and familial (remaining ties to home) capital [23].

Emerging qualitative research has begun to show that Latinas demonstrate certain qualities that are associated with persistence in STEM majors, particularly in HSIs in the south. Such qualities include strength through moral obligation to family [24], self-efficacy [25], and looking forward to financial autonomy [26]. Rendón and colleagues [27] have identified specific factors that provide support for Latinx students in STEM: (1) participation in STEM high-impact practices, (2) having multiple sources of financial support, (3) getting validation from significant others, (4) utilizing their own personal assets and ways of knowing, (5) becoming involved in Latinx-based STEM social and academic extracurriculars, and (6) using family cultural wealth learned at home. Such factors are informative and relevant in the investigation of Latinas in this study.

Method

Qualitative research methods were utilized to describe and understand the success strategies and experiences of Latina undergraduate students as they persist in their degree program.

Undergraduate junior and senior students self-identifying as Latinas and majoring in STEM fields were interviewed at a public R1 doctoral HSI in Texas. The HSI's Institutional Review Board reviewed and approved the study.

Participants were recruited through faculty recommendations and student organizations. Participants were additionally recruited via flyer sent out through the HSI's largest STEM college. Emails were sent out requesting voluntary participation in our study. 17 participant interviews were transcribed and analyzed; 5 transcripts belonged to engineering majors and 2 belonged to computer science majors. Engineering and computer science majors are highlighted in the Findings and Discussion below. Table I below shows demographic details about the participants in addition to a couple of findings from the interviews. Eight interviews were completed virtually and the rest in person, which were conducted in only one of the researchers' offices at the HSI.

The design used a semi-structured interview. Interviews were audio and video recorded, but only audio recordings were sent out to be transcribed verbatim. (A few interviews were transcribed manually by the researcher.) Using inductive analysis, participants' verbatim responses during interviews were interpreted, organized, and coded utilizing the contexts described in the Gonzalez [14] resilience model: home, college, school (K through 12), workplace, and community contexts. Additional codes emerged as the interviews were analyzed. Content analysis and constant comparative method were utilized to develop themes and categories [28], [29].

Table I
Participants' Demographic and Interview Data

Pseudonym	Undergraduate level	Major	Attributes persistence to family	Active in STEM org *
Amanda	senior	Biochemistry	Yes	Yes
Sandra	senior	Biology	Yes	Yes
Belinda	senior	Biology	Yes	No
Nina	junior	Biology	Yes	No
Valerie	junior	Mathematics	Yes	Yes
Erica	senior	Biomedical engineering	Yes	Yes
Bibi	junior	Environmental science	Yes	Yes
Lily	senior	Mechanical engineering	Yes	Yes
Claudia	junior	Mechanical engineering	Yes	Yes
Michelle	junior	Biochemistry	No	Yes

Valeria	junior	Chemical engineering	Yes	Yes
Cassandra	junior	Biology	Yes	Yes
Alejandra	senior	Biology	Yes	Yes
Virginia	junior	Biology	Yes	No
Mari Jose	senior	Civil engineering	Yes	Yes
Jasmin	senior	Computer science	No	Yes
Ana	junior	Computer science	Yes	Yes

Demographic data consists of the first three columns. Data emerged from interviews consists of the last two columns and are further discussed in the Findings.

*"Active in STEM org" indicates current or previous activity in a STEM organization.

Findings

When considering the Latina resilience model [14], categories largely fell in the college and home contexts. Prevailing themes that emerged from the data included *family encouragement and motivation*, *supportive academic peers/friends*, and *self-efficacy/overcoming challenges*. Another finding that emerged that was unique to participants in engineering and computer science was *gendered or racialized experiences*. The overarching themes are further discussed below.

Motivation and encouragement through family

All participants listed family as one of their top reasons for persisting in their STEM degree, and thus *family encouragement, motivation, & support* was one of the most cited themes in this analysis. Families provided all kinds of support, from direct (verbal encouragement, financial) to more indirect (pride, drive) types of support. The ultimate goal for the family, particularly parents, was to allow their daughter to do well in college, sometimes encouraging them when they struggled. Sandra, a senior biology major, talked about her family:

“As soon as I started getting more interested in STEM related fields everyone wanted to push me to go into these fields I guess, because there would be sometimes where I would get scared... And everyone would like push me to be better in a sense. I feel like... this doesn't just happen to me but like my siblings and cousins and stuff too. Everyone, being that we're all like first-generation, that they all want us to like do bigger things than like what they've done you know? So, they've definitely been very motivating.”

Family members were often said to be proud of the participants for pursuing their college degree, and occasionally understanding the intensity of completing a STEM degree. However, sometimes the motivation through family was not through direct encouragement but providing financial stability, Valeria, a junior engineering major, described. She acknowledged that she primarily pursued her major for career and financial stability. While she found chemical engineering intriguing, interest in this field was the secondary reason for pursuing her degree.

Encouragement from family was predominant throughout most participants, but this did not mean that all participants received 100% support from family. Sometimes, support was

complicated by familial expectations. Lily, a mechanical engineering major, described how her parents were generally supportive while her grandfather expressed doubt in her pursuit of an engineering education and career, saying that in his generation “it wasn’t expected” for women. Ana, a computer science major, initially received “backlash” when she told her parents that she would be majoring in computer science (her current major) instead of engineering (her previously declared major which parents had approved of). Nonetheless, she notes that her family plays a very supportive role in her life,

“They’re just really supportive of me, and they’re always checking up on me. I’m really close to my family. So, we’re like talking with each other all the time. We kind of have that family bond.”

Participants are thus resilient and know how to navigate family, not letting differences sow division in their relationships. Family is a salient presence and support for nearly all participants.

Supportive academic peers and friendships

A frequent presence in the lives of Latinas as they navigated their STEM degree were peers and friends they interacted with on a regular basis, for which they credited for providing both social and academic support. The theme *academic peers & networks* was among the most frequent themes cited. The resources of this support were STEM courses and student organizations, of which 14 of the participants were active or recently active in these organizations (see Table I). Not uncommonly, these were the same peers which the participants had developed friendships with given their ties to their major requirements and extracurricular activities. Lily describes this:

“Honestly a lot of other STEM students, a lot of engineering students just because a good majority of the time, I am outside of the classroom, I’m doing homework, or I have a set group that I will study with and we tend to take the same classes every semester... I tend to hang around with mostly engineering students. I think sometimes I will, let’s see, when I’m not doing things related to academia, it’s still pretty much engineering students, or at least STEM related students.”

Lily discussed here who she socialized with outside the classroom. She additionally talked about her involvement in a Latinx engineering student organization. This was not an uncommon pattern among those heavily involved in an organization.

Self-efficacy and overcoming challenges

The American Psychological Association [30] defines self-efficacy as one’s perception of their ability in a given situation. This overarching theme of *self-efficacy and overcoming challenges* was often intertwined with the theme of *perseverance*. The participants demonstrated a desire and ability to persist despite encountering obstacles, such as struggling but persisting through intensive STEM coursework. One interviewee, Erica, provided insight on this and how one’s own capability to perform ultimately helps one overcome challenges:

“...my own personal perseverance and motivation over the years. You kinda have to learn to do that on your own cuz you can't always – you can't always depend on other people to motivate you. Sometimes it's just you. And even then, it's not always motivation, it's kind of discipline and being able to get into a routine. So even if you don't feel like doing it, you're already in like the motions of it, so you never kind of set yourself back in that sense. ”

Self-efficacy was additionally driven by family. Some Latinas expressed a desire to complete their degree for the sake of their family, whether it was to simply make them proud or to help their families in the future with the increased social mobility their degree will provide, or both. Self-efficacy thus overlaps with family encouragement/motivation discussed above.

Gendered and racialized experiences in engineering / computer science

Perhaps not surprisingly, most engineering and both computer science majors discussed gendered experiences in STEM spaces. The subtheme *men-dominated* appeared more often by engineering and computer science majors, with many noting the lack of women throughout their field. Jasmin, a computer science major, said:

“The culture is very male-dominated, so a lot of the times they overlook you or they could dismiss an idea that you may have. I don't really feel like the time that I had been in college has been that way.”

She shrewdly described a pattern in the data whereby instances of gender discrimination or microaggressions were not uncommon (even if she did not experience it often) and resulted in a subtheme called *not taken seriously by men*. This was sometimes intersected with *men-dominated* subtheme. Lily summarized her journey in this context, noting this gender issue over time:

“Engineering is progressing and allowing women in STEM, but there's that's always going to be a problem is women having to fight for their opinion, having to fight for a seat at the table, having to prove themselves maybe a little bit more than we'll have to... as I get more into the higher-level courses, I think it comes out a little bit more surprisingly. I think that's more of the bad side. I see it, I guess, everywhere I go. I've seen it in classrooms. I've seen it from professors...”

These types of observations were not often described among life science majors, which made up nearly half of the data of this analysis (see Table I). However, it was not absent either. A couple of life science majors (biology and biochemistry) noted that there was a time they were not taken seriously or talked over, particularly by White and/or Asian male peers. Most participants, regardless of STEM major, noted the lack of women of color faculty/staff in their departments, a noteworthy finding given the institution has been an HSI for years.

Additionally, some participants specifically expressed having trouble being taken seriously as a *Latina*. Valeria, a chemical engineering major, described not being taken seriously for the way “she looked,” hinting at her identity as a Latina. In Lily's case, extended family seemed to

express doubt in her pursuit of engineering (discussed above), noting that this “state of mind that women can do a whole lot in STEM is not quite where it should be.”

However, many participants found solace in minority STEM student organizations and/or in the company of female minority peers. Discussions of academic peers and forming close communities within these organizations were particularly described by engineering and computer science majors. Ana even described a desire to mentor:

“I [wanted] to be a mentor this year for a SWE, because I wanted to help someone in computer science, like another woman in computer science maybe or someone that needed help in computer science, but SWE has such a small amount of computer science majors that I couldn’t even be a mentor. So, I was really sad. [Laughter] No one needed mentoring for computer science, because there’s no one.”

A few participants additionally noted the opportunity for service work or outreach through student organizations or through their general desire to help others in STEM.

Conclusion

The research questions utilized in this study was, *how do experiences in a Texas HSI influence and promote resilience of Latina students in the STEM fields? What strategies promote resilience among Latina STEM majors in HSIs in Texas?* Overall, the current data shows that family, supportive peers/friends, and the participants’ own self-efficacy in overcoming obstacles play significant roles in Latinas’ persistence in STEM at this HSI. Engineering and computer science majors demonstrate an additional layer to their experience that largely revolved around their intersectional identity.

Family is a powerful presence and largely provides the culture and background that Latinas use as a foundation for achieving their goals. Not only did family contribute to motivating or encouraging participants to complete the STEM degree, Latinas in STEM were also motivated to do well in order to share their success with their families, a finding we have shown in the recent past [25]. This can be logically interpreted as communal or shared success and demonstrates the value placed on Latinx culture (strong ties to family) in the pursuit of higher education. It is not uncommon for Latinas’ family members to support them through interdependence and attachment [31]. Our findings indicate that Latinas utilize culturally-relevant strategies (such as family as motivation) to persist in their STEM degrees. Such strategies overlap with others’ finding on Latinx students coping strategies in higher education, such as seeking support [33].

Latinas in this study developed friendships with their academic peers, particularly through student organizations related to their major or career interest. Thus, this is a strategy utilized for success in undergraduate STEM. These groups particularly provided what seemed like a safe community for engineering and computer science participants in this study. They were the main participants reporting gendered and/or racialized experiences in the undergraduate STEM journey. Specifically, they encountered trouble being taken seriously by their male peers, a finding previously reported in other HSIs [24]. This may be why Latinas in engineering often seek and join race-based (Latinx) groups [32].

Preliminary recommendation

As a whole, STEM Latinas should be encouraged to be active in STEM organizations, as this was a beneficial experience for participants that were integrated into this experience as they formed a supportive academic and social network. Moreover, for engineering and computer science participants in this analysis, student organizations that are also identity-based (female and/or Latinx organizations) should be specifically encouraged, as these groups seemed to offer a layer of “protection” for participants as they more frequently encountered prejudice tied to their identity. In this way, Latinas have a greater opportunity to enhance their resilience.

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